Five County Association of Governments Natural Hazard Mitigation Plan

Effective 2022-2027

The Five County Association of Governments is a voluntary association of local governments from the five southwestern counties of the State of Utah. The five counties in southwestern Utah that comprise the Five County Association of Governments are Beaver, Garfield, Iron, Kane, and Washington.

Five County
Association of Governments

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Introduction

Southwestern Utah is a diverse region of dramatic red rock cliffs, mountains, and canyons, home to one of Utah's most populace urban areas, two national parks, numerous state parks, national forests, and multiple rural communities. The region's unique geography has been shaped by a historic series of natural events, including flooding, volcanoes, storms, and earthquakes, leading to a beautiful landscape where people come to live and recreate.

Residents and visitors to the southwest have experienced frequent occurrence of natural hazards, which pose significant impacts to the population and infrastructure. Since 2006, the Five County Association of Governments has developed a Natural Hazard Mitigation Plan, intended to equip the region with an action plan to preserve the built environment, populations, industry, and natural world that make Southwestern Utah a vibrant place to live and recreate.

The Five County Association of Governments Natural Hazard Mitigation Plan is a local plan, supporting 43 jurisdictions in the Southwest region of Utah. This plan provides each participating jurisdiction with a set of actions specific to the needs observed in their community through data collection and analysis for this plan. The region has determined that eight hazards are of most concern, listed in Figure 1. Through this planning process, the jurisdictions have ranked the hazards that are of greatest concern to them, based on historic occurrence, community risks and vulnerabilities, and future probability.

What is mitigation planning?

Natural hazard mitigation is any sustained action taken to reduce or eliminate the long-term risks to human life and property from natural hazards. Mitigation is most effective when based on a comprehensive, long-term planning that is implemented before a disaster occurs.

The Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) allows States, Tribes, and local governments to take a new approach to mitigation planning. The DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act, emphasizing the need for State, Tribal, and local entities to closely coordinate mitigation planning and implementation efforts and authorized up to 7% of HMGP funds available to a State to be used for development of State, Tribal, and Local Mitigation Plans. Mitigation planning requirements for States, Tribes, and local governments are outlined in 44 CFR Part 201. The federal mitigation regulations aim:

- fulfill federal, state, and local hazard mitigation planning responsibilities,

Southwest Utah Natural Hazards

Geologic:
Problem Soils
Radon Gas
Earthquake
Landslide

Climate:
Wildfire
Severe Weather
Drought
Flooding

Definitions

Risks: The threat posed by a hazard on a community, which measures the likelihood to occur, severity, and extent of a natural hazard in an area.

Vulnerabilities: the potential exposure and damage to a community's assets, resources, people, natural spaces, infrastructure, or culture from Natural Hazard events.

Figure 1: Southwest Utah Natural Hazards and Risk and Vulnerability Explanation

- promote natural hazard mitigation measures, short/long range strategies that minimize loss of life, and damage to property resulting from natural hazard occurrences to which public/private constituents are exposed,
- eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the Five County region.

A mitigation plan is a representation of each jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources toward reducing the effects of natural hazards. Local plans serve as the basis for the State to provide technical assistance and to prioritize project funding. Mitigation planning is not a regulatory practice. To strengthen the goals, objectives, and strategy of the hazard mitigation plan, communities should incorporate the mitigation plan actions into existing planning documents, including but not limited to the General Plan, Municipal Code, Capital Improvement Plan, etc.

Natural Hazard Mitigation Strategies can come in many forms from structural and infrastructure projects to preserving natural and open space areas to code and zoning updates to community engagement activities. The strategy types considered throughout the plan equip the region and jurisdictions with a robust toolbox to address Natural Hazard risks through mitigation. A variety of mitigation strategies can accommodate the needs and capabilities for a community, allowing them to customize a strategy to address natural hazard risks in a realistic and manageable way for their community.

Why develop a mitigation plan?

Across the United States, natural hazards cost communities billions of dollars, impacting human life, the built environment, and the local economy. Predicting when natural hazard events will occur is challenging, and in some cases unreliable. When disasters do happen, response and recovery activities are time and cost intensive activities that must be engaged in before communities can resume "business as usual" of the pre-disaster state. Mitigation seeks to reduce the time and costs required after a major natural hazard event. Mitigation actions can help to reduce a community's risk to natural hazards when implemented and invested in before a disaster occurs. These activities are implemented knowing that eventually a natural hazard will impact a community, and the action will lessen potential impacts, allowing a community to recover more quickly.

Local mitigation planning is enabled by code 44CFR.201. Participating jurisdictions with an eligible Natural Hazard Mitigation Plan may apply for certain Federal Emergency Management Agency (FEMA) funding for pre-disaster mitigation projects. Findings from the National Institute of Building Sciences describes that "mitigation saves up to $13 per dollar" invested by a community or jurisdiction. (National Institute of Building Sciences, 2020) Not only do these actions preserve the population and community way of life, but they can also be cost effective for a community.

In addition to the hazard risk reduction, a mitigation plan provides resources, information, and analysis which support communities in better understanding the hazards they are exposed to and the potential impacts on the community. Potential resources, information, and data can include updated mapping, project funding sources, assessment of new development or annexed areas, and an understanding of

critical infrastructure and facilities, in addition to many other data points. These tools and information can be implemented long term by a community to reduce future losses from natural hazard events.

How to use the plan

To ensure that the mission of this Natural Hazard Mitigation Plan is met, participating communities defined and established a list of goals, which are directly related to accomplishing the mission of the plan. Figure 2: Plan purpose, mission, and goals

describes the plan purpose, mission, and goals. Mitigation plan goals are statements of direction that public and private entities can work toward to reduce the risk associated with natural hazards. Goals form a bridge between the broad mission statement and specified community level action items.

The plan contains a discussion on the plan purpose and methodology used to develop the plan, a profile on communities within the Five County region, as well as a hazard identification study and a vulnerability analysis of the eight hazards. To assist in the explanation of the above-identified contents each County within the region is analyzed separately. The benefit of this separation is that each County is provided with a separate and distinct hazard identification, vulnerability analysis, and mitigation measures. Ultimately, this framework provides a streamlined plan which will afford additional readability and implementation.

This plan contains county-level geographic and demographic information, together with a risk and vulnerability assessment and mitigation strategies. The Plan details goals, objectives, and specific tasks or actions to reduce risk. This analysis is meant to offer a general understanding of the risks and vulnerabilities of natural hazards that are in a jurisdiction and are not meant to offer a site-by-site analysis for any hazard. For greater depth and analysis about a specific site in the community, a special study should be conducted by an engineer or scientist.

Plan Purpose

To understand and identify natural hazard risks in the Five County region and reduce those risks through leadership and action.

Plan Mission

Create disaster resilient communities in southwestern Utah.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 2: Plan purpose, mission, and goals

The chapters in this document offer communities resources, information, and coordination to implement a mitigation strategy. An overview of the document can be found below:

Chapter 2 is a description of the planning process and the data analysis and assessment methods used throughout this plan.

Chapter 3 is an overview of the Five County Region, including a description of the geography, demographics, economy, and recent development of the area.

Chapter 4 discusses in depth the hazards that have been identified for this plan process, conducting an overview of large-scale risks and vulnerabilities common to the region.

Chapters 5 through 9 give an overview of the community characteristics and capabilities, risk assessment, and a mitigation strategy for each of the Five County Region's Counties. Incorporated cities and town community characteristics and capabilities, risk assessment, and mitigation strategies are documented as a section within their respective county's chapter.

Chapter 10 presents a plan implementation and maintenance strategy for the region, including continued opportunities for public and stakeholder engagement.

Summary

The Five County Natural Hazard Mitigation Plan process analyzes data sources, community knowledge and capabilities, and historical occurrences to assist local communities in developing a mitigation strategy. Knowing what the plan is, its structure, and how it contributes to the communities, it is important to discuss the process by which the plan was developed. Documentation of the planning process identifies participating individuals, organizations, stakeholders, and recruitment and community engagement processes. Documentation meets state and federal requirements for the plan and records potential gaps in participation for future iterations of the plan for continued improvement.

Planning Process

The Five County Association of Governments Community and Economic Development staff engaged in an 18-month planning process to update this mitigation plan for the 2022 year. Activities to develop this plan included recruiting planning teams, meetings and workshops with the planning team, mapping and data analysis, public engagement and outreach, and document drafting. Participants in this planning process were made aware of meeting dates and plan progress through a series of meetings and through the plan website, where public comment and updates were available.

Who was involved?

The Five County Association of Governments is a voluntary group of local and county governments in southwestern Utah's five counties: Beaver, Iron, Garfield, Kane, and Washington Counties. The Five County Natural Hazard Mitigation Plan was prepared in the offices of the Five County Association of Governments (FCAOG) by appointed staff members: Gary Zabriskie, Community and Economic Development Planning Manager; Nathan Wiberg, Senior Planner; and Alyssa Gamble, Associate Planner. The plan was supported by Eric Martineau of the State of Utah Division of Emergency Management. Other local agencies that contributed to this planning process include City and County GIS departments, planning departments, elected and local officials, emergency managers, police and fire safety professionals, and local government agencies.

This Natural Hazard Mitigation Plan for the Five County Region invited all Counties, Incorporated cities and towns, and the Paiute Indian Tribe of Utah to participate in this planning process through direct outreach via phone, email, and meetings.

Participation

The Five County Association of Governments contacted each of the jurisdictions in the region in July of 2020 to remind participants that the region would be engaging in a NHMP update. At this time, each jurisdiction provided a point of contact to lead their local planning team and provide the AOG with local data. This individual was included as a member of the core planning team. County emergency managers often serve emergency management functions for incorporated communities and their input was requested to discuss and inform communities of needs or capabilities. In some cases, the emergency manager gathered community representatives for natural hazard plan meetings to ensure involvement from their jurisdictions. Other participants asked to serve on the core planning team include the FCAOG Economic Development Staff and the Steering Committee, which is the governing body for the FCAOG.

The plan development began in the summer of 2020, during the peak of the Coronavirus pandemic. Much of the communication with planning team members occurred via virtual meetings, phone calls, and email to protect all participants of the planning process. The AOG held two kick-off meetings to discuss the context for hazard mitigation and set timelines for the projects. During these meetings, participants discussed goal setting, plan mission statement, hazards, and community engagement strategies. The meetings were held on the following dates:

- 8/27/2020- Kickoff meeting #1
- 9/3/2020- Kickoff meeting #2
- 4/1/2021- Stakeholder meeting

Jurisdiction meetings were held from October 2020 to February 2021 to work with communities in developing their risk assessments and mitigation strategies. These meetings provided the 38 participating jurisdictions with opportunities to brainstorm and review information in the plan and bring in voices to the conversation. Due to the ongoing coronavirus pandemic, in some cases, these communications took place as emails and the community met with their team independently.

Date	Meeting
10/13/2020	Beaver City Council Plan information
10/27/2020	Flood Control Authority Risk Assessment
10/30/2020	Santa Clara City Data collection
11/6/2020	Escalante City Plan information
11/12/2020	Antimony Town Risk Assessment
11/12/2020	Beaver County Risk Assessment
11/18/2020	Hatch Risk Assessment
11/19/2020	Paiute Indian Tribe of Utah Plan information
12/9/2020	Enoch City Risk Assessment
12/17/2020	La Verkin City Risk Assessment
1/5/2021	Escalante Risk Assessment
1/11/2021	Kanarraville Risk Assessment
1/20/2021	Cedar City Risk Assessment
1/26/2021	Boulder Town Risk Assessment
1/27/2021	Enoch Mitigation strategy
2/1/2021	Parowan City Plan Information
2/4/2021	Garfield County Plan Information
2/9/2021	Kanarraville Risk Assessment
2/11/2021	Garfield County Risk Assessment
2/16/2021	Kane County & incorporated jurisdictions Risk Assessment
2/23/2021	Boulder Town Mitigation Strategy
3/16/2021	Escalante Mitigation Strategy
4/19/2021	La Verkin Mitigation Strategy
5/4/2021	Garfield County and Ticaboo Community
2/16/2021	Kane County & incorporated jurisdictions Risk Assessment

Date	Meeting
5/5/2021	Cedar City Mitigation Strategy
6/24/2021	Boulder Town Mitigation Strategy
9/28/2021	Hatch Mitigation Strategy
11/18/2021	Hildale Plan Information
11/19/2021	Paiute Indian Tribe of Utah
11/30/2021	Santa Clara City Risk Assessment
12/2/2021	Ivins City Risk Assessment
12/8/2021	Springdale Risk Assessment
12/9/2021	Rockville Risk Assessment
12/14/2021	Hildale Mitigation Strategy
1/5/2022	Springdale Mitigation Strategy
1/27/2022	Rockville Mitigation Strategy
3/1/2022	Santa Clara City Mitigation Strategy
3/2/2022	St. George City Mitigation Strategy
3/2/2022	Iron County Risk Assessment
3/2/2022	New Harmony Risk Assessment & Mitigation Strategy
3/7/2022	Big Water Risk Assessment
3/8/2022	Washington County Mitigation Strategy
3/9/2022	Washington City Mitigation Strategy
3/11/2022	Virgin Town Mitigation Strategy
3/14/2022	Toquerville City Mitigation Strategy
3/23/2022	Beaver County Mitigation Strategy

Below see the list of community participants for the Natural Hazard Mitigation Plan, by jurisdiction. These participants contributed to the risk assessment and mitigation strategy development for their community. They provided feedback and comments on the natural hazard mitigation plan development.

Jurisdiction	Participant Name	Position
Beaver County	Les Whitney	Fire Chief
Garfield County	Denise Dastrup	Emergency Manager
Garfield County	Kaden Figgins	Planner and Economic Development Director
Garfield County	Jared Woolsey	Building Official
Garfield County	Dave Dodds	Public Works Director
Iron County	George Colson	Emergency Manager
Kane County	Alan Alldredge	Emergency Manager
Washington County	Jason Whipple	Emergency Services Director
Beaver City	Tyler Schena	Council Member
Milford	Nolan Davis	Mayor
Milford	Makayla Bealer	City Administrator
Minersville	Cherie Wood	Town Clerk
Antimony	Roma Henrie	Town Clerk
Antimony	Shannon Allen	Mayor
Antimony	Marcus Dean	Community Volunteer
Antimony	Becky Dean	Town Board Member
Antimony	Kasey King	Town Board Member
Boulder	Judy Geil	Boulder Wildfire Council
Boulder	Pete Benson	Fire Marshal
Boulder	Elizabeth Julian	Town Council Member
Boulder	Steve Cox	Mayor
Bryce Canyon City	Bryce Syrett	Town Council Member
Cannonville	Jeff Stock	Mayor
Escalante	Stephanie Steed	City Recorder
Escalante	Melani Torgersen	Mayor
Escalante	Guy Graham	Council Members
Escalante	Marlene Stowe	Council Members
Escalante	Louise Barnes	Council Members
Escalante	Lenza Wilson	Council Members
Hatch	Jacie Torgersen	Town Clerk
Hatch	Kevin Eldredge	Mayor
Hatch	Tony Dinges	Councilor
Hatch	Melissa Poulsen	Councilor
Hatch	Jonathan Spendlove	Councilor
Hatch	Kurt Sawyer	Councilor
Henrieville	Cliff Mathews	Town Board
Panguitch	Kim Soper	City Mayor
Tropic	Gene Anderson	Mayor Pro Tempore
Tropic	Marie Niemann	City Clerk / Recorder

Jurisdiction	Participant Name	Position
Brian Head	Chief Dan Benson	Public Safety Director
Cedar City	Paul Bittmenn	City Manager
Enoch	Rob Dotson	City Manager
Enoch	Andrew Meacham	City Planning Commissioner
Enoch	Leonard Correa	Resident
Enoch	Lynn Nielson	City Building Inspector
Enoch	West Harris	City Council Member
Kanarraville	David	Clerk
Kanarraville	Heidi	Clerk
Kanarraville	Tyler Allred	Fire Chief
Kanarraville	Mike Humes	
Kanarraville	Jeremy Severe	
Kanarraville	Stoney Shugart	Town Board Member
Paragonah	Nancy Dalton	Planning Commission
Parowan	Cleve Matheson	City Manager
Alton	Dustin Cox	Mayor
Alton	Carrie Heaton	Clerk
Big Water	Michelle	Assistant Clerk
Big Water	David Schmuker	Mayor
Glendale	David Maxwell	Council Member
Kanab	Joe Decker	City Manager/Fire Chief
Orderville	Carol Lamb	Clerk
Orderville	Merlin Esplin	Mayor
Apple Valley	Dale Beddo	Mayor
Enterprise	Brenden Moody	Emergency Manager
Hildale	Eric Duthie	City Manager
Hildale	Harrison Johnson	Deputy City Manager for Special Projects
Hildale	Kevin J. Barlow	Fire Chief
Hurricane City	Arthur LeBaron	City Engineer
Hurricane City	Kaden DeMille	City Manager
Ivins City	Chuck Gillette	Public Works Director/Engineer
La Verkin	Kyle Gubler	City Administrator
La Verkin	Derek Imlay	Public Works Director
Leeds	Wayne Peterson	Mayor
New Harmony	Doneva Hecker	Town Clerk
Rockville	Vicki Bell	Town Clerk
Rockville	Pam Leach	Mayor
Rockville	Dave Firmage	Town Council Member, Fire Ecologist NPS
St. George	Jay Sandberg	City Engineer
Santa Clara	Rick Rosenberg	Mayor
Santa Clara	David Black	Engineer, Rosenberg and Associates
Santa Clara	Jim McNulty	Planning & Economic Development Manager

Jurisdiction	Participant Name	Position
Santa Clara	Brock Jacobsen	City Manager
Santa Clara	Dustin Mouritsen	Public Works Director
Santa Clara	Cody Mitchell	Building Official
Santa Clara	Jared Bates	Rosenberg and Associates
Santa Clara	Wayne Rogers	AGEC-Applied Geotechnical Engineering
Santa Clara	Kristelle Hill	Public Works Executive Assistant
Santa Clara	Selena Nez	Building & Planning Department Administrative Assistant
Springdale	Rick Wixom	Town Manager
Springdale	Tom Dansie	Director of Community Development
Springdale	Rob Totten	Public Works Superintendent
Springdale	Garen Brecke	Police Chief
Toquerville	Afton Moore	City Manager
Toquerville	Jared Bates	Engineer, Rosenberg and Associates
Virgin	Chris Holm	Public Works Manager
Washington City	Paul Mogle	City Engineer
Paiute Indian Tribe of Utah	Shane Parashonts	Tribal Administrator

Stakeholder Involvement

The Five County AOG and participating communities engaged stakeholders working with or impacted by natural hazards in this planning process by offering communication about the plan progress and objectives and welcoming input from interested parties. Neighboring jurisdictions were invited in Summer 2020 via email to participate in stakeholder meetings or submit comments on the Five County NHMP website. Jurisdictions contacted include:

- Paiute County, Utah
- Milford County, Utah
- San Juan County, Utah
- Lincoln County, Nevada
- Mohave County, Arizona
- Coconino County, Arizona
- Colorado City, Arizona
- Angel Springs Special Service District
- Ash Creek Special Service District
- Beaver County Special Fire District #1
- Beaver County Special Fire District #2
- Cedar City Housing Authority
- Cedar Mountain Fire Protection District
- Central Iron County Water Conservancy District
- Church Wells Special Service District
- Dammeron Valley Fire Special Service District
- Diamond Valley Fire Special Service District
- Dixie Deer Special Service District
- East Zion Special Service District
- Elk Meadows Special Service District
- Glen Canyon Special Service District
- Gunlock Special Service District
- Iron County Special Service District #3
- Kane County Human Resource Special Service District
- Kane County Recreation and Transportation Special Service District.
- Leeds Area Special Service District
- Long Valley Sewer Improvement District
- Mammoth Creek Special Service Fire District
- Milford Area Health Care Service District #3
- Pausaugunt Cliffs Special Service District
- Pine Valley Special Service District
- Rockville/Springdale Fire Protection District
- Southwestern Special Service District
- Ticaboo Utility Improvements District

- Western Kane County Special Service District #1
- Paiute Indian Tribe of Utah

A stakeholder meeting was held on Thursday, April 1, 2021 and provided interested parties to describe impacts, challenges, and needs to mitigate from natural hazards as well as allowing feedback or suggestions for the planning process. Special Service Districts and neighboring communities from the region were contacted by the AOG via email and the local planning teams were encouraged to consider and invite important stakeholders to this meeting. Local planning team members and the region wide planning team were invited to this meeting as an opportunity to hear perspectives of stakeholders, leverage opportunities for coordination, and share information. The stakeholders present at this meeting include:

- Jessica Staheli, Central Iron County Water Conservancy District
- Chip Shortreed, Executive Director Ticaboo Utility District
- Tammy Gallegos, Emergency Manager San Juan County

Other members present at this meeting include:

- Kaden Figgins, Garfield County
- Judith Geil, Boulder Town
- Jay Sandberg, St. George City
- Kyle Gubler, La Verkin City
- Alan Alldredge, Kane County
- Denise Dastrup, Garfield County
- Jason Whipple, Washington County
- Steve Cox, Boulder Town
- Shane Parashonts, Paiute Indian Tribe of Utah
- Rob Dotson, Enoch City
- Heidi Loveland, Kanarraville Town
- Arthur LeBaron, Hurricane City
- Megan Horton, Rockville Town
- Dave Dodds, Garfield County
- Eric Duthie, Hildale City

Public involvement

The public was invited to participate in the Natural Hazard Mitigation Plan update throughout the planning process. Initially the Five County Association of Governments staff posted a request for comments on the website for the update, hazardmitigationplan.org. Members of the public were informed that the update was in progress and that comments on the current plan were welcome. Comment options were available through webform, email, and phone by the FCAOG Community Planner.

Participating entities were encouraged to include a notice for the hazard plan update in their community. Across the region, communities used Facebook, city websites, public meetings, newsletters, and notice boards to inform residents about the ongoing plan update, referring them to AOG staff or the hazardmitigationplan.org website to leave questions or comments.

On March 26, 2022, a 30-day comment period began to allow interested persons to review and comment on the plan. A completed copy of the plan was posted to the hazardmitigationplan.org website and to the Utah Public Notice Website for comment. A copy of the plan was also made available at the Five County Association of Governments office in St. George, at 1070 W 1600 S, Building B, St. George, 84770 and was available for interested persons to review from 9 am to 5 pm Monday through Friday. Participating entities were instructed to make the plan available for review during the comment period, with instruction that comments be submitted to the AOG staff.

During the update process, several comments were received.

- Grammatical changes were made to the Leeds Town section.
- A 2021 flooding event and new participation in the NFIP was added to the Enoch City flood hazard history
- An updated annexation boundary was added to the Enoch City section.
- St. George City added drainage basin inundation maps to the flood section.
- Hatch and Henrieville added cost categories
- Antimony and Boulder added development descriptions.

Mitigation Progress

Reporting progress in completing mitigation actions is a required element for participating communities. Each community documents their mitigation strategy progress in the community section of the hazard plan. Incomplete actions are either reported as no longer needed, still needed, or unknown. Communities described any reasoning behind incomplete actions if they were no longer needed or unknown.

Adoption

The success of the Five County NHMP depends on action implementation. Periodic monitoring of the plan is necessary to ensure that the goals, objectives, and actions are met during the identified time. To ensure that the communities implement actions, each participating jurisdiction will formally adopt the NHMP. In doing so, they will gain eligibility for Flood Mitigation Assistance, Hazard Mitigation Grant Program, and Building Resilient Infrastructure and Communities funding.

Each jurisdiction describes hazard mitigation in their governing plans and code. Participating communities are encouraged to integrate the hazard mitigation plan in their local planning processes. Integration of these plans codify the mitigation activities and promote mitigation project implementation.

Methods

This section illustrates the specific methods used to determine the plan mission, goals, and objectives, hazard identification and analysis, prioritization, and development of the mitigation strategy. This section is a precursor to later chapters, which describe assessment and findings.

The planning team established a mission, goals, and objectives for this multi-jurisdictional plan during the first regional planning group meeting and several subsequent communications via email with the regional planning group. The intent being a set of common goals throughout the region to integrate into the mitigation strategy, resulting in a safer and more resilient Five County Region. These ideas contribute to the region's development and prioritization of a mitigation strategy, given that actions should fall within the scope of the goals and objectives for this plan.

Plan Purpose: To understand and identify natural hazard risks in the Five County region and reduce those risks through leadership and action.

Mission: Create disaster resilient communities in southwestern Utah.

Goals:

- **Goal 1- Protect life & property** – address risks to residents and users of community infrastructure, assets, and private properties through structural and mitigation actions.
- **Goal 2- Secure critical infrastructure** – action identifies a local infrastructure or facilities need that address risks and vulnerabilities from natural hazards.
- **Goal 3- Public education and outreach** – informing residents and visitors of the risks and vulnerabilities to natural hazards that exist in the community and how they can reduce their individual or property risks.
- **Goal 4- Partnership and coordination** – address a need for local partnership and coordination among all levels of government, with nonprofits, businesses and industry, and other organizations to effectively mitigate risks.
- **Goal 5- Emergency response** – support and bolster the ability for first responders to effectively respond to and manage natural hazard events.
- **Goal 6- Protect the natural environment** – protect, restore, and utilize the natural landscape and environment of Southwestern Utah to mitigate natural hazards.

The mission and goals are an expression of the region's interest in engaging in mitigation activities and risk reduction. Participating jurisdictions will describe in their mitigation strategy the actions to be taken to meet the mission and goals outlined in this regional plan, to make a more resilient Region. Communities may select objectives which are community specific in their respective mitigation strategy.

Hazard Description and Identification

The mitigation team identified natural hazards that pose threats to the region during kick-off meetings with the regional planning team in August and September of 2020. These hazards were selected based on occurrence and representation from previous planning processes. Each representative was given the opportunity to discuss adding or removing hazards for analysis throughout the planning process. Each planning meeting offered local planning team representatives to describe any other natural hazards that they saw as impactful for their community.

At the end of this process, the Five County Association of Governments described flood, landslide, earthquake, wildfire, drought, severe weather, radon, and problem soils as hazards present throughout the planning area. These hazards are described further in the Hazard identification section.

Communities in southcentral Washington county opted to add several natural hazards which are specific to their areas. The metropolitan St. George area added riverine erosion and shallow groundwater as natural hazards present in the community. Hildale also added Radium exposure as a natural hazard in their community as high levels have been detected in a water source. These hazards are described in the respective community's section.

Location

Hazard location is indicated primarily by using mapping tools. Unfortunately, some of the available data is not at a scale that supports a detailed description of impacts that could be seen in a city or town. In these instances, a narrative description of the potential hazard impacts is included. For site specific hazard analysis, an engineer, architect, geologist, floodplain manager, or other professional should be contacted for an assessment.

Mapped hazards

Hazards which have mapping include the geologic hazards, flood, and wildfire. Available data allows for a description of where in the community the greatest risks or presence of these natural hazards are identified. The inclusion of a risk rating, where it is available is used in part to describe the extent or severity of hazard, especially as these at-risk areas overlap with community assets and infrastructure.

In some cases, the available data differs from community to community. For example, more urban areas of the region have greater detail in mapping of landslide and problem soil risks from the Utah Geological Survey, where more general data is available for the rural areas. Some communities also do not have digital Flood Insurance Rate Maps or have not participated in flood mapping in the past and have limited data. These instances are explained in the jurisdictions risk assessment where applicable.

Unmapped hazards

Severe weather and drought are two natural hazards which are generally not appropriate for long term mapping, as the location of the hazard varies and often includes a large area. For these hazards, it is assumed that all a community may be impacted by these hazards.

Extent

The extent of a natural hazard considers the strength, magnitude, or severity of an event. Each hazard is measured differently, and these descriptors will be presented in the hazard identification section. An understanding of the extent of hazards contributes to the overall analysis and prioritization of hazard risks for this Hazard Mitigation Plan. Where possible, mapping of areas that experience high magnitude events will be included in the community risk assessment.

Where not available, the planning team will refer to the documented damages and injury caused by an event to determine the recorded severity of events in that area.

Hazard History

This plan documents a hazard history for each hazard to help estimate future potential events and impacts. Historical details have been compiled as tables for each hazard presented in the plan, describing the event date, location, and any impacts associated including damages, injuries, and recovery costs where possible. These data were collected from NOAA, FEMA, USGS, UGS, the University of Utah Geology department, and other federal, state, and local sources. Additional input was given by the local planning teams, who offered context and depth to the community experience and impacts from natural hazards.

Some hazards, like radon gas and problem soils are common due to the soil and rock composition in the region. These hazards' histories are measured differently. Problem soils histories are recorded by documenting negative impacts seen across the region to the built environment and human activities. The data used for these records were from state sources and local descriptions of the impacts. Radon hazard does not have sufficient data to determine the hazard history, as tests and mitigation in homes are not always reported to state sources.

The hazard history is used to inform the future probability of hazards, assuming that an area with a record of past hazard events is likely to experience these events in the future.

Community Characteristics and Capabilities

The Five County Association of Governments Natural Hazard Mitigation Plan describes each participating jurisdiction's geography, demographics, government, economy, development, and capabilities. These factors contribute to a community's ability to plan for and respond to a hazard. These details further indicate the gaps that can be filled in a community through coordination, data collection, or other means that can reduce a community's vulnerability to hazards. The characteristic and capability details are recorded for each community in tables, charts, and narrative in the community's respective section of the plan.

Tables and figures are summarized in Appendix B and C.

Risk Assessment Analysis

Using the hazard identification, risk assessment, and community capabilities data collected for each community, the hazards were then prioritized, indicating the hazards that have the greatest community impacts to the jurisdiction. The prioritization process was completed by analyzing the hazard frequency, historical impacts, proportion of the region at risk to the hazard, and capabilities to address the hazards. Appendix x summarizes each jurisdictions analysis of natural hazard metrics. This analysis informs the risk assessment identification of high, moderate, and low risk hazards for each jurisdiction.

Vulnerabilities

Each jurisdiction identifies vulnerabilities informed by the risk assessment. The data used to inform vulnerabilities include descriptions from members of the planning team, identified assets, infrastructure, and facilities exposed to risk areas, and an understanding of the community capabilities. If for example a community repeatedly experiences wildfires, but there is no fire station or service district nearby, this would be a community vulnerability.

Priority

The Disaster Mitigation Act of 2000 requires that a NHMP demonstrate how mitigation strategies were evaluated and prioritized. Normally used to evaluate alternative mitigation strategies for a single identified problem, the STAPLEE process should be used as a rational basis to determine the Prioritization of each mitigation strategy. The NHMP Planning participants believe that using the STAPLEE provided a reasonable and objective means to determine relative priority of the mitigation strategies identified in this plan. The STAPLEE process allows for a review of each strategy based upon the following considerations:

• Social- Is the proposed action/project socially acceptable to the community and does it unfairly affect one segment of the community?

• Technical- Is the action/project feasible from a technical standpoint? Can it be accomplished using available engineering practices?

• Administrative- Is there adequate staffing, funding and maintenance available for the proposed mitigation project?

• Political- Is there political support for the proposed action/project?

• Legal- Does the jurisdiction possess the appropriate legal authority to undertake the action/project?

• Economic-Are there sources of funding to accomplish the action/project? What benefits does the action/project provide and are the estimated costs in line with the benefits the action/project would provide?

• Environmental-Will the proposed action/project have an adverse effect on the environment (land, water, endangered species) and will the action/project comply with applicable environmental laws?

Changes in Priorities

The prioritization method has not changed. Five County provided each jurisdiction with recommended priorities and worked with each jurisdiction to finalize the priority ranking for each action.

Mitigation Strategy

Each jurisdiction determined a mitigation strategy to address the identified risks and vulnerabilities from the risk assessment. The strategy was determined following a series of communications and review of their risk assessment. Elements included in each mitigation strategy for the region include:

The elements included in the mitigation strategy are defined as follows:

- Priority- The implementation priority of each action is determined using the STAPLEE method and is represented as:
    - L= Low Priority
    - M= Moderate Priority
    - High= High Priority
- Hazard- describes the natural hazard the action is intended to address and numbers the actions to easily differentiate between actions. The numeration does not indicate the local priority.
- Action- Summarizes a specific need in the community that addresses natural hazard risks.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action. Given the rapid changes in pricing and diversity of communities with variable capacity to fund projects, cost is represented as a range.
    - L= Low= $0-$100,000
    - M= Moderate= $100,001- $500,000
    - H= High= $500,001+
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Hazard Identification

Southwestern Utah has been shaped by natural hazards. Some of the area's most famous natural features have been developed through a series of natural hazards throughout history, including Zion National Park. The rich geologic history of the area presents a series of hazards that can be expected to continue in current and future years. Natural events continue to occur throughout the region, although with population increases, transportation corridors, and increased visitation to the area, Southwestern Utah is more vulnerable to the impacts from naturally occurring events.

Hazards identified in by the communities as most prevalent to include in this plan are: Landslides, Earthquakes, Problem Soils, Wildfire, Severe Weather, Drought, Flooding, and Radon Gas.

This chapter includes a general overview of each hazard, including locations, magnitudes, and recorded history to improve communities understanding of the hazard. Maps, recorded data, historical natural hazard events, and other data will be represented here to give a general overview of the hazard impacts on the region.

Problem Soils

The soil on which we build our environment can impact the permanence of our buildings and infrastructure. Throughout southwestern Utah, there are so called “problem soils” with properties that lead to soil expansion or collapse that can destroy buildings and infrastructure at the surface. These soils can respond to geologic and climate conditions in the area, which put these soils at risk of collapse or expansion.

Problem soils are common throughout Southwestern Utah. All five counties in the region have addressed problem soils by requiring geological studies before construction, to better understand and mitigate for problem soils that may be underground. Several of the cities in the region either contract with the county to enforce geologic studies or have adopted ordinances to require geologic studies for certain hazards, including problem soils in pre-development phases.

Types of problem soils

There are six identified types of problem soils in Southwestern Utah, including expansive rock and soil, collapsible soil, limestone and karst, Gypsiferous soil and rock, piping soils, and sand dunes. These soils each have differing impacts on human activity and the built environment. The sections below describe the effects of these soils and maps the areas where these soils have been identified in the region.

Expansive soil and rock.

The most common type of problem soil deposit in Southwestern Utah, expansive deposits contain clay minerals that expand and contract with changes in moisture. Clays absorb water when wet, expanding the rock. When the material dries, the loss of water causes the deposit to shrink. Development in areas with expansive clays have been damaging to structures foundations, floor slabs, and basement walls. In addition, wastewater disposal systems, sidewalks and roads may be damaged by expansive soil and rock.

Collapsible Soil

Soil and rock containing gypsum are susceptible to subsidence or sinking of land. Collapse occurs when susceptible soils are whetted to a depth below that normally reached by rainfall, destroying clay bonds between soil bands. Collapsible soil is present in geologically young materials such as alluvial fan, debris-flow sediments, and wind-blown silts.

Gypsum is a weak mineral with low bearing strength and can cause problems when loaded with the weight of a structure. When dissolved, gypsum can cause land subsidence and sinkholes due to a loss of internal structure and volume in the deposit. Gypsum dissolved in water creates sulfuric acid and sulphate, which react with certain cements and can weaken foundations.

Limestone and Karst Terrain

Karst is characterized by closed depressions (sinkholes), caverns, and streams that abruptly disappear underground. Most Karsts terrain in Southwestern Utah is ancient and relates to moist climates during the Pleistocene era or may have been created by groundwater prior to uplift and tilting during basin and range seismic faulting. Karsts ground-water systems also have little filtering capacity, making contamination of ground water a concern.

Soils subject to piping

Piping is subsurface erosion by groundwater that moves along permeable, non-cohesive layers in unconsolidated materials and exists at a free face, usually along a stream bank or cliff that intersects with the layer. Deposits susceptible to piping are common in the southwestern part of the state. Holocene-age alluvial fill in canyon bottoms is the most common material susceptible to piping in Utah. Road construction can contribute to piping problem by disturbing natural runoff and concentrating water along paved surfaces, allowing greater infiltration and potential for pipes to develop. Piping can cause damage to roads, bridges, culverts, dams, agricultural land, and any structure built over soils subject to piping.

Sand Dunes

Common surficial deposits in arid areas where sand derived from weathering of rock or unconsolidated deposits is blown by the wind into mounds and ridges. In areas where development encroaches on dunes, inactive or vegetated dunes may be reactivated, allowing them to migrate over roads and bury structures. Migration of dunes across roads and burial structures are common problems in areas where active dunes are present. Avoidance of dunes is the best way to prevent damage to structures. However active dunes usually are a maintenance problem only and do not preclude development.

Extent

Some soils cover large areas, where others have a limited extent. The most extensive problem soils in the region are expansive soil and rock. As development encroaches on less suitable terrain, damage from problem soil and rock has increased. Detailed geotechnical study is needed in areas of problem soil and rock to identify and mitigate problems to avoid costly corrective measures or blights in developed areas. Each participating community includes a map of their potential problem soil risk and describes the

Hazard History

Very little data exists discussing the extent of structural damage to problem soils throughout the region. As of the time of this plan's development there is not an inventory of past problem soil events throughout the region. The history therefore has been largely reliant on the community knowledge of residents in the region, sharing experiences with problem soil impacts. Each County has described the presence of expansive or collapsible soils and clay, however the impacts vary from community to community.

No deaths have been directly reported from problem soils hazards, although documented instances of problem soils have caused property damages, and delays or additional costs in development.

Summary

Geologic characteristics of the common problem soils in southwestern Utah are well known, however the impacts of these problem soils on the built environment are not thoroughly documented. Mapping problem soils throughout the region are also not comprehensive. These data limitations should be addressed to get a better picture of the impacts from problem soils on the region.

Radon Gas

Radon is an odorless, tasteless, and colorless radioactive gas from the decay of uranium. In nature, radon is found in small concentrations in nearly all rocks and soils. When uranium decays, the radon gas can escape the underground rock by seeping to the surface. In outdoor environments, radon is diluted by the surrounding air and poses little risk to health. Radon enters buildings through cracked foundations or walls, gaps in suspended floors or around service pipes and other passageways. Structures trap radon gas inside and can result in unhealthy concentrations of the gas. It is important to be aware of radon in buildings where people spend significant time, like homes, because long-term, high exposure to radon can cause lung cancer. Other buildings where people spend significant time include workplaces, daycares, schools, and hospitals, could benefit from radon testing and mitigation measures.

Radon gas, when experienced in concentrations for long periods of time can cause lung cancer. Although there is insufficient data for radon caused lung cancer in Southern Utah, the Utah Environmental Public Health Tracking system states that radon is the second leading cause of lung cancer in the United States. Radon gas is Utah's most deadly geologic hazard, accounting for 97% of all geologic hazard fatalities in the state. (Utah Geological Survey, 2021)

No level of radon is considered safe for humans. To lower radon risk and impacts, one should decrease the concentration inside a home or structure where people spend significant time. Radon risk is heightened when structures are built on ground that contains uranium, the underlying soil allows movement of radon gasses, buildings have cracks, porous materials, or other openings below ground, and lower air pressure inside a building than in the soil and foundation. (Utah Division of Emergency Management, 2019)

Radon Monitoring

The State of Utah does not have any written laws for radon testing or standards for home construction. The Department of Environmental Quality/Division of Radiation Control indicate that 35.4% of tested homes in Utah are at concentrations above the US Surgeon General's guidance of 4.0 pCi/L (pico-curies/liter). (Division of Radiation Control, 2019) At these elevated concentrations, mitigation actions should be implemented to reduce radon exposure and future risk of personal impacts. The EPA also recommends mitigation measures if levels register between 2 and 4 in the home. (United States Environmental Protection Agency, 2016)

Installing a radon resistant system during construction is cost effective and simple, when planning is done in advance. Homes constructed without a radon reduction system may use measures to mitigate and minimize the hazard, although methods vary in cost effectiveness. Appropriate mitigation measures depend on the home construction and a licensed Radon Mitigation contractor should be contacted to assess a building's specific needs. (United States Environmental Protection Agency, 2016)

Utah does not have Radon testing or disclosure laws for home purchase, nor is there clear language about renters rights if the property is found to have a high radon level. (Utah Environmental Public Health Tracking Network and Utah Cancer Control Program, 2015) Radon Mitigation is not required in the State of Utah, as the relevant appendix was omitted when the state adopted the 2015 International Residential Building Code. (Utah Geological Survey, 2021) The Utah Geologic Survey recommends following radon control methods to reduce the potential for high concentrations of radon in residences.

Radon hazard areas in southwestern Utah are widespread and are generally underlain by silicic igneous rocks of low-grade metasedimentary deposits. The EPA conducts national mapping by county which indicates three zones for communities to understand the average indoor radon screening level. In the Five County Region, all counties are rated as zone 2, meaning that the predicted average indoor screening levels are between 2 and 4 pCi/L. Counties in the region are considered at low risk to radon by the US Surgeon general at this concentration, however a 2-4 pCi/L is still considered hazardous and should have mitigation measures in place to further reduce indoor levels. (United States Environmental Protection Agency, 2021) Homes in the Five County Region should be tested for radon and take mitigation actions to address their radon level, as no levels of radon are safe.

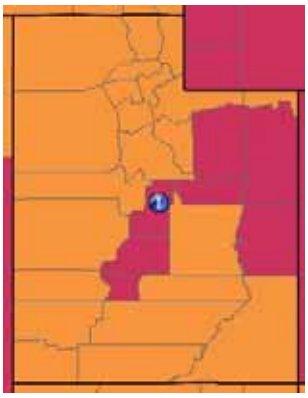


Figure 3: Estimated average indoor radon level pCi/L

Figure 3: Estimated average indoor radon level pCi/L indicates the estimated average indoor radon per liter of air using the EPA mapping tool and zones.

- Zone 1: Counties with predicted average greater than 4 pCi/L
- Zone 2: Counties with predicted average between 2 and 4 pCi/L
- Zone 3: Counties with predicted average lower than 2 pCi/L

Radon levels will not change over time without mitigation. The metrics that may change are the information available to residents, homeowners, and home buyers; the number of tests conducted; and mitigation activities completed.

Radon Testing

The quickest way to test for radon is with a short-term test, which uses charcoal canister detectors and provide results within a matter of days. A long-term test can take up to 90-days to complete. Citizens in the Five County region should be encouraged by local building officials to evaluate the radon levels in their homes. A valuable tool for communities is resident reported radon testing results. This data is submitted to the EPA for tracking purposes. This data can then provide an improved picture of the indoor radon levels that might be present in a community, informing future policy and recommendations to residents.

Radon potential maps can help to determine where indoor radon may exist. However, the only way to know if a building is subject to this hazard is by testing. Generally testing only takes two-to-three-days, but some can take up to 90-days. Residences and other spaces where people spend significant time are recommended to receive radon testing. The EPA recommends that all schools participate in radon testing. (United States Environmental Protection Agency, 2010)

Hazard History

There is unfortunately no formal record of Radon hazard impacts beyond the testing record maintained by the State of Utah Department of Environmental Quality.

Summary

Radon gas exposure has been linked to lung cancer and is the geologic hazard that causes the most deaths in the state. This gas is emitted by rock and trapped in the structures above,

impacting the populations that use that structure. Mitigation before or after construction can lower indoor radon levels, thus decreasing the risk of radon exposure and subsequent impacts. Radon is prominent across the Five County Region, as evidence from the state records from 2019. While getting below 2 Pci/L indoors is a challenge, at the levels reported in the region, residents with more information, access to testing, and mitigation support can address this natural hazard in their home.

Earthquakes

Earthquakes are unpredictable and occur when two blocks of earth slip past each other, releasing energy. The initial point of rupture takes place at what is called the focus, typically miles underground on the fault. The epicenter is the surface point directly above the focus. Ground shaking or movement is caused from seismic waves, originating from the focus.

There are hundreds of earthquakes annually in Southern Utah, many too small to be noticed. Earthquakes are regional hazards, often affecting multiple cities, towns, and counties because almost the entire area could experience a seismic event. All communities contain some degree of risk from earthquakes. Because ground shaking can proceed miles from the fault, an earthquake can trigger additional hazards such as structural damage, soil liquefaction, surface fault rupture, slope failure, and flooding. Ground shaking is generally the most destructive aspect of an earthquake because the seismic waves move both vertically and horizontally. Structural damage usually varies depending on the distance from the epicenter, magnitude of the earthquake, and type of sediment in the area.

A quaternary fault is likely to be the cause of future large earthquakes. The two significant faults are the Hurricane and Sevier faults, which can produce earthquakes between 6.0 and 7.0 each. These faults are relatively near many communities along the I-15 corridor and present many risks and vulnerabilities to those communities. Some cities and towns in the region are relatively far away from the fault lines. This does not mean that these communities avoid earthquake risks. As can be seen in the documented epicenters, earthquakes have been documented throughout the region, despite distance from the fault line. Communities throughout the region can experience shaking and impacts to their built environment.

Measuring Earthquakes

Earthquakes are measured by magnitude, which is the total energy released in an earthquake event. Larger magnitude earthquakes release energy over a larger area for more time and each unit of magnitude measures 32 times increase in energy release. (Applied Technology Council, 2020) There are several methods that geologists measure earthquake magnitude, including:

- Local Magnitude (ML) measures the largest amplitude from seismograph station data, also called the Richter Magnitude (United States Geological Survey , 2021)
- Body wave magnitude (Mb) measures seismic waves that travel through the earth rather than at the surface. (United States Geological Survey, 2021)
- Surface wave magnitude (Ms)- measures seismic waves near the earth's surface. (United States Geological Survey, 2021)
- Moment magnitude (Mw) measures earth's movement, considering the fault's geometry and displacement of the fault across its surface. (Rafferty, 2021) this method produces the most accurate measure for the largest earthquakes.

The scales all have differing limitations and best uses but should produce similar magnitude values. Maps and tables in this plan use local magnitude to measure magnitude of earthquakes, per the recording of the University of Utah Seismograph Stations. A trained and qualified geologist should be contacted if there are any questions about a structure being near a fault.

- Maps

    - The faults mapped in this document have quarter mile-buffers around them because many were originally mapped at a 1:500,000 scale.
    - The tables in maps in each respective county chapter displaying historic earthquakes were recorded from the University of Utah Seismograph stations, using local magnitude (ML) to determine the size of each earthquake.
    - Earthquake epicenters data only available between 1950 and 2016. Mapping supplemented by reports of seismic activity from the University of Utah in the Hazard History section for each community.
- Data
    - The most accurate historic earthquake data in Utah began between 1962 and 1974 when there were fewer than ten seismograph stations. Between 1974 and 1980 there began to be a denser network of high-gain telemetered stations, this allowed for more accurate size and location determination. After 1981 earthquake recording was digitized to improve accuracy.
    - In this document we rely on the Utah Seismograph Stations/University of Utah for earthquake epicenter and event records. Earthquakes are measured using Local Magnitude (ML)

Earthquake Impacts

Earthquake hazards produce ground shaking effects, which cause structural damages to buildings and infrastructure, endangering humans who may be in or near structures or features prone to damage, collapse or falling. There are various structural and non-structural impacts caused by earthquakes, in addition to secondary or cascading natural hazard events.

Structural Damage

Vulnerability of structures is determined through the age of the construction. Utah building codes began to address seismic design as early as 1976; although, the state did not adopt building codes fully addressing seismic activity until 1989. The State currently uses the International Code Council Codes, which includes the International Building Code, International Residential Code, and the International Existing Building Code. These codes are updated every three years and must be adopted by the State. (FEMA, 2021) As of 2019, the State of Utah has adopted the 2018 IBC.

Structures constructed prior to the use of seismic code may not perform as well during an earthquake event, as buildings constructed to meet these seismic code standards. FEMA considers older buildings, that existed before seismic building codes as some of the biggest contributors to seismic risks. (FEMA, 2021) Seismic retrofitting can make these structures less vulnerable. A trained professional should be contacted to assess a structure to determine building safety, potential earthquake impacts, and mitigation measures on a site.

Non-Structural Damage

In addition to the damage that earthquakes can do to a physical structure, there are also impacts on the items and people inside of structures. Earthquake shaking can topple bookcases, shelves, heavy furniture, ceiling tiles, light fixtures, and any other furniture not securely fixed to a wall, creating a hazard for those who might be in a home or building. Simple and affordable steps can be taken to secure most furnishings in a building to limit impacts during an earthquake event.

Secondary Hazards

There are several secondary hazards that can be triggered by an earthquake or seismic event. Predicting exact outcomes is unlikely, however there are some secondary hazards that are likely following a seismic event. These hazards include liquefaction, fault rupture, tectonic deformation, and triggered landslides.

- *Liquefaction*. During an earthquake, loose, sandy, and saturated soils near the surface can produce a viscous liquid causing structures to tip or settle. Liquefaction can also create debris flows and ground cracking. Liquefaction typically occurs during an earthquake of magnitude five or greater.
- *Fault rupture* is significant ground movement that causes blocks of earth to be uplifted or downthrown. This movement creates fault scarps and has the potential to cause tectonic subsidence or the sinking of the earth's surface.
- *Tectonic Deformation* the lowering and tilting of a valley floor on the down-dropped side of a fault during an earthquake and commonly causes localized flooding and gravity flow utility failure.
- *Earthquake-triggered landslides* Earthquakes can cause debris flow, rockfalls, and landslides by shifting sediment and creating situations in which it can flow down a slope.

Flooding, fire ignition, ground collapse and other natural hazards can be triggered by an earthquake. These secondary hazards can cause additional damages and disruptions following an event, especially within the built environment as transportation and essential resources are affected. Secondary hazards point to the essential need to harden infrastructure and develop a robust, well rounded mitigation strategy to protect a community from the variety of risks they are exposed to.

Hazard History

The Five County Region experiences earthquakes on a regular basis. While these events tend to occur at a lower magnitude, with minimal impacts, there have been some earthquakes in the past 100-years which have led to structural damages in cities and towns throughout the region.

This plan includes recorded earthquake events with a magnitude of 4.0 or larger, which are considered minor earthquakes which are felt by humans. (Earthquake Hazards, n.d.) Larger earthquakes are likely to be felt with strong shaking and cause some property damage. Distance from the epicenter, which also impacts how an earthquake is felt, have been recorded but we have not removed earthquake records based on distance from a city or town.

Detail of Recent Earthquake Events

Washington City, 1992- In nearly 60 years, Southwestern Utah has only experienced one earthquake above 5.0. A 5.93 earthquake in Washington City triggered a landslide that destroyed homes and blocked a highway in Springdale. Impacts elsewhere include cracked walls, loosened plaster, broken water lines, and damaged cars due to rockfall throughout the County. No deaths or serious injuries were reported. (Sumsion, 2021) Washington County officials estimated damage at $750,000 to public facilities including roads, bridges, schools, water, and sewer lines. A newly constructed home worth $300,000 was destroyed, and thousands of dollars in damages to retail stock and stores were reported associated with this event. (Gorrell, 1992) The last event over a magnitude 5.0 was also in St. George City in the late 1800s.

Resources Addressing Earthquakes

In addition to Building Codes to prevent structural damage from earthquakes, the Utah Geological Survey provide recommendations for communities to mitigate their earthquake risks. It is recommended that when building or development crosses a fault that has not had a special study, an in-depth special study should be conducted by a geologist. (Gary E. Christenson, 2003) Risk reduction measures offered by UGS include using setbacks from a fault. Setback distance depends on the building use and fault class. Critical facilities like schools, hospitals, fire stations, high-occupancy buildings, water treatment plants, and hazardous material facilities, should have a setback of 50 Feet from the fault. (Gary E. Christenson, 2003)

Like Flooding, there are earthquake insurance policies that residents and property owners can purchase. While these are not directly a mitigation action, the insurance can help to reduce the impact that a hazard has economically on a region and individual. Homeowners insurance may not cover damages incurred from an earthquake event.

FEMA also provides an Earthquake Safety at Home guide. The guide is an educational tool for residents to better understand their risk and vulnerability to earthquakes in their homes. This guide discusses how to prepare, protect against, survive, and recover from an earthquake event on an individual basis. Measures include individual actions to lessen a family or household's risk to Earthquakes.

Summary

The Five County region, only a handful of the total earthquakes recorded have been large enough to be felt. In this frequently occurring hazard there have been some significant occurrences that caused damage in communities throughout the region, primarily in the St. George Metropolitan area and Springdale during the 1992 5.9 magnitude earthquake. Communities throughout the region should pay particular attention to their built environment to ensure buildings will handle strong shaking sufficiently. Impacts from cascading hazards are also expected during and after strong shaking events, making a wholistic mitigation approach even more crucial throughout the region.

Landslides

In 1985, it was estimated that landslides cause an average of 25 to 50 deaths and cost $1-2 billion in damages annually in the United States. (Committee on Ground Failure Hazards, 1985) Adjusting to 2020 dollars, landslides cost the United States $2.4 to $4.8 billion annually, causing damage to homes, buildings, and infrastructure, as well as loss of life and injury. While landslides are more common in less inhabited areas, growing populations and new development in landslide susceptible area.

Landslide Description

Landslides are geologic hazards caused by the movement of rock and earth over a steep slope. Many different types of ground movements are considered a landslide, but the primary types include Debris Flow, Slide, and Rockfall.

Rockfall is one of Southwestern Utah's most common form of slope failure or landslide. Hazard areas can be identified by visible boulders at the bottom of a steep slope. (Lund W. R., ROCK FALL: AN INCREASING HAZARD IN URBANIZING SOUTHWESTERN UTAH, 2013) The most effective mitigation is to avoid areas prone to rockfall, however several communities throughout the Southwest have already been developed in rockfall areas. In areas where development has already taken place in a rockfall or landslide area, mitigation measures are essential to lower future impacts on homes, buildings, and other development in its path. Geotechnical consultants can provide site specific recommendations for an area to lower this risk. Like many hazards, landslides are difficult to predict, and it is only a matter of time until the next landslide or rockfall event occurs. (Lund W. R., ROCK FALL: AN INCREASING HAZARD IN URBANIZING SOUTHWESTERN UTAH, 2013)

The area from the northern Wasatch Front and back valleys, south to Southwest Utah and St. George see numerous landslides due to the weak rock types, steep slopes, and annual precipitation in this zone. (Utah Division of Emergency Management, 2019, p. 143) Factors that cause landslides in the Five County Region include over steepened slopes, excess weight, accumulation of rain or snow duration and intensity of precipitation, earthquakes, wildfire, and man-made structures like roads and buildings which place additional stress on slopes. Areas that are susceptible to landslides are:

- Existing landslide or slope failure sites
- Steep natural slopes, particularly in weak geologic materials.
- Stepp construction- related cut or fill slopes.
- Areas at the mouth of drainages
- Slopes between leaking canals or ponds.

Types of Landslides

Debris flows- sediment-water mixtures that flow down a stream bed or hillslope, commonly depositing sediment at canyon mouths.

Slide- are downslope movements of soil or rock on slopes.

Rockfall- consists of rocks falling from a cliff or cut slope.

Figure 4: Types of Landslide

Source: Utah Geological Survey

- Developed hillsides where septic-tank soil absorption systems are used, and landscapes are irrigated.

Hazard History

Landslides are historic across the region and integral to the forming of many areas of the Southwest, including Zion Canyon. Given the growing population landslides will have greater impacts on humans and development as we move into less developed areas.

Landslides occur frequently throughout the southwest, but predominantly impact areas outside of cities and towns, however as cities and towns grow and development occurs in new areas, the potential for increased landslide impacts increases. Observing the extent to which our environment has been shaped by natural hazards points to the earth changing forces that come with these events. As our cities and towns grow and age, it is important to consider how we will adapt and secure our future as we continue to be impacted.

Recorded Landslide Hazards

Southwest Utah has experienced numerous recorded incidents of landslide that have impacted travel routes, property, lives, and other human activities. Forty-nine have been recorded as significant events, with five landslides occurring since 2016. Each community section will reference landslides in or around the community.

Detail of Recent Landslide Events

2013 Rockville- Rockfall resulted in two deaths at a home in a after a boulder destroyed a home. (Lund, Knudsen, & Bowman, Investigation of the December 12, 2013 Fatal Rockfall at 368 West Main Street, Rockville, Utah, 2014) Other boulders from the fall destroyed a garage and car in the driveway. Neighboring properties are in a mapped high hazard zone that includes the site of these damages. According to the Utah Geologic Survey, it is a matter of time until future rockfall impacts homes in the area.

2011 Milford- A debris flow was recorded by a family going fishing in Beaver Canyon. The flow blocked SR-153, covering the road with rocks, bud, branches, and roots. The slide also dammed the river with a boulder and debris. (O'Donoghue A. J., 2011)

2005 Black Mountain- UDOT had to remove approximately 20,000 cubic yards of sediment from SR-14 following a debris flow in Iron County. The debris flow travelled 1.6 miles, blocked SR-14 and flowed into Crow Creek. (Giraud & Lund) The slide occurred on a preexisting landslide area.

Climate Change

There is very little data that describes the ties of climate change to landslide hazards. Landslides are influenced by weather and climate events, such as drought, severe weather, wildfire, and flooding, which are expected to increase in severity with climate change. The southwest should anticipate potential for heightened landslide risk because of climate change.

The Five County region is subject to severe storms and weather on an annual basis, with monsoon rains regularly triggering flash flooding or debris flow events. Where severe storm events are expected to increase in frequency and intensity, landslides are likewise expected to become more frequent. (Gariano

& Guzzetti, 2016) Given that the Southwest is also expected to see population increases, there will likewise be more people exposed to this landslide hazard.

Events such as wildfire and drought can change the landscape of an area as vegetation is damaged or lost with these events. These changes can make landscapes vulnerable to landslides and debris flows, as seen during recent wildfire events, like the Brian Head fire, where landslides sent debris and mud into nearby communities following rainfall on the burn scar.

Summary

Landslide hazards have the potential to cause severe damage in Southwestern Utah. Looking to the historic record, property and infrastructure damage, personal injury, and loss of life have been a consistent impact of hazards in this region. This plan will identify measures for each community to take to address these impacts at the local level to decrease the extent and future impacts of landslides.

Wildfire

Fire is a natural process to maintain a healthy forest ecosystem. When the human and built environment begins to overlap with this forest area, and residents become subject to the annual threat of wildfire. A major cause of fire in Southwest Utah is lightning strike, however, the potential risk for human caused fires increases as urban land grows, causing the wildland development areas to increase. Recent wildfire impacts have included recreational areas and immense smoke in the air can cause harm during these activities.

Most Utah fires are human caused. While fires can cause loss of landscapes, homes, structures, and economies, they also impact essential facilities and infrastructure, which can impact the public health and safety. Damage to communications, electrical, water systems, and transportation can impede responder's ability to access fire and communicate with the public. (Utah Division of Emergency Management, 2019, p. 246)

Wildland Urban Interface (WUI)

Southwestern Utah is projected to see significant population growth in the next 50-years, primarily from new residents moving from other communities. This not only increases development outside of currently established urban areas, but there will also be a population of new residents who may not be aware of the fire risks in the area. Costs of housing in urban areas across the US have shifted development and residents moving to wildland areas, where they may be better able to afford housing.

The wildland urban interface (WUI) is the zone where human development meets undeveloped wildlands. In 2019, communities in all five of the region's counties were identified as "at risk" to wildfire events in the wildland urban interface by the Utah Division of Forestry, Fire, and State Lands. (Utah Division of Forestry, Fire, and State Lands) This scoring of communities ranks them from 0 (no risk)-12 (extreme risk), with factors including fire history, local vegetation, and firefighting capabilities of the community. (Utah Division of Forestry, Fire, and State Lands)

A study described that suppression costs are connected to addressing fires that threaten structures in the WUI, meaning that fires with an origination outside the WUI that have the potential to impact homes are linked to high suppression costs. (Mietkiewicz, et al., 2020) This points to the importance of creating fire breaks and fuels management in residential areas to mitigate suppression costs and potential damages to structures in the WUI.

Wildfire Risk Assessment Portal

The Utah Wildfire Risk Assessment Portal assesses several metrics to understand wildfire hazards in the state of Utah, which shares information about wildfire risks and creates public awareness to wildfire hazards. The tool identifies risk and threat to understand wildfire hazards locally and has included a wildfire index which identifies severity of these respective measures. The portal allows comparison of areas across the state as it measures risk consistently.

Risk: possibility of loss or harm occurring from a wildfire.

Threat: a measure related to the likelihood of an area burning.

Wildfire risk is a conglomerate measure which incorporates threat and effects of fire and yields the greatest potential impacts from a wildfire event by considering the asset impacts and likelihood of an area burning. This is the measure used in mapping throughout this document to provide a picture of

where assets are in respect to those areas at risk. Risk is measured across a scale of nine items from very very low to extreme fire hazard.

The Oregon Department of Forestry, in partnership with the West Wide Wildfire Assessment have developed a fire risk assessment tool, which indicates the relative risk, threat, suppression difficulty, relationship to Wildland Urban Interface (WUI), forest assets, riparian assets, areas of drinking water importance, and infrastructure assets in the area. This tool allows a viewer to observe both current and historic fire outbreaks compared to these metrics. Use or viewing of the tool can be accessed at https://utahwildfirerisk.utah.gov/.

Metrics

Wildfire Risk - Is the possibility of loss or harm occurring from a wildfire. Wildfire Risk combines the likelihood of a fire occurring (Threat), with those areas of most concern that are adversely impacted by fire (Fire Effects), to derive a single overall measure called the Wildfire Risk Index. The Fire Effects Index identifies areas that have important assets that could be adversely impacted by a wildfire and might be in areas where fire suppression activities are difficult. Values Impacted include Wildland Development Areas (WUI), Forest Assets, Riparian Assets, Drinking Water Importance Areas (watersheds) and Infrastructure Assets.

Wildfire Threat - is a number that is closely related to the likelihood of an acre burning. The Fire Threat Index is derived from historical fire occurrence, landscape characteristics including surface fuels and canopy fuels, percentile weather derived from historical weather observations and terrain conditions.

Suppression Difficulty - reflects the difficulty or relative cost to suppress a fire given the terrain and vegetation conditions. This combines the slope steepness and the fuel type characterization to identify areas where it would be difficult or costly to suppress a fire due to underlying terrain and vegetation.

Wildland Development Areas (WUI) - Is an area where structures and other human improvements meet and intermingle with wildland or vegetative fuels. This data set defines areas where people and homes are threatened by fire burning in wildland fuels.

Forest Assets - Are the prioritization of landscapes reflecting forest assets that would be most adversely affected by fire. This includes forested lands categorized by canopy height, canopy cover, and susceptibility, or response to wildfire.

Riparian Assets - Are riparian areas characterized by functions of water quantity and quality as well as ecology. This identifies riparian areas that are important as a suite of ecosystem services, including terrestrial and aquatic habitat, water quality, water quantity, and other ecological functions.

Drinking Water Importance Areas (DWIA) – DWIA are identified watersheds where the quality and quantity of public surface drinking water is measured.

Infrastructure Assets - Is a measure of the effects or potential wildfire impacts to infrastructure assets such as schools, airports, hospitals, roads, and railroads.

Climate Change

Increases in temperature, drought, and less precipitation is expected to exacerbate wildfires throughout the state. The fire season has already seen a documented extension, beginning earlier, and ending later year to year. These trends can have significant impacts on the longevity of communities and the

frequency at which they interact with wildfires. Mitigation is even more essential given the data indicating worsening wildfire seasons.

Fire poses a public health risk to water and air quality. Many fires produce PM2.5, which is too small to be captured by a human's nose and lungs, entering our blood stream, and causing heart and respiratory problems. (Rott, 2021) Wildfire smoke is increasing in fire prone areas and increases the number of people in the hospital. These fires that are expected to become more frequent and severe with climate change may have an unexpected impact on those living in and near fire prone communities regarding their health.

Hazard History

Wildfires are natural events, which contribute to the overall health of a forest environment. "A review of two decades of government agency wildfire records between 1992 and 2012 shows the length of the fire season across the west increased by nearly six weeks in that 20-year span". (Utah Division of Emergency Management, 2019, p. 243) Five of Utah's 10 largest fires have occurred in the Southwest region, with the largest being the Milford Flat fire of 2007 in Beaver County. This is the largest fire in Utah's history. There have been seven Fire Management Assistance Declarations in Southwest Utah have occurred since 2004, The most recent of which is the Veyo West fire of 2020.

Detail of Recent Wildfire Events

Milford Flat Fire, 2007- The Milford Flat Fire of 2007 is Utah's largest recorded fire, burning 363,052 acres between July 6 and July 17. What started as a small brush fire rapidly grew due to dry, hot, and windy conditions. (Gonzalez, 2007) The blaze caused highway closures and evacuations in and near the affected areas. According to NOAA, $4,000,000 in property damage was recorded, burning rangeland, cattle, and buildings. Several vehicle accidents occurred on roadways are attributed to the fire, including a passenger car hitting and killing two motorcyclists.

Brian Head Fire, 2017- The Brian Head Fire had an immense community impact in Iron and Garfield Counties. The fire destroyed 26 structures, including 13 homes. 1,562 people were forced to evacuate from 11 communities across the two counties. The fire impacted nearby community water quality and animal habitats, including the Sage Grouse. Several landslides have occurred on the burn scar due to heavy rains following the fire, further impacting nearby communities.

Turkey Road Fire, 2020- Fireworks ignited the Turkey Road Fire, which burned 11,993 acres of land. Suppression efforts cost more than $2.5 million dollars and further investment is required for restoration of the burned areas. (St. George News, 2020)

Wildfire Hazard Resources

As part of a West Wide Wildfire Assessment that covers seventeen Western States, the Utah Department of Natural Resources (DNR) has partnered with many other western states organizations to prepare thorough wildfire assessments throughout the Western U.S. These tools seek to provide communities with assistance and information so that they may make effective decisions as it relates to policy, preparation, and mitigation of wildfire risks in their community. These include the Utah Cooperative Wildfire System and the Catastrophic Wildfire Reduction Strategy. A national organization, Firewise, has also been included as it gives information to property owners to create defensible space surrounding properties in the WUI. This is not a comprehensive list of resources to address wildfire risks.

Utah Cooperative Wildfire System

In Utah's 2016 legislative session, the wildland Fire Policy Updates became law, which is implemented through the Division of Forestry, Fire, and State Lands Cooperative Wildfire System. Participating communities are required to draft a Community Wildfire Protection Plan, provide initial attack to control catastrophic fires, and engage in prevention, preparedness, and mitigation activities to reduce wildfire costs and risk. (Utah Division of Forestry, n.d.) In exchange, the state will pay the cost and provide support in fire suppression of these catastrophic fires. In the Five County Region, all but one incorporated city participates in this Cooperative Wildfire System.

Catastrophic Wildfire Reduction Strategy

The State of Utah organized a committee to set priorities for wildfire mitigation to prevent "catastrophic" wildfires. This process was drafted into a report resulted in an annual project proposal across the state to reduce wildfire risks, coordinated by the Division of Forestry, Fire, and State Lands. The division coordinates with local, county, state, and federal governments, and various stakeholders to determine and implement projects which meet the goals of the Catastrophic Wildfire Reduction Strategy program. In the Southwest area, over 40 mitigation projects have been identified since the program inception, according to the CatFire Projects Map. (Division of Forestry, Fire, and State Lands, n.d.)

Firewise

The National Fire Prevention Association promotes the Firewise program, where communities voluntarily organize among a neighborhood to reduce losses of their homes and community to wildfires. Residents set goals and actions based on an assessment from a State forestry agency or fire department, to be updated every five years. (National Fire Protection Association, 2021) The neighborhood tracks hours spent addressing mitigation goals and actions to remain in the Firewise program. Fire professionals believe that this wildfire risk reduction can influence the fire's behaviors and that these changes in fire behavior allow firefighters to take control of a fire and homeowners to keep their homes safe. In the Five County Region, only Hi/Lo, Beaver County is a Firewise community.

Summary

Wildfires pose several threats to southwestern Utah communities. According to the State Hazard Plan Vulnerability assessment, more than 1/3 of each Washington, Iron, and Beaver counties are considered at high, very high, or very very high risk to wildfire. Impact on water sources and riparian areas following wildfire events, given the extent of drought and available water sources in the region are significant. Wildfire also has a history of causing secondary hazards, following an event, such as landslides and flooding, as the wildfire season often aligns with the summer monsoon season.

Some of the state's largest wildfires have occurred in the Five County Region, and while this in part may be due to the significant amount of wildland in the region, the continuously increasing population in the urban areas pose potential threats, as more and more people locate residences and property in the wildland urban interface. This contributes to high costs of suppression and impacts to property from wildfires.

Severe Weather

Severe weather includes a broad range of weather phenomena which affect southwestern Utah, namely: tornadoes, strong winds, lightning, winter storms and extreme cold, and extreme heat. Severe weather events are the among the deadliest type of natural hazard in Utah.

Tornado events are observed by a rotating column of air extending from a thunderstorm to the ground. Most tornadoes have winds less than 112-miles per hour and zones of damage less than 100 feet wide. According to the National Weather Service, a total of 12 tornadoes have been observed in Southwestern Utah. Beaver and Iron counties see more tornadoes than others in the region, with 4 and 5 recorded, respectively.

Tornados are measured using the Enhanced Fujita Scale with several indicators assessing the damages during an event, to estimate the tornado windspeed. This method replaced the Fujita Scale in 2007. Tornado damages come from the strong winds and debris. (National Severe Storms Laboratory) (NOAA)

Damaging Wind events exceed 50-60 MPH and can reach up to 100 MPH. Wind often results from thunderstorm events and can be damaging to structures, infrastructure, and crops. (National Severe Storms Laboratory)

Hail is formed when rain is carried by wind drafts to higher, colder areas of the atmosphere and freeze. When the hail becomes too heavy to be carried by the wind, it will drop to the ground. To classify as hail, the stone must be 0.2 inches. The larger the stone, the greater the expected risk. Hail is known to cause damage to vehicles, structures, crops, and people or animals outdoors during an event. There are also reported cases of flights landing and reporting damages while flying through hailstorms. (National Severe Storms Laboratory)

Thunderstorms are rainstorms which have lightning and are considered severe when hail 1" or greater, winds above 57.5 MPH, or a tornado are produced in the storm. Approximately 10% of US thunderstorms meet severe criteria. Damage from severe thunderstorm winds account for half of all severe reports in the contiguous US.

Lightning is created when static electricity builds up between particles in clouds and/or the ground. After the positive and/or negative charges in the storm clouds are strong enough the insulation in the air breaks down and creates lightning between two clouds, or clouds and the ground. (National Severe Storms Laboratory)

Winter storms can immobilize a region or city, stranding commuters, closing airports, stopping the transport of goods, and disrupting emergency response and medical services, according to the National Weather Service and NOAA. The weight of snow can cause roofs to collapse and knock down trees and powerlines. Most snow and ice injuries are the result of automobile accidents. (National Severe Storms Laboratory)

Winter storms are measured using the Winter Storm Severity Index (WSSI), which considers the amount and weight of snow, ice accumulation, flash freeze potential, blowing or drifting snow, or blizzard events associated with a winter storm, which might impact infrastructure, utilities, or human activities. (National Weather Service, n.d.)

Extreme heat is defined as days where the temperature is ten degrees warmer than the average high temperature for an area and is the weather event that kills the most people in the US on average.

In Washington County, on average there are 22-days annually that surpass 100 degrees, as recorded by the La Verkin temperature station. (Government, U.S. Federal, 2021) Compared to other areas of the region, Washington county has the greatest number of days over 100 degrees annually, likely due to their southern latitude and low elevation. Some areas including Beaver and Garfield counties have comparably lower occurrence of heat at this degree, although it is important to note that Beaver County only has one station to record temperatures.

Hazard History

Severe Weather events almost reliably cause damages, injury, or death somewhere in the Southwestern region. The unique geology of the area make recreation particularly susceptible, including canyons and slot canyons, where rainfall can cause flash flooding, leading to damages to popular recreation assets or injuring users of these spaces.

In communities, severe weather can impact roads, infrastructure, and structures. Common damages reported include downed powerlines, damaged roof structures from wind or tornado, and delays on roadways due to winter storms. In the region, power outage is a noted vulnerability, especially to the elderly populations throughout the region. This concern poses significant risks during the summer heat in cities like Kanab and St. George and during winter months in higher elevations, where inability to heat or cool structures may pose threat to public health.

Table 1 summarizes a count of the various severe weather types and includes a summary of the damages, injuries, and deaths reported. Heat in the Southwest has killed more people than any other of the severe weather natural hazards, while winter storms and thunderstorms have caused the most property damage in the region.

Table 1: Severe Weather Impacts Summary

Severe Weather Type	Deaths	Injuries	Property Damage	Crop Damage
Cold/wind Chill	0	0	$ 20,000	$ 100,000
Hail	0	0	$ 115,000	$ 3,200
Heat	6	0	$ -	$ -
Heavy Rain	0	0	$ 8,500	$ -
Heavy Snow	0	1	$ 20,000	$ 4,000
Lightning	2	5	$ 418,000	$ -
Strong Wind	0	0	$ 1,000	$ -
Thunderstorm Wind	0	3	$ 695,000	$ 26,200
Tornado	0	0	$ 300,090	$ -
Winter Storm	0	10	$ 767,000	$ 5,000
Grand Total	**8**	**19**	**$ 2,344,590**	**$ 138,400**

Source: NOAA Stormtracker Database

Severe weather can contribute or trigger other natural hazard events. In the southwest, several large wildfires have been started by lightning strikes. Other potential hazards include flash flooding, landslides, and debris flows.

Southwestern Utah weather events have been recorded by NOAA dating back to 1950. Many of these hazard events included impacts statewide or regionally through south-central Utah.

Climate Patterns

Weather is the state of the atmosphere at a specific location and time, where climate is a measure of the long-term atmospheric patterns of an area. Data in figures 5-9 illustrate the long-term changes in climate and projected which are attributed to a increases in greenhouse gases in the atmosphere.

Average daily temperatures in the region have been trending upward and are forecast to continue this trend. Figure 5 to Figure 9 illustrates the expected future temperature ranges by referencing historical temperature ranges and considering two scenarios of global emissions through 2100. (U.S. Climate Resilience Toolkit Climate Explorer, 2020) In each of the Counties, temperatures have been increasing since 1950 and are expected to increase substantially under both models in the future. Estimated daily temperatures of the historic record, indicate that the Southwestern region has an average daily temperature around 62 to 70 degrees Fahrenheit, depending on the county. Over the next 80 years, it is expected that this average daily temperature could increase to 72 to 78 degrees average, shown as red trend line, on the high end or 66 to 74 degrees, shown as the blue trend line, on the low end.

Kane county

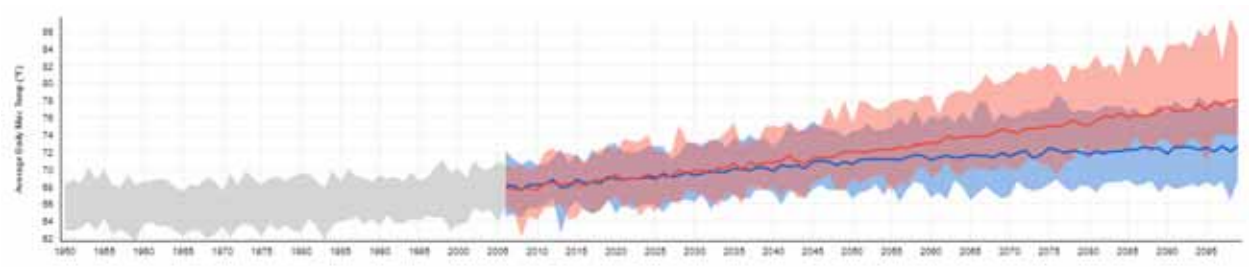


Figure 5: Kane County Projected Temperature Ranges

Iron county

Figure 6: Iron County Projected Temperature Ranges

Garfield county

Figure 7: Garfield County Projected Temperature Ranges

Washington county

Figure 8: Washington County Projected Temperature Ranges

Beaver County

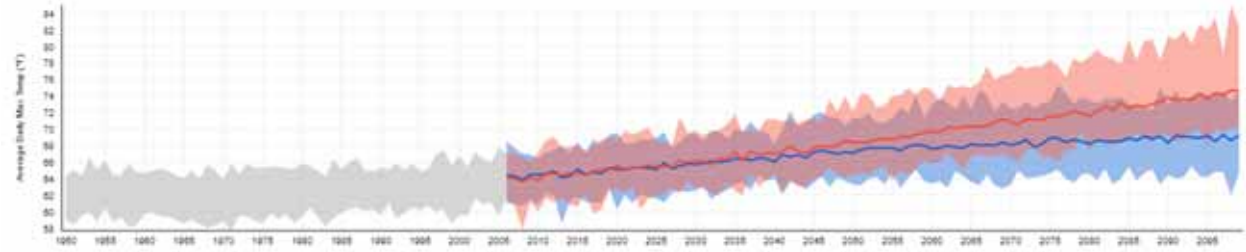


Figure 9: Beaver County Projected Temperature Ranges

Source: U.S. Climate Resilience Toolkit Climate Explorer, Accessed 3/31/2021

Severe weather events will increase with climate change. (Utah Division of Emergency Management, 2019, p. 229) This will likely have impacts on the monsoon season for southwestern Utah, bringing more intense than usual rain, further increasing risks of flash flooding, landslide, and other rainfall associated secondary hazard in the southwest. It is anticipated that in the Southwest we may receive more rain from these more intense storms, but that increased temperatures will lead to greater evapotranspiration and drier environment according to models from the Climate Toolbox. (Hegewisch & Abatzoglou, n.d.) The region is forecast to experience heightened wildfire risk and increased drought potential as a result.

Discussing the long-term conditions of the climate provide a more detailed picture of the potential future condition of the region, which can impact the probability, severity, and frequency of natural hazards.

Resources Addressing Severe Weather Hazards

Nearly 90% of all presidentially declared disasters are weather related. To guard against the negative effects of severe weather, the National Weather Service has designed the StormReady program. This program is a nationwide community preparedness program that uses an approach which helps communities develop plans to handle all types of severe weather. To be classified as a StormReady community several criteria must be met; however, the county Local Emergency Planning Committee (LEPC) is positioned to satisfy the StormReady application and program guidelines. Ultimately the benefit of becoming formally recognized as a storm ready community lies in the additional planning, preparation for severe weather occurrences. However, some grant opportunities are available through the National Weather Service as well as possible adjustment to insurance rates through the Insurance Services Organization (ISO).

Summary

Southwestern Utah experiences regular exposure to severe weather seasonally. These events tend to be widespread, often regional in their extent and impacts. The region is currently in a period of extended drought, with the state experiencing its driest year on record in 2020. Severe weather in the region have also caused some of the state's most deadly and costly flood events, including a flash flood in Hildale and a severe flood and debris flow event which impacted communities from Gunlock to Leeds. The region anticipates and plans for these events through stormwater and water conservation planning, among other efforts

Drought

Drought is a cyclical event marked by below normal precipitation. Every climate region can experience drought, but because a drought is below normal precipitation for a region, the amount of annual rainfall that would be considered a drought in one climate region may be completely different in another.

There are four types of droughts that consider several components and natural and human functions in their measurement. All can accurately define drought, although they relate to the moisture condition on several factors in our environment, including agriculture, water sources, and economies.

- Meteorological Drought is measured by recent precipitation and is easiest to gauge drought conditions. When recent precipitation is below normal levels, meteorological drought conditions exist.
- Agricultural Drought: The circumstances where soil water deficits no longer meet the demands of a specific crop during all stages of development.
- Hydrological Droughts are tied closely to the amount of precipitation there is, but it is referred to on the hydrological level, such as streams, rivers, lakes, and reservoirs. A hydrological drought period usually follows a meteorological, or agricultural drought by at least a few months.
- Socioeconomic Drought occurs when the amount or lack of precipitation negatively effects economic goods and resources.

Weather, climate, and environmental components which may influence drought include, but are not limited to runoff, percolation, ground water recharge, temperature, wind, humidity, evapotranspiration, and streamflow into larger bodies of water.

Palmer Drought Index

Drought analysis for the Five County Region incorporates the Palmer Drought Index, which measures drought severity. The Palmer Drought index has consistently been one of the most used indicators because it considers precipitation totals, temperature, evapotranspiration[1], soil runoff and soil recharge. The Palmer Drought Index displays drought as a negative number, described in Table 2.

Table 2: Palmer Drought Index Measures

Value	Description
4.0 or More	Extremely Wet
3.0 to 4.0	Very Wet
2.0 to 3.0	Moderately Wet
1.0 to 2.0	Slightly Wet
0.5 to 1.0	Incipient Wet Spell
-0.5 to 0.5	Near Normal
-0.5 to -1.0	Incipient Dry Spell
-1.0 to -2.0	Mild Drought
-2.0 to -3.0	Moderate Drought
-3.0 to -4.0	Severe Drought
-4.0 or Less	Extreme Drought

Source: Drought in Utah, Learning from the Past-Preparing for the Future, Utah DNR 2007

[1] Evapotranspiration is the process of water transitioning from land and plant sources to the atmosphere.

Climate Divisions

Drought throughout the US is tracked and recorded using geographic zones called climate divisions, the four climate divisions represented in Southwestern Utah are Western, Dixie, South Central, and Southeast. Figure 10 details illustrates where in the region these climate divisions lie.

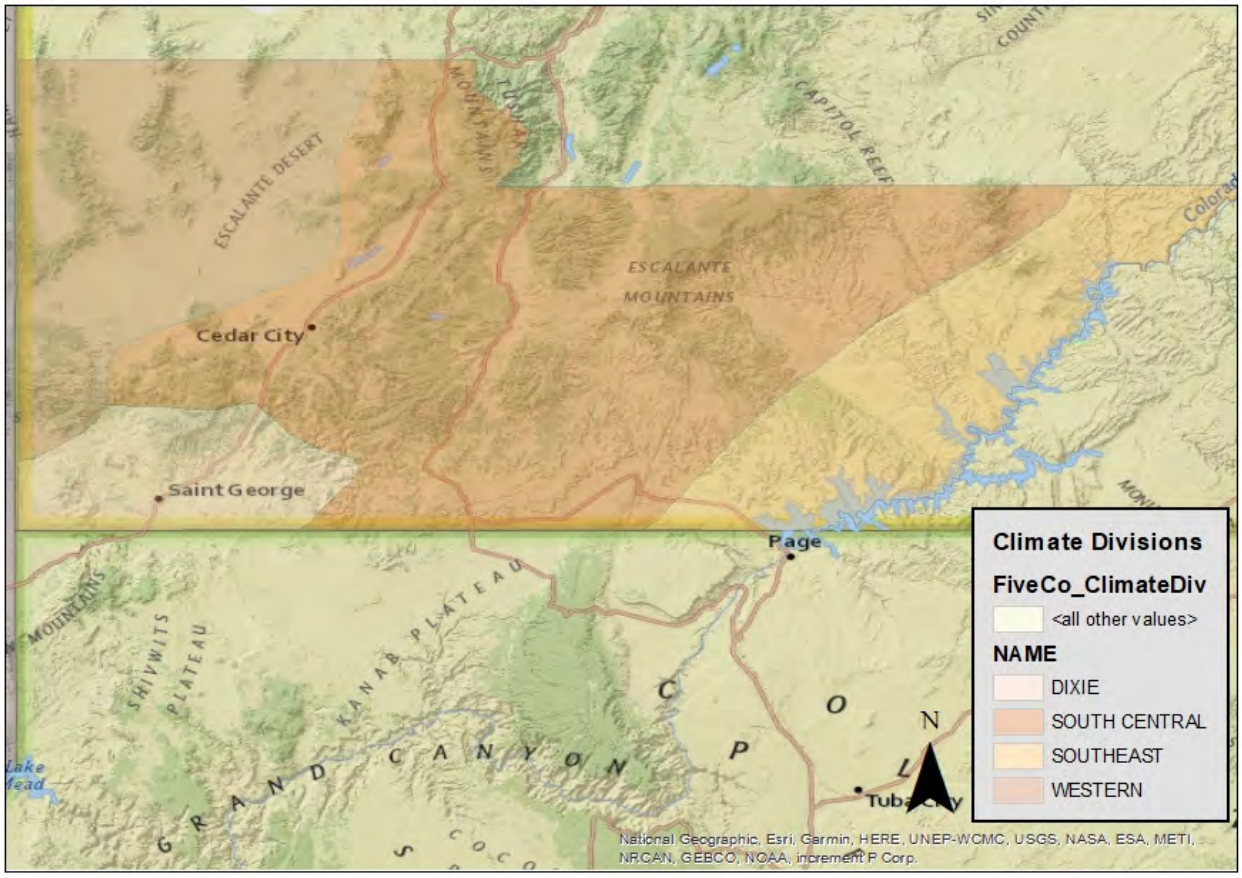


Figure 10: Five County Climate Divisions

This plan refers to the "Drought in Utah, Learning from the Past-Preparing for the Future," criteria to define drought as having a start with two consecutive years with Palmer Drought Severity Index (PDSI) less than or equal to -1.0 of average precipitation and end with two consecutive years with PDSI greater than -0.5. This methodology indicates that there have been seven regionwide periods of drought in Southwestern Utah.

Figure 11- Figure 14 contextualize the historic drought patterns in region's climate divisions, referencing precipitation records from 1895 through 2019. Each of the region's climate division has observed a trend toward lower-than-average precipitation and drier conditions overtime. It is expected that the region will continue to experience dry conditions marked by extended periods of drought.

The Western division

This region comprises 4,290 square miles 24% of the total land area of the Five Counties and is found in the western parts of Beaver, Iron, and Washington Counties. Over the last 120 years, many have exhibited drought conditions, however, there have only been eight periods of extended drought based

on the State of Utah's definition, of two consecutive years of -1.0 average precipitation or less. The longest drought in the western climate division spanned 12-years, from 1950 to 1961. The last half of the documented period saw increased long-term droughts with fewer wet periods between droughts. If annual droughts continue in this trend, the Western Division will continue to see more frequent drought years.

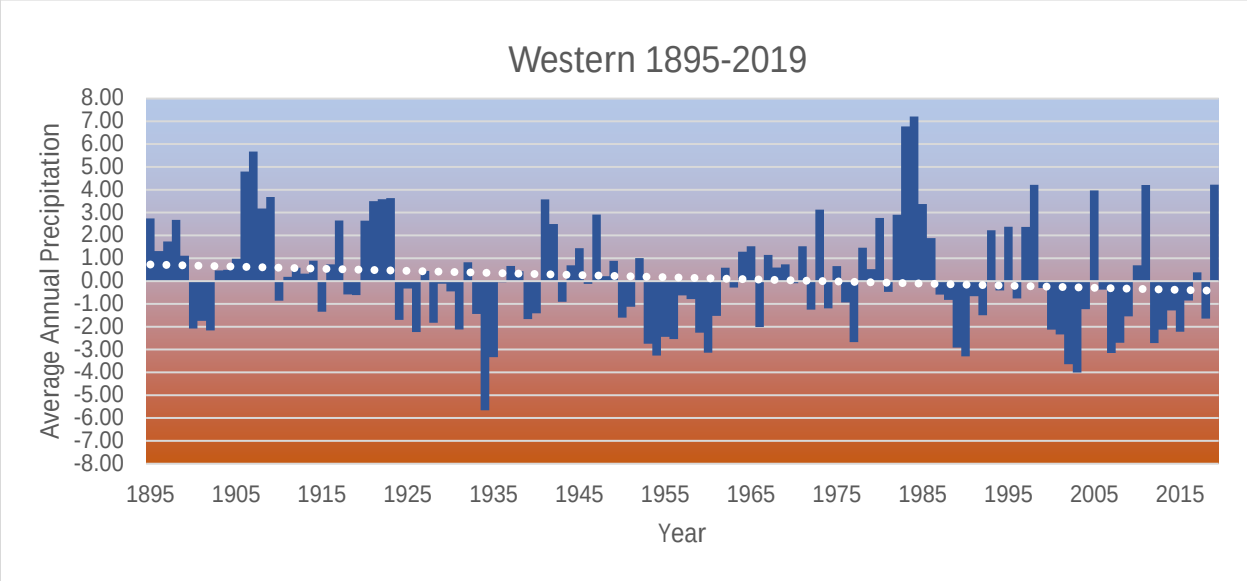


Figure 11: Western Division Historic Drought Patterns

The Dixie Division

Comprises 1,423 square miles or eight percent of the total land area of the Five Counties, the majority of which is in Washington County, with a small portion found in Kane County to the west. The Dixie Division has had seven major drought periods varying in length since 1895. One of the more notable drought periods began in 1999 and ended in 2009, reaching extreme drought conditions. Droughts in the Dixie Division have been occurring more frequently within the last 60 years.

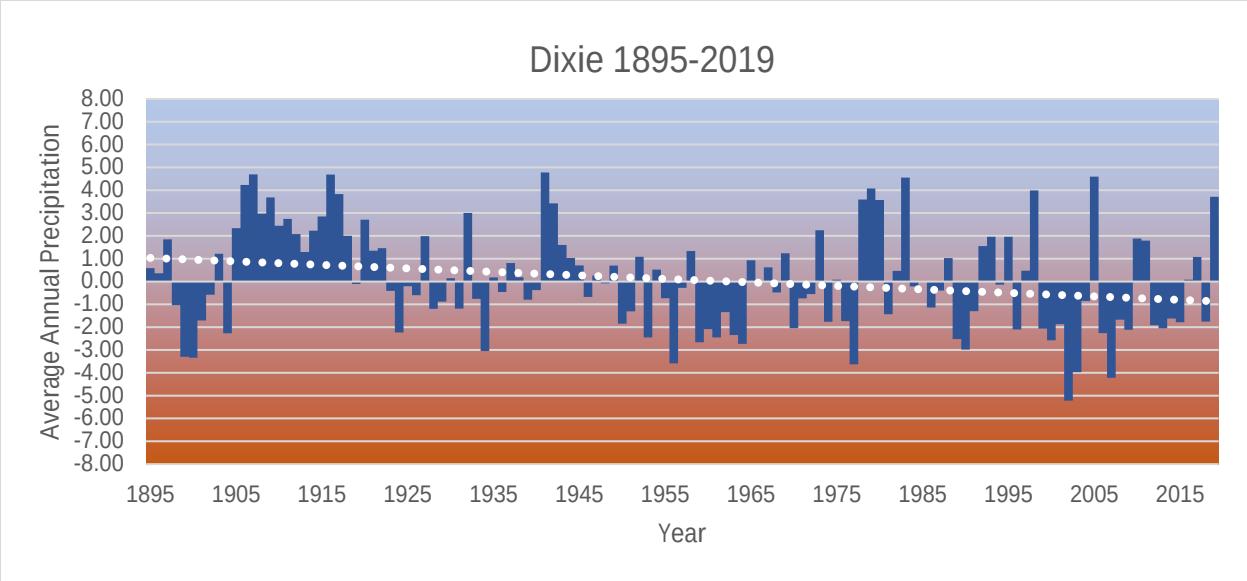


Figure 12: Dixie Division Historic Drought Patterns

The South-Central Division

Comprises 9,9097 square miles (52%) of the total land area of the Five Counties. The South-Central Division includes segments of all five of the counties and lies on the bulk of the region. Over the past 120-years there have been eight major droughts that meet the criteria for drought conditions. The last 50 years saw several droughts, three of which reached extreme conditions. It is expected that droughts continue to be longer and more frequent in future based on the historical record.

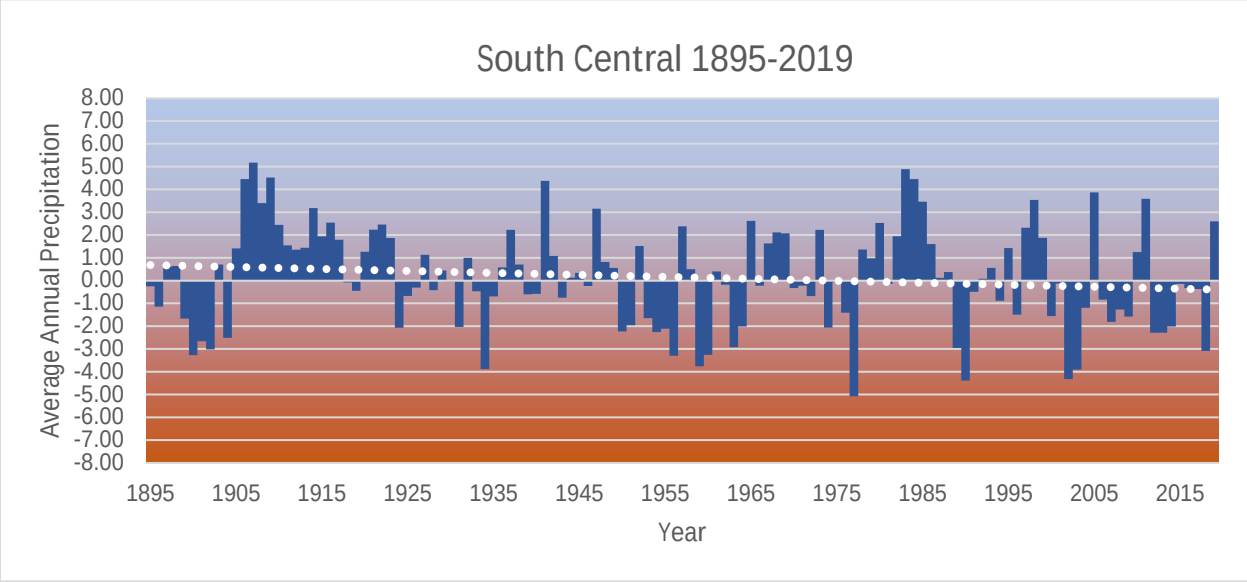


Figure 13: South Central Division Historic Drought Patterns

The Southeast Division

The Southeast division comprises 2,813 square miles (16%) of the total land area of the Five County region, in the eastern half of Kane and Garfield Counties. There have been seven major drought periods.

All of the notable droughts in this division reached severe to extreme conditions except for the drought recorded in the 1890's.

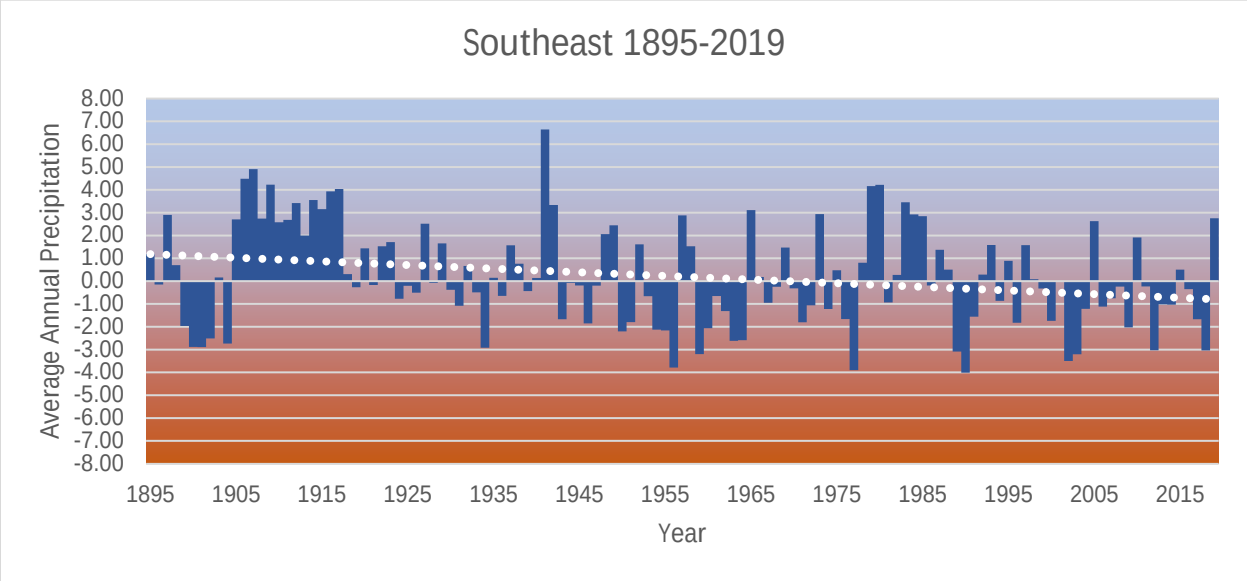


Figure 14: Southeast Division Historic Drought Patterns

While all four of the climate divisions are trending toward drought conditions, illustrated by the horizontal dotted line on each table, the Dixie and Southeast Climate Division tables reflect a trend toward more frequent and severe drought years. These trends have been confirmed in a report, which describes that over the past 50-years in the desert southwest, the period between rainstorms is now estimated at 45-days, up from the previous 30-days between precipitation events. (Matthew Brown, 2021) Local planning must address anticipated drought impacts to prepare for the expected population growth in the region.

Drought Impacts

According to NOAA, drought conditions have impacted the southwest significantly, costing billions of dollars and in some cases, creating dangerous environments for residents and visitors. Drought has cost Utah between $250 and $500 Million dollars between 1980 and 2020. (NOAA National Centers for Environmental Information (NCEI), 2021) According to the Washington County Water Conservation District, southern Utah's desert has experienced 12-years of drought during the last 20-years, (Washington County Water Conservancy District, 2019) culminating in 2020, North America's hottest recorded temperature measured in decades and the worst drought conditions seen in 20-years.

Water availability and contamination are heightened risks during a drought event. During drought, surface water evaporates faster than normal. This effect can also lead to slower or inadequate recharge of ground water. Water quality is a concern due to drought as well. Warmer temperatures and lower flow rates can encourage the growth of certain toxins, bacteria, and algae, or stagnate the water, creating hazards to recreation and consumption of these water sources.

Drought conditions can contribute to increased risk of other natural hazards. Wildfire hazard can be heightened during drought as vegetation is dried in these conditions. The Utah Drought report indicated that in a national assessment, acreage burned increased by 49%, the cost of firefighting increased by

160% when burning in drought conditions. (Utah Department of Natural Resources , 2007) Increased wildfires can also contribute to poorer air quality from smoke and ash.

The agricultural sector is one of the first to see impacts of drought. Water shortages can mean economic losses for this industry, and across the region. Agricultural assets impacted by drought can produce lower crop yields, lead to injury or death to livestock, and increase costs. Drought can require a reliance on other water sources to ensure that crops receive adequate moisture. In response to these impacts on the agricultural sector, consumers and residents can see impacts of drought in grocery stores with increased prices and shortages. (Centers for Disease Control and Prevention)

Communities exposed to drought conditions may face economic, public health, and safety concerns. Certain populations are at a greater vulnerability to drought impacts, including infants and children, adults older than 75, low-income persons, and those with chronic medical conditions, including cardiovascular and respiratory conditions. Drought can be compounded by extreme heat which can lead to illness. Poor air quality onset by dust and wildfire smoke can further impact at risk groups.

Drought has the potential to impact our outdoor recreation and tourism, which are significant draws to the local economy in many southwestern communities. Parts of the region that receive annual snowfall and draw winter recreation may be faced with short seasons with less snowfall in drought years. In the west decreased snowfall has an impact on the availability of water. A report from the University of Colorado indicated that recreation areas that are perceived to have wildfire or low water level conditions may cause potential visitors to go elsewhere for their recreational activities. Outdoor recreation visitors may also be faced with less water access on the trail and increased interaction with waterborne illness from bacteria and algae if consumed. (Centers for Disease Control and Prevention)

Climate Patterns

As described in the severe weather section of this chapter, historic temperature records and future projections estimate that the region is expected to get hotter and see increased evapotranspiration in future years. This will translate to increased aridity in the area and will contribute to anticipated water challenges in the region. (Utah Department of Natural Resources , 2007)

Other plans, policies, and organizations

The state of Utah developed a water plan to describe the importance of drought resilience in the state. The plan calls for communities and local governments to support healthy watersheds to encourage the local ecological survival during these conditions. (Team, 2017) This in turn improves water resources for local use. Local water conservation districts in the southwest seek to manage the available water in the area to provide for residents in the region. These agencies, the Washington County Water Conservation District, Kane County Water Conservation District, and Central Iron County Water Conservation District engage in planning, infrastructure development, and conservation of waterways to support access to clean water now and in the future.

Summary

Drought is an ongoing challenge in the Southwest that has impacted the local environment, economy, and populations. There are immense vulnerable populations and activities in the region that are at risk to drought to consider in planning and mitigation activities, including agricultural and recreation sectors, low-income persons, those with health challenges, and at-risk age groups. The population growth in the

region further complicates managing drought, as more people will be susceptible to impacts, particularly as sustained dry conditions are expected.

Flooding

In the southwestern flooding, erosion and sedimentation are responsible for loss of life, land, and infrastructure, along with damage to reservoirs and natural habitats. Flooding is a temporary overflow into an area not normally inundated with water. Understanding the different types of floods prevalent to an area contribute to improved mitigation efforts. Some of the flood types in the Five County Region defined by the National Weather Service- National Oceanic and Atmospheric Administration (NOAA) are:

Riverine Flooding is an event that occurs when river levels rise and overflow their banks or the edges of their main channel and inundate areas normally dry. Significant rivers through the Southwest include the Virgin River, Colorado River, Sevier River, Paria River, and the Escalante River.

Burn Scars/Debris Flow- Wildfires burn away the vegetation of an area leaving behind bare ground that does not easily absorb water. When rain falls, it runs off a burn scar toward a low-lying area, sometimes carrying branches, soil, and other debris along with it. Without vegetation to hold the soil in place, flooding can produce mud and debris flows. A recent example of the impacts of flooding on a burned area is the Brian Head Fire burn scar, which has impacted both Iron and Garfield Counties with flash flooding, debris flow, and landslide events in the summer following the fire.

Ice/Debris Jams- A back-up of water into surrounding areas can occur when a river or stream is blocked by a build-up of ice or other debris. Ice and debris jams impact rivers and can compound ongoing flooding events by blocking outlets with debris washed downstream.

Snow-melt- flooding due to snowmelt most often occurs in the spring when rapidly warming temperatures quickly melt the snow. The water runs off the already saturated ground into nearby streams and rivers, causing them to rise rapidly and potentially overflow their banks.

Dry Wash- When heavy rain falls over extremely dry land the water rushes toward low-lying areas which may include dry riverbeds and canyons. This can quickly turn a dry channel into a raging river.

Dam Breaks/Levee Failure- A break or failure can occur with little to no warning. Most often they are caused by water overtopping the structure, excessive seepage through the surrounding ground, or a structural failure.

Flash flooding- a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causing event, rainfall, dam failure, ice jam). Common causes of flash flooding are sudden, heavy rains as seen in the monsoon season in the south.

Southern Utah has a higher risk of flash flooding due to heavy storm systems. Flash flooding has the potential to change the landscape as sediment, debris, and rocks can be shifted during a flooding event. Flash flooding has impacts on people and property through flooding of homes, blocked roads, causing damages to property and human connectivity to a community. A commonly cited effect is particular to outdoor recreators and those living in rural areas, which make up a significant portion of our region. Residents and visitors have been stranded or injured due to flash flooding on hiking trails, in slot canyons and dry creeks.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is available for participating communities' residents, businesses, and property owners to purchase government backed flood to protect their property from damages incurred from flooding. Participating communities are required to adopt floodplain ordinances to prevent future flood losses.

Table 3describes the NFIP policies and coverage by county in the Five County Region. There are 4 repetitive loss properties in the Five County Region, two located in Washington County and two located in Iron County. Each county has submitted claims through the NFIP. Within this plan, each community will have a description of their participation in the NFIP.

Table 3: NFIP policies and coverage

	# of Policies	Total Coverage	Total Premiums	Total Claims since 1978	Total Claims paid since 1978
Beaver County	0	$ -	$ -	2	$ 7,119
Garfield County	11	$ 3,222,900	$ 9,965	2	$ 10,806
Iron County	95	$ 28,091,700	$ 59,293	19	$ 103,072
Kane County	45	$ 12,543,100	$ 28,566	6	$ 68,408
Washington County	448	$ 141,917,000	$ 259,008	51	$ 422,656
Total	599	$ 185,774,700	$ 356,832	80	$ 612,061

Source: Community Status Book

Flood events are not limited to the floodplain, and neither is flood insurance. Most homeowner's insurance does not cover flood damages, which can leave residents paying thousands of dollars in damages out of pocket. The use of flood insurance can lead to faster recovery and protect important financial assets. Homes and businesses in high-risk flood areas with mortgages from federally backed lenders are required to have flood insurance. https://www.fema.gov/flood-insurance

Community Rating System (CRS)

The NFIP seeks to credit communities that go beyond the minimum standards of floodplain management through the Community Rating System (CRS). Communities engage in certain mitigation and management activities to participate in the CRS, which can result in a reduction of flood insurance premium costs in the community depending on the community rating. In the Five County region Cedar City, St. George City, and Santa Clara City participate in the Community Rating System.

Flood Insurance Rate Maps

Flood maps are the basis of National Flood Insurance Program requirements. FEMA has been supporting communities with floodplain mapping in southern Utah since the 1970s. These maps indicate where the floodplain interacts with a community and allows a floodplain manager to enforce adopted policy relevant to this area. Six of the Five County communities do not have Flood Insurance Rate Maps and are not documented in the Community Status Book, 2020.

Flooding events are often described as a 100 or 500-year flood. This does not mean that the probability of that flood occurring is once every 100 or 500-years. For example, A 100-year flood can occur in an area several years in a row. Rather, this descriptor is trying to communicate that the area has a certain

percent chance of flooding in any given year. Areas which have a 1% chance or higher chance of experiencing a flood each year is considered to have high risk. (FEMA, n.d.)

- 5-year floodplain- 20% special flood hazard area
- 10-year floodplain- 10% special flood hazard area
- 50-year floodplain- 2% special flood hazard area
- 100-year floodplain- 1% special flood hazard area
- 500-year floodplain- 0.2% special flood hazard area

Beaver County is a mapped Zone D area, meaning that their flood risk requires further assessment to determine floodplain exposure. To assess flood risk in Beaver County, identification of major water ways and dams was included in the mapping in this plan.

Hazard History

Southwestern Utah has several lakes, rivers, creeks, and dams that have experienced flooding because of surplus water topping banks. In this region, sheet or flash flooding is common because of severe storms on impervious surfaces like rock, asphalt roads, sidewalk, etc. Flash floods can occur year-round but are typical in the summer monsoon season which occurs between July and September in this region. Flash floods can move debris and contribute to erosion in this region.

Historic flooding in some cases caused the modern settlements we know today in the region. Santa Clara, Springdale, Rockville, Kanarraville, and New Harmony were settled after earlier settlements were destroyed by flooding during the 1862 Great Flood. This event caused significant flooding throughout the west, stretching from Oregon to the Utah Territory after 40 plus days of rainfall. (Seegmiller, 1998)

NOAA reports 490 flood events in the region since 1996, 130 of which have reported damages or deaths. Several of the flood events are attributed to the same storm system. Each community risk assessment section will include the flood hazard history for the community being assessed.

Washington County has also had historic flooding, with one of the deadliest floods in the state's history occurring in Hildale and Zion National Park during a severe storm. A 2005 flooding event cost near $300,000 in damages as rain waters could not be absorbed by a snow covered and saturated ground. These waters flowed down the Santa Clara River and impacted a significant portion of the St. George Metropolitan area. Across the region floods have cost approximately $350.4 million in damages and several deaths and injuries. Several of these reported flooding events have occurred in recreational areas, which in this region can leave people stranded or injured far from community resources. This is a challenge in some unincorporated areas which also see significant increases in population throughout the year for tourism.

Interaction with other Hazards

Flooding events can be caused by severe weather, landslides, and earthquake events in some circumstances. This section has described the relationship between flooding and severe weather, but land movement events like landslides or earthquakes can cause blockages to water flow, or damage infrastructure holding water like dams or drainages, flooding an area. Likewise, flooding events can increase the risk of landslides and debris flows, especially on recently burned areas or other unvegetated landscapes. Flooding events often involve powerful flows of water which can move debris and rocks, creating damming in the flood waters.

Climate Change

Flooding may worsen in future years as a warmer climate causes a scenario where snowpack melts rapidly or earlier in the year than usual. It is anticipated that climate change will cause storms to increase in severity, contributing to sheet and flash flooding in the southwest, especially during the monsoon season. Expected growth may place more of the population at risk to flooding and climate associated natural hazards as new development is introduced to previously undeveloped areas.

Summary

Flooding has a long history in the Southwest and can cause damages to structures, infrastructure, economies, and cultural assets in the area. Outdoor recreation is vulnerable to flooding events, especially in areas where access is difficult or slot canyons throughout the area.

Five County Association of Governments

Local officials in southwestern Utah have a long history of cooperation. Long before the creation of regional development organizations or economic development districts, coordinated, formal economic development efforts were underway in the region.

The first meeting of an informal group named the Five County Organization was held on April 5, 1956. The meeting was called by the Iron County Commission, and included the commissioners and clerks from Beaver, Garfield, Iron, Kane and Washington counties. Others invited included the editors of all local and Salt Lake City newspapers, KSUB radio, Congressman H. Aldous Dixon, and representatives of the US National Park Service, Dixie National Forest, the Utah State Road Commission, and the Utah Water & Power Board.

Participants discussed "the advisability of forming an organization… for the purpose of working collectively and for the development of the resources of the five counties especially and for progress and development of the entire southern Utah area."

This collective and united effort continued through the late 1960s, when Utah Governor Calvin Rampton created state planning districts and encouraged local governments to form Associations of Government under the auspices of the state's Inter-local Cooperation Act. Southwestern Utah officials initiated the challenge and created the Five County Association of Governments on May 5, 1972.

Regional community and economic development continued to be a major focus of effort, culminating in the designation of the Five County Economic Development District on March 17, 1980. Community and economic development staff members have worked continuously since that designation to assist local governments in efforts to improve the physical infrastructure and economic viability of southwestern Utah. Besides administering several vital federal and state grant programs that benefit this region, the community and economic development department of the Five County Association of Governments continues to provide planning and technical assistance throughout the region, including the drafting of this plan. This section will describe several natural hazards which have impacts on the region and the AOG assets, and the provision of AOG services in the Five County region.

Regional Characteristics

The Five County Association of Governments (AOG) is a voluntary association of local governments in Southwest Utah. The AOG serves cities, towns, and counties in Beaver, Garfield, Iron, Kane, and Washington Counties, totaling 42 jurisdictions. Programs offered by Five County include aging, human, childcare, community and economic development, transportation planning services, and weatherization programs. The Association of Governments is also a regional connector for communities to share information, get assistance, and engage across the southwest of Utah.

While all the communities in the region are involved with the Five County Association of Government activities, services of the organization dominantly serve low- and moderate-income person, aging persons, and/or children. Other services are provided to the region including community development, economic development, and transportation planning services, are offered directly to communities. Nearly all residents in southwestern Utah interact with a project or service from the Five County AOG.

Geography and Climate

Southwestern Utah is where the Colorado Plateau, Great Basin, and Mojave Desert meet, creating a unique landscape with plains, buttes, mesas, and mountain ranges in the region. Several significant rivers and lakes also mark the area with interesting features and recreation opportunities. Vegetation in the region consists of native grasses, juniper, pinion pine, desert scrub, and varieties of cacti.

The range in geology also influences the climate throughout the region. Higher elevations are considered cool deserts and experience comparatively cooler temperatures year-round and snowy winters. Low elevation areas have a winter average temperature above freezing and do not see winter snow and experience summers with several days above 100 degrees Fahrenheit.

Weather patterns in the southwest can be severe and have notably marked the landscape, causing erosion, flooding, and other impacts. Flash flooding accompanies monsoon rains, common in southern months region wide, impacting communities, roadways, and popular outdoor recreation areas. Mountain snow, extreme temperatures, high winds, and thunderstorms are regularly reported weather events which can cause damages, injury, and death in the five-county region.

The AOG serves the entire region and has offices in Cedar City and St. George. The offices are in the valleys near mountain ranges. St. George regularly has warm temperatures, with several days exceeding 100 degrees annually and mild winter temperatures. Cedar City is at higher elevation and experiences cold winter temperatures and snow. Summers in Cedar City are normally quite hot, associated with the lower latitude.

Demographics

Southwestern Utah has seen considerable growth in the past thirty years, illustrated in Figure 15. As of the 2018 American Community Survey, it is estimated that the Five County region has a population of 229,038 people. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates for each of the represented Counties were used to estimate the region's population. The most rapid changes in population have been observed between 1980 and 2010, described in Figure 16. The average growth from the 1970 to 2010 census has been 46% for the Five County Region.

Population projections are available at the county level and are produced by the Kem C. Gardner Policy Institute at the University of Utah. All five of the counties are expected to see growth over the next several decades, as Utah is expected to see significant growth. See each county's chapter of the plan for a description of the anticipated growth in the coming years.

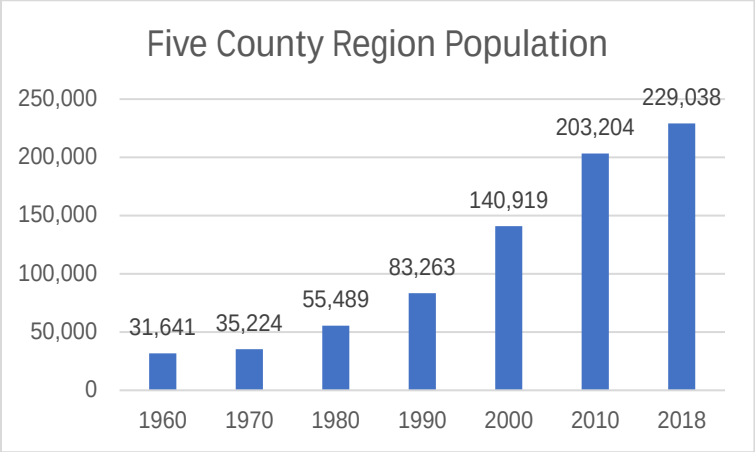


Figure 15: Five County Population by Decade

Source: US Census Bureau

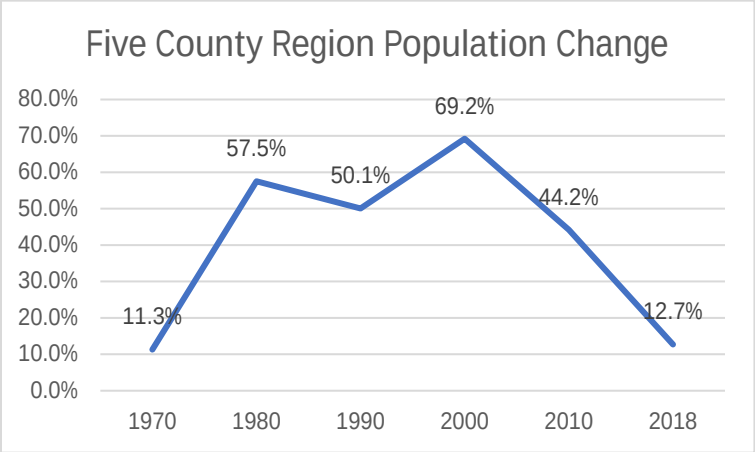


Figure 16: Five County Population Change

Source: US Census Bureau

Economy

The Five County regional economy is diverse and supported by both rural and urban industry and jobs. Each community risk assessment details the private primary jobs within the jurisdiction boundary. These sections should be referenced for a description of the jobs by industry for a county or community.

Across the Five County region, retail, health care, accommodation and food services, and construction are the dominant industries by the number of jobs in the industry, described in Figure 17. Several hospitals and clinics can be found in the region, in addition to service organizations. Tourism at the national parks and outdoor amenities contribute to the prominence of accommodation and food

service. Industries like agriculture and mining still have a foothold in the southwest, although the number of jobs in these industries is near 1% of the total.

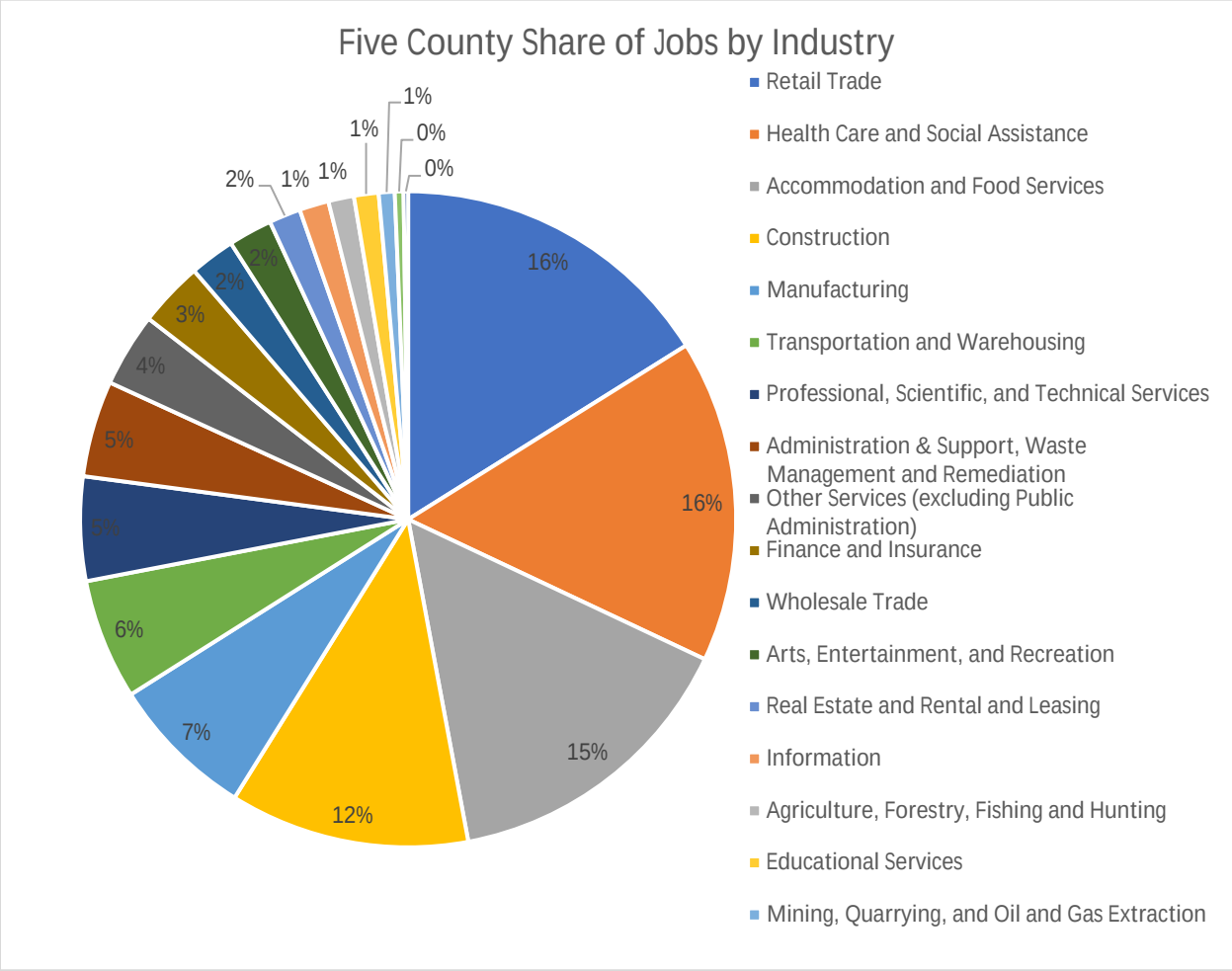


Figure 17: Five County Share of Jobs by Industry

Source: US Census Bureau

The Five County Association of Governments also acts as the local Economic Development District designated by the Economic Development Administration (EDA) and participates in a regional Comprehensive Economic Development Strategy (CEDS) planning process every five years. The CEDS identifies the current economic conditions of the counties and the future economic goals and vision they would like to achieve. A copy of the CEDS is available for reference on the AOG website: http://www.fivecounty.utah.gov/.

Development

The AOG does not have zoning authority and does not have development independent of the cities, towns, and county jurisdictions in the region. Description of residential and commercial development in the past five years can be found in the community sections of the plan.

As population has increased, the region has seen a need for development of infrastructure. Much of the significant infrastructure in the region does cross city, town, and county boundaries and holds

significance to the economy and connectivity of the region. Regionally significant projects which have been constructed since 2016 include:

- Expansion of Dixie Tech and Southwest Tech campuses
- East Zion Corridor development
- New recreation development

The Five County region includes several Opportunity Zones, which are designated areas where investors receive tax breaks in exchange for investing in new development. The objective is to increase economic measures like job creation and poverty reduction. Kane County is the only county in the region which does not have an opportunity zone nomination.

Organization Capabilities

The Five County Association of Governments staff hold various specialties and serve the region in unique ways, often filling gaps in local communities for services, planning, analysis, and coordination. Staff capabilities include grant writing, GIS and data analysis, economic development, technical writing, transportation planning, HEAT and weatherization support, case management, and knowledge of services and funding sources.

The Five County Association of Governments is not a taxing district and does not generate revenue from programs. Programs are operated dominantly through state and federal grant funding. The Association of Governments does not have legislative authority over jurisdictions and cannot pass policy for the region or jurisdictions to follow, including zoning codes and ordinances. No emergency services or response capabilities are housed in the AOG.

Plans and Policies

The Five County AOG has drafted an Emergency Management and Agency Continuity Plan to set procedures for responding and recovering to a hazard event in or impacting the offices or staff. The document defines a disaster as "any loss of utility service, connectivity, or catastrophic event that causes and interruption in the service provided by the Five County Association of Government operations. The hazards addressed in this planning process include: natural disasters broadly, fire, network services provider outage, and flood or water damage. This plan sets roles for the various organization departments in responding to an event at the office.

Local and county level plans and policies addressing hazard mitigation are described in the community sections of the plan, where plans have been made available.

Assets

The Five County Association of Governments offices can be found in St. George and Cedar City at the following addresses. Additional services are provided in other office space leased in Beaver, Garfield, Iron and Kane Counties. Only the Association's main office building in the Tonaquint Center Business Park in St. George office is owned by the AOG. The rest of the locations are in leased facilities.

Five County AOG Office 1070 W 1600 S, BLDG B St. George, UT 84770	St. George HEAT Office 1664 S Dixie Dr Unit L-104 St. George, UT 84770	Cedar City Office 585 N Main Str, Suite 1 Cedar City, UT 84720	Cedar City HEAT Office 2069 N Main St SUITE 103, Cedar City, UT 84721

The AOG supports staff travel throughout the region using vehicles maintained by the organization.

Technology assets and information which support employees' provision of services include phone, email, computer, and software equipment. In providing services, the AOG has significant physical and digital technology assets. Digital assets may include data and analysis, drafted documents, and critical information for service providers, in addition to the administrative and financial information of the organization.

The underground infrastructure which supports the AOG, including electrical, water, and sewer services, while not owned by the AOG are essential to provide services from our offices. Several of our services require in person visits with clients and impacts on any of these essential utilities can reduce levels of service offered by the AOG, or cause health or other impacts to users of our buildings.

Assets significant to the Five County region, that are not owned or operated by the AOG, include:

- Airports
- Watersheds and water infrastructure
- The rail line connecting Iron County to the rest of the state
- I-15
- National, state, and local parks
- Outdoor recreation assets
- Secondary education institutions
- Hospital networks

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Five County region, considering the regional nature of the hazards and the scope of the organization's capabilities, Drought, severe weather, and radon are the only hazards reported on for the AOG, described in Table 4. The planning process and methodology chapter of this plan describes the variables and process for this assessment in greater detail.

Table 4: Five County Association of Governments Risk Assessment

HAZARD	RISK
DROUGHT	1- High
SEVERE WEATHER	2- Moderate
FLOOD	3- Moderate
RADON	4- Low

The remainder of this section will describe each hazard in greater detail and the variables used to develop the risk ranking. The section will conclude with a mitigation strategy based on The Five County AOG risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. Extended drought can have increased negative impacts, with increased risk due to the continued population growth of the region. The State of Utah is entering an extended period of drought, which continued into 2021. Drought has the potential to impact residents, economies, and the environment.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in several of the communities in the Five County region, with three National Parks, several National Monuments, State parks, heritage sites, and dozens of other tourism opportunities in the region. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Agriculture can suffer during drought as crops and livestock are injured or die due to high temperatures and low moisture. Losses in agriculture hurt farmers with lost costs and the neighboring communities through impacts on their economy, whether increased food prices or impacts due to lost exports. The Five County region has several large and small farms, ranches, grazing operations, and other agricultural endeavors which have experienced past droughts. Impacts were observed most recently in 2021, when Utah farmers and ranchers reported selling livestock and leaving fields bare due to poor drought conditions across the state.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality, and lower overall water levels can concentrate toxins in water sources, further impacting wildlife, recreation activities, and impacting drinking water.

While droughts impact the Five County region wide, they also have the potential to impact services provided by the AOG offices, as drought impacts economies, public health, and costs of goods like food, likely to have increasing impacts on low- and moderate-income families.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting impacts to weather agencies, like NOAA. There is not GIS data available to show where or how severe weather will impact the Five County region, however our analysis assumes that severe weather events will impact the whole of the community,

residents, facilities, infrastructure, businesses, and property. In fact, many severe weather events include reported impacts across the region and in some cases, the state.

The climate in the Five County region sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains in lower elevations, with comparatively cooler temperatures and more humidity in higher elevation areas. Winters are marked by rain in low elevation areas and snow at high elevation. Thunderstorms frequently impact the region, which can produce hail, high winds, rain, and lightning. The entire region is considered a desert, and most of the region is considered arid and marked by dry, desert landscapes and vegetation.

Hazard History

NOAA reports that there have been 667 severe weather events reported for the Five County region between 1950 and 2020. Snow, wind, dust, thunderstorms, and extreme temperatures are among the hazards which have caused impacts throughout the region. Table 5 describes the total events, injury, deaths, and property damage caused by the various types of severe weather hazards. High winds and winter storms cause the greatest number of injuries, but heat hazards have caused the most deaths throughout the region. High winds cause the most property damage and crop damage in the region.

Table 5: Five County AOG Severe Weather Impacts Summary

Weather Hazard	Total Events	Deaths	Injuries	Property Damages	Crop Damage
Blizzard	4	0	0	$ -	$ -
Cold/Wind Chill	7	0	0	$ 20,000	$ 100,000
Dust Devil	1	0	0	$ 1,000	$ -
Dust Storm	1	0	0	$ -	$ -
Funnel Cloud	3	0	0	$ -	$ -
Hail	66	0	0	$ 115,000	$ 3,200
Heat	4	6	0	$ -	$ -
Heavy Rain	23	0	0	$ 8,500	$ -
Heavy Snow	81	0	1	$ 20,000	$ 4,000
High Wind	132	0	10	$ 1,295,000	$ 212,200
Lightning	8	2	5	$ 418,000	$ -
Strong Wind	1	0	0	$ 1,000	$ -
Thunderstorm Wind	151	0	3	$ 695,000	$ 26,200
Tornado	19	0	0	$ 300,090	$ -
Winter Storm	164	0	10	$ 767,000	$ 5,000
Winter Weather	2	0	0	$ -	$ -
Grand Total	**667**	**8**	**29**	**$ 3,640,590**	**$ 350,600**

Source: NOAA Storm Database, 2021

Details about specific severe weather events can be found in the community sections of this plan, which will provide dates, impacts, and a description of each event. There have not been severe weather events which have caused significant impacts to the Five County Association of Governments assets or personnel.

An AOG program, HEAT and Weatherization, can improve residents' resilience to severe weather events, including extreme temperatures, in the region, as these organizations support the implementation of rehabbing and renovating aged residential infrastructure to make energy bills more affordable. Often this is either providing direct payments for utilities or retrofitting existing homes with energy efficient materials.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example. It is important to understand the future conditions of the region, and is essential to review the weather record, as has been done here, but to also incorporate the potential future climate and weather conditions based on modelling. It is expected that the region may experience more severe storms, but overall have experience increased aridity, which can influence the risk of other natural hazards. See the hazard identification section describing severe weather for further details.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. In the Five County region, flooding has been experienced near office sites and there is the potential for assets to be impacted by flood when driving around the region to provide services.

Office locations in the St. George area have conducted mitigation to address previous mapping in the floodplain. Future development in current open space could place the office structure back in the floodplain, despite mitigation efforts from constructing a deep stormwater drainage adjacent to the building. Further, the Cedar City office was exposed to flooding potential during the severe storms in summer of 2021. While drainages exist near the office location, flows that top the drainage may impact the office.

Staff regularly drive throughout the region providing services. The entire region has reported some instance of flash flooding, which is a rapid onset of flood waters due to severe storm or rapidly melting snow run off. These flows can be forceful enough to wash vehicles away on the road. Damages from flash floods have been documented regionwide, and reference to a specific community's flood section will provide additional context.

National Flood Insurance Program

St. George property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

St. George City and Cedar City both participate in the National Flood Insurance Program. The Association's main office is not located within a designated 100-year flood plain risk area, therefore the Association does not carry flood insurance policies for that office. The Cedar City office is in space leased from Iron County.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. describes the flooding events which have impacted St. George and the surrounding area.

Review of the St. George and Cedar City reported flood events can describe community wide how flooding has impacted those communities. At the AOG offices, one event had the potential to impact the offices, assets, and personnel. On January 10, 2005, rapid snow melt and rain caused flooding on the Santa Clara and Virgin Rivers. Damages to two bridges on either side of the AOG office nearly left staff stranded at the offices. The AOG did not report major damages at either of their St. George offices

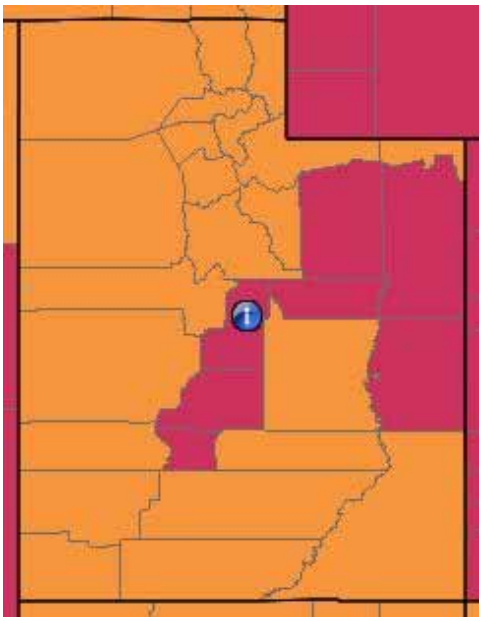
during the event. In St. George, floods which impact the South Gate Golf Course may also impact the area around the St. George AOG offices.

Flooding near the Cedar City AOG office includes inundation of Coal Creek, which runs directly behind the AOG office. In 2021, heavy rains caused heavy rain, and the creek running high had debris flow into the river and block up the creek at certain points. Damages and injury were not reported at AOG offices.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to increase in magnitude, which will influence flooding locally as flooding is often attributed to significant rain fall or snow melt events.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 18. At this level, mitigation is recommended by the EPA, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.



Radon

Radon Data

- Zone 1: Counties with predicted average indoor radon screening levels greater than 4 pCi/L
- Zone 2: Counties with predicted average indoor radon screening levels from 2 to 4 pCi/L
- Zone 3: Counties with predicted average indoor radon screening levels less than 2 pCi/L

Figure 18: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter buildings, become trapped and concentrating. While homes tend to be at higher risk to radon, given the extended time people spend in their home compared to other spaces, structures like schools or workplaces are also susceptible to radon impacts. Any concentration of radon gas is unhealthy for humans. Outdoor spaces are lower risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this statistic, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is

important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 6 describes the reported findings from short term radon testing in the Five County Region. Regionwide average test results are between 2.2 and 40.2 pCi/L of air. While some county's average result is within the radon estimate for the region, some counties report higher averages with more frequent tests surpassing the 4.0 pCi/L recommended for mitigation. The takeaway from this data is that radon gas has been identified in structures in the region, in some cases at high levels and that testing of individual homes and structures is necessary to understand and reduce risk to users of those structures.

Table 6: Short Term Radon Testing Reported by County

County	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
Beaver	27.2%	72.8%	664.0 pCi/L	40.2 pCi/L	423
Garfield	59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49
Iron	84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516
Kane	69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100
Washington	88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. While estimates of radon levels in the region and records of past tests can be helpful to describe the problem, individual testing is the best way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a radon mitigation specialist.

The Five County Association of Governments has three offices, one of which is owned by the organization, which do not have a record of previous on site testing for Radon. The majority of staff work onsite, at at least one of the AOG offices throughout the week.

Mitigation Strategy

The mitigation strategy is an outline for the Five County Association of Governments to address the risks and vulnerabilities identified in this planning process. The strategy includes a list of actions, estimated timeline, funding opportunities, and responsible parties to complete the actions outlined in the strategy. Actions for the Five County AOG include mitigating natural hazard risks for AOG assets and personnel to provide services safely and effectively to the region. Actions may also relate to AOG services in the region which further the goals and objectives of this mitigation plan. While the AOG does not have zoning or taxing authority in the region, the organization can coordinate with partners and share best practices in the region.

Progress on 2016 Mitigation Strategy

The Five County Association of Governments participated in the 2016 iteration of the Five County Natural Hazard Mitigation Plan and identified 11 actions to mitigate natural hazard risks in the region.

Table 7 describes the progress made on these actions. The natural hazard plan is intended to be iterative and documents progress from previous planning efforts.

Table 7: 2016 Five County Association of Governments Mitigation Strategy Progress

Hazard ID	Objective	Action	Timeline	Funding Source	Progress
Drought #1	To provide education to the public with regard to drought and water conservation	County-level distribution of water conservation information via newsletter and/or website to affiliated constituents.	Ongoing	State and Federal grants; local government operating budget; water purveyors.	Ongoing. Communities distributed information in the 2021 drought year.
Drought #2	To provide education to the public with regard to drought and water conservation	Water purveyors distribute water conservation information to affiliated constituents.	Ongoing	State and Federal grants; local government operating budget; water purveyors.	Unknown
Drought #3	To conserve water within the agricultural sector.	Develop/demonstrate water conservation practices for agricultural use.	Ongoing	State and federal grants; water purveyors	Unknown
Drought #4	Establish specific county-level water conservation measures.	County-level implementation of mitigation strategies identified in "Drought in Utah-Learning from the Past-Preparing for the Future." http://www.water.utah.gov/	3-5 years	State and Federal grants; Local government operating budget; Water purveyors.	Unknown
Radon #1	Promote radon gas reduction measures through non-structural improvements.	Increase public education related to radon gas hazards by distributing Utah Department of Environmental Quality informational brochures to County and City planning and engineering departments.	Ongoing	County and City operating budget; Utah Dept. of Environmental Quality operating budget.	Not complete
Radon #2	To reduce radon gas risk as it relates to the built environment.	Utilize the Radon Risk Map provided in this plan as a tool to assess radon gas risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific radon hazard identification study and implement applicable control techniques.	Ongoing	Private funds/ developer; County or City government operating budget (where applicable).	Not complete

Hazard ID	Objective	Action	Timeline	Funding Source	Progress
Radon #3	Promote radon awareness	Provide Radon brochures in every new home, promote and observe National Radon Action Month, address radon kits during the foundation permitting.	Ongoing	Local, state, and federal funds as available.	Unknown
Severe Weather #1	To reduce severe weather risk as it relates to the built environment.	Continued dedication/vigilance in enforcing the standards established in the International Building Code (IBC) as it relates to wind-loading, electrical grounding, snow-loading, and other weather-related hazards.	Ongoing	County or City government operating budget (where applicable).	Unknown
Severe Weather #2	Ensure that the public is warned of severe weather occurrences via broadcast media.	Enhance the Emergency Alert System (television and radio).	Ongoing	Federal and State government operating budget.	Unknown
Severe Weather #3	Ensure that the public is warned of severe weather occurrences via broadcast media.	Enhance NOAA Weather Radio All Hazard coverage.	Ongoing	Federal and State government operating budget.	Unknown
Severe Weather #4	Guard against the negative effects of severe weather by becoming a StormReady community.	At the county Local Emergency Planning Committee (LEPC) level, meet the program guidelines then apply to the National Weather Service StormReady program.	3-5 years	County and City operating budget.	Unknown

Source: 2016 Hazard Mitigation Plan

The previous Hazard Mitigation Plan documented regional mitigation items in the Five County section, which were to be addressed by Counties, Cities, and Towns in the region. Unfortunately, the AOG has neither the staff or funding capacity, nor the power to make regional policy to enforce or implement the actions from the previous plan. Actions from this list which are identified by individual communities as needed have been documented in their section of the hazard plan in this iteration of the plan.

2022 Mitigation Strategy

The Five County AOG mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 8. These actions have been identified and discussed during planning meetings based on the risk assessment. The elements included in the mitigation strategy are defined as follows:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are in Figure 19.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 19: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Five County has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 8, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 8: 2022 Five County Association of Governments Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Party
Radon #1	1	Protect employees and clients from radon risk.	Complete radon testing at AOG offices and implement mitigation measures if needed.	H	1-3 years	L	Utah DEQ, org. budget.	AOG admin

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Party
Radon #2	1, 3	Protect employees and clients from radon risk.	Provide information about the importance of radon testing and mitigation to childcare providers, aging service clients, and other AOG clientele.	M	Ongoing	L	Utah DEQ, program budgets.	AOG programs
Flood #1	2, 6	Increase capacity of the storm drainage basin for the St. George building.	Replace the aging and non-functioning stormwater detention system with a direct drainage system to the wash north of the St. George building.	M	Ongoing	M	State, local, and federal sources, organization budget.	AOG Admin
Severe Weather #1	1, 2, 3	Inform jurisdictions of planning and mitigation tools.	Provide jurisdictions in the Five County region with information and planning tools to address severe weather impacts.	H	Ongoing	M	State, local, and federal sources, organization budget.	AOG programs
Severe Weather #2	2	Collect data to inform mitigation actions.	Assess AOG office vulnerabilities to severe weather and mitigate accordingly.	M	5-years	M	Organization budget.	AOG Admin
Severe Weather #3	1, 4	Inform jurisdictions of planning and mitigation tools.	Continue to promote the HEAT and Weatherization programs offered by the AOG to low- and moderate-income persons.	H	Ongoing	L	Organization and Program budget.	AOG Admin and Programs
Drought #1	6	Conserve water on AOG owned properties.	Set policy to use drought tolerant landscaping and waterwise irrigation on AOG owned properties.	L	1-year	L	Organization budget.	AOG Admin
Drought #2	2	Conserve water on AOG owned properties.	Install water efficient toilets and sinks in existing and future AOG properties.	L	5-years	L	Organization budget.	AOG Admin
Drought #3	4	Inform jurisdictions of planning and mitigation tools.	Coordinate with jurisdictions in the region to complete a drought plan.	M	5-years	M	Local, state, and federal sources.	AOG Community and Economic Dvt.

Source: Local Planning Team

Beaver County

Beaver County is bordered on the south by Iron County, on the east by Piute County, on the north by Millard County, and on the west by Lincoln County Nevada. Within Beaver County there are several state highways and one Interstate, the most prominent being Interstate (I) 15, State Route (SR) 130, and SR-21. I-15 runs in a north-south direction across the mid-eastern portion of the County. SR-130 runs in a north-south direction with Cedar City (Iron County) at the southern end of the road and connects to SR-21 in Minersville (Beaver County) at the northmost end. SR-21 generally runs in a southeast-northwest direction beginning in Beaver City and connecting to SR-159 near the Nevada border.

The variety of cultural and natural resources within the County provides several diverse uses. The mountains, valleys, forests, deserts, and water resources provide wonderful settings for recreation uses and leisure activities such as horseback riding, hunting, fishing, skiing, camping, and rock hounding.

Beaver County has several short mountain ranges oriented generally on a north-south axis, the highest being the Tushar range in the east side of the County with Delano Peak, reaching over 12,000 feet, and the Indian Peaks range in the west. The Beaver River originates in the Tushar range and flows in a westerly and north-westerly direction. The entire eastern portion of the County lies within the Beaver River drainage areas. The remainder of the County is drained by intermittent streams. The elevation of the County's valley floor ranges 4,962 feet in the west to 5,970 feet in the east. There are four well-defined seasons.

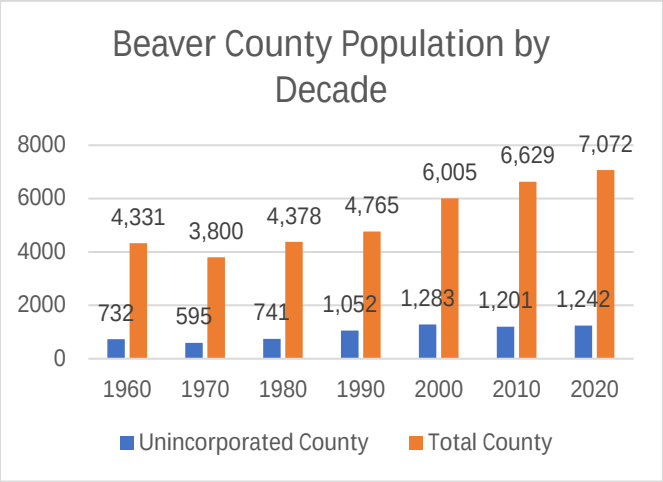


Figure 20: Beaver County Population By Decade

Source: US Census Bureau

Community Characteristics

Beaver County is a rural county in southwest Utah and is one of the least populous counties in the state. The county has three incorporated communities: Beaver City, Milford City, and the Town of Minersville where most of the population lives. These communities have stand alone sections of the plan to describe their risks and vulnerabilities. Several unincorporated communities will be addressed in this county section of the plan.

The tables below further discuss the population of Beaver County and its incorporated cities, detailing how the population has changed overtime, the makeup of this population, and what future population changes are expected to bring to the county.

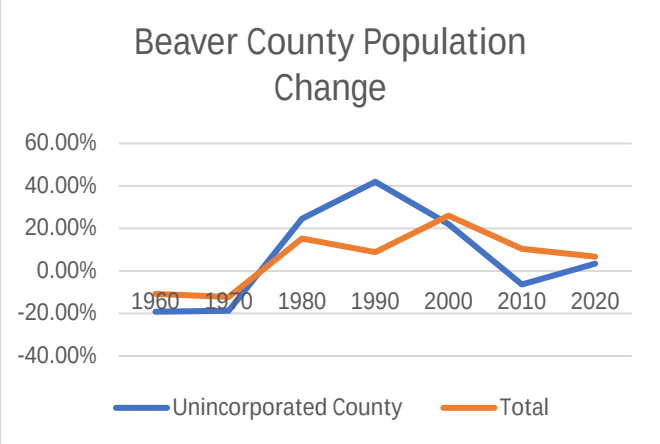


Figure 21: Beaver County Population Change

Source: US Census Bureau

Demographics

Beaver County has experienced growth countywide, with an average growth rate of 9.15%. The unincorporated county has observed an average growth rate since 1970 of 11.13%, showing that proportionally, the unincorporated county is growing faster than when you consider the entire county. Figure 20 describes the county's population by decade. Rapid growth was observed in the unincorporated county in 1990, with population growth steadying since that time, described in Figure 21.

Based on current population growth and trends, it is expected that, countywide, Beaver County will continue to see growth in the coming years. The Kem C Gardner Institute forecasts a 34.1% increase in the County's population between 2020 and 2060. According to this estimate the population of Beaver County, including incorporated areas, could be 10,176 people.

Development

The County encourages all development in unincorporated county to be in concert with the General Plan. Most urban land uses, including residential, commercial, industrial, and public uses are in or near the three incorporated municipalities in County. Beaver City and Milford City are the County's primary centers for commerce and social activity.

The largest use of private land in Beaver County is agriculture, representing 11.3% of the County's land area, according to the County's General Plan. Agricultural activity is primarily located in the Beaver and Milford Valleys. Privately-owned lands are generally located in and near incorporated communities as well as a swath through the center of the County. Many of these lands are subject to natural hazards such as earthquake faults and wildfires.

The Bureau of Land Management operates the largest portion of the lands in the county and is predominately used for recreation opportunities. Recreation importance of the region is increasing, with growing numbers of tourists attracted to the recreation opportunities in Southwest Utah. The county itself is also a destination for thousands of hunters, fishermen, hikers, bikers, ATVs, and campers looking for a high-country outdoor experience.

Minimal new development has occurred in the unincorporated county. Any new structures built are for residential use.

Economy

According to the On the Map tool from the US Census Bureau, in 2018, Agriculture, Forestry, Fishing and Hunting made up the largest share of private sector jobs at 17.8%. This is likely due to Smithfield Hog Production, the County's largest employer. Figure 22 describes the other prominent industries by number of jobs. Retail trade, accommodation and food services, and health care and social assistance are other industries that employ a larger share of people in Beaver County.

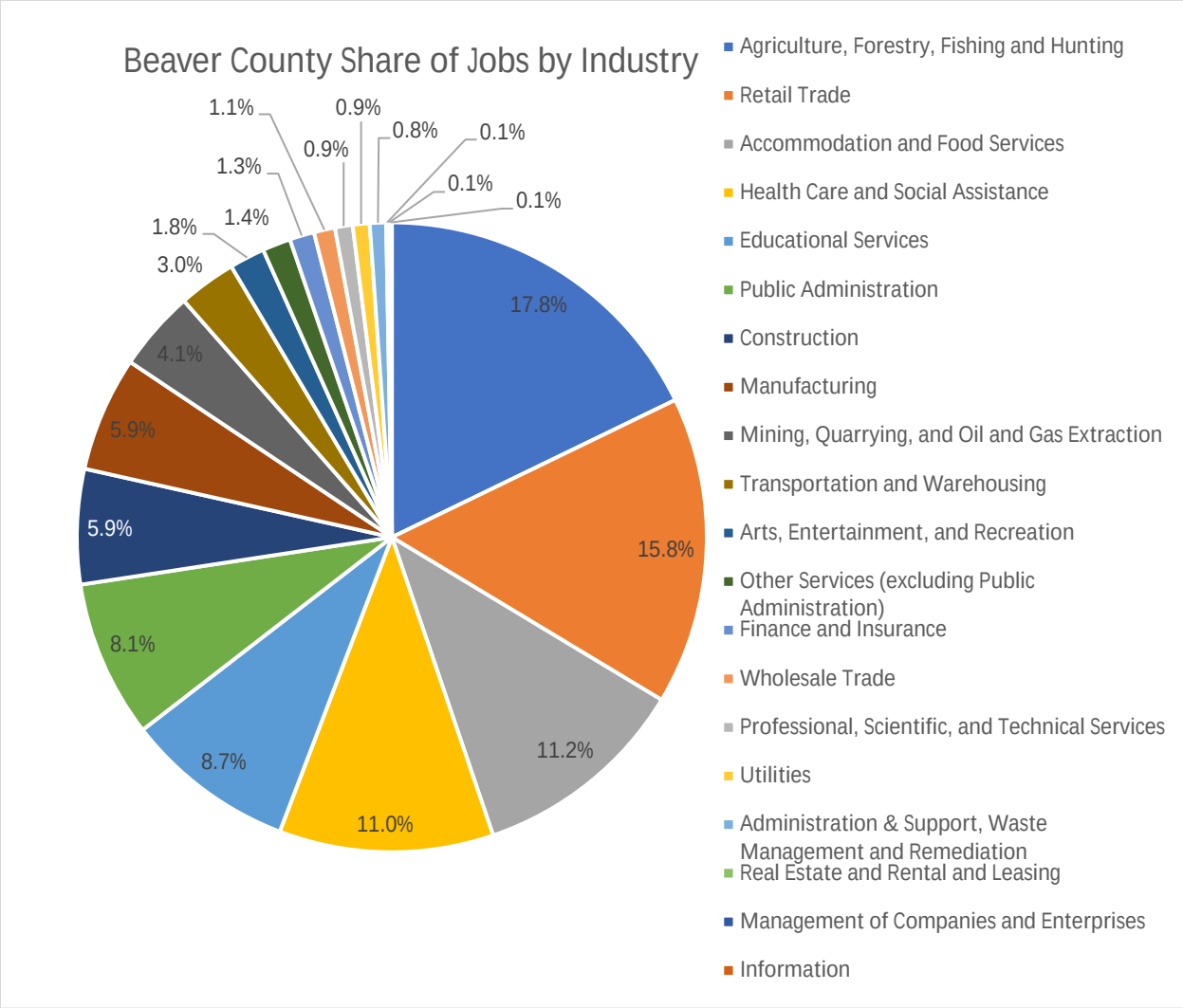


Figure 22: Beaver County Share of Jobs by Industry

Source: Beaver County Share of Private Primary Jobs, On the Map, 2018.

Agriculture, Forestry, Fishing and Hunting in the County is the County's largest economic driver followed closely by Retail Trade. Large distances between the rural communities and distant economic centers of the County make it difficult to provide adequate resources like emergency response and communications to the County's citizens. This challenge is prominent in areas outside of community centers.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward. This plan also includes a description of the unincorporated communities in the county, to better identify challenges or problems which may exist within these communities.

Plans and Policies

Beaver County policies and plans are recorded in several adopted documents, many of which include descriptions of natural hazard risks and methods to address hazards locally. This plan reviews and references these policies to inform discussions about the risks identified and mitigation actions to include in the strategy. Plans reviewed include the General plan, County Ordinances, and the Resource Management Plan.

General Plan

The Beaver County General Plan, Amended January 1999, stipulates, the health, safety, and general welfare of Beaver County citizens is the primary purposes for local land use plans. Because of this basis, the location and extent of potentially hazardous natural conditions should be identified and disclosed to present and future residents and visitors. Growth as it relates to natural hazard conflicts is managed through implementation of policy statements which describes the protection of sensitive lands in the community.

County Ordinances

The floodplain overlay district is enforced by the county commission, county building inspector or the county engineer, as described in Chapter 10, Article B of the County code. This chapter identifies areas of special flood hazard and procedures for developments to apply prior to construction in flood prone areas.

The County also describes reporting for developments which may occur in areas of geologic, flood or other natural hazards in Chapter 12 of the code. Further considerations of natural hazards in Beaver County's code include compliance with fire control publications, snow load compliance, restrictions of uses on steep slopes and hillsides, and other requirements.

Resource Management Plan

Resource Management Plan, 2017, discusses areas of critical concern, cultural and natural resources in the County. The management of these areas influences the impacts of fire, severe weather, drought, and floods on these resources. There are several mitigation action items identified in this plan, including management of ditches and canals for flood control, fire fuels reduction, reseeding burned areas, and invasive species management.

Community Assets

Beaver County is one of the least densely populated Counties in Utah. Many of the incorporated communities rely on the County for services, including Building Officials, Floodplain Management, public works, emergency management, and law enforcement. Other assets described in this section include government roles and capacity, utilities, schools, and emergency services that serve the unincorporated County.

Government roles

The county is governed by a three-person elected Commission, who pass ordinances, consider needs, and make decisions for the County. This body receives information and recommendations from the public, county staff, and other local councils and commissions. County boards which provide information to the Commission include the Planning and Zoning Commission, County School District, Special Service Districts, The Noxious Weed Control Board, Reservoir Park and Recreation Committee, Southwest Behavioral Health, Southwest Public Health, and The Travel Council.

The county employs several staff who work directly or indirectly with natural hazards, mitigation, preparedness, or response and recovery. Several of the staff people serve both the unincorporated and incorporated areas of the county, including law enforcement and the building department. The County employs economic development, GIS, information technology, and a buildings department who provide residents with information and enforce policies. The County employs an Emergency Manager who leverages agencies, contacts, and needs for preparedness, response, and recovery for many events, including natural hazards. A county roads department maintains and constructs over 988 miles of road in the County.

County capabilities include GIS mapping, develop mutual aid agreements with other agencies and communities, grant writing, and planning.

Funding for Capital improvement and infrastructure projects in the County are typically funded through Capital Improvement Project funding, debt through General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Utilities

The County does not provide any utilities to residents of the unincorporated county. Water is accessed by private wells and sewer is operated through septic systems. Gas is provided by Dominion Energy and Electric utilities by Rocky Mountain Power. Communications are operated by South Central Communications and major internet and cellular providers.

Schools

The County School District supports the operation of five schools, Beaver High School, Belknap Elementary, Milford High School, Milford Elementary, and Minersville School. The Minersville School, located just outside of the Minersville municipal boundary and is the only school in the unincorporated County. The school is within a quarter mile of the Mineral Mountains (west wide) fault.

Emergency Services

Beaver County Emergency and Healthcare Services tend to be in Beaver City or in other incorporated cities in the region. Services like Hospitals, Fire departments, Emergency Medical Service, and Law Enforcement are critical to the response and recovery from a natural hazard event. The services available in the unincorporated County are described below.

Hospitals

The two hospitals in the County are in Beaver City and Milford, both of which serve the entire County. The Beaver Medical Clinic is in Beaver City. Beaver Valley Hospital has an emergency room with three bays and an enclosed treatment room for outpatient surgical procedures. Milford Memorial Hospital is a 23-bed critical access hospital providing 24/7 health care such as inpatient, swing bed, long-term, emergency room, out-patient physical therapy, lab, and x-ray services at the hospital.

Fire and EMS

Within Beaver County there are three fire stations, one in each of the incorporated areas of Beaver, Milford and Minersville. The Fire Departments are administered through Special Service District #1 (Beaver) and Special Service District #2 (Milford & Minersville). These fire stations are volunteer departments.

- Beaver Fire District #1 serves the east side of Beaver County. Their services include firefighting, fuel reduction, EMT and emergency response services.
- Special Service District #2 (Milford & Minersville) provides fire protection and first response for Western Beaver County

Milford Ambulance Service currently is a volunteer service with four ambulances; two are in the City of Milford and two are located in Minersville Town

Law Enforcement

The Beaver County Sheriff's Office provides law enforcement throughout the County, including in unincorporated areas. The Public Safety Facility, Corrections Facility, and Sheriff's Office are all located in Beaver City.

Beaver County Search & Rescue is a volunteer group who respond to emergency situations in Beaver County's varied terrain, including rock, snow and ice, swift-water, and subterranean. The team is on call 24-hours a day.

Unincorporated Communities

Several unincorporated communities with historic and agricultural significance are in Beaver County. While these communities have very few permanent residents, there are still vulnerabilities to identify.

Adamsville is at the west end of the Beaver Valley in eastern Beaver County. It lies near the base of the Mineral Mountains, just northeast of Minersville Reservoir along the northern bank of the Beaver River.

Greenville is largely an agricultural community and bedroom community to Beaver City that sits just north of the Beaver River and south of SR-21. The location of Greenville was originally a camp on the north side of a ford on the Beaver River. The community was named for the thick green grass which covered the original town site.

Manderfield is an agricultural community located approximately five miles north of Beaver City.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for Beaver County, Utah. This assessment describes the natural hazards considered in this plan which pose risks to unincorporated Beaver County. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 9 summarizes the natural hazards in a list from high to low hazard risk as it pertains to the unincorporated County.

Table 9: Beaver County Hazard Risks

HAZARD	RISK
DROUGHT	5- High
SEVERE WEATHER	6- High

FLOOD	7- High
EARTHQUAKE	8- High
WILDFIRE	9- Moderate
LANDSLIDE	10- Moderate
RADON	11- Moderate
PROBLEM SOILS	12- Low

The remainder of this section will describe each hazard in greater detail and the variables that contributed to the risk ranking. The section will conclude with a mitigation strategy based on Beaver County's risk assessment.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories. Figure 23 describes the mapped wildfire risk in Beaver County. Wildfire risk is greatest near population centers, watersheds, and roadways as described on the map. This mapping does not factor the other uses of the land and potential vulnerabilities to tourism outside of more populated areas.

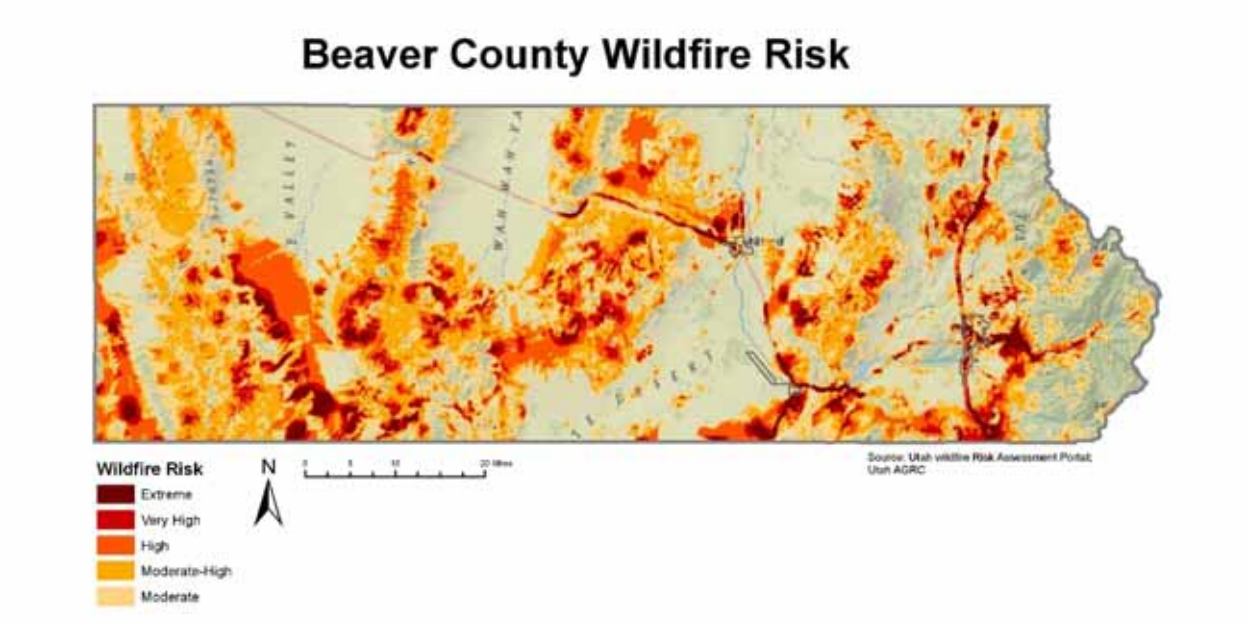


Figure 23: Beaver County Wildfire Risk

Source: Oregon Department of Forestry

Table 10 describes the assets in the unincorporated county that are at moderate to extreme risk to wildfire events. Notably, 59.1% of all parcels in the unincorporated County are in wildfire risk areas. Assessor data did not extrapolate Roadways are also exposed to wildfire risks throughout the county.

Table 10: Beaver County Wildfire Risk Exposure

Parcels	Road Miles	Rail Miles	Local Parks	Critical Facilities
59.1%	39.8%	39.8%	100%	0.0%

Source: Oregon Department of Forestry, Beaver County Assessor, AGRC, UDOT

In the Beaver County forest/recreation zone, a building official will enforce the standards outlined in the state department of natural resources, division of forestry and fire control publication titled "Wildfire Hazards And Residential Development; Identification, Classification And Regulation", dated 1978 or subsequent edition on applicable land uses. The building official may require any appropriate standard

described in the above-mentioned publication as a condition of approval. The building official shall review all building permit applications to assure compliance with the above publication.

The Modifying Regulations (9-6C-6) section of the Beaver County code states that "due to the presence of a potential wildfire hazard in the forest/recreation zone, all uses listed in this article shall be reviewed by the building official in relation to the standards outlined in the state department of natural resources, division of forestry and fire control publication titled "Wildfire Hazards And Residential Development; Identification, Classification And Regulation", dated 1978 or subsequent edition. The building official may require any appropriate standard described in the above-mentioned publication as a condition of approval. The building official shall review all building permit applications to assure compliance with the above publication."

Hazard History

Wildfire is a continuous challenge in the southwest, given the dry, arid climate. Fire starts throughout the region are attributed to both human causes and natural causes, like lightning strikes. Table 11 describes the wildfire history in the County. The Milford Flat Fire is one of Utah's largest wildfires and was designated a Fire Management Assistance Grant (FMAG) to provide federal funds to support mitigation, management, and control of the fire. Utah Fire Info documents significant wildland fires in Utah from Fall 2017 to present. There have several documented fires for Beaver County on this database.

Table 11: Wildfire Hazard History

Fire Name	Year	Acres Burned	Other Impacts
Rockpath and Antelope Fires	2020	20,941	• The fire was lightning caused and impacted both Millard and Beaver Counties.
3 Creeks Fire	2020	60	• Fire ignited in a fuels treatment which had slash piles.
Cougar Fire	2020	476	• One heat related illness
Greenville Fire	2020	1,800	• Caused the closure of SR-21 near the Minersville reservoir, threatened a campground in the recreation area.
Baboon Fire	2020	305	• Burned fields and trees near SR-130.
Horse Valley Fire	2020	55	• The fire caused closures of SR-31 between Enoch and Minersville.
Skull Flat 2 Fire	2019	1,676	• The fire occurred adjacent to the Skull Flat Fire area from earlier in the summer.
Skull Flat Fire	2019	1,625	• The fire occurred five miles east of Beaver Utah and did not prompt any evacuations and threatened no structures. The fire was lightning caused.
Black Mountain Fire	2018	5,998	• SR-130 closed and the blaze nearly prompted the evacuation of Minersville residents.
Milford Flat Fire (FM-2707-UT)	2007	337,675	• Rangeland, cattle, four buildings, and a cabin were burned. • $4,000,000 in property damage recorded. • Impacted both Millard and Beaver County

Source: Utah Fire Info, FEMA

Wildfires are likely to impact Beaver County in the future as drought conditions create dry fuels and low air moisture. Wildfires can be caused by severe weather events, flood, landslides, and earthquakes. Fires can also trigger or increase risks of landslides or flooding on bare soils.

Earthquake

Southwestern Utah frequently has earthquakes and has several faults capable of producing severe shaking events. Beaver County has segments of the Wah-Wah Mountains, Mineral Mountains, Beaver Basin, and San Francisco Mounts faults; as well as the Cove Fort Fault Zone. Identified quaternary faults and earthquake epicenters are described in Figure 24.

Recorded earthquake events with a magnitude at 4.0 or greater. The largest shaking event in Beaver County has been in the 4.0 to 4.5 range. Earthquakes of this size may cause minor damage, including breaking windows and knocking over items. Fault zones are expected to be the cause of future large earthquakes, although epicenters can be anywhere. Shaking nearest the epicenter typically experience stronger shaking and shaking further from the epicenter lessens in intensity. Earthquakes miles from the epicenter can still be felt and cause damages depending on magnitude.

Figure 24: Beaver County Earthquake Epicenters and Quaternary Faults

According to the Utah Geological Survey, the County may experience strong or very strong shaking, indicated by the map in Figure 25. The strongest shaking is expected in the east side of the county, indicated by the orange coloring.

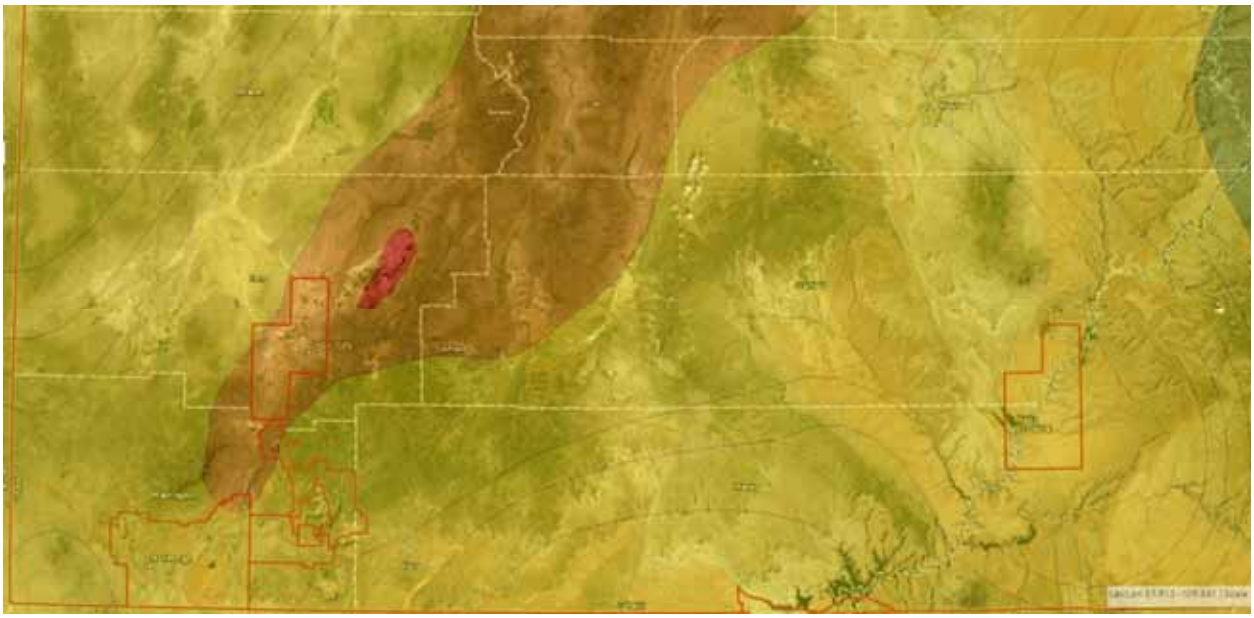


Figure 25: Five County Ground Shaking Hazard

Five County's assessment of earthquake hazard included overlaying community assets within a quarter mile of a mapped faults, described in Table 12. Assessor data in Beaver County does not separate parcels by use, for this reason, this assessment evaluates the sum of all parcels rather than separating parcels by use. In the unincorporated county, approximately 23.7% of parcels and less than 8.3% of road miles are within a quarter mile of a quaternary fault. Road miles are likely to be a significant vulnerability during an earthquake event as losses on roadways can result in isolation for parts of the county, including incorporated and unincorporated communities. Access can be cut off or require significantly longer routes to access certain areas of the County. Areas that are already far from resources are especially vulnerable.

Table 12:Beaver County Quaternary Fault Exposure

Parcels	Road Miles	Rail Miles	Local Parks	Critical Facilities
23.7%	8.3%	0.0%	50.0%	100.0%

A factor in structures that contribute to risk during an earthquake event is the age of the structure, type of construction, and compliance with modern seismic codes. The State of Utah has adopted the International Building Code, which describes design standards for seismic safety. Such codes have been in use since 1975, and there are some structures throughout the state that have been built with unreinforced masonry. 2019 ACS data from estimates that 30.6% of housing units in unincorporated County were built pre-1975, before the use of seismic codes. These may be unreinforced masonry construction types and may be less stable during a shaking event, contributing to the loss of the structure and damages to users inside and outside of the structure.

Hazard History

Table 13 describes the five earthquake events that have been reported in Beaver County, with magnitudes equal to or greater than 4.0. This magnitude has the potential for some minor damage,

including knocking over items or breaking windows. These earthquake epicenters were in various locations across the western portion of the unincorporated and incorporated County.

Table 13: Beaver County Recorded Earthquake Events

Incident Date	Location	Description
1908	Milford, Beaver County	A 4.05 magnitude earthquake recorded within the Milford municipal boundary.
1966	Minersville, Beaver County	A 4.17 magnitude earthquake recorded 16.2 miles southwest of Minersville.
1923	Minersville, Beaver County	A 4.05 magnitude earthquake recorded 21.5 miles southwest of Minersville.
1873	Beaver City, Beaver County	A 4.05 magnitude earthquake recorded within the Beaver City municipal boundary.
1998	Beaver City, Beaver County	A 4.48 magnitude earthquake recorded 9 miles Southeast of Beaver City.

Earthquakes are difficult to predict and can be damaging to a community. Events occur often in Utah, although normally at lower magnitudes. Earthquakes have the potential to trigger other natural hazard events due to structure and infrastructure damage, including floods, wildfire, and landslides and rockfall. Liquefaction is another byproduct of strong shaking in certain scenarios, the soil becomes like a liquid and can flow or lose integrity, damaging structures, and infrastructure.

Flood

Beaver County has limited mapped floodplains and has documented several flooding events, most commonly flash flooding events. Flash flooding often results from severe storms or significant precipitation events.

Current Floodplain mapping completed for Beaver County, dated to 1987, indicates that all of the county is in Zone D, which indicates that there is a potential risk of flooding, but the probability has not been calculated. (FEMA) The Figure 26 maps Beaver County's dam inundation areas and where the County's major bodies of water are. The map does not document the floodplain, as the entire county is classified as Zone D. Both the bodies of water and dam inundation zones parallel Highway 21 and flow through the most developed portions of the County. These Mapped areas tend to be in the east side of the county, but that does not mean that flooding will not occur elsewhere. Flooding events have been documented in various location in the county.

Figure 26: Beaver County Floodplain and Dam Inundation Zone

Table 14documents the assets and resources in the unincorporated county that are exposed to mapped dam inundation zones. Road miles are an at-risk asset to flooding in the unincorporated county. Flooded or damaged roads can lead to traffic delays or cut off communities from response and resources. Assessor data in Beaver County does not separate parcels by use, for this reason, this assessment evaluates the sum of all parcels rather than separating parcels by use.

Table 14: Beaver County Water Body and Dam Inundation Exposure

Parcels	Road Miles	Rail Miles	Local Parks	Critical Facilities
17.6%	2.6%	19.5%	50%	0.0%

According to historical data, Roadways, Agriculture, residential structures, and Outdoor recreation has been identified as a risk.

NFIP

Beaver communities and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding. Flood Insurance Rate Maps were developed for Beaver County in 1987, had no CAC, and CAV in 11/04/2015. No repetitive losses have been reported in the County.

Table 15 describes the NFIP participation and claims paid in Beaver County. There are no flood insurance policies in the County, yet there are two claims made to the NFIP. There are no premiums to account for in the County.

Table 15: Beaver County NFIP Participation

Community	Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978

Beaver County	$0.00	0	0	0	$0.00	1	$3,672
Milford	$0.00	0	0	0	$0.00	1	$3,447

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

The county code describes how the community participates with the NFIP and enforces their flood management ordinance. The County Commission, county building inspector or the county engineer enforces the ordinance which identifies areas of special flood hazard and requirements for developments to receive permits for construction in flood prone areas.

Hazard History

Beaver County has experienced several flooding events, often the result one hazard or a combination of hazards such as of severe weather and wildfire causing flash flooding. Table 16 describes the events. While some of the events described here may describe impacts to an incorporated city or town in the county, it is likely that the event also had impacts on unincorporated areas of the County.

Table 16: Beaver County Recorded Flood Events

Beaver County Flood Hazard Record		
Date	Damage/Injury	Description
7/22/2021	None Reported	Milford experienced street flooding which was 3-feet deep, which left debris on SR-21 following heavy rain.
7/18/2021	None Reported	A heavy rainstorm caused water and debris to flow across SR-21.
7/12/2018	None Reported	Heavy rain fell on the Black Mountain Fire burn scar, resulting in a debris flow that temporarily closed State Route 130 near Minersville.
8/11/2018	None Reported	Heavy rain resulted in a flash flood that temporarily closed state Route 21 near milepost 85.
5/21/2005	$2,500 in property damage	Flood
1/10/2005	$0 in property damage	Flood
9/5/1998	$5,384 in property damage	Flood
8/26/1988	$500 in property damage	Flash Flood
2/19/1986	$29,411 in property damage	Flooding
8/15/1984	$5,000 in property damage	Flash Flood
5/1/1983	$2,380,952 in property damage	Flood
9/18/1972	$384 in property damage	Flooding
8/20/1971	$5,000 in property damage	Flash Flood

Source: NOAA Storm Database, SHELDUS

Flood impacts from this record indicate that roadways and roadway users are vulnerable to flooding. Events that close bridges and roads can separate communities from resources, supplies, and essential services. Outdoor recreators in the County can also be at risk to flooding in canyons and on trails. Flooding events seem to impact residences and structures infrequently. This may be due to the low-density nature and high percentage of public lands in the County.

Climate impacts flooding risks, and as storms are projected to increase in severity in the coming decades, it is possible that southwestern Utah will see an increase in the severity of floods. Increased

risk of wildfires also creates flooding concerns, as burn scars can turn to debris flows as vegetation cannot hold the soil in place. Flooding trigger landslides, as changes in soil moisture on steep slopes can lead to landslides, debris flows, and rockfall.

Landslide

Landslide and rockfall hazards are prominent in southwestern Utah, with a geography marked by steep slopes, cliffsides, tall mountains, and mesas. Beaver County is one of the four Utah counties impacted by one of the largest surface landslides, the Markagunt Gravity Slide, which is estimated to have occurred millions of years ago and impacted what is now the eastern portion of Beaver County. (Robert F. Biek (UGS), 2016) Landslide and rockfall are common in wilderness settings, but as structures are built in susceptible areas, more people, property, and assets are exposed to the effects of landslides.

Beaver County has widespread exposure to moderate and high landslide susceptible areas, as seen in Figure 27. The incorporated cities have very little exposure to landslide susceptible areas. The mountainous areas of the unincorporated County have the highest exposure to landslide risks.

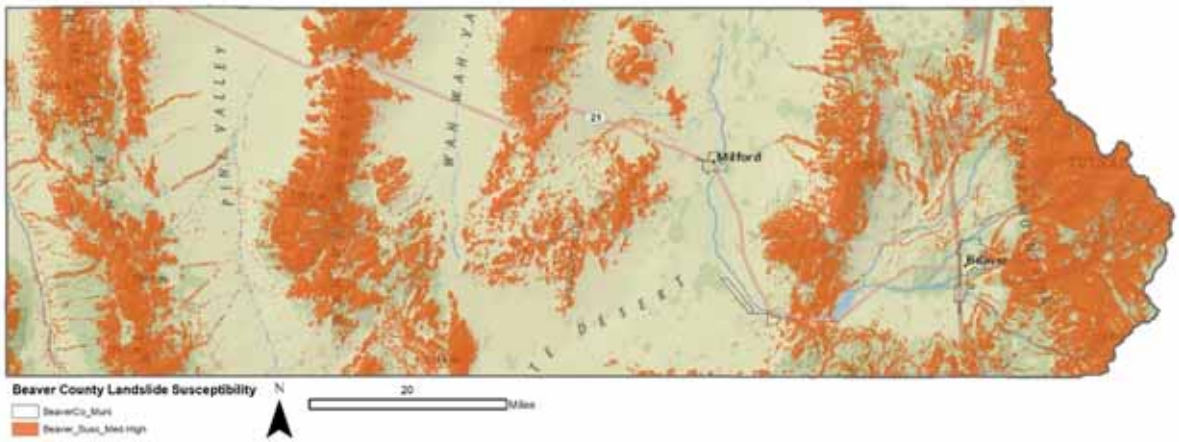


Figure 27: Beaver County Landslide Susceptibility

Table 17 describes the exposure of people, property, and assets to landslide susceptible areas. Twenty Five percent of parcels in the unincorporated county are at moderate to high susceptibility to landslides. Parcels built on or under steep slopes and cliffs are vulnerable to landslides and pose a significant threat to property owners. Properties identified as vulnerable to landslides typically are concentrated in and around the mountainous areas of the county with very little susceptibility in the valleys. Growth and development in the county could contribute to greater exposure to landslides and rockfall for residents over time.

Eleven percent of roadways in the unincorporated County are susceptible to landslides. Landslides can damage roadways and impact roadway users through injury and traffic delays, among other consequences. Significant time and expense can be required to clear landslides and repair the roadways. Landslide events on roadways can limit access to County resources, response, and supplies for rural or remote communities.

Table 17: Beaver County Landslide Susceptibility Exposure

Parcels	Road Miles	Rail Miles	Local Parks	Critical Facilities

25.2%	11.1%	0.0%	0.0%	0.0%

Hazard History

Landslides and rockfall frequently occur in the Five County region, causing damage to infrastructure, structures, and other property. Table 18describes the landslide events and impacts reported in Beaver County.

Table 18: Beaver County Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
1923	South of Milford	Unknown	Unknown	A landslide occurred at the rail road south of Milford.
1936	Adamsville	Unknown	Unknown	A debris flow was reported at Dry Gulch near Adamsville.
1967	Milford	Unknown	Unknown	Debris flow
1983	Beaver County	Unknown	Unknown	Landslide
1984	Beaver County	Unknown	Unknown	Landslide
1984	Beaver County	Unknown	Unknown	Heavy Snow and mudslide were reported.
2011	Beaver County	None reported	None reported	Mud and debris flowed onto SR-153 in Beaver Canyon, blocking the road with rocks, mud, roots, and branches.
2011	Beaver County			NCDC Landslides from Sheldus.
2018	Minersville, Beaver County	None reported	None reported	Mudflow in Beaver County, near Minersville nearly washed an occupied vehicle into a ravine.

Source: SHELDUS, (O'Donoghue B. A., 2011), (Adams, 2018)

Landslide hazards can be caused by precipitation or runoff, especially on land that is exposed and not covered by vegetation. In turn, Landslides can contribute to flooding hazards, especially when a landslide blocks a waterway, causing water to pool. Changes in climate patterns will likely contribute to landslide hazards as severe storms and wildfires increase in severity.

Hundreds of landslides have been mapped in Beaver County and will continue to occur, especially in the mountainous areas of the county. Table 18 refers to several historic landslides that have been recorded in the County. As development moves into areas with steeper slopes, more people and infrastructure will be more susceptible to landslides and debris flows.

Drought

The Five County Region has experienced seven periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe

weather.

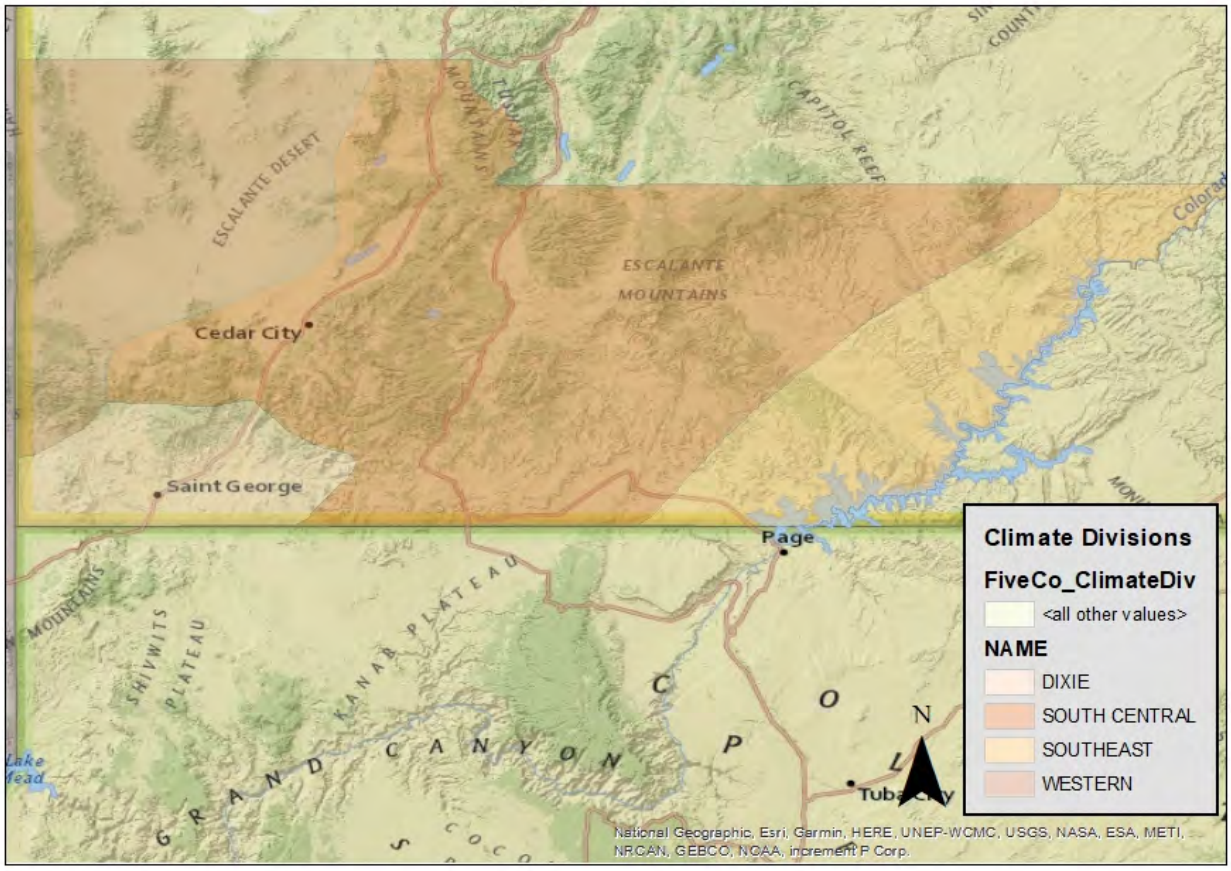
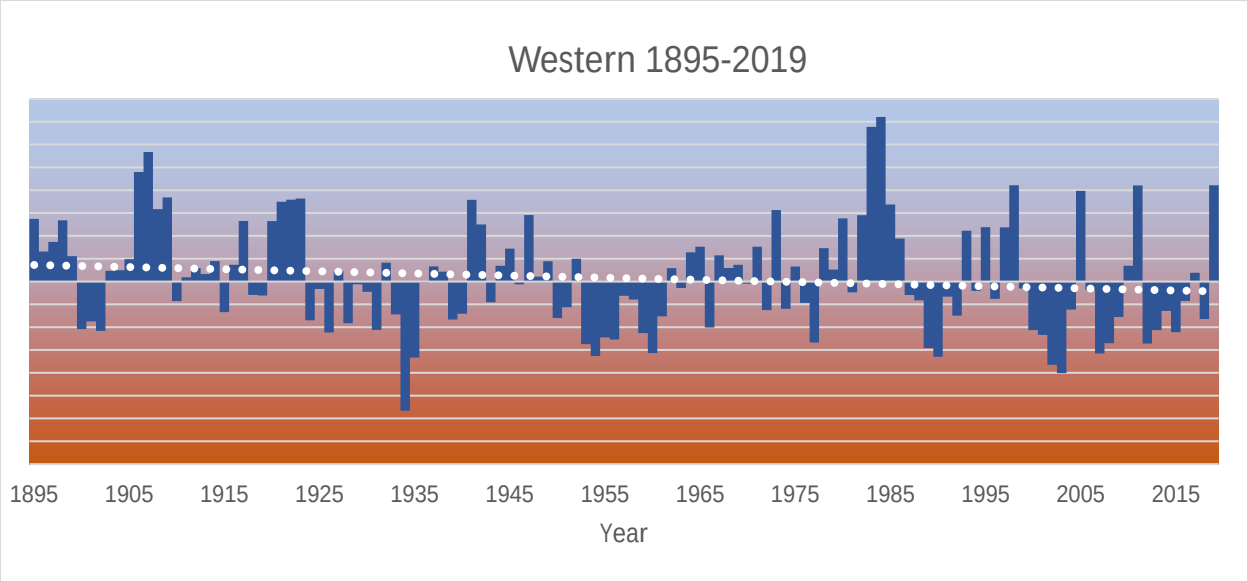


Figure 28: Five County Climate Divisions

Climate divisions were historically used to track long term climate patterns for a region. The division measured temperature and precipitation across a region to track patterns over an area. Figure 7 shows that Beaver County predominantly includes the Western region, although a large portion of the County's population resides in the South-Central region. Figure 29 describes the annual precipitation averages for the Western and South-Central Region. As observed in this table, these regions have been trending toward more sporadic precipitation years, with longer stretches of observed drought conditions between 1895 and 2019.



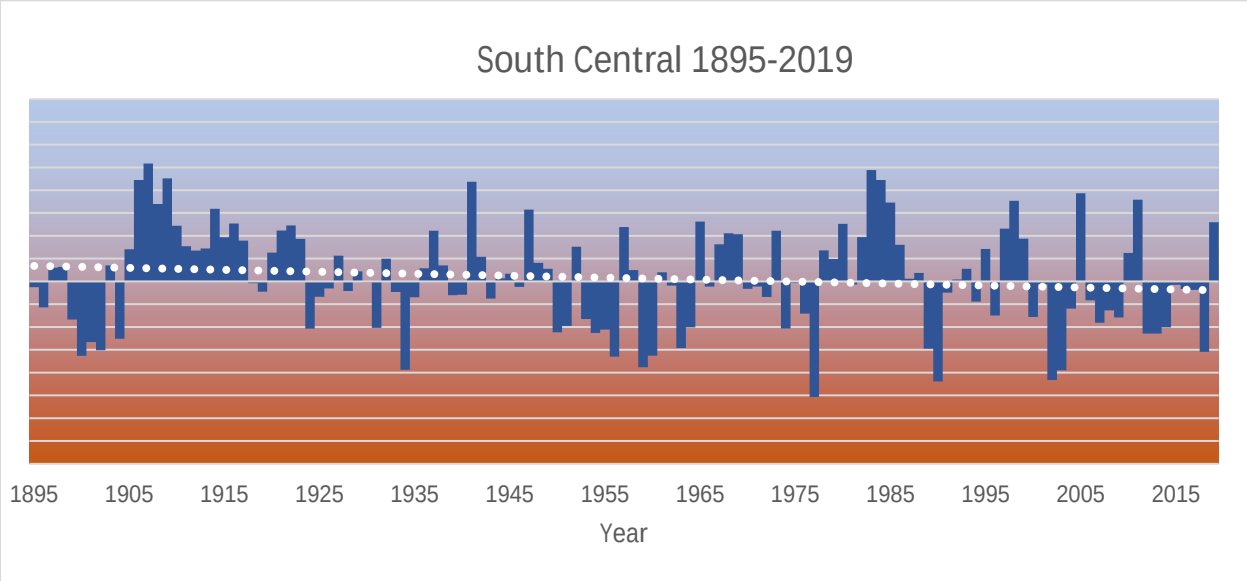


Figure 29: Western & Southcentral Climate Division precipitation by year

Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community. Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is at risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on farming, tourism, and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah, including Beaver County, is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 30. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

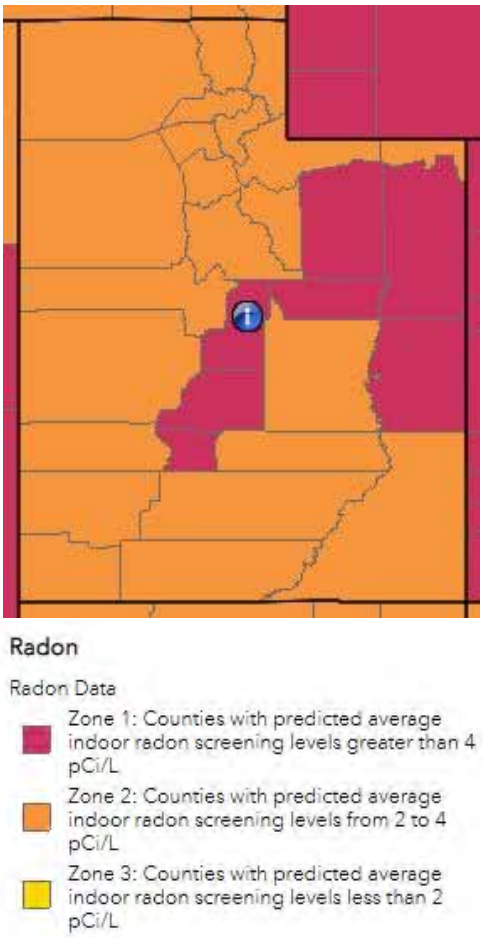


Figure 30: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 19 describes the reported findings. Across Beaver County, the average test result is 40.2 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 19: Beaver County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
27.2%	72.8%	664.0 pCi/L	40.2 pCi/L	423

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather events are frequent and impactful in the Southwest. Weather events in the southwest tend to occur seasonally in the summer and winter. Severe weather occurs during thunderstorms and winter storms, including high winds, heavy rain or snow, hail, lighting, and tornados. Other events include severe temperatures, heat and cold, which can be impactful to people, property, and industry, like agriculture and tourism.

The area has an arid climate, being situated in the high desert region of western Utah. Daily summer temperatures can reach near 100 degrees Fahrenheit. However, temperatures reach below zero during winter months and snowfall amounts to about 34 inches annually. There are four well defined seasons. The sun shines an average of 320 days each year. Precipitation averages 11.65 inches annually in Beaver Valley and 8.5 inches in the Milford area.

Table 20 describes the severe weather events that resulted in injury or death that have impacted Beaver County. One death and several injuries are attributed to winter weather in Beaver County. These winter storms expose thousands of people passing through the area every year. Increased visitation of outdoor spaces will likely compound this vulnerability. Other notable hazard events including high wind and lighting are known to cause injury and damage across the County.

Table 20: Beaver County Severe Weather Record

Date	Hazard	Injury / Damage	Description
12/1/1996	Winter Storm	None Reported	A winter storm caused whiteout conditions from Nephi to Cedar City on I-15.
10/15/1998	Winter Storm	$100,000 in damage	A strong winter storm moved through Utah on the 15th and 16th. The heaviest snow fell in the southern half of the state
12/21/1998	Cold/wind chill	$20,000 in property damage statewide.	Milford experienced extreme cold, with temperatures reported at -30 degrees Fahrenheit.
7/17/2001	Hail	None Reported	Hail 3/4” in diameter were reported in Milford.
8/17/2001	Thunderstorm	$2,000 in Property Damage $1,000 in Crop Damage	A wind gust estimated at 80 MPH was reported in Milford. A sensor recorded a 67 MPH gust. The event resulted in several downed trees and power lines.
9/4/2001	Tornado	None Reported	A tornado touched down near Milford and then dissipated after 15-minutes.
3/29/2007	Winter storm	None Reported	A winter storm produced eight inches of snow in Milford, four of which fell in a two-hour period.
5/24/2009	Tornado	None Reported	A tornado touched down five miles west of Milford in an uninhabited area. No damage was reported.

3/13/2010	Winter Storm	None Reported	A winter storm caused a pileup on I-15 near Beaver which impacted 10 vehicles and two semis. Traffic was slowed significantly.
8/3/2010	Hail	None Reported	One inch diameter hail fell in Beaver during a thunderstorm.
12/20/2010	Winter Storm	None Reported	A winter storm produced 15-inches of snow in Milford.
8/21/2012	Tornado	None Reported	A tornado was reported in the western portion of the unincorporated County, near the border with Nevada.
10/28/2013	High Wind	$35,000 in damage	Strong winds were reported in southwest Utah, which produced a wind gust of 64 MPH recorded by the Milford ASOS
4/25/2014	High Wind	None Reported	High winds led to blowing dust and poor visibility on roadways. I-15 between Parowan and Beaver experienced several vehicle accidents and injuries during the event.
5/10/2014	Winter Storm	$100,000 in damage	Heavy snowfall in southwest Utah triggered many automobile accidents, knocked out power to thousands, Travel was greatly impacted by the snowfall, especially along the Interstate 15 corridor between Beaver and Cedar City, where the Utah Highway Patrol reported 21 crashes, 19 slide-offs, and a semitruck rollover in an eight hour period.
4/14/2015	High Wind	$10,000 in property damage	High winds were reported in Milford and at the Brimstone reservoir with maximum gusts over 60 MPH. Trees were downed during the event.
1/30/2016	Winter Storm	2 injuries	Storm total snowfall was perhaps most impressive in southwest Utah, where storm totals included 20 inches in Milford. Automobile incidents along Interstate 15 attributed to the snow included 2 injury accidents, 24 collisions, and 46 slide-offs.
2/18/2016	High Wind	$50,000 in damage	Very strong winds developed across much of western Utah on February 17 and 18. These winds caused significant damage in some locations, particularly with the passage of the cold front on February 18.
3/26/2016	Winter Weather	1 death, 2 injuries	A winter storm created slick conditions on Interstate 15, which led to several accidents near Beaver, Utah. These slick roads were a factor in several accidents including a rollover accident that led to two injuries and one fatality.
4/28/2016	Hail	3 injuries, $25,000 in damage	A strong thunderstorm in Southern Utah dropping heavy rain and significant accumulating small hail. This storm led to a large pileup accident involving 4 semitrucks and one passenger vehicle. Interstate 15 was shut down in both directions for about 2 hours.
7/25/2016	Thunderstorm	$20,000 in damage	Strong winds downed 176 power poles near SR 21 and 129, causing nearly all Milford residents to lose power.
3/5/2017	High Wind	10 injuries, $80,000 in damage	A cold front produced strong winds with a gust of 70 MPH recorded at the Milford Municipal Airport. Windblown dust caused low visibility caused multiple car accidents along State Route 21 near Milford. The wind blew a roof of a barn off, which became caught in power lines.
7/29/2017	Lightning	2 injuries	Thunderstorms across Utah produced heavy rainfall. Lightning struck and injured two girls while camping with relatives near Big Flat in the Beaver Mountains.

Source: NOAA Storm Database, 2020.

High winds are frequently reported in Milford and at the Brimstone Reservoir. These wind events do not often cause damages, so these events are not reported in this table. Uses in these areas experience a high frequency of wind events and are more vulnerable to impacts from wind. Some wind events are reported to cause damage, which include downed power lines, blowing dust, and damaging trees, which result in local impacts like traffic hazards and power outages.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Beaver County from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Problem Soils

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated in Figure 31. Limestone (Karst) have been identified in the western mountains of the county, far from any incorporated communities. Other problem soils, like expansive soils and dunes have not been identified in this data set. Local descriptions of problem soils, or clay rich soils may be a more accurate representation of the exposure to problem soils locally.

Figure 31: Beaver County Mapped Problem Soils

Table 21 shows the exposure of Beaver County assets, infrastructure, and parcels to mapped problem soils. Limestone (Karst) are prevalent in the mountainous areas of western Unincorporated County and have very little overlap with development. Further, GIS analysis of Beaver County parcel tax data and the AGRC's problem soils layer reveals that there are no taxable structures within the mapped problem soils areas. Because detailed soil studies have not been conducted throughout the entire county, one should not assume that problem soils do not exist.

Table 21: Beaver County Problem Soil Exposure

Parcels	Road Miles	Rail Miles	Local Parks	Critical Facilities
0.0%	1.5%	0.0%	0.0%	0.0%

Due to a lack of record keeping there is an undetermined number of structures that have been negatively affected by problem soils within Beaver County. Further, detailed mapping of hazardous soils has not been produced within the county, and current maps indicating where soils are display little risk to structures. Updated mapping of problem soil hazards in the region could provide greater understanding of the challenges, especially as the population and development in the County grows.

Mitigation strategy & actions

Beaver County participated in the 2017 iteration of the Five County Multijurisdictional Natural Hazard Mitigation Plan and identified several actions to include in their mitigation strategy. Providing a progress report on identified actions is a requirement for each plan update and is documented in Table 22.

Table 22: 2016 Beaver County Mitigation Strategy

Strategy	**Objective**	**Action**	**Timeline**	**Funding Source**	**Progress**
Problem Soils	Lessen the risk to buildings from problem soils.	Action #1: Address problem soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	ongoing	Private funds/developer, local government operating budget, Utah Geologic Survey operating budget.	incomplete
Problem Soils	Lessen the risk to buildings from problem soils.	Action #2: If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey perform a review of the report.	ongoing	Private funds/developer, local government operating budget, Utah Geologic Survey operating budget.	incomplete
Problem Soils	Lessen the risk to buildings from collapsible and expansive soils.	Through mapping, identify areas which contain collapsible and expansive soils. Require soils testing at the building/construction levels and ensure that engineer's recommendations are followed.	ongoing	Private funds/developer, Local government operating budget.	Incomplete, still needed
Landslide	Increase the level of knowledge	Increase public education related to landslide hazards by	ongoing	Local, jurisdictional level.	Unknown.

	related to landslides	distributing Utah Geological Survey landslide informational brochures to local municipality level emergency management, engineering and planning departments.			
landslide	To reduce landslide risk as it relates to the built environment.	Action #1: Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	ongoing	Private funds/developer, local government operating budget, Utah Geologic Survey operating budget.	incomplete
landslide	To reduce landslide risk as it relates to the built environment.	Action #2: If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey perform a review of the report.	ongoing	Private funds/developer, local government operating budget, Utah Geologic Survey operating budget.	incomplete
landslide	To reduce landslide risk as it relates to the built environment.	Action #3: Drafting/updating zoning and/or landslide ordinances to prevent development of structures near debris flow, landslides, and rock fall areas.	ongoing	Private funds/developer, local government operating budget, Utah Geologic Survey operating budget.	Incomplete, still needed
Wildfire	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas and to encourage local governments to require property owners and developers to utilize	Action #1: Provide printed Information, Public Service Announcements; Encourage new homes and communities in the Wildland-Urban Interface to follow the WUI code and be Firewise compliant. Complete WUI assessment.	2-3 years/ongoing	State and Federal wildfire grant programs, Local governments operating budget, Special Service District operating budget.	Ongoing.

	defensible space tactics.				
Wildfire	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas and to encourage local governments to require property owners and developers to utilize defensible space tactics.	Action #2: Voluntary site visits (to CARs) by fire crews to consult with landowners about specific ways to reduce risk to their property.	2-3 years/ongoing	State and Federal wildfire grant programs, Local governments operating budget, Special Service District operating budget.	ongoing
Wildfire	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas and to encourage local governments to require property owners and developers to utilize defensible space tactics.	Action #3: Develop local code enhancements that require utilization of defensible space tactics.	2-3 years/ongoing	State and Federal wildfire grant programs, Local governments operating budget, Special Service District operating budget.	Unknown
Wildfire	Provide training, equipment, and resources for fire departments to fight wildfires.	Enhance existing wildfire training programs, equipment procurement, and firefighting resources for wildfire suppression.	ongoing	State CIB funding, Federal wildfire grant programs	ongoing

Flood	Identify flood prone areas in the County.	Work with State Floodplain Coordinator and FEMA. Attain FEMA Flood Maps for the County	2-5 years	Federal flood programs	Still needed.
Flood	Minimize future flood damage in the County	Nonstructural measures appear to be the most prudent option for the county to implement. Zoning to prevent development of structures near all rivers, creeks, and lakes (100' min. setback).	ongoing	Local government operating budget, State and Federal flood and planning grant programs.	Complete.
Flood	To reduce flooding risk as it relates to the built environment	Address flood control at the building/construction level by requiring all subdivision proposals to have a storm water drainage system.	ongoing	Private funds/developer	Unknown
Flood	To reduce flooding risk at the community level	Clear debris and other material from all waterways.	ongoing	related public/private property owners	Ongoing.
Flood	Indian Peaks Band of Paiute Indians- Prevent future roadway erosion of the road which leads to the water tank.	Add culverts to keep water off the road.	1-5 years	Federal flood grant programs	Still needed to address flooding on the county road to the area.
Flood	Obtain FEMA flood mapping throughout the County	Follow the proper steps to obtain flood mapping for the county.	unknown	Local, State, and Federal funding as available	Still needed.
Flood	Install flash flood warning signs along roadways in areas that are prone to flash floods.	Obtain and install flash flood warning signs in the appropriate areas.	Within the next 5 years	Local governments, State and Federal funding as available	Area most at risk is on a UDOT road. Coordinate with UDOT to address in Beaver Canyon.
Flood	Improve floodplain management activities by exceeding the minimum	Each community will voluntarily participate in the FEMA Community Rating System which will help to keep communities more safe,	ongoing	Local, State, and Federal funding sources.	Incomplete, no longer needed.

	Nation Flood Insurance Program standards. Decrease flood insurance rates.	reduce flood insurance rates, and improve floodplain management activities.			
Earthquake	Promote building safety through non-structural improvements .	Increase public education related to earthquake hazards by distributing Utah Seismic Safety Commission informational brochures to County and City emergency management agencies.	ongoing	County and City operating budget, Utah Seismic Safety Commission operating budget.	Ongoing.
Earthquake	To reduce earthquake risk as it relates to the built environment.	Continued dedication/vigilance in enforcing the seismic standards established in the International Building Code (IBC).	ongoing	County or City government operating budget	Ongoing
Earthquake	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #1: Utilize the Earthquake Risk Map provided in this plan as a tool to assess earthquake risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study	ongoing	Private funds/developer	Ongoing.
Earthquake	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #2 At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	3-5 years	Local government operating budget, Utah Geologic Survey operating budget.	Ongoing.

The Beaver planning team identified actions to include in the community mitigation strategy, listed in Table 23. Each action in table includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 32.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 32: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Beaver County has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 23: 2022 Beaver County Mitigation Strategy, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 23: 2022 Beaver County Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	3	Encourage citizens to take water-saving measures.	Provide the public with information about ongoing drought conditions and conservation efforts from Slow the Flow.	H	Ongoing, annually	L	Beaver County	Beaver County
Drought #2	1, 3	Reduce drought impacts on critical economic assets in the County.	Provide agricultural interests with information about crop insurance and	H	Ongoing, annually.	L	Beaver County	Beaver County

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			encourage participation. Provide information on County website.					
Earthquake #1	2	Protect County owned historic structures and users of those spaces from earthquake damages.	Inventory and assess county owned structures for URM. Where need is identified, implement structural and nonstructural retrofits.	M	5-years, ongoing	M	Beaver County, Preservation Utah, State and Federal Tax Credit.	Beaver County
Earthquake #2	3	Inform residents and businesses about earthquake safety.	Participate in the Great Utah Shake out and provide public education for earthquake safety. Directly work with county departments, schools, and businesses to participate.	H	Annually, ongoing.	L	Beaver County	Beaver County
Severe Weather #1	5	Reduce impacts on emergency services during severe weather and power outage events.	Coordinate with fire special service districts to acquire generators.	H	5-years	M	Beaver County	Beaver County Emergency Manger
Severe Weather #2	5	Reduce impacts on emergency services during severe weather and power outage events.	Coordinate with identified county and municipal emergency operations centers to ensure they are set up to operate with power outage. As needed, acquire generators for these spaces.	H	5-years	M	Beaver County	Beaver County Emergency Manger
Wildfire #1	4, 6	Participate in fuels reduction efforts.	Coordinate with the forest service to engage in fuels reduction and mitigation on the east side of the	M	Ongoing	M	Beaver County, USFS, DNR	Beaver County, partner USFS, DNR, private

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			County, near Beaver Mountain.					property owners.
Wildfire #2	4, 6	Participate in fuels reduction efforts.	Coordinate with BLM and property owners throughout County.	M	Ongoing	M	Beaver County, BLM, DNR	Beaver County, partner BLM, Private property owners.
Wildfire #3	1, 4, 6	Inform property owners of defensible space tactics.	Provide voluntary site visits (to CARs) by fire crews to consult with landowners about specific ways to reduce risk to their property.	H	Ongoing	M	Beaver County	Beaver County, partner with Fire SSDs
Landslide #1	1, 2	Address landslides and steep slopes in codes and ordinances.	Assess and consider need for hillside and geologic hazard ordinances.	M	5-years	L	Beaver County	Beaver County
Flood #1	1, 2	Encourage property owners to acquire flood insurance.	Provide public information about NFIP participation on the County website.	M	Ongoing, annually	L	Beaver County	Beaver County
Flood #2	1, 2, 6	Harden drainage infrastructure from dams and reservoirs.	Restructure and rebuild the drainage from the Minersville lake.	H	5-years	M	Beaver County, CIB, NCRS	Beaver County
Flood #3	2	Indian Peaks Band of Paiute Indians- Prevent future roadway erosion of the road which leads to the water tank.	Add culverts on the county road into Indian Peaks to control roadway flooding	H	1-5 years	M	Beaver County, CIB, CDBG, FEMA	Beaver County
Flood #4	4	Obtain FEMA flood mapping throughout the County	Participate in flood mapping efforts in Beaver County.	M	unknown	M	Beaver County	Beaver County, State RiskMAP coordinator, FEMA
Flood #5	2, 3	Install flash flood warning signs along roadways in areas that are	Coordinate with UDOT to install flash flood warning signs	L	Within the next 5 years	L	Local govern ments, State	Beaver County, UDOT

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		prone to flash floods.	on the Beaver Canyon Road.				and Federal funding as availabl e	
Problem Soils #1	1, 2, 4	Collect data to inform mitigation needs and actions.	Coordinate with the Utah Geological Survey to map and identify the extent of problem soils in the County.	L	5-years	L	Beaver County	Beaver County
Radon #1	3	Inform residents of radon risk, testing, and mitigation.	Engage in a public education campaign to inform residents of the risks, testing availability, and mitigation of Radon. To be distributed on County website.	H	Ongoing annually	L	Beaver County	Beaver County
Radon #2	2	Identify radon risk in public facilities.	Coordinate with the Beaver County School District to engage in radon testing in k-12 public schools.	M	5-years	L	Beaver County School District	Beaver County

Source: Local Planning Team

Beaver City

Beaver City is the County Seat of Beaver County and is the most urban community in Beaver County. The City of Beaver is in the Beaver Valley, with the Tushar Mountains to the East. The area is home to many outdoor opportunities, with a ski resort, horseback riding, hiking, biking, hunting, and many other recreation activities. Beaver City is a higher elevation area of the Five County region and receives regular annual snow fall. The area had vegetation and characteristics of a high elevation, alpine desert, with forested areas and plains. The city is located along I-15 and SR-21, which provides access to the rest of the County.

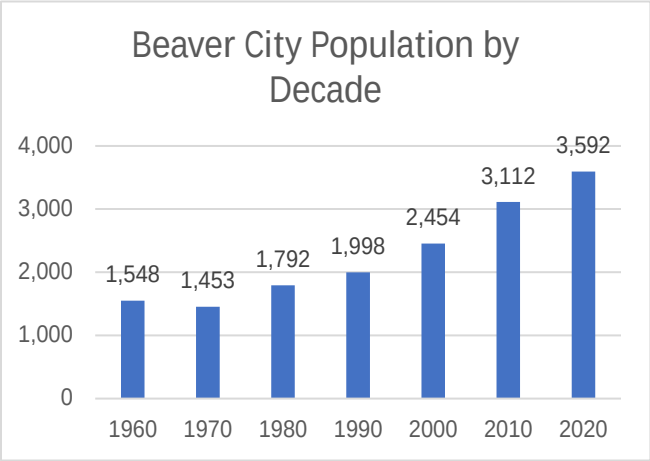


Figure 33: Beaver City Population by Decade

Source: US Census Bureau

Community Characteristics

Beaver City is a rural community in Southwestern Utah but is also the most urban of the incorporated areas of Beaver County. The city has a growing population and diverse economy which will be described throughout this section.

Demographics

Figure 33 documents the population in Beaver City in each decade since 1960.

Beaver City has seen an average growth rate of 15.6% since 1970. Figure 34 describes the percent change in population at each census since 1960. As can be seen, the population experienced rapid growth between 1970 and 1980, with consistent growth since 1980.

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Beaver City could see approximately, 34.1% growth in their population, bringing the population to an estimated 4,816 persons. (Hollingshaus, et al., 2022)

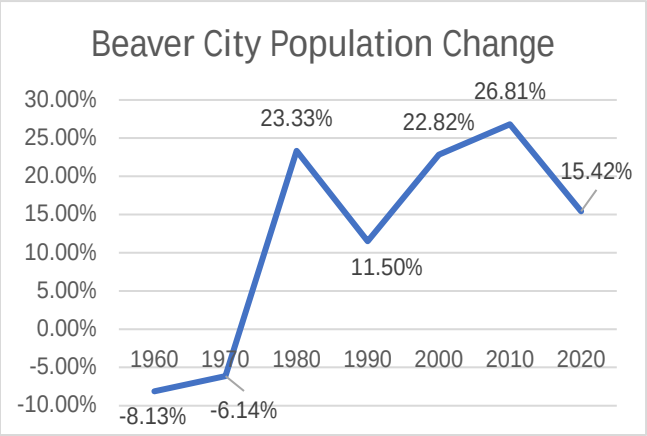


Figure 34: Beaver City Population Change

Source: US Census Bureau

Using the average change in population for the county, the future population by 2060 was also projected. The projection is solely based on historic patterns in the City since 1970, and does not account for land availability or other metrics in the county. Figure 35 illustrates the projected population, which is estimated at 6,420.

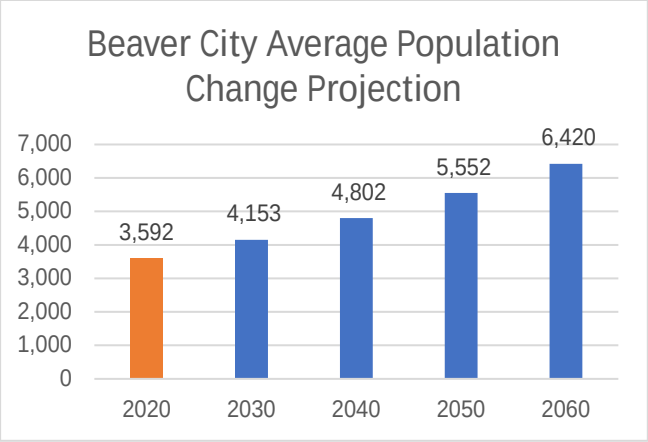


Figure 35: Beaver City Population Projection

Source: US Census Bureau

Economy

Beaver City has strong local business which contribute to the community. According to the US Census OnTheMap tool, most jobs in Beaver City are in either the retail trade or accommodation and food services industries, illustrated by Figure 36. Given the proximity to the I-15 corridor and outdoor recreation attractions in Southwest Utah, accommodation and food services make up approximately more than a quarter of the jobs in the community. The Beaver Valley Hospital is also located in the community, which makes up a significant portion of the jobs in the community. Other significant industries in the community are from Public Administration and Educational Services.

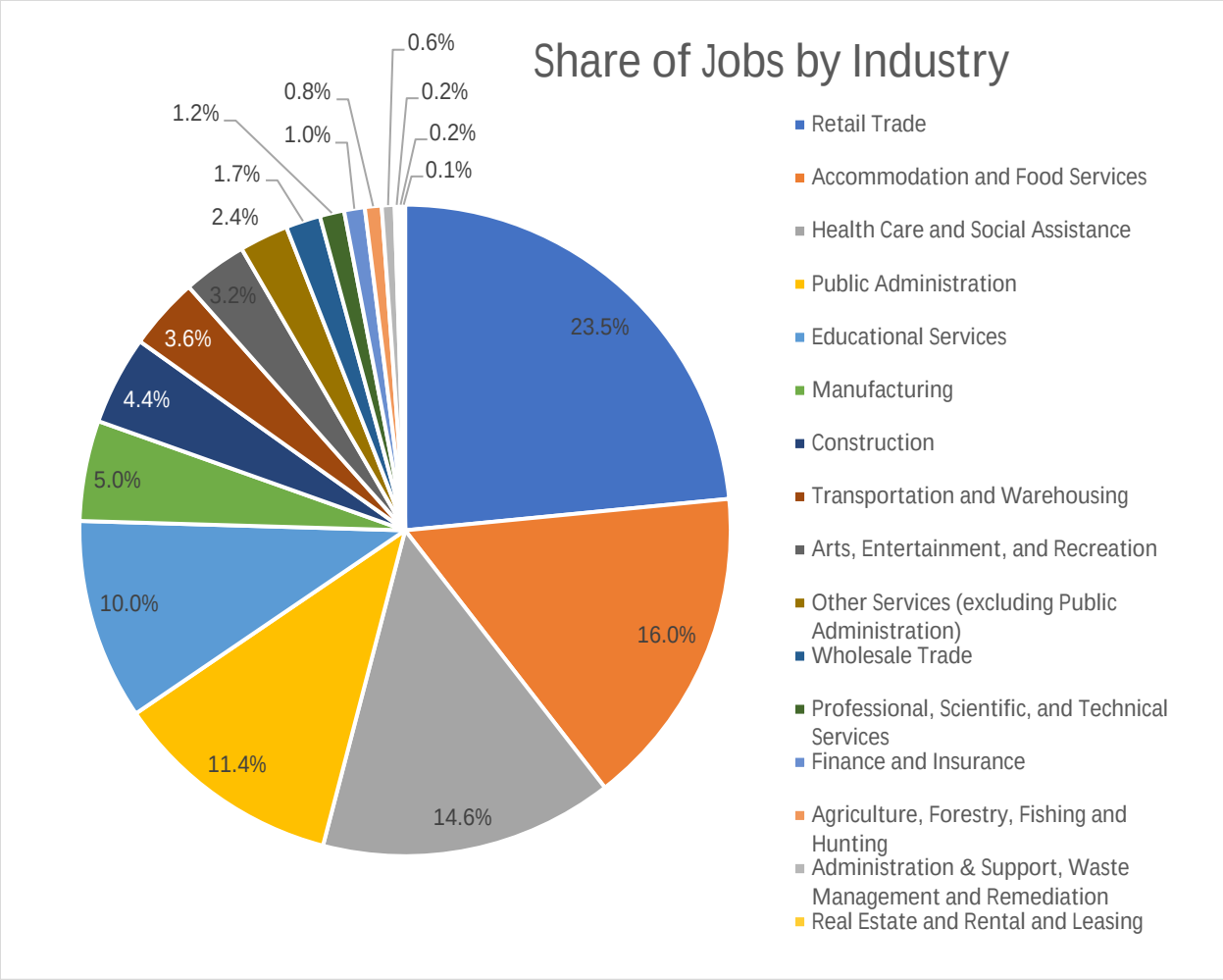


Figure 36: Beaver City Share of Private Primary Jobs by Industry

Development

Beaver City has grown at a continuous pace to the north and northeast of the city. The newly developed is historic agricultural land which has transitioned to residential subdivisions.

Community Capabilities

Beaver City is governed by an elected council and mayor. Several city staff support government and city operation, including a clerk, city manager, recorder, treasurer, planning, licensing, and cemetery staff. City departments include Beaver City Electrical, water and sewer, public works, planning and zoning, and parks and recreation departments. Beaver electric is a hydro electric utility on the Beaver River, owned and operated by Beaver City. The water and sewer department provides water for residents and plans for future need.

Beaver City is a small city, which relies on the County to support some public services, like public safety and emergency services. Law enforcement is provided by the Beaver County Sheriff's Office. Fire and EMT services are also provided by the County.

Water, sewer, and electric utilities are supported by the city. Dominion Energy is the area natural gas provider. Residents purchase phone, and internet utilities from private organizations, including South Central Communications, Century Link, InfoWest, and other mobile phone providers.

Funding for Capital improvement and infrastructure projects in the City are typically funded through Capital Improvement Project funding, debt through General Obligation or Special Tax Bonds, Community Development Block Grant, and other state and federal funding sources.

Plans and Policies

Beaver City develops plans and policies to guide the community development and set rules and regulations to provide for the health, safety, and public welfare of the city. A General Plan and the municipal ordinances communicate these objectives for the community.

General Plan

The Beaver City General Plan is intended to communicate long term visions and goals for the community, with policies which will be implemented overtime to uphold these visions. Typical elements addressed in a general plan include housing, transportation, economic development, etc. The 2004 Beaver City General Plan includes a safety element which describes natural hazards and goals and policies to address development, natural resources, and other community characteristics which may interact with natural hazards. The public safety, park standards, emergency preparedness, landscape architecture, fire hazards, and public services sections of the plan all address natural hazards.

Municipal Ordinances

Beaver City ordinances are policies and regulations locally which provide for the health, safety, and welfare of the city. In the ordinances, several permitting processes, limitations, and requirements exist for development in identified hazard areas. In some cases, professional reports are required to demonstrate a development site is not in a hazard area or that the development has plans to mitigate hazards on the site. Ordinances describe geologic hazards, flood, earthquake, problem soils, severe weather, steep slopes, and wildfire.

Risk Assessment

Beaver City experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Beaver City to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 24 describes the relative risks of hazards in the community.

Table 24: Beaver City Risk Assessment Summary

HAZARD	RISK
DROUGHT	High
SEVERE WEATHER	Moderate
WILDFIRE	Moderate
EARTHQUAKE	Moderate
FLOOD	Moderate

RADON	Moderate
LANDSLIDE	Low
PROBLEM SOILS	Low

A detailed description and mapping of each of the natural hazards that impact Beaver City can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Beaver City include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West

According to FEMA and the Utah Wildfire Info tracker, there has not been a significant wildfire events within the boundary of Beaver City. The lack of past events does not mean that a wildfire cannot occur as there are swaths of land in Beaver that are at risk of wildfire. Fires in unincorporated county have the potential to affect quality of life and infrastructure in the community as smoke settles in the valley and fires spreads.

Figure 14360 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Beaver City that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Beaver City has mapped extreme risk throughout much of the city and east of the community in the mountains. Roadways in and near the community also are mapped at a moderate to high risk to wildfire, likely because these areas are where essential assets exist in the community.

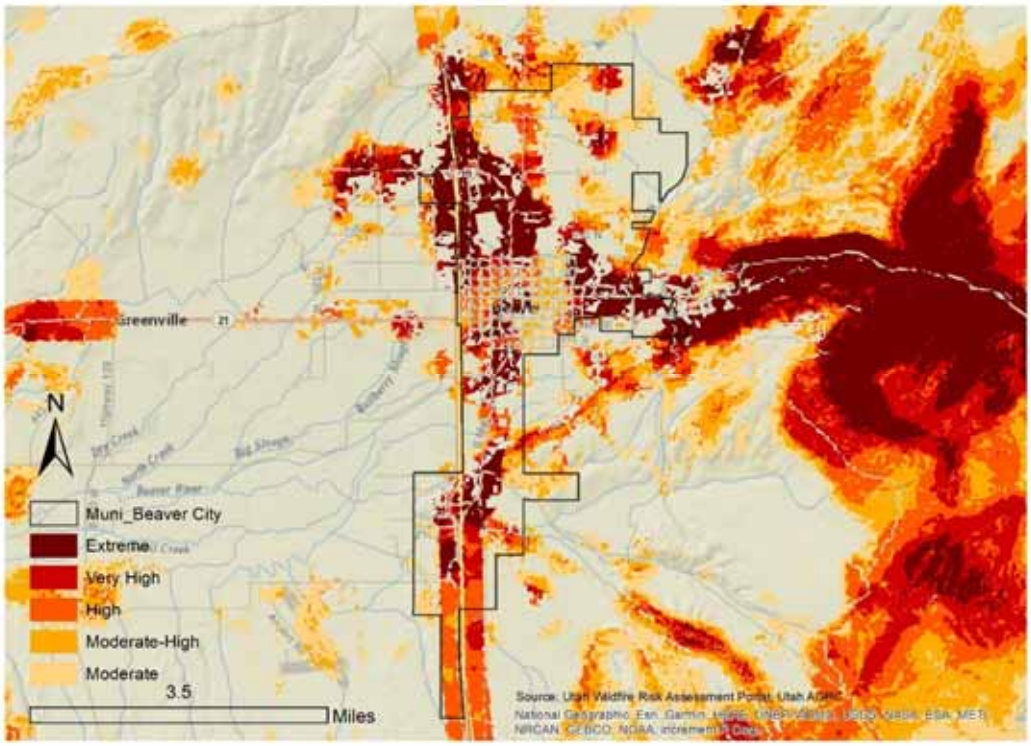


Figure 37: Beaver City Wildfire Risk
Source: Oregon Department of Forestry, AGRC.

Table 25 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Beaver City. A significant portion of residential parcels and all community parks are in an area considered moderate to extreme risk to wildfire. Thirty-two road miles and six critical facilities in the community are exposed. These highlight vulnerabilities to residents and spaces where residents congregate, in addition to access to neighborhoods and portions of the community.

Table 25: Beaver City Wildfire Risk

Beaver City Exposure to Wildfire Risk				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
66.7%	91.0%	32.1%	N/A	100.0%

Source: Oregon Department of Forestry, Beaver County Assessor, Utah AGRC.

Hazard History

No wildfire hazards have been reported in the Beaver City boundaries. The wildfires described in Table 26likely impacted the city through secondary impacts, like smoke and ash.

Table 26: Beaver City Wildfire Record

Fire Name	Year	Acres Burned	Other Impacts
Skull Flat 2 Fire	2019	1,676	• The fire occurred adjacent to the Skull Flat Fire area from earlier in the summer.
Skull Flat Fire	2019	1,625	• The fire occurred five miles east of Beaver Utah and did not prompt any evacuations and threatened no structures. The fire was lightning caused.

Source: Utah Fire Info, 2020

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned areas do not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Beaver City and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. There a few faults running through the city, and has several faults adjacent to the community, as seen in Figure 38 Earthquakes can happen throughout the state, although fault lines tend to be the most common cause of large earthquakes which can trigger impacts in areas miles away.

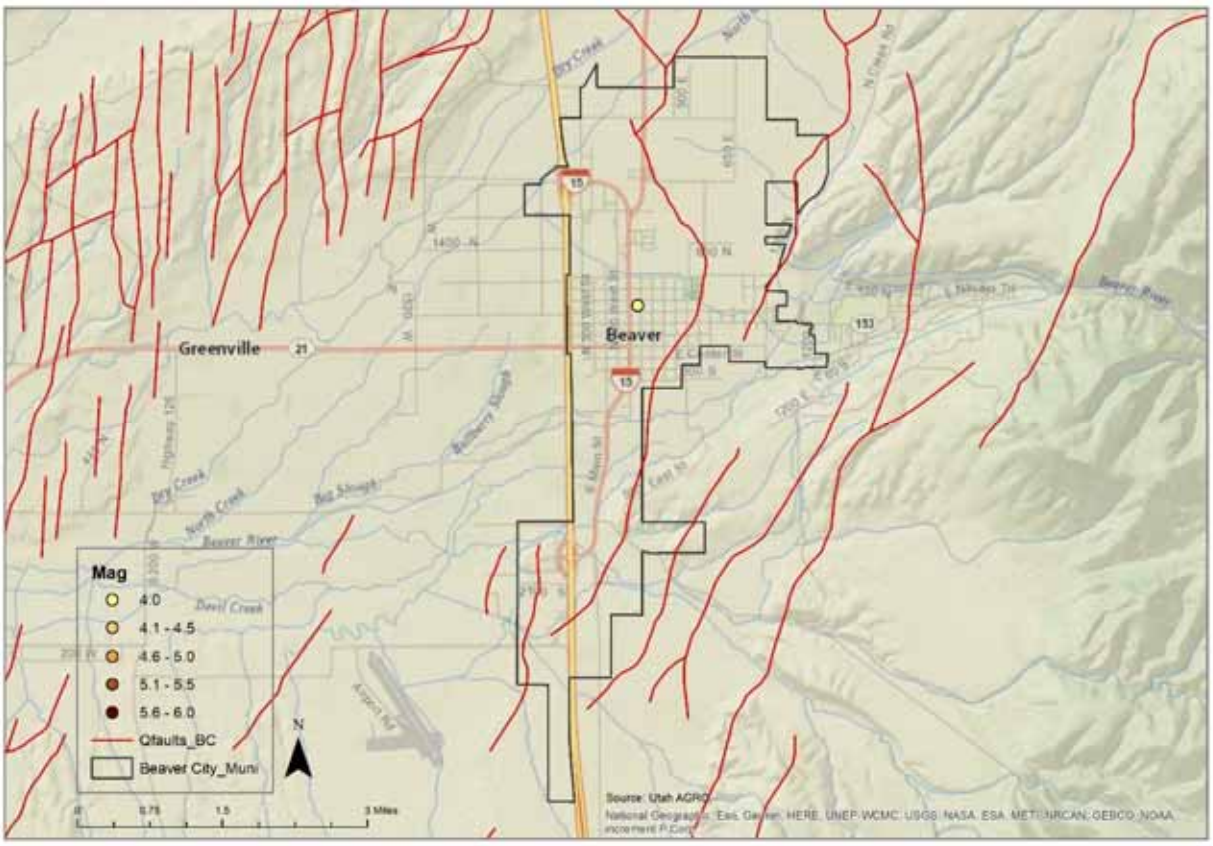


Figure 38:Beaver City Earthquake Epicenters and Quaternary Faults

Source: UGS, Beaver County Assessor, AGRC

Five County analysis to understand local exposure to earthquakes involves computing the community assets which exist within a quarter mile of a fault. Based on this analysis many Beaver City facilities, parcels and road miles are within a quarter mile of a fault. Table 27 describes this exposure. Approximately 40% of road miles and residential parcels are exposed to a fault in Beaver City.

Table 27: Beaver City Quaternary Fault Exposure

Beaver City Exposure within a Quarter Mile of a Quaternary Fault				
Critical Facilities	Parcels	Road Miles	Parks	Rail Miles
44.4%	43.7%	39.3%	60.0%	N/A

Source: Utah Geological Survey, Beaver County Assessor, UDOT, AGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. A common building type from the early 1900s is unreinforced masonry, which do not fare well during a ground shaking event. According to the American Community Survey approximately 50% of structures in Beaver City were built prior to 1975. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Hazard History

Two earthquake epicenters with a magnitude of 4.0 or higher have been reported in Beaver City. Table 28 describes the event history.

Table 28: Beaver City Earthquake Epicenter Record

Incident Date	Location	Description
1873	Beaver City, Beaver County	A 4.05 magnitude earthquake recorded within the Beaver City municipal boundary.
1998	Beaver City, Beaver County	A 4.48 magnitude earthquake recorded 9 miles Southeast of Beaver City.

Source: University of Utah Geology Department

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Beaver City.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 39 maps Beaver City's dam inundation areas and where the major bodies of water are. FEMA floodplain mapping indicates that Beaver County is at an undetermined flood risk, which is why water bodies were selected for mapping. The major portion of the mapped dam inundation zone is just south a most of the City's current development. Planners and decision makers in Beaver City should be cognizant that flooding is a possibility throughout the community, whether near a mapped dam inundation zone or major body of water, or not.

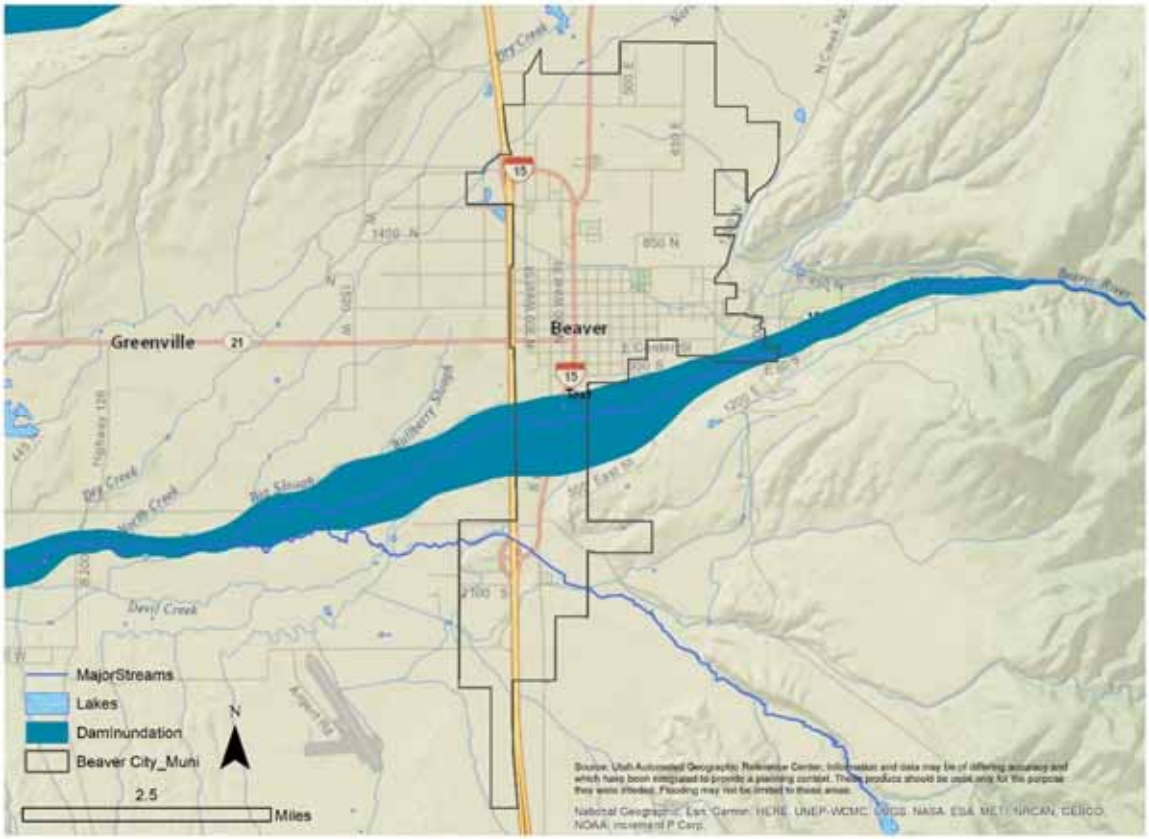


Figure 39: Beaver City Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped dam inundation areas illustrates the potential greatest risks to the community. Table 29 further examines the exposure to identified flood risk areas in Beaver City, by observing community assets and structures that are in at-risk areas. Few parcels and road miles are exposed to the dam inundation zones. Flooding on access roads can lead to transportation delays, and impact response during an emergency event. No critical facilities are in the mapped dam inundation zone. Critical facilities in hazard areas are community vulnerabilities as the ability to respond or provide community information can be impacted.

Table 29: Beaver City Floodplain and Dam Inundation Exposure

Beaver City Exposure to Floodplain and Dam Inundation Zones				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
0.0%	4.5%	3.1%	N/A	0.0%

Source: Flood Insurance Rate Map, AGRC, Beaver County Assessor.

National Flood Insurance Program

Beaver City property, assets, and homes outside of the mapped zones are not free of flooding risk. The National Flood Insurance Program (NFIP) has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Beaver City does not participate in the National Flood Insurance Program. Communities must participate in the NFIP for their residents and businesses to purchase insurance. Community participation requires certain policies and practices for the floodplain and can reduce the cost of recovery following flooding. According to the FEM Community Status Book Report, Beaver City has been sanctioned since 1975 for non-participation. Flood Insurance Rate Maps were developed for Beaver City in 1977. The community participated in a community assistance contact (CAC) on 11/04/2015.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Beaver City receives weather events that can cause floods such as monsoon rains that occur in the late summer and fall, which bring a rapid and heavy rainfall. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. No flooding events were reported to the NOAA Storm Database for Beaver City, despite known risks in the community. Flooding has been reported locally and continues to be a risk to the community.

A severe thunderstorm in July 2021 caused flash flooding in Beaver City causing some roads to be washed out. Road closures can have an impact on a community with delays and limited access. Further, impacts to agricultural areas can threaten crops and livestock.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 40 maps the landslide susceptible areas in and surrounding Beaver City.

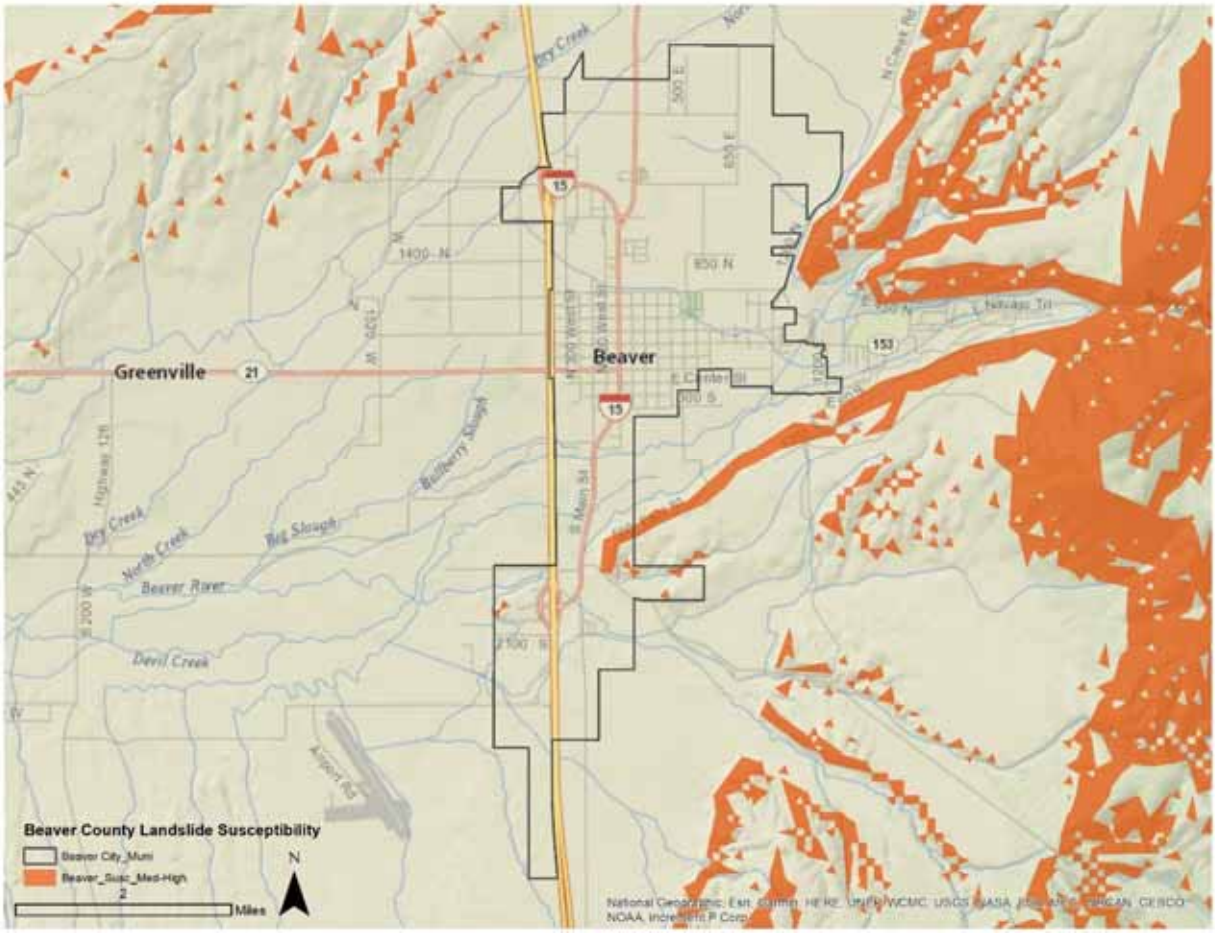


Figure 40: Beaver City Landslide Susceptibility Exposure

Source: Utah Geological Survey

Beaver City has very little exposure to moderate and high landslide susceptible areas within the city limits. However, the mountains and canyon due east of the city, where many people recreate have significant exposure to landslide susceptibility. Table 30describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Beaver City describe that 0.6% of road miles are in a moderate to high landslide susceptible zone and 0.5% of the parcels are in in mapped susceptible areas. No critical facilities or parks are presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 30: Beaver City Landslide Susceptibility Exposure

Beaver City Exposure to Landslide Susceptible Areas				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
0.0%	0.5%	0.6%	N/A	0.0%

Source: Utah Geological Survey, Beaver County Assessor, AGRC.

Hazard History

To date, landslides have not been reported in Beaver City. In 2011 a landslide was reported approximately eight miles up Beaver Canyon from Beaver City covering SR-153. Other landslides reported in unincorporated county are reported in the Beaver County section.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Drought may impact the local water supply, for the city includes wells and spring water. Southwestern Utah also saw threats to energy generation in hydroelectric dams, like the Glen Canyon Dam, as Lake Powell reported record low water levels this year. Where Beaver City's electricity is generated in part by hydro electric processes on the Beaver River, the city could be faced with impacts to energy production using these methods during worsening drought years.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Tourism and related industries are pieces of the economy in Beaver City. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought is connected to other natural hazards, like wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 41. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

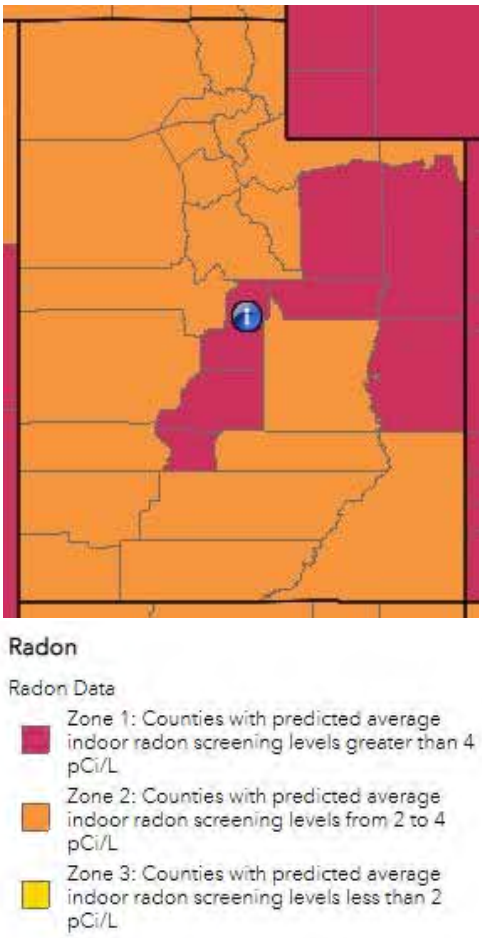


Figure 41: Estimated Indoor Radon Level Zones- Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 31 describes the reported findings for the County. Across Beaver County, the average test result is 40.2 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 31: Beaver County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

27.2%	72.8	664.0 pCi/L	40.2 pCi/L	423

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is no GIS data depicting where or how severe weather will impact Beaver City, however our analysis assumes that severe weather events will impact the whole of Beaver City residents, facilities, infrastructure, businesses, and property.

Beaver City has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by hot, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Beaver City, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 23 weather events that have caused damages in Beaver County since 1996. Several of these events are reported for the Beaver City area in Table 32. Given the proximity to I-15, several of the events prompted road hazards like slide offs and traffic accidents over a wide area of the county. These have been reported for Beaver City, as it is likely that the city saw the impacts of these events.

Table 32: Beaver City Severe Weather Record

Date	Hazard	Injury / Damage	Description
3/13/2010	Winter Storm	None Reported	A winter storm caused a pileup on I-15 near Beaver which impacted 10 vehicles and two semis. Traffic was slowed significantly.
8/3/2010	Hail	None Reported	One inch diameter hail fell in Beaver during a thunderstorm.
4/25/2014	High Wind	None Reported	High winds led to blowing dust and poor visibility on roadways. I-15 between Parowan and Beaver experienced several vehicle accidents and injuries during the event.
5/10/2014	Winter Storm	$100,000 in damage	Heavy snowfall in southwest Utah triggered many automobile accidents, knocked out power to thousands, travel was greatly impacted by the snowfall, especially along the Interstate 15 corridor between Beaver and Cedar City, where the Utah Highway Patrol reported 21 crashes, 19 slide-offs, and a semitruck rollover in an eight-hour period.
1/30/2016	Winter Storm	2 injuries	Storm total snowfall was perhaps most impressive in southwest Utah, where storm totals included 20 inches in Milford. Automobile incidents along Interstate 15 attributed to the snow included 2 injury accidents, 24 collisions, and 46 slide-offs.

2/18/2016	High Wind	$50,000 in damage	Very strong winds developed across much of western Utah on February 17 and 18. These winds caused significant damage in some locations, particularly with the passage of the cold front on February 18.
3/26/2016	Winter Weather	1 death, 2 injuries	A winter storm created slick conditions on Interstate 15, which led to several accidents near Beaver, Utah. These slick roads were a factor in several accidents including a rollover accident that led to two injuries and one fatality.
4/28/2016	Hail	3 injuries, $25,000 in damage	A strong thunderstorm in Southern Utah dropping heavy rain and significant accumulating small hail. This storm led to a large pileup accident involving 4 semitrucks and one passenger vehicle. Interstate 15 was shut down in both directions for about 2 hours.

Source: NOAA Storm Database, 2020.

Winter and snow events are the primary reported severe weather event in Beaver City based on the record of historic weather events in Beaver County. These hazards have the potential to cause damage, injury, and death. Extreme heat is also a challenge throughout the Southwest and while the deaths reported did not occur in the city, the Beaver City and nearby recreation areas likely also saw extreme heat in the area during summer months.

Severe weather will continue to impact Beaver City as weather events are frequently occurring in this region. Heavy snow, rain, thunder, and hailstorms can cause damages. Flooding events which occur because of severe weather are reported in the flooding section of this assessment.

Problem Soils

Problem soils are a challenge for construction, infrastructure, and development. Problem soils are subject to expansion, compression, solution, or collapse when exposed to water, depending on the content of the soil. The changes in the soil structure and occupied space can damage or impact infrastructure built on top of the problem soil.

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated by Figure 148. The map identifies that problem soils have not been mapped in Beaver City.

Figure 42: Beaver County Mapped Problem Soils

Source: UGS, AGRC

Chapter 16 of the Beaver City Code states that the purpose of the chapter is to "protect the general public from geologic, flood or other natural hazards that might be detrimental to the health, safety and general welfare of the residents of the City." The city does require professional reports to demonstrate soil suitability for proposed construction.

The City's General plan has a goal to minimize damage and hazards resulting from unstable soils. There may be identified challenges with problem soils experienced locally, which were not mapped. Further mapping may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types that could be challenging to the region.

Summary

Beaver City is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. The hydroelectric energy production, agriculture, and tourism are vulnerable to drought impacts identified in this plan. Residents may be at risk to injury and property damage several natural hazards that can occur in the area. Some critical facilities in Beaver may be exposed to and property natural hazards such as wildfire and earthquakes. Visitors to recreational areas outside of the city have been impacted by severe weather and landslide and have the potential to be impacted by flooding, drought, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Beaver City has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Beaver City and are listed in Table 33 with a description of their progress.

Table 33: 2016 Beaver City Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flooding & Water Availability	Prevent damage to private and public property, continue to generate power, and continue provide secondary water to citizens.	Replace the pressurized irrigation and hydro power plant diversion.	Bonding: Sept. & Oct. 2016. Construction: Oct. 2016 Project Finished Nov. 2016	Utah Division of Water Resources, Water Fund for City Portion.	Completed.

Source: 2017 Five County Association of Governments NHMP

Beaver City identified actions to include in the community mitigation strategy. Each action in Table 34includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 43: Regional Plan Goals

Table 34: 2022 Beaver City Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of Radon risk.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing annually	L	Beaver City	Beaver City, Department of Environmental Quality.
Flood #1	1, 2, 4, 6	Collect data to inform mitigation activities.	Work with Beaver County, State of Utah, and FEMA to create flood maps.	M	Ongoing	L	FEMA, Beaver County, Beaver City	Beaver City
Flood #2	1, 2, 4	Community compliance with federal programs.	Work with the State of Utah and FEMA to participate in the NFIP.	L	Ongoing	L	Beaver City	Beaver City
Flood #3	1, 2, 6	Reduce stormwater flooding.	Limiting the percentage of allowable impervious surface within developed parcels.	M	Ongoing	L	Beaver City	Beaver City
Flood #4	1, 2	Reduce stormwater flooding.	Requiring developers to construct on-site retention basins for excessive stormwater and as a firefighting water source.	M	Ongoing	L	Beaver City	Beaver City
Flood #5	2, 4	Protect equipment which supports critical infrastructure and facilities.	Work with local utilities to raise utilities or other mechanical devices above expected flood levels.	L	Ongoing	L	Beaver City, local utility companies	Beaver City, local utility companies
Drought #1	1, 2, 6	Inform residents of drought hazards and conservation.	Encourage citizens to take water-saving measures.	H	Ongoing	L	Beaver City	Beaver City
Drought #2	2	Complete the baker canyon spring development project.	Install infrastructure to deliver spring water from the Baker Canyon	H	1-year	H	Beaver City, Division of Drinking	Beaver City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			Spring into the culinary water system.				water, CDBG, CIB	
Earthquake #1	2	Reduce falling or tipping hazards.	Requiring bracing of generators, elevators, and other vital equipment in hospitals and public buildings.	M	Ongoing	L	Beaver City, local hospitals, and clinics.	Beaver City, local hospitals, and clinics.
Earthquake #2	1, 2	Reduce falling or tipping hazards.	Require anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc).	M	Ongoing	L	Beaver City	Beaver City
Earthquake #3	2	Reduce utility shut off, leaks, and infrastructure damage.	Using flexible piping when extending water, sewer, or natural gas service.	M	Ongoing	L	Beaver City, local utility companies	Beaver City, local utility companies
Earthquake #4	1	Prevent injuries from shattered glass.	Install window film at public facilities.	L	Ongoing	L	Beaver City	Beaver City
Earthquake #5	3	Inform residents and visitors of earthquake hazard.	Developing an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.	H	Ongoing	L	Beaver City	Beaver City
Earthquake #6	1	Reduce falling or tipping hazards.	Requiring new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	M	Ongoing	L	Beaver City	Beaver City
Earthquake #7	3, 5	Inform residents and visitors of earthquake hazard.	Educating homeowners on safety techniques to follow during and after an earthquake.	H	Ongoing	L	Beaver City	Beaver City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #1	1, 3	Inform residents and visitors of extreme temperature hazard.	Educate residents and visitors of the dangers of extreme temperatures (hot and cold) and severe weather events and the steps they can take to protect themselves during an event.	H	Ongoing	L	Beaver City	Beaver City
Severe Weather #2	1, 3	Inform residents and visitors of lightning hazard.	Developing a lightning brochure for distribution by recreation equipment retailers or outfitters.	H	Ongoing	L	Beaver City	Beaver City
Severe Weather #3	2	Reduce loss and damage of equipment.	Installing and maintaining surge protection on critical electronic equipment.	H	1-year	L	Beaver City	Beaver City
Severe Weather #4	1	Reduce loss of structures due to snow load.	Discouraging flat roofs in areas that experience heavy snows.	H	Ongoing	L	Beaver City	Beaver City
Severe Weather #5	1	Reduce structural damage from high wind.	Require or encourage wind engineering measures and construction techniques.	H	Ongoing	L	Beaver City	Beaver City
Severe Weather #6	1	Reduce structural damage from high wind.	Use anchor bolts, Laminated or impact-resistant glass, Reinforced pedestrian & garage doors, Window shutters, Waterproof adhesive sealing strips, Interlocking roof shingles, etc.	H	Ongoing	L	Beaver City	Beaver City
Landslide #1	1, 2, 6	Identify and address vulnerable	Identify and apply soil stabilization measures, such as planting soil	M	Ongoing	M	Beaver City	Beaver City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		landslide areas.	stabilizing vegetation on steep, publicly owned slopes.					
Landslide #2	1, 2, 6	Identify and address vulnerable landslide areas.	Using debris-flow measures that may reduce damage in sloping areas, such as stabilization, energy dissipation, and flow control measures.	M	Ongoing	M	Beaver City	Beaver City
Landslide #3	1, 2, 6	Plan for future growth which may include areas with steep slopes.	Establishing setback requirements and using large setbacks when building roads near slopes of marginal stability.	M	Ongoing	L	Beaver City	Beaver City
Landslide #4	1, 2, 4	Prevent rockfall damage to roads and travelers.	Installing catch-fall nets for rocks at steep slopes near roadways.	L	5-years	M	Beaver City, UDOT, Beaver County	Beaver City, UDOT, Beaver County
Problem Soils #1	1, 2, 4	Collect data to inform mitigation activities.	Work with Beaver County and the Utah Geological Survey to update problem soil mapping of the area.	L	5-years	M	Beaver City, Beaver County, UGS	Beaver City, Beaver County, UGS
Problem Soils #2	1, 2, 6	Reduce structural damage from problem soil impacts.	Restrict development in areas where soil is considered unsuitable for development.	M	Ongoing	L	Beaver City	Beaver City
Wildfire #1	1, 2	Establish standards to address wildfire impacts on structures and infrastructure.	Adopt a Wildland Urban Interface Code.	M	2-years	L	Beaver City	Beaver City, Beaver County Fire District.
Wildfire #2	1, 2, 5	Establish standards to address	Using zoning and/or a special wildfire overlay	M	2 years	L	Beaver City	Beaver City, Beaver County Fire District.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		wildfire impacts on structures and infrastructure.	district to designate high-risk areas and specify the conditions for the use and development of specific areas.					
Wildfire #3	1, 2	Establish standards to address wildfire impacts on structures and infrastructure.	Encouraging the use of non-combustible materials (i.e., stone, brick, and stucco) for new construction and renovations in wildfire hazard areas.	M	ongoing	L	Beaver City	Beaver City, Beaver County Fire District.
Wildfire #4	1, 2	Reduce vulnerability of fire accelerants in the community.	Protecting propane tanks or other external fuel sources.	L	ongoing	L	Beaver City	Beaver City
Wildfire #5	2	Reduce fire potential at critical facilities and infrastructure.	Coordinate with local utility providers to mitigate hazardous fuels around utility infrastructure.	M	Ongoing annually	M	Beaver City, local utility companies	Beaver City, local utility companies
Multi Hazard #1	1, 3	Inform residents and visitors of extreme temperature hazard.	Providing educational materials to local businesses/hotels for visitors use to understand natural hazard risks while recreating.	H	Ongoing	L	Beaver City	Beaver City

Source: Local Planning Team

Milford

Milford city was originally settled as a mining and railroad community, with silver discovered near the area, which led to the development of the Union Pacific Railroad line to the community. The community sits on Southern Paiute lands and was settled by Mormon Pioneers in 1870.

Milford is a small community in central Beaver County, which is connected by SR-21 and SR-257. The community lies in the valley between two mountain areas, Frisco Peak and Granite Peak. An airport can be found south of the city.

The elevation in Milford City is near 5,000 feet, and it is one of the colder communities in the region. The community receives snow in winter and is subject to hot summer days. A nearby reservoir and the Rock Corral serve as local recreation amenities.

Community Characteristics

Milford City is a rural community in Southwestern Utah. The city has had a stable population over the decades and a diverse economy which will be described throughout this section.

Demographics

Figure 44 documents the population in Milford City in each decade since 1960. As demonstrated by the figure, the population has remained relatively stable, near 1400 people, with some decline reported from 1970 to 1990.

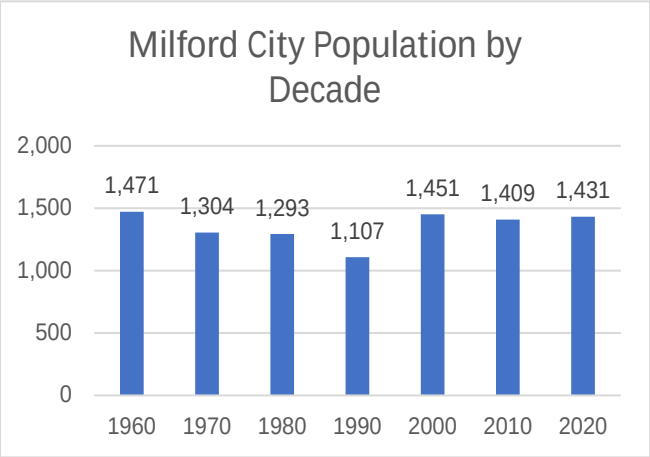


Figure 44: Milford City Population by Decade

Source: US Census Bureau

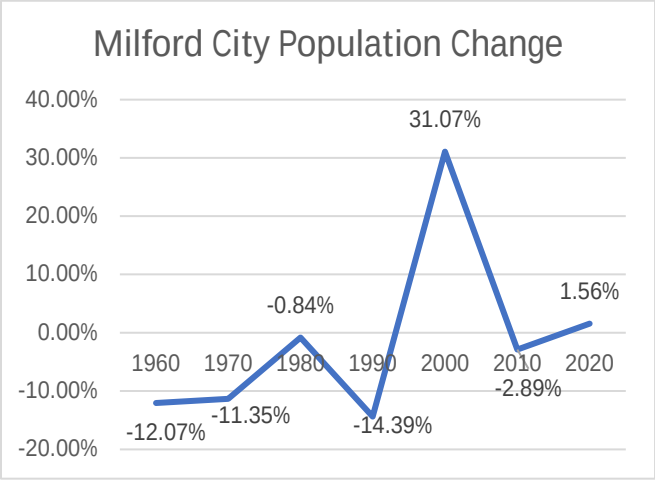


Figure 45: Milford City Population Change

Source: US Census Bureau

Milford City has seen an average growth rate of 0.53% since 1970. Figure 45 describes the percent change in population at each census since 1960. As can be seen, the population experienced rapid growth between 1970 and 1980, with consistent growth since 1980.

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Beaver County could see approximately, 34.1% growth in their population. If applied to Milford City in a step-down analysis, the population could be 1918 persons. (Hollingshaus, et al., 2022)

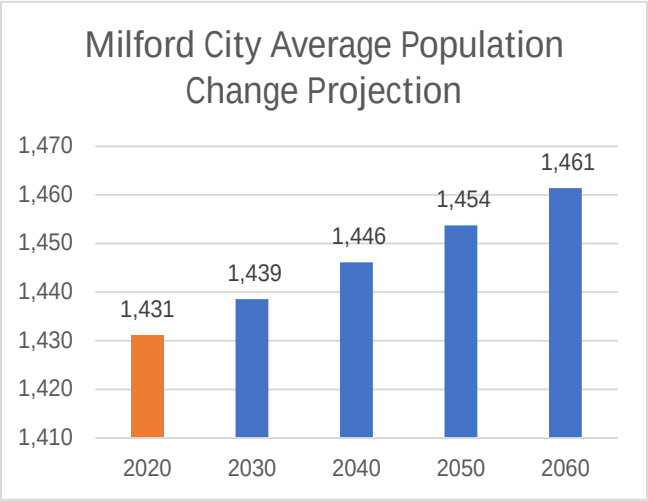


Figure 46: Milford City Population Projection based on Average Change

Source: US Census Bureau

Using the average change in population for the county, the future population by 2060 was also projected. The projection is solely based on historic patterns in the city since 1970 and does not account for land availability or other metrics in the county. Figure 46 illustrates the projected population, which is estimated at 1,461 people.

Economy

Milford has agriculture presence which contribute to the community. According to the US Census OnTheMap tool, most jobs in Milford are in Agriculture, Forestry, Fishing, and Hunting, illustrated by Figure 47. Given the proximity to Smithfield's Hog farms (the County's largest employer), rural setting, and access to the outdoors, it is no surprise that 57% of the jobs are within this industry. The other industries that make up a large portion of the job share are Educational Services, Health Care and Social Services, and Manufacturing.

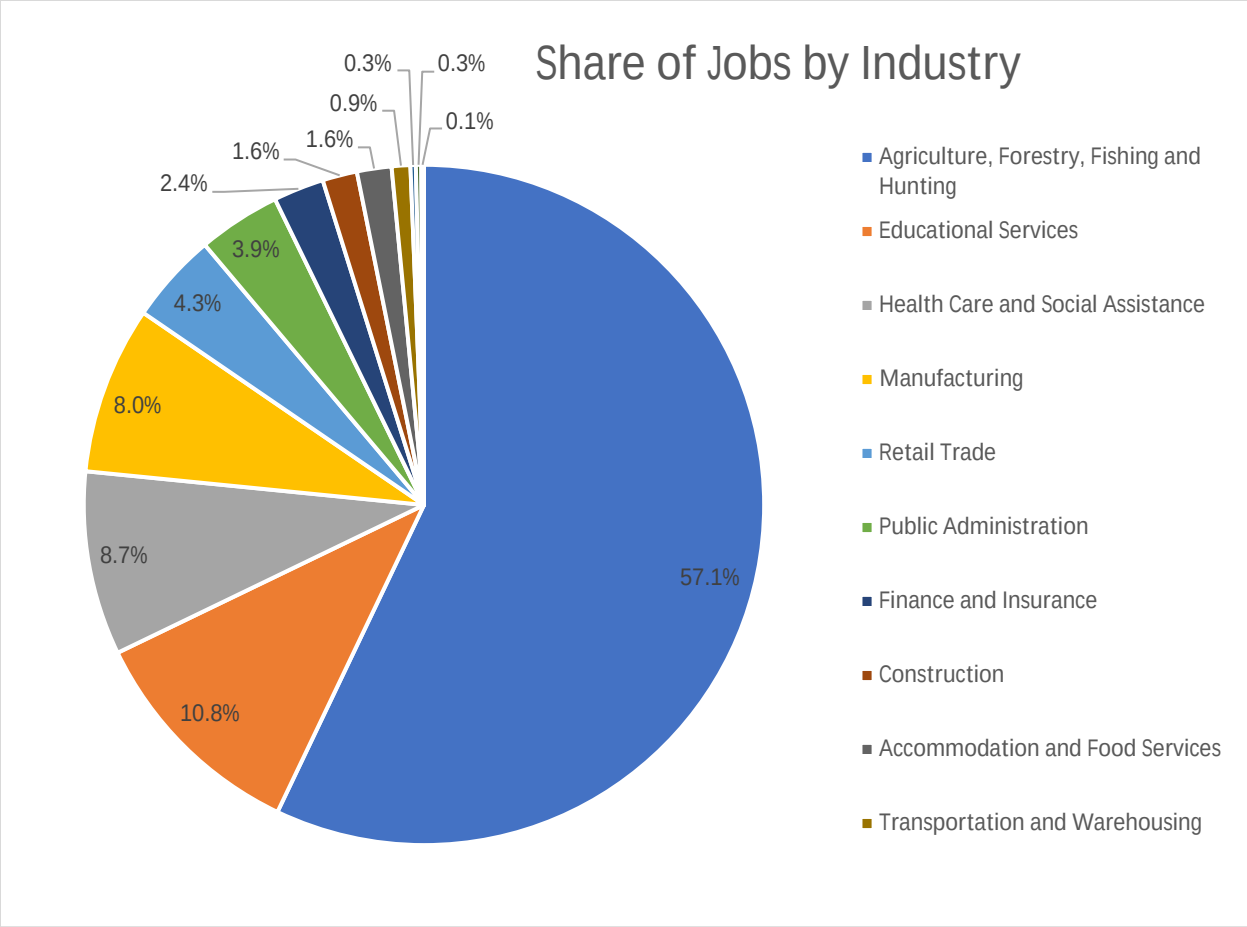


Figure 47: Milford Share of Private Primary Jobs by Industry

Development

Milford City is a rural community experiencing minimal growth. Within the last 3-5 years the city has seen 8 new homes constructed and approximately 75% of vacant homes remodeled to make them habitable. Most of the growth in the area is not in city limits. The unincorporated county near the city is seeing additional commercial and manufacturing districts.

Community Capabilities

The community is governed by an elected city council and Mayor. The community does have staff to support government and city operation, which includes a city administrator, recorder, building official, and zoning administrator. The town includes several boards which provide insight the council on decision making, including a Beautification Board, Board of Adjustments, Library Board, and Planning and Zoning Commission. City Council members are designated to oversee several community services and departments, like water, public safety, recreation, cemetery, airport, etc.

Law enforcement is provided by the County Sheriff's Office while emergency medical and fire services are provided by special service districts.

The city provides sewer and water service to residents and private companies offer all other local utilities. Rocky Mountain Power and Dominion Energy provide electricity and gas utilities locally. Waste

management is provided by Hughes and Sons. Communications utilities are provided by South Centra Communications, Infowest, and major cellular networks.

Funding for Capital improvement and infrastructure projects in the City are typically funded through Capital Improvement Project funding, debt through General Obligation or Special Tax Bonds, Community Development Block Grant, and other state and federal funding sources.

Plans and Policies

Milford City develops plans and policies to guide the community development and set rules and regulations to provide for the health, safety, and public welfare of the city. Other plans and policies may exist for the community, but the only plans and policies made available for review were the city ordinances.

Municipal Ordinances

Milford City ordinances are policies and regulations locally which provide for the health, safety, and welfare of the city. In the ordinances, several permitting processes, limitations, and requirements exist for development in identified hazard areas. In some cases, professional reports are required to demonstrate a development site is not in a hazard area or that the development has plans to mitigate hazards on the site. Ordinances describe geologic hazards, sensitive lands, flood, earthquake, problem soils, severe weather, steep slopes, and wildfire natural hazards.

Ordinances describe that the Streets department controls all waters flowing on streets, sidewalks, and public ways. The building official in contrast is responsible for determining whether proposed buildings or development are safe from flooding and enforcing requirements set on at risk construction.

Risk Assessment

Milford experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with Milford to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 35 displays the relative risks of hazards in the community.

Table 35: Milford Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. Moderate
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate

RADON	6. Moderate
LANDSLIDE	7. Low
PROBLEM SOILS	8. Low

A detailed description and mapping of each of the natural hazards that impact Milford can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Milford include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area.

Wildfire

Figure 48 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Milford that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Milford has mapped extreme risk throughout much of the city and east of the community in the mountains. Roadways in and near the community also are mapped at a moderate to high risk to wildfire, likely because these areas are where essential assets exist in the community.

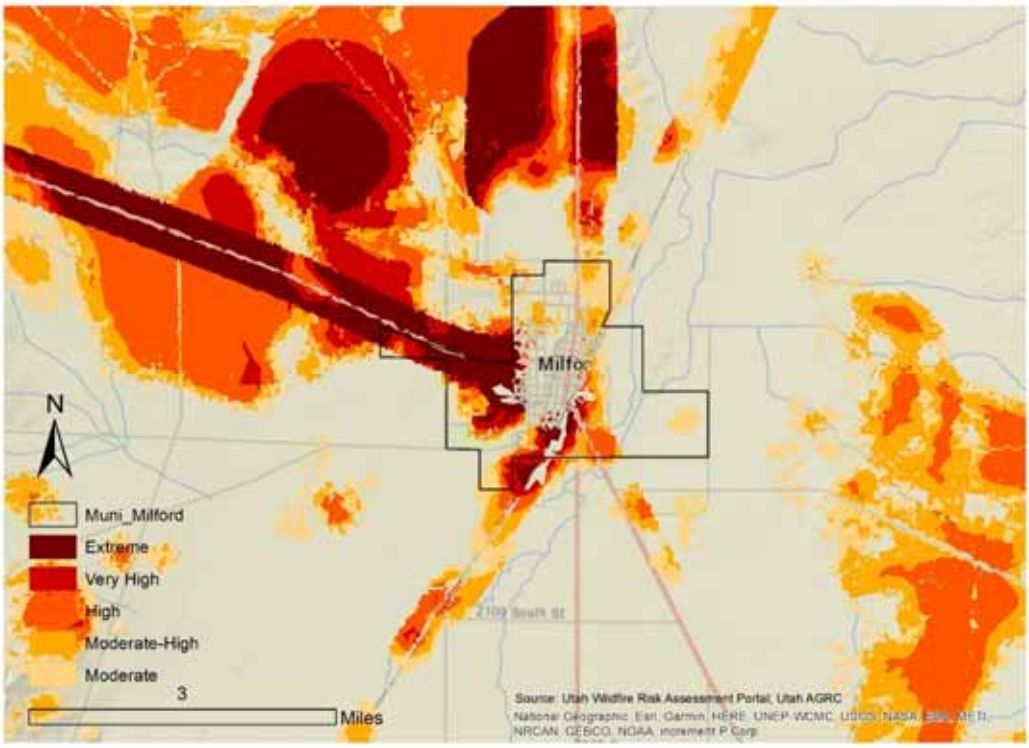


Figure 48: Milford Wildfire Risk

Source: Oregon Department of Forestry, AGRC

Table 36 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Milford City. A significant portion of residential parcels and all community parks are in an area considered moderate to extreme risk to wildfire. Twenty-three road miles and one critical facility in the community are exposed. One quarter of the rail miles within the community's boundaries are exposed to wildfire risk area. These highlight vulnerabilities to residents and spaces where residents congregate, in addition to access to neighborhoods and portions of the community.

Table 36: Milford Wildfire Risk

Milford Exposure to Wildfire Risk				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
40.0%	45.9%	23.0%	25.4%	66.7%

Source: Oregon Department of Forestry, Beaver County Assessor, Utah AGRC.

Hazard History

Wildfire is a continuous challenge in the southwest, given the dry, arid climate. Fire starts throughout the region are attributed to both human causes and natural causes, like lightning strikes. The Milford Flat Fire was a large wildfire which started near Milford, Utah. The impacts of the blaze are described in Table 37. Large wildfires have not been reported in or near the Milford City boundaries since the 2007 fire.

Table 37: Milford Wildfire Hazard History

Fire Name	Year	Acres Burned	Other Impacts
Milford Flat Fire (FM-2707-UT)	2007	337,675	• Rangeland, cattle, four buildings, and a cabin were burned. • $4,000,000 in property damage recorded. • Impacted both Millard and Beaver County

Source: FEMA

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Milford and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. While there are no faults running through Milford, several faults are mapped adjacent to the community, as seen in Figure 49. Fault lines are the most common cause of large earthquakes, epicenters and ground shaking impacts often affect areas miles away.

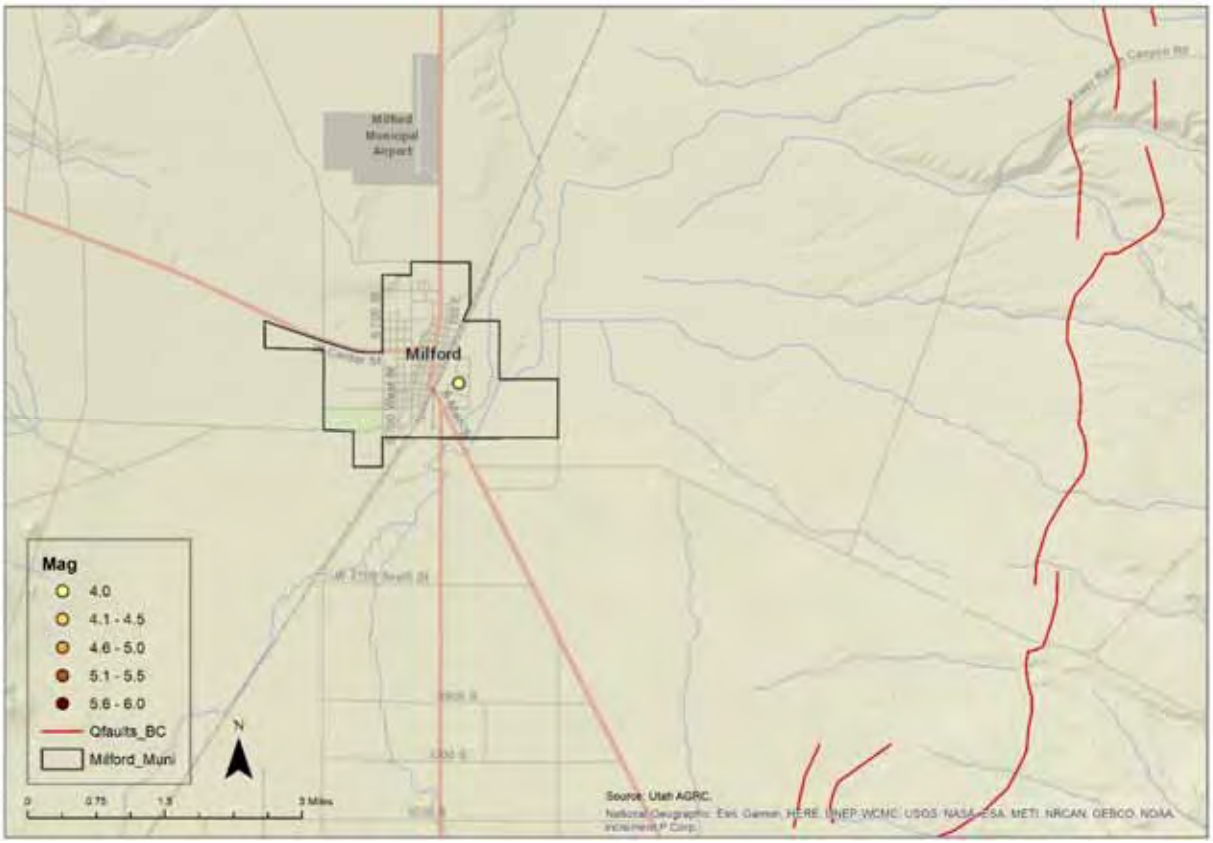


Figure 49: Milford City Earthquake Epicenters and Quaternary Faults

Source: UGS, Beaver County Assessor, AGRC

As there are no faults identified in the community, surface fault rupture is not a risk in the community, however ground shaking, and liquefaction are risks in the community.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. These structures were frequently built using unreinforced masonry, which does not withstand strong shaking. According to the American Community Survey, 382 residential structures in Milford City were constructed prior to 1970. These structures are more likely to be unreinforced masonry. Assessment, information, and retrofits may secure these structures in the future.

Hazard History

Beaver County is a seismically active area. Milford has reported one magnitude 4.05 earthquake epicenter within the municipal boundary, dated to 1908, as described in Table 38. This area has also

been known to experience clusters of several smaller earthquake events, where many earthquakes are reported over a period of time.

Table 38: Milford City Earthquake Epicenter Record

Incident Date	Location	Description
1908	Milford, Beaver County	A 4.05 magnitude earthquake recorded within the Milford municipal boundary.

Source: University of Utah Geology Department

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Milford City.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Current Floodplain mapping completed for Beaver County that all the county, including Milford City, is in Zone D, which indicates that there is a potential risk of flooding, but the probability has not been calculated. (FEMA) The Figure 50 maps Milford City's dam inundation areas and where major bodies of water are. The map does not document the floodplain, as the entire county is classified as Zone D. The mapped dam inundation zone and identified water bodies are in the east side of the city. One should note that flooding events have been documented in various location in the county.

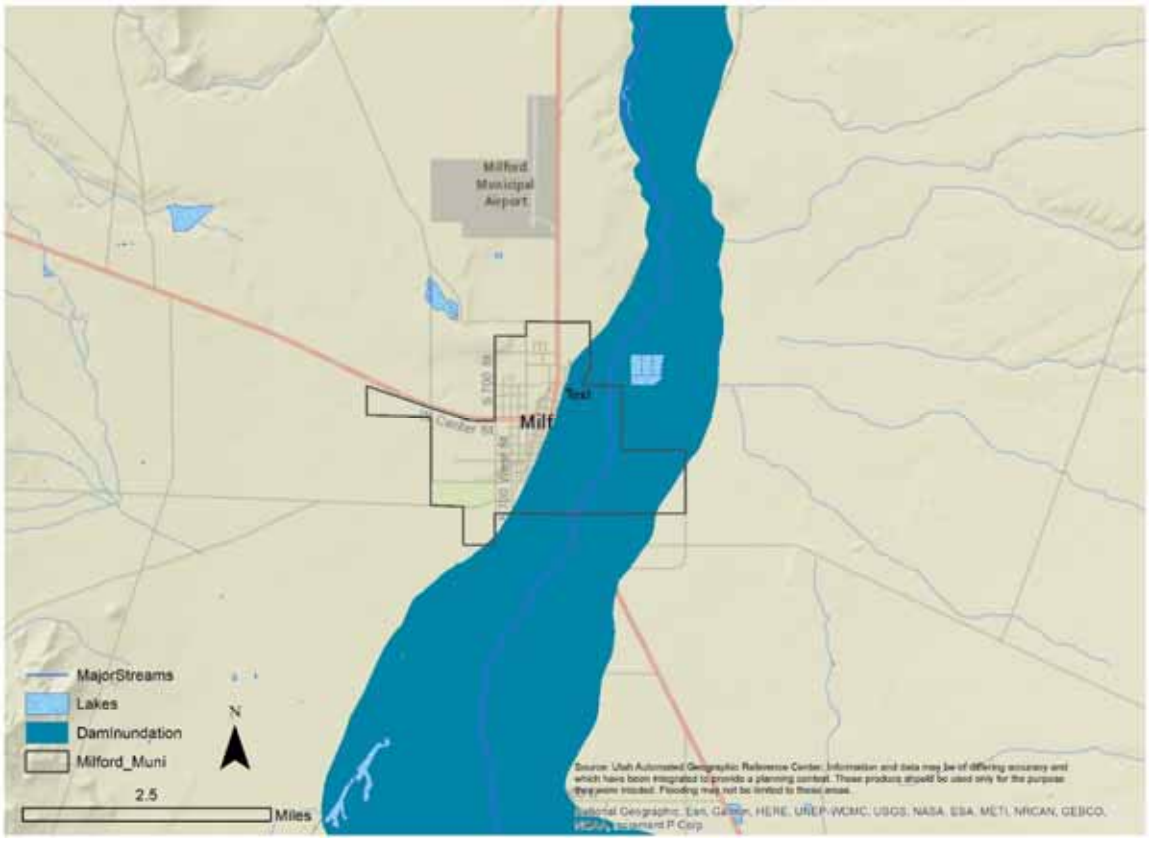


Figure 50: Milford Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

Table 39 includes an assessment of the exposure to identified flood risk areas in Milford, by observing community assets and structures that are in at-risk areas. The table shows that one fifth of residential parcels and nearly one third of road miles are exposed to identified water bodies or dam inundation zones. Flooding on access roads can lead to transportation delays, and impact response during an emergency event. One critical facility is in an at risk area. Critical facilities in hazard areas are community vulnerabilities as the ability to respond or provide community information can be impacted.

Table 39: Milford Water Body and Dam Inundation Exposure

	Road Miles	Rail Miles	Parcels	Parks	Critical Facilities
Milford	30.6%	100.0%	20.2%	0.0%	20.0%

Source: Flood Insurance Rate Map, AGRC, Beaver County Assessor.

National Flood Insurance Program

Milford City property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 40 describes the community participation in the NFIP. The FEMA Community Status Book Report describes that there is No Special Flood Hazard Area (NSFHA) in Milford. There are presently no active policies and only one claim submitted, which was paid in the amount of $3,447. The community received a Community Assistance Contact on 2/26/2019 and a Community Assistance Visit on 9/22/2008.

Table 40: Milford NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978	Repetitive Losses
$0	0	0	0	$0	1	$3,447	0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

The County Emergency Manger acts as the floodplain administrator locally and enforces relevant floodplain ordinances to minimize exposure to flood hazard areas.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 41 describes the flooding events which impacted Milford.

Table 41: Milford Reported Flood Events

Milford Flood Hazard Record		
Date	Damage/Injury	Description
7/22/2021	None Reported	Milford experienced street flooding which was 3-feet deep, which left debris on SR-21 following heavy rain.

Source: NOAA Storm Database, SHELDUS

Roadways in and out of the community have historically been impacted by flooding events. While damages may not have occurred, closures can impact a community with delays and limited access. Further, impacts to agricultural areas can threaten crops and livestock.

Events in neighboring communities may have also impacted Milford but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Climate trends indicate that severe weather events are expected to become less frequent but will increase in severity, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 51 maps the landslide susceptible areas in and surrounding Milford.

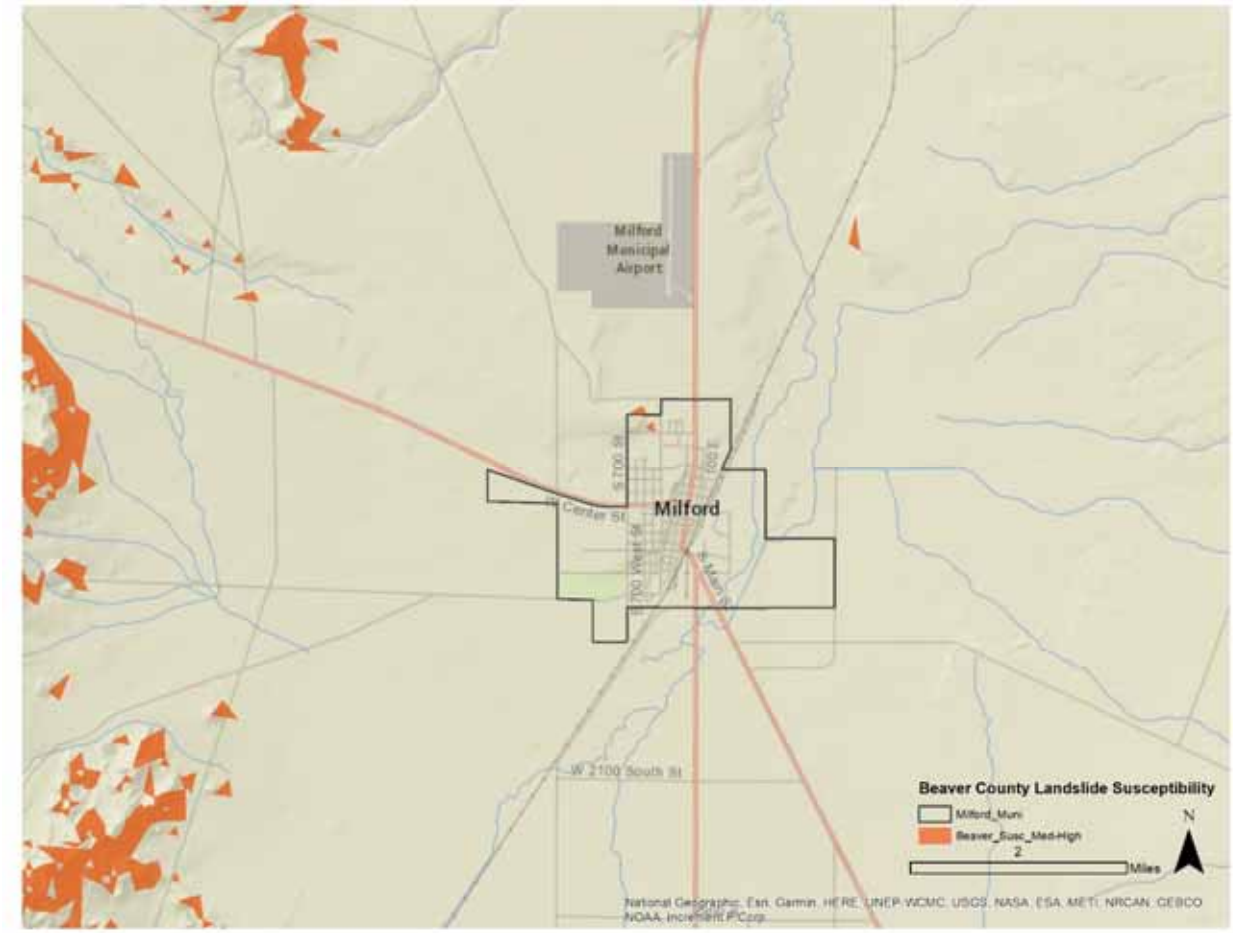


Figure 51: Milford City Landslide Susceptibility Exposure

Source: Utah Geological Survey

Milford has very little exposure to moderate and high landslide susceptible areas within the city limits. *Table 42* describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Milford describe that 0.5% of road miles are in a moderate to high landslide susceptible zone and 0.7% of the parcels are in in mapped susceptible areas. No critical facilities or parks are presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 42: Milford Landslide Susceptibility Exposure

Milford Exposure to Landslide Susceptible Areas				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
0.0%	0.7%	0.5%	0.0%	0.0%

Source: Utah Geological Survey, Beaver County Assessor, AGRC.

Hazard History

Landslides and rockfall frequently occur in the Five County region, causing damage to infrastructure, structures, and other property. Table 43 describes the landslide events and impacts reported in Milford.

Table 43: Milford Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
1923	South of Milford	Unknown	Unknown	A landslide occurred at the railroad south of Milford.
1967	Milford	Unknown	Unknown	Debris flow

Source: Source: 1, 6, 9 UGS newspaper reference, see references & works cited page. & SHELDUS

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts.

Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area. Residents in the past two years have been asked by local and state governments to conserve water to address the current drought which has affected the area for over 20-years.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Agriculture and related industries provide a significant portion of the jobs in Milford City. Impacts may include damage to crops and the health of livestock, which can affect workers in this industry.

Drought may also impact the local water supply in wells, rivers, and reservoirs. Low water levels can contribute to poor quality and impacts to local species in the area, affecting the greater ecosystem of the area.

Drought is connected to other natural hazards, like wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 52. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

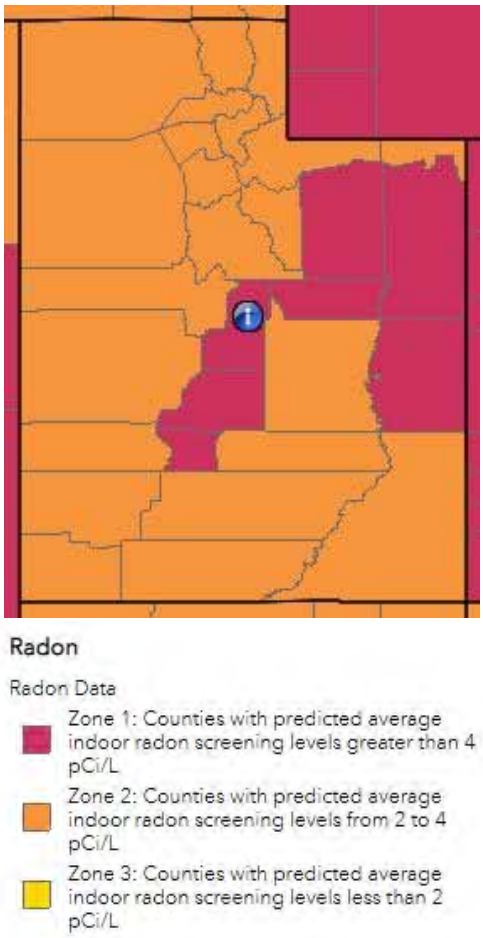


Figure 52: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 44 describes the reported findings for the County. Across Beaver County, the average test result is 40.2 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk

Table 44: Beaver County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

27.2%	72.8	664.0 pCi/L	40.2 pCi/L	423

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Milford, however our analysis assumes that severe weather events will impact the whole of Milford residents, facilities, infrastructure, businesses, and property.

Milford has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Milford, which can produce hail, high winds, rain, and lightning.

There have been dozens of severe weather events that have caused damages in Beaver County. Thirteen weather events have been recorded with impacts to Milford between 1995 and 2020, which are documented in Table 45. Other county events likely impacted Milford and should be reviewed in the County section of this hazard plan.

Table 45: Milford Severe Weather Record

Date	Hazard	Injury / Damage	Description
10/15/1998	Winter Storm	$100,000 in damage	A strong winter storm moved through Utah on the 15th and 16th. The heaviest snow fell in the southern half of the state
12/21/1998	Cold/wind chill	$20,000 in property damage statewide.	Milford experienced extreme cold, with temperatures reported at -30 degrees Fahrenheit.
7/17/2001	Hail	None Reported	Hail 3/4” in diameter were reported in Milford.
8/17/2001	Thunderstorm	$2,000 in Property Damage $1,000 in Crop Damage	A wind gust estimated at 80 MPH was reported in Milford. A sensor recorded a 67 MPH gust. The event resulted in several downed trees and power lines.
9/4/2001	Tornado	None Reported	A tornado touched down near Milford and then dissipated after 15-minutes.
3/29/2007	Winter storm	None Reported	A winter storm produced eight inches of snow in Milford, four of which fell in a two-hour period.
5/24/2009	Tornado	None Reported	A tornado touched down five miles west of Milford in an uninhabited area. No damage was reported.
12/20/2010	Winter Storm	None Reported	A winter storm produced 15-inches of snow in Milford.

10/28/2013	High Wind	$35,000 in damage	Strong winds were reported in southwest Utah, which produced a wind gust of 64 MPH recorded by the Milford ASOS
4/14/2015	High Wind	$10,000 in property damage	High winds were reported in Milford and at the Brimstone reservoir with maximum gusts over 60 MPH. Trees were downed during the event.
1/30/2016	Winter Storm	2 injuries	Storm total snowfall was perhaps most impressive in southwest Utah, where storm totals included 20 inches in Milford. Automobile incidents along Interstate 15 attributed to the snow included 2 injury accidents, 24 collisions, and 46 slide-offs.
7/25/2016	Thunderstorm	$20,000 in damage	Strong winds downed 176 power poles near SR 21 and 129, causing nearly all Milford residents to lose power.
3/5/2017	High Wind	10 injuries, $80,000 in damage	A cold front produced strong winds with a gust of 70 MPH recorded at the Milford Municipal Airport. Windblown dust caused low visibility caused multiple car accidents along State Route 21 near Milford. The wind blew a roof of a barn off, which became caught in power lines.

Source: NOAA Storm Database

High wind, thunderstorm, and winter storms are frequently occurring weather events which cause the most damages or injury in the area. The area is vulnerable to extreme cold, as demonstrated by a 1998 event. Infrastructure, like power lines and roadways, have been impacted in past severe weather events. Two tornadoes impacted the area surrounding Milford but did not produce any damages.

Severe weather will continue to impact Milford as weather events are frequently occurring in this region, particularly high wind events. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. Flooding events which occur because of severe weather are reported in the flooding section of this assessment.

Problem Soils

Problem soils are a challenge for construction, infrastructure, and development. Problem soils are subject to expansion, compression, solution, or collapse when exposed to water, depending on the content of the soil. The changes in the soil structure and occupied space can damage or impact infrastructure built on top of the problem soil.

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated by Figure 53. The map identifies that problem soils have not been mapped in Milford.

Figure 53: Beaver County Mapped Problem Soils

Source: UGS, AGRC

Milford City's ordinances indicate that council may call on a developer to show whether a site has hazards, including soil hazards. There may be identified challenges with problem soils experienced locally, which were not mapped. The Utah Geological Survey (UGS) has developed new mapping for other communities in the region, which have provided a clearer picture of the challenges that exist to construction and development in those areas. Updated mapping of the Beaver County area may provide additional information about the risks posed by problem soils locally.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Milford is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Several local vulnerabilities were identified. Agricultural industries are most vulnerable to severe weather, flood, and drought. Roads and roadway users are vulnerable to wildfire, flood, and severe weather impacts, including traffic delays, vehicle accident, road damage, and other hazards. Landslides are a relatively low risk within the city, but records from nearby the community show that infrastructure is vulnerable, namely the railroad. All residents, structures, and infrastructure may be vulnerable to a severe earthquake event, although the probability of such an event occurring is low.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Milford has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Milford and are listed in Table 46 with a description of their progress.

Table 46: 2016 Milford Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Allow the water to move freely and eliminate water from backing up into private properties.	Install a culvert with a box in our man drainage ditch (300 S 100 E). The culvert will be extended 15' past the 100 East. This will allow the water to move more efficiently and freely. The culvert will end in the main drainage canal, which is located on Railroad Property, east of 100 East. The City crew will be cleaning out the drainage ditch, which is on the Railroad Property to ensure the water moves freely out of city limits.	1 year	Milford Operating Budget	Completed

Source: 2017 Five County Association of Governments NHMP

Milford City identified actions to include in the community mitigation strategy. Each action in Table 47 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 54.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 54: Regional Plan Goals

The city did not develop mitigation actions for landslide or problem soils as their risk is low in the community based on present data.

Table 47: 2022 Milford Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2	Improve drainage capacity in Town.	Flush and replace culverts as needed to facilitate moving of water from the west side of town to the main drainage canal.	H	5-years	M	Milford City	Milford City
Drought #1	6	Inform the community of risks and use natural	Encourage the use of native vegetation in new development.	L	1-year, ongoing	L	Milford City	Milford City, Developers

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		systems to mitigate hazards.						
Earthquake #1	2, 4, 5	Prevent tipping and falling of equipment during an earthquake.	Brace essential equipment in city owned critical facilities. Work with facilities not operated by the city (fire stations, schools, hospitals, etc) to inform them of safety concerns with unsecured equipment during earthquake events.	M	2-years, ongoing	M	Milford City	Milford City, Milford Hospital, Fire Service District, Schools
Severe Weather #1	2, 5	Ensure the continuation of operations following an event.	Install and maintain surge protection on critical electronic equipment.	H	1-year	L	Milford City	Milford City
Wildfire #1	1, 3, 4, 6	Inform the community of risks and use natural systems to mitigate hazards.	Coordinate with local fire service district to educate residents on fuels reduction on personal property during planned community clean-ups.	H	1-year, ongoing	M	Milford City	Milford City, Fire Service District.
Radon #1	3	Inform the community of risks	Provide information about local radon risk, testing, and mitigation to residents.	H	1-year, ongoing	L	Milford City , Depart ment of Environ mental Quality	Milford City

Source: Local Planning Team

Minersville

The town of Minersville is a rural community in southeastern Beaver County at an elevation over 5,000 ft. The town is in a mountainous area of southwestern Utah and is marked by summer heat and winter cold. The Black mountains are to the southeast and Mineral Mountains are northeast of the community. The town is connected by SR-21 and SR-130. Like neighboring Milford, mining was a primary draw for settlement in Minersville.

Community Characteristics

Minersville is in a rural county, surrounded by the west desert of Utah. This area has a history of use for mining, natural resources, and agriculture. The areas demographics, economy, and development reflect these uses and changes overtime.

Demographics

Minersville has experienced growth countywide, with an average growth rate of 7.49%. Figure 55 describes the town's population by decade. A brief period of decline was reported in 1970, but since that time, population growth has continued, described in Figure 56. (Hollingshaus, et al., 2022)

Based on current population growth and trends it is expected that the town will continue to see growth in the coming years. The Kem C Gardner Institute forecasts a 34.1% increase in the County's population between 2020 and 2060. According to this estimate the population of Milford could be 1,082 people.

An estimate of projected population using the average population change of 7.49% for the town yields a similar number, estimating that by 2060, the towns population could be as high as 1,077 people, seen in Figure 57.

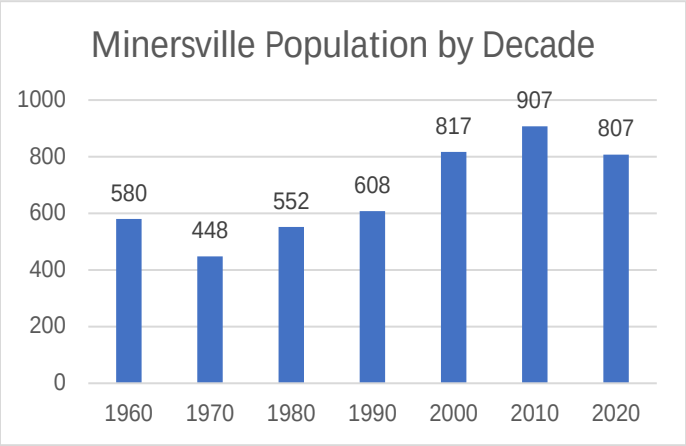


Figure 55: Minersville Population by Decade

Source: US Census Bureau

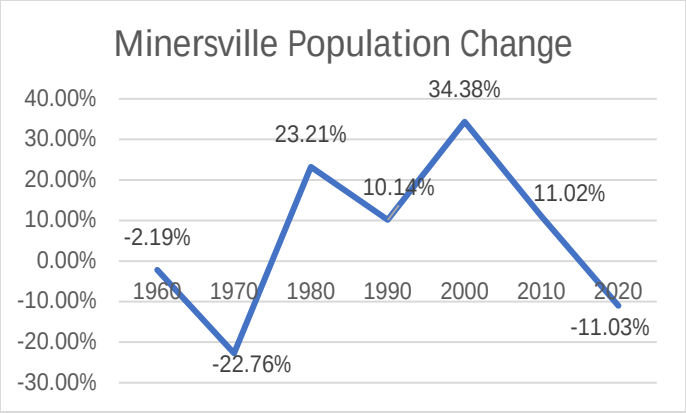


Figure 56: Minersville Population Change

Source: US Census Bureau

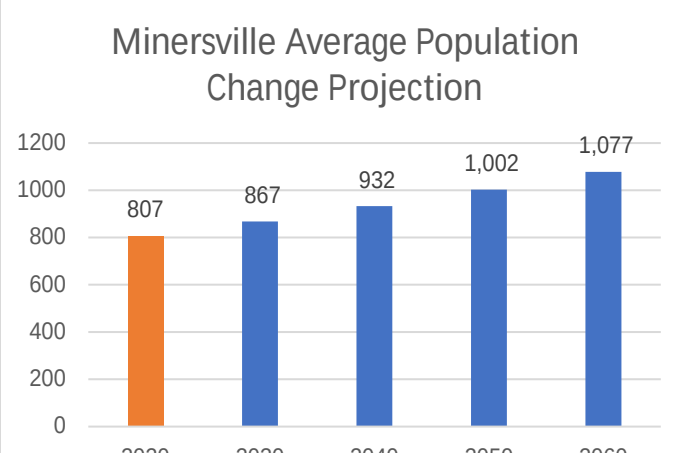


Figure 57: Minersville Population Projection based on Average Change

Source: US Census Bureau

Economy

According to the US Census OnTheMap tool, most jobs in Minersville are in the Transportation and Warehousing and Public Administration, illustrated by **Error! Reference source not found.**. Minersville is located centrally in Beaver County and sits at the intersection of SR-21 and SR-130 and is only 18 miles from I-15 making it an ideal location for transportation. Other significant industries in Minersville are Utilities, Construction, and Retail Trade.

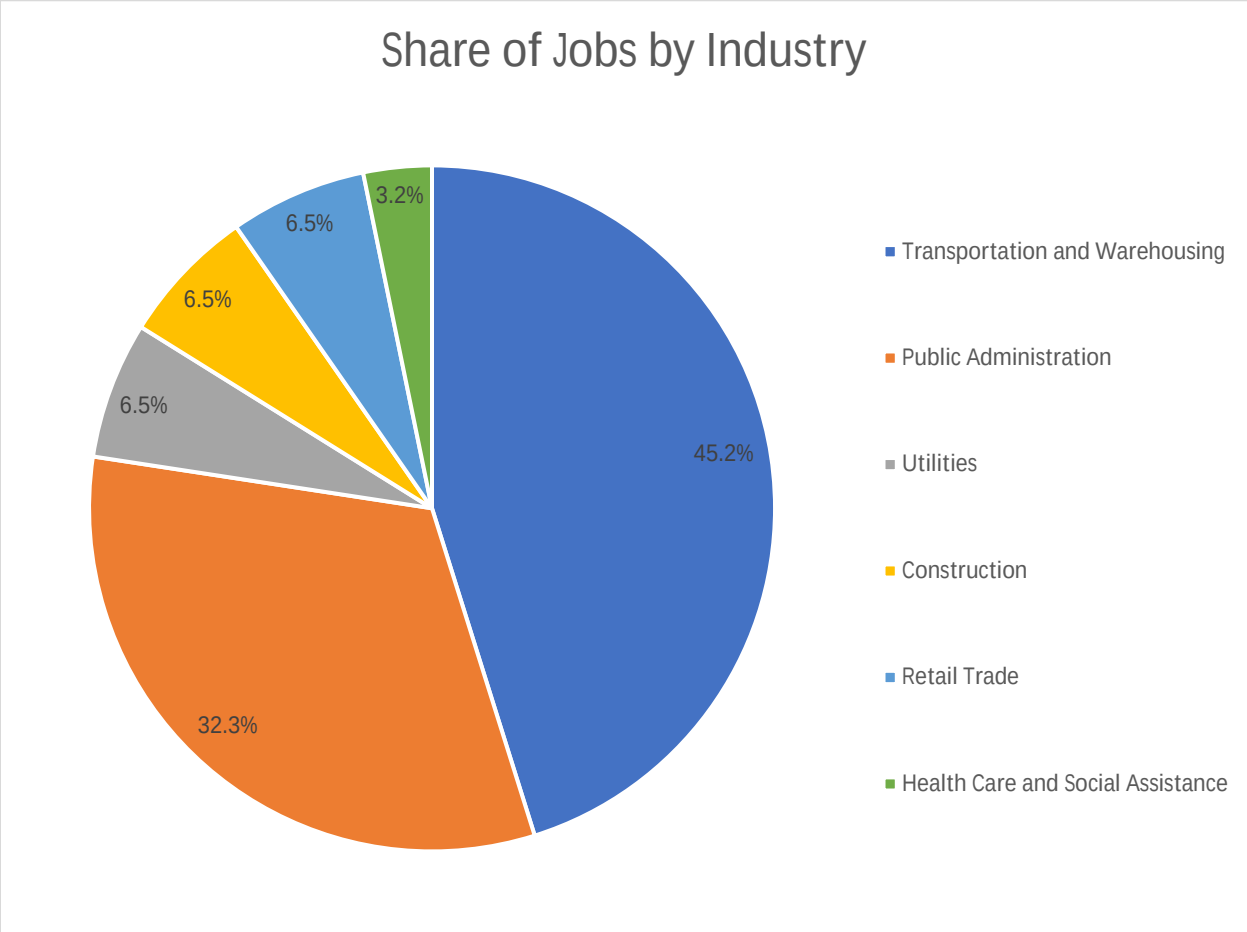


Figure 58: Minersville Share of Private Primary Jobs by Industry

Development

Minersville has added a handful of homes to the community but has not experienced new development otherwise.

Community Capabilities

The community is governed by an elected town council and a mayor. The community does have staff to support government and city operation, including: a town Clerk, public works staff, and town manager. The town supplies sewer and water utilities, while other utilities are provided by private companies. Rocky mountain power provides electricity, Dominion Energy supplies gas, and South Central and Info West provide communications, phone, and internet. Waste removal is provided by Hugh and Sons.

Emergency response is supported by a variety of agencies. Law enforcement is provided by the County Sheriff's Office, in Beaver City. The town does include a fire station, which is operated under the Fire Special Service District #2 for Minersville and Milford. Similarly, the Milford Area Health Care Service District provides ambulance service in the community, with a volunteer group of EMTs with facilities that include two ambulances in Minersville.

Plans and Policies

No plans were made available for this update.

Risk Assessment

Minersville experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and the landscape.

Five County has worked with Minersville to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 48 displays the relative risks of hazards in the community.

Table 48: Minersville Hazard Risk

HAZARD	RISK
DROUGHT	9. High
SEVERE WEATHER	10. High
WILDFIRE	11. Moderate
FLOOD	12. Moderate
EARTHQUAKE	13. Moderate
RADON	14. Low
LANDSLIDE	15. Low
PROBLEM SOILS	16. Low

A detailed description and mapping of each of the natural hazards that impact Minersville can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Minersville include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories. Figure 59 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Minersville that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan.

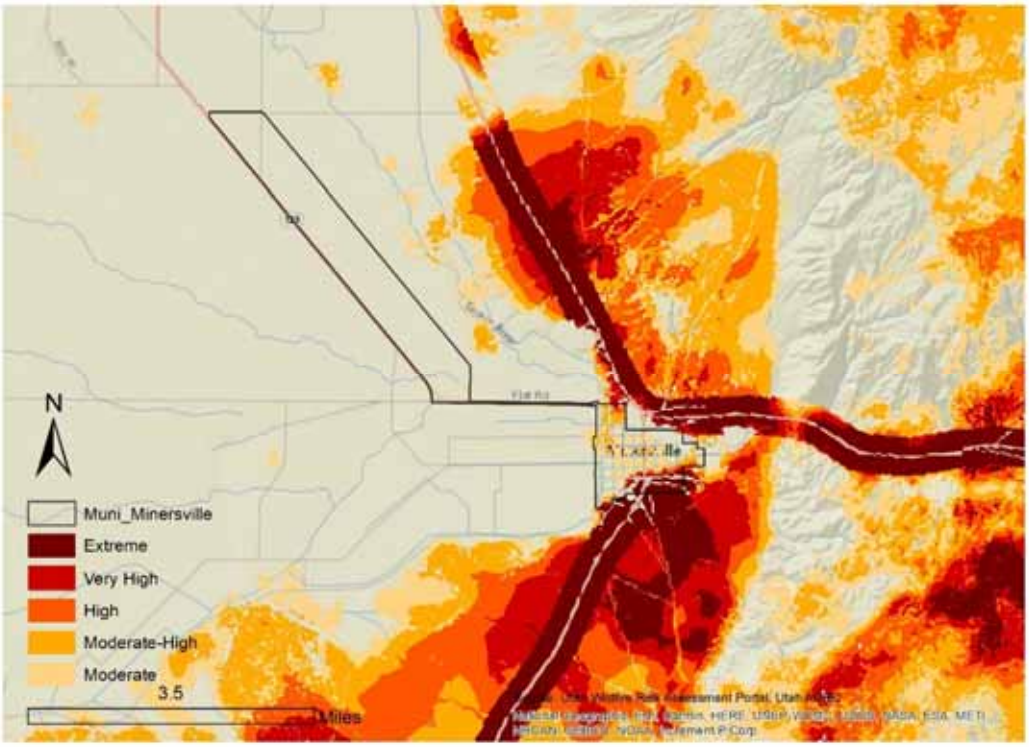


Figure 59: Minersville Wildfire Risk

Source: Oregon Department of Forestry, AGRC

Minersville has mapped extreme risk throughout much of the city and east of the community in the mountains. Roadways in and near the community also are mapped at a moderate to high risk to wildfire, likely because these areas are where essential assets exist in the community. This mapping does not factor the other uses of the land and potential vulnerabilities to tourism outside of more populated areas.

Table 49 describes the community's risk by measuring community assets that fall in identified moderate to high wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Minersville. A significant portion of residential parcels and all

community parks are in an area considered moderate to extreme risk to wildfire. Ten percent of road miles in the community are exposed. These highlight vulnerabilities to residents and spaces where residents congregate, in addition to access to neighborhoods and portions of the community.

Table 49: Minersville Wildfire Risk

Minersville Exposure to Wildfire Risk				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
0.0%	70.6%	10.9%	N/A	100.0%

Source: Oregon Department of Forestry, Beaver County Assessor, Utah AGRC.

Hazard History

Several wildfires have been reported by news sources and the Utah Fire Info tracking website. Vulnerabilities during all of the recorded fires impacting Minersville describe closures or impacts to the major roadways in and out of the community, namely SR-21 and SR-130, shown in Table 50.

Table 50: Minersville Wildfire Record

Fire Name	Year	Acres Burned	Other Impacts
Greenville Fire	2020	1,800	• Caused the closure of SR-21 near the Minersville reservoir, threatened a campground in the recreation area.
Baboon Fire	2020	305	• Burned fields and trees near SR-130
Horse Valley Fire	2020	55	• The fire caused closures of SR-31 between Enoch and Minersville.
Black Mountain Fire	2018	5,998	• SR-130 closed and the blaze nearly prompted the evacuation of Minersville residents.

Source: Utah Fire Info, St. George News, Cedar City News, and Fox13 Now. (Burt, 2020) (Blowers, Firefighters battling 2 wildfires in Beaver County; Baboon Fire grows to 300 acres, Greenville at 85% contained, 2020) (Kessler, 2020) (Richards, 2020)

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Minersville, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential

to produce severe earthquakes. While there are no faults running through the city, Minersville has several faults mapped in the community, as seen in *Figure 60*. Earthquakes can happen throughout the state, although fault lines tend to be the most common cause of large earthquakes which can trigger impacts in areas miles away.

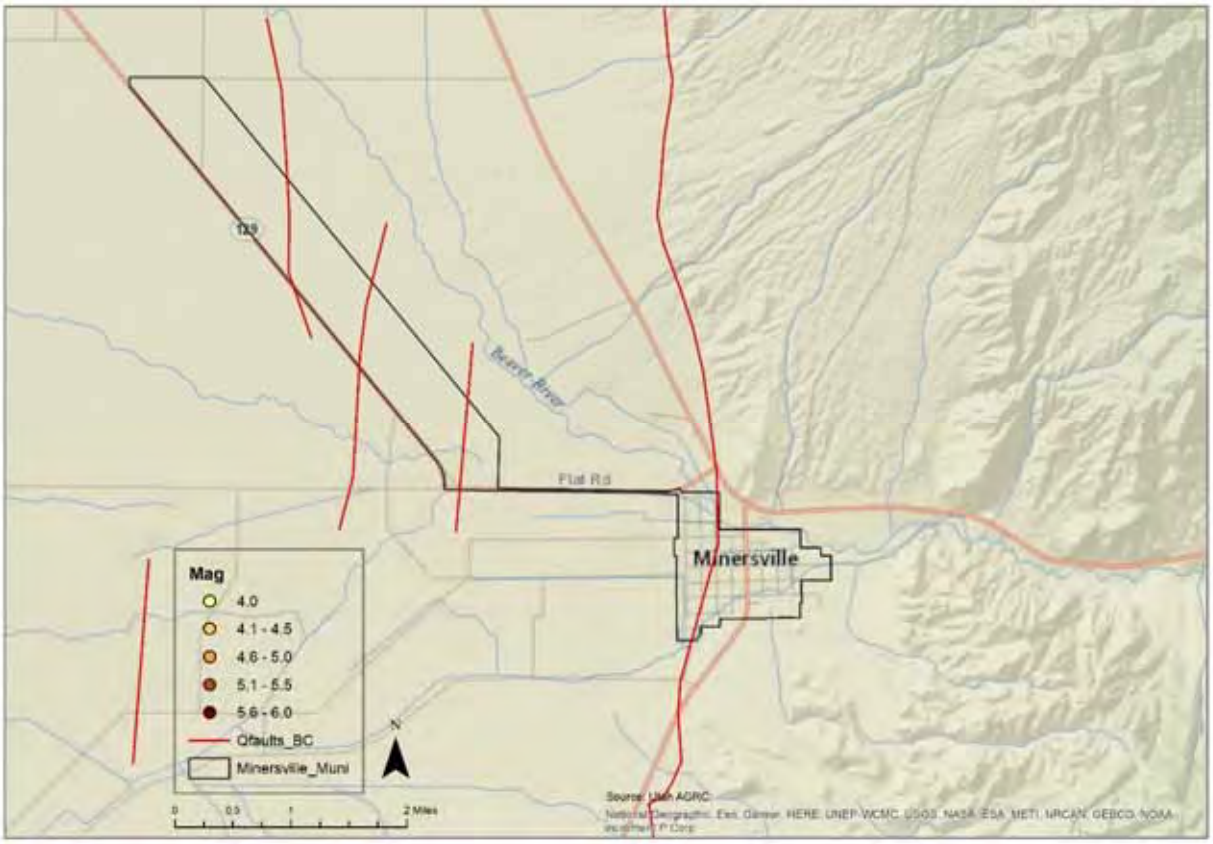


Figure 60: Minersville Earthquake Epicenters and Quaternary Faults

Source: UGS, Beaver County Assessor, AGRC

Five County analysis to understand local exposure to earthquakes involves computing the community assets which exist within a quarter mile of a quaternary fault. Four faults have been identified in Minersville, which may present local risks of surface fault rupture in the community. Table 51 describes the exposure of several town assets. In the town, critical facilities, residential parcels, and miles of roadway all see high exposure to quaternary faults.

Table 51: Minersville Quaternary Fault Exposure

Minersville Exposure within a Quarter Mile of a Quaternary Fault				
Critical Facilities	Residential Parcels	Road Miles	Parks	Rail Miles
100.0%	58.5%	48.0%	100.0%	N/A

Source: Utah Geological Survey, Beaver County Assessor, UDOT, AGRC

A factor in structures that contribute to risk during an earthquake event is the age of the structure, type of construction, and compliance with modern seismic codes. The State of Utah has adopted the International Building Code, which describes design standards for seismic safety. Such codes have been

in use since 1975, and there are some structures throughout the state that have been built with unreinforced masonry. 2019 ACS data from estimates that 101 housing units in Minersville where built before 1970, before the use of seismic codes. These may be unreinforced masonry construction types and may be less stable during a shaking event, contributing to the loss of the structure and damages to users inside and outside of the structure.

Hazard History

Minersville is a seismically active area of the state, having two recorded earthquake events surpassing 4.0 magnitude, described in Table 52.

Table 52: Minersville Recorded Earthquake Events

Incident Date	Location	Description
1966	Minersville, Beaver County	A 4.17 magnitude earthquake recorded 16.2 miles southwest of Minersville.
1923	Minersville, Beaver County	A 4.05 magnitude earthquake recorded 21.5 miles southwest of Minersville.

Source: University of Utah Geology Department

Earthquakes are difficult to predict and can be damaging to a community. Events occur often in Utah, although normally at lower magnitudes. Earthquakes have the potential to trigger other natural hazard events due to structure and infrastructure damage, including floods, wildfire, and landslides and rockfall. Liquefaction is another byproduct of strong shaking in certain scenarios, the soil becomes like a liquid and can flow or lose integrity, damaging structures, and infrastructure.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Minersville has not participated in floodplain mapping and is not a member of the NFIP, but a town Drainage evaluation identifies flooding as a risk due to existing drainage conditions in the community.

. To identify areas which may be subject to flooding, mapped waterbodies, like lakes and streams, have been included in this assessment, shown in Figure 61. As illustrated in the map, Minersville is exposed to dam inundation risk.

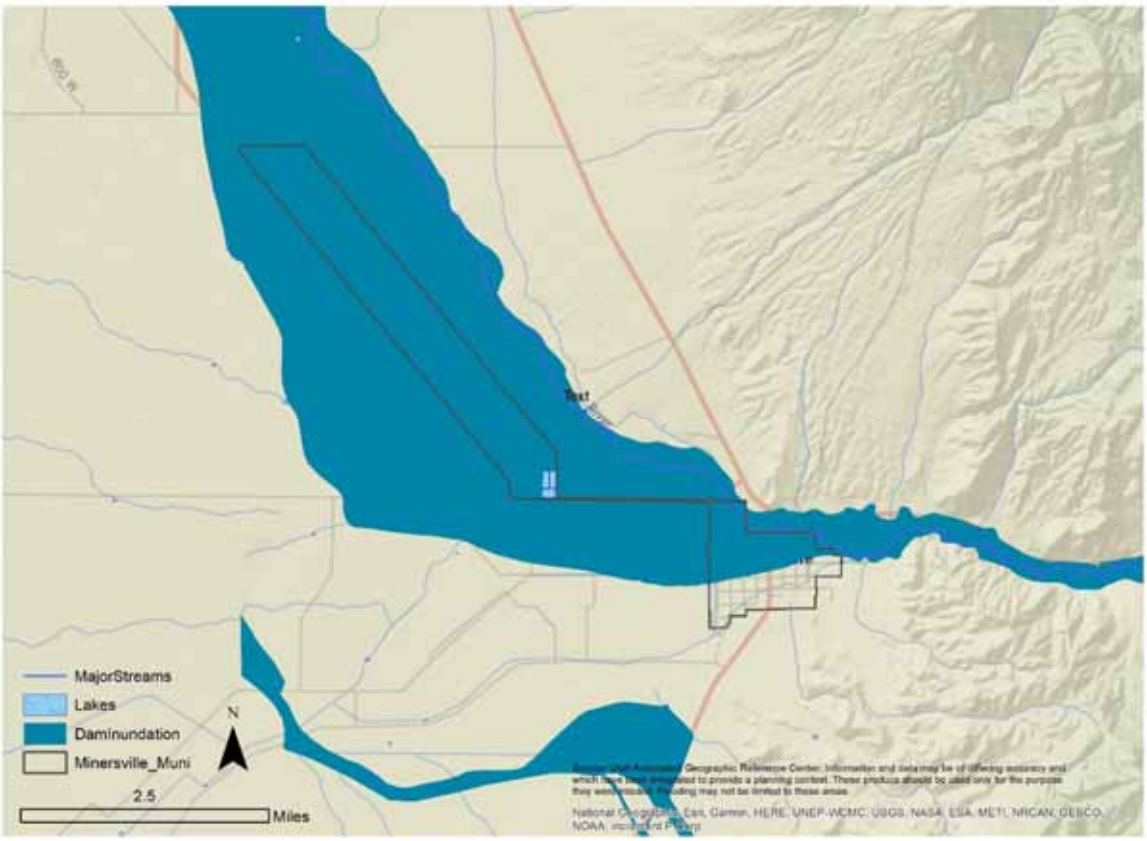


Figure 61: Minersville Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped dam inundation zone and water bodies illustrates the potential vulnerabilities to flood. Table 53 further examines the exposure to identified flood risk areas in Minersville, by observing community assets and structures that are in at-risk areas. The table shows that all critical facilities and parks are vulnerable to flooding and that over half of all parcels and road miles are exposed. Flooding on access roads can lead to transportation delays, and impact response during an emergency event. Critical facilities in hazard areas are community vulnerabilities as the ability to respond or provide community information can be impacted. Parks on the other hand can act as a buffer for flooding in some cases, although park facilities may see damage.

Table 53: Minersville Floodplain and Dam Inundation Exposure

Minersville Exposure to Floodplain and Dam Inundation Zones				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
100.0%	58.5%	65.6%	N/A	100.0%

Source: Flood Insurance Rate Map, AGRC, Beaver County Assessor.

National Flood Insurance Program

Minersville does not participate in the National Flood Insurance Program (NFIP). It is important to note that homes outside of a mapped floodplain may experience flooding. Approximately 25% of all paid NFIP claims were located outside of a special flood hazard area. (Insurance Information Institute, 2020)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 54 describes the events. While some of the events described here may describe impacts to an incorporated city or town in the county, it is likely that the event also had impacts on unincorporated areas of the County.

Table 54: Minersville Recorded Flood Events

Minersville Flood Hazard Record		
Date	Damage/Injury	Description
7/18/2021	None Reported	A heavy rainstorm caused water and debris to flow across SR-21.
7/12/2018	None Reported	Heavy rain fell on the Black Mountain Fire burn scar, resulting in a debris flow that temporarily closed State Route 130 near Minersville.
8/11/2018	None Reported	Heavy rain resulted in a flash flood that temporarily closed state Route 21 near milepost 85.

Source: NOAA Storm Database, SHELDUS

Flood impacts from this record indicate that roadways and roadway users are vulnerable to flooding. Events which impact roadways can separate communities from resources, supplies, and essential services. Events in neighboring communities may have also impacted Minersville but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Climate impacts flooding risks, and as storms are projected to increase in severity in the coming decades, it is possible that southwestern Utah will see an increase in the severity of floods. Increased risk of wildfires also creates flooding concerns, as burn scars can turn to debris flows as vegetation cannot hold the soil in place. Flooding trigger landslides, as changes in soil moisture on steep slopes can lead to landslides, debris flows, and rockfall.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 62 maps the landslide exposure in the town.

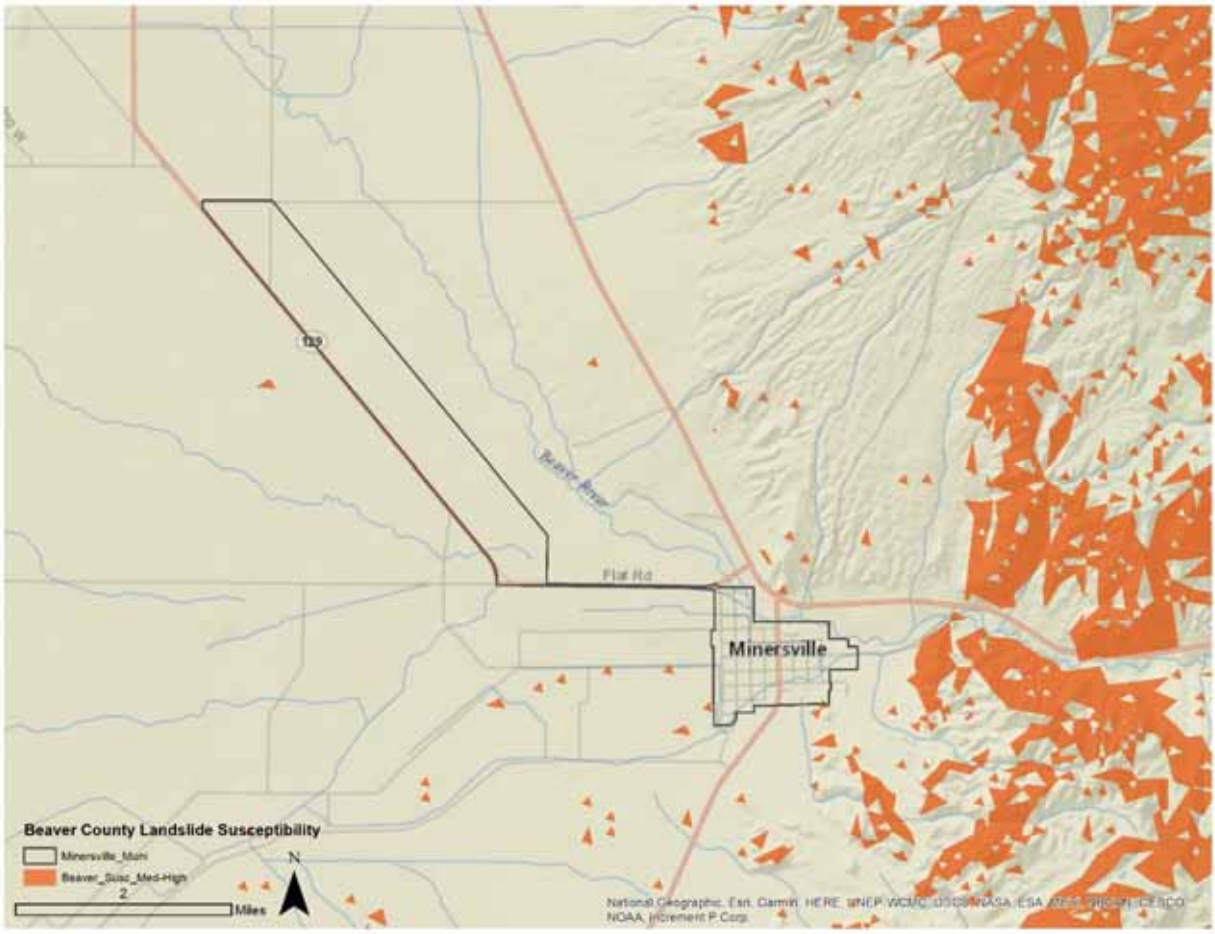


Figure 62: Minersville City Landslide Susceptibility Exposure

Source: Utah Geological Survey

Minersville has very little exposure to moderate and high landslide susceptible areas. Table 55 describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Minersville describe that 0.4% of parcels in moderate to high landslide susceptible zone. No road miles, critical facilities, or parks are presently mapped in landslide susceptible areas. Future growth, especially if annexing areas to the east of town for development could place new construction in susceptible areas without proper planning.

Table 55: Minersville Landslide Susceptibility Exposure

Minersville Exposure to Landslide Susceptible Areas				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks
0.0%	0.4%	0.0%	N/A	0.0%

Source: Utah Geological Survey, Beaver County Assessor, AGRC.

Hazard History

Landslides and rockfall frequently occur in the Five County region, causing damage to infrastructure, structures, and other property. Table 56 describes the landslide events and impacts reported in Minersville.

Table 56: Minersville Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
1936	Adamsville	Unknown	Unknown	A debris flow was reported at Dry Gulch near Adamsville.
2018	Minersville, Beaver County	None reported	None reported	Mudflow in Beaver County, near Minersville nearly washed an occupied vehicle into a ravine.

Source: (Adams, 2018), SHELDUS

Landslide hazards can be caused by precipitation or runoff, especially on land that is exposed and not covered by vegetation. In turn, Landslides can contribute to flooding hazards, especially when a landslide blocks a waterway, causing water to pool. Changes in climate patterns will likely contribute to landslide hazards as severe storms and wildfires increase in severity.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water.

Tourism and related industries are pieces of the economy in Minersville. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought. The Department of Natural Resources permitted the harvesting of additional fish from the Minersville Reservoir for a short time in 2021 due to expected low water levels, which would kill the fish, during drought conditions. (Drought, hot temperatures prompt increased fishing limits at additional Utah waterbodies, 2021) Drought is ongoing in the west and has already impacted the area.

Drought is connected to other natural hazards, like wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 63: Estimated Indoor Radon Level Zones- Utah. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

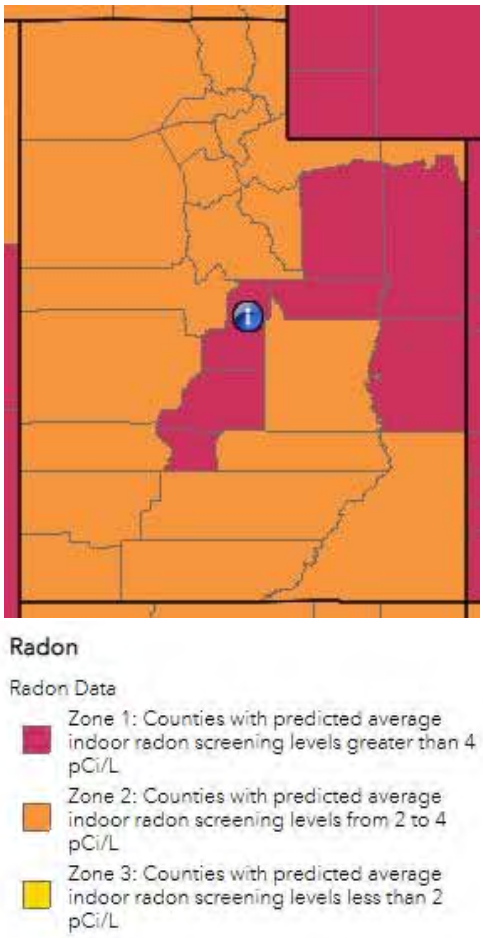


Figure 63: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 57 describes the reported findings for the County. Across Beaver County, the average test result is 40.2 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk

Table 57: Beaver County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
27.2%	72.8	664.0 pCi/L	40.2 pCi/L	423

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather events are frequent and impactful in the Southwest. Weather events in the southwest tend to occur seasonally in the summer and winter. Severe weather occurs during thunderstorms and winter storms, including high winds, heavy rain or snow, hail, lighting, and tornados. Other events include severe temperatures, heat and cold, which can be impactful to people, property, and industry, like agriculture and tourism.

The area has an arid climate, being situated in the high desert region of western Utah. Daily summer temperatures can reach near 100 degrees Fahrenheit. However, temperatures reach below zero during winter months with annual snowfall.

The National Oceanic and Atmospheric Administration documents severe weather records. No records have been reported for Minersville on events which have caused damages. Past events have likely had impacts on Minersville, including those reported for the unincorporated County or other communities, like Milford or Beaver City. Reference the Countywide record in the beaver County section for a full detail of the severe weather events for the area.

Across Beaver County, winter storms and high winds are impactful severe weather hazards that occur frequently in the area. A severe cold event reported in Milford, likely also impacted nearby Minersville. These events have notably impacted transportation routes, which Minersville has identified as a vulnerability for other natural hazards. Other impacts include the electrical grid and structures and infrastructure.

Severe weather will continue to impact Minersville as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. Flooding events which occur because of severe weather are reported in the flooding section of this assessment.

Problem Soils

Problem soils are a challenge for construction, infrastructure, and development. Problem soils are subject to expansion, compression, solution, or collapse when exposed to water, depending on the content of the soil. The changes in the soil structure and occupied space can damage or impact infrastructure built on top of the problem soil.

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated by Figure 64. The map identifies that problem soils have not been mapped in Minersville.

Figure 64: Beaver County Mapped Problem Soils

Source: UGS, AGRC

The Utah Geological Survey has completed updated mapping for other areas of the Five County region, which include much greater detail on the exposure of these hazards. Unfortunately, Beaver County was not included in the study. Further mapping may provide additional insight to the local risks and vulnerabilities to Problem Soils.

The community and the county do not have a record of problem soil impacts, although building permits may describe whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Minersville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have historically been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Minersville has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Minersville and are listed in Table 58 with a description of their progress.

Table 58: 2016 Minersville Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood	Prevent high intensity rains from flooding property in Minersville	Construct proper drainage as addressed in a storm water and drainage master plan to prevent flood damage to property. Will be putting in sidewalk curb and gutter where necessary.	10 years	Minersville Town operating budget, CIB, CDBG, FEMA, UDOT	Complete
Flood	Officially recognize Minersville as a NSFHA	Draft and adopt a no special flood areas (NSFHA) ordinance.	1-5 years	Local Government operating budget, State and Federal flood grant programs	Community has not adopted and is not identified in a NSFHA area.

Source: 2017 Five County Association of Governments NHMP

The Minersville Town planning team identified actions to include in the community mitigation strategy. Each action in Table 59 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 65.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 65: Regional Plan Goals

Table 59: 2022 Minersville Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2	Conserve water resources.	Encourage citizens to take water-saving measures through town website and utility billings.	H	Unknown	L	Minersville Town	Minersville Town, Division of Water Resources
Drought #2	6	Reduce water intensity of future development.	Require new development to use drought tolerant and native vegetation.	H	Unknown	L	Minersville Town	Minersville Town, developers.
Drought #3	6	Promote groundwater recharge	In codes and ordinances encourage the use of permeable driveways and surfaces.	M	Unknown	L	Minersville Town	Minersville Town
Flood #1	2	Increase stormwater drainage capacity.	Complete stormwater improvements on SR-130/Center Street Drainage as described in the Stormwater Drainage Evaluation.	M	Unknown	M	Minersville Town, CDBG, CIB	Minersville Town
Flood #2	2	Increase stormwater drainage capacity.	Modify/repair the side ditches on Main Street as described in the Stormwater Drainage Evaluation.	M	Unknown	M	Minersville Town, CIB	Minersville Town
Flood #3	2	Increase stormwater drainage capacity.	Modify/repair the side ditches on both sides of 100 North as described in the Stormwater Drainage Evaluation.	M	Unknown	M	Minersville Town, CIB	Minersville Town
Flood #4	2	Increase stormwater drainage capacity.	Modify/repair the side ditches along both sides of 300 West as described in the Stormwater Drainage Evaluation.	M	Unknown	M	Minersville Town, CIB	Minersville Town
Flood #5	2	Increase stormwater drainage capacity.	Modify/Repair the side ditches along the east side of 400 West as described in the Stormwater Drainage Evaluation.	M	Unknown	M	Minersville Town, CIB	Minersville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #6	2	Increase stormwater drainage capacity.	Construct retention/detention ponds on the west side of 400 W near the outlet of watershed W2-4 or consider conveyance to Beaver River.	M	Unknown	M	Minersville Town, NRCS, CIB, CDBG	Minersville Town
Wildfire #1	1, 2	Set requirements for development in wildfire vulnerable areas.	Adopt a Wildland Urban Interface Code.	M	Unknown	L	Minersville Town	Minersville Town
Wildfire #2	1, 2	Set requirements for development in wildfire vulnerable areas.	Use non-combustible materials (i.e., stone, brick, and stucco) for new construction and renovations in wildfire hazard areas.	M	Unknown	L	Minersville Town	Minersville Town
Wildfire #3	1, 2	Set requirements for development in wildfire vulnerable areas.	Coordinate with local utility providers to mitigate hazardous fuels around utility infrastructure.	M	Unknown	M	Minersville Town, local utilities	Minersville Town, local utilities
Earthquake #1	1	Reduce potential for harm from structures and infrastructure during earthquake events.	Require new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	M	Unknown	L	Minersville Town	Minersville Town
Earthquake #2	1	Reduce potential for harm from structures and infrastructure during earthquake events.	Anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc) on Town owned property.	H	Unknown	M	Minersville Town	Minersville Town
Earthquake #3	1, 2	Reduce infrastructure damage during earthquake events.	Use flexible piping when extending or replacing water, sewer, or natural gas service.	M	Unknown	M	Minersville Town, local utilities	Minersville Town, local utilities
Earthquake #4	2	Reduce potential for harm from structures and infrastructure during earthquake events.	Install window film at critical facilities to prevent injuries from shattered glass.	L	Unknown	L	Minersville Town	Minersville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #5	3	Communicate earthquake risks and vulnerabilities.	Develop and distribute an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.	H	Ongoing annually	L	Minersville Town	Minersville Town, Earthquake Utah
Landslide #1	6	Reduce land sliding and slope failure.	Applying soil stabilization measures, such as planting soil stabilizing vegetation on steep, publicly owned slopes.	M	Unknown	M	Minersville Town	Minersville Town
Landslide #2	6	Prevent landslides and debris flows following fire.	Develop a revegetation plan to address bare slopes following fire or other natural hazard has damaged vegetation.	L	Unknown	M	Minersville Town, BLM, Forest Service	Minersville Town, BLM, Forest Service, Fire Department .
Severe Weather #1	2, 5	Ensure critical facilities can continue operations.	Installing and maintaining surge protection on critical electronic equipment.	H	Unknown	L	Minersville Town	Minersville Town, critical facilities, fire stations.
Severe Weather #2	1, 2	Protect critical facilities from severe weather and high wind.	Use anchor bolts, Laminated or impact-resistant glass, Reinforced pedestrian & garage doors, Window shutters, Waterproof adhesive sealing strips, Interlocking roof shingles, etc. at critical facilities.	M	Unknown	M	Minersville Town	Minersville Town, critical facilities, fire stations.
Severe Weather #3	2, 5	Ensure critical facilities can continue operations.	Purchase generators to ensure the function of essential equipment during or after a natural hazard event or power outage.	H	Unknown	M	Minersville Town	Minersville Town, critical facilities, fire stations.
Radon #1	1	Inform residents of radon risk.	Provide radon risk, testing, and mitigation	H	Unknown	L	Minersville Town	Minersville Town, Utah DEQ

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			information to residents.					
Radon #2	1	Set standards for residential development to address hazard risks.	Require radon mitigation in new development of residential property.	L	Unknown	L	Minersville Town	Minersville Town, developers
Problem Soil #1	1, 2	Collect data to inform mitigation.	Work with Beaver County and the Utah Geological Survey to update problem soil mapping of the area.	L	Unknown	M	Minersville Town	Minersville Town, Beaver County, Utah Geological Survey
Problem Soil #2	1, 2	Set standards for development to address hazard risks.	Restrict development in areas where soil is considered unsuitable for development.	M	Unknown	L	Minersville Town	Minersville Town
Problem Soil #3	1, 2	Set standards for development to address hazard risks.	Adopt a Geologic Hazard Ordinance.	M	Unknown	L	Minersville Town	Minersville Town

Source: Local Planning Team

Garfield County

Garfield County is bordered on the west by Iron County, on the south by Kane County, on the east by the Colorado River and San Juan County, and on the north by Piute and Wayne counties. Within Garfield County there are several state and federal highways, the most prominent being Federal Highway 89 and State Route (SR) 12. US-89 runs in a north-south direction and is in the extreme western portion of the County. SR-12 begins at US-89 midway between Hatch and Panguitch and runs east/southeast where it makes connection with SR-24 in Wayne County.

The variety of cultural and natural resources within the Count provides several diverse opportunities. The mountains, forests, deserts, high plateaus, and water resources provide wonderful settings for recreation uses such as hunting, fishing, and camping, as well as popular activities such as mountain biking, all-terrain vehicle riding, and cross-country skiing.

The County is the "gateway" to many of the region's parks and recreational areas. Many non-residents visit the County each year. Full-time residents live in one of the state's lowest density counties.

Community Characteristics

Garfield County is a rural county in south central Utah and is one of the least populous counties in the state. Garfield County is also the least densely populated county in the state. The tables below further discuss the population of Garfield County and its incorporated cities, detailing how the population has changed overtime, the makeup of this population, and what future population changes are expected to bring to the county.

Geography and Climate

High wooded plateaus, fertile river valleys, steep rugged mountains and canyons, deserts, and picturesque red sandstone rock formations contribute to the varied landscape of Garfield County. Like much of Southwestern Utah, Garfield County includes a mix of the Colorado Plateau in the East and Great Basin in the West of the county. The Northeast trending Hurricane Fault, which passes through the County, is the approximate break between the two geographic features. A portion of the Great Basin is characterized by elaborately faulted and folded strata, arranged as north to south trending ridges, generally less than 9,000 feet in elevation, separated by broad, semiarid valleys.

Elevations in Garfield County range from less than 5,000 feet to over 10,000 feet. This wide range of elevation has marked influence on the climate of the County. Annual precipitation shows a direct relationship to change in elevation, and ranges from less than ten inches at the lower levels to more than 20 inches annually in the higher mountains. Summers are characterized by hot, dry weather with average maximum temperatures of 100 degrees Fahrenheit at lower elevations to temperatures at or above 80 degrees Fahrenheit at elevations above 6,000 feet. Winters are relatively severe because of the mountains acting as barriers. Winter snowfall can be less than five inches in lower valleys to over five feet in higher elevations.

Demographics

Overall population of Garfield County and its incorporated cities and towns is relatively low. Generally, the largest population is in Panguitch, the County Seat, as described in Table 60. The next largest population as of the 2018 estimate is in Escalante City, on the Eastern side of the County. These have

long been large shares of the overall Garfield County population, with the unincorporated county also having some of the large shares of the population between 2000 and 2010.

Table 60: Garfield County Population by Incorporated Place

Garfield County Population by Incorporated Place							
City/Town	1960	1970	1980	1990	2000	2010	2018
Antimony	161	113	94	83	122	122	86
Boulder	108	93	113	126	180	226	178
Bryce Canyon City	na	na	na	na	na	198	201
Cannonville	153	113	134	131	148	167	294
Escalante	702	638	652	818	818	797	810
Hatch	198	139	121	103	127	133	167
Henrieville	152	145	167	163	159	230	242
Panguitch	1435	1318	1343	1444	1623	1520	1,773
Tropic	382	329	338	374	508	530	596
Unincorporated County	286	269	711	738	1,050	1,249	670
Total	3,577	3,157	3,673	3,980	4,735	5,172	5,017
na: Data not available							

Table 61 describes the stable County growth rate since 1980, with a recent decline in population countywide observed in the 2018 estimate. Generally, larger communities, like Panguitch, Tropic, and Escalante have observed steady growth, while communities like Antimony, Boulder, and the Unincorporated County show declines in population in the 2018 population estimate.

Table 61: Garfield County Population Percent Change

Garfield County Population Percent Change							
City/Town	1960	1970	1980	1990	2000	2010	2018
Antimony	-13.9%	-29.8%	-16.8%	-11.7%	47.0%	0.0%	-29.5%
Boulder	na	-13.9%	21.5%	11.5%	42.9%	25.6%	-21.2%
Bryce Canyon City	na	na	na	na	na	na	1.5%
Cannonville	-25.4%	-26.1%	18.6%	-2.2%	13.0%	12.8%	76.0%
Escalante	-9.2%	-9.1%	2.2%	25.5%	0.0%	-2.6%	1.6%
Hatch	-18.9%	-29.8%	-12.9%	-14.9%	23.3%	4.7%	25.6%
Henrieville	33.30%	-4.6%	15.2%	-2.4%	-2.5%	44.7%	5.2%
Panguitch	-4.4%	-8.2%	1.9%	7.5%	12.4%	-6.3%	16.6%
Tropic	-20.9%	-13.9%	2.7%	10.7%	35.8%	4.3%	12.5%
Unincorporated County	-55.6%	-5.9%	164.3%	3.8%	42.3%	19.0%	-46.4%
Total	-13.8%	-11.7%	16.3%	8.4%	19.0%	5.0%	-3.0%
na: Data not available							

Based on current population growth and trends, it is expected that, countywide, Garfield County will continue to see growth in the coming years. The Kem C Gardner Institute forecasts a 45% increase in the County's population between 2015 and 2065. (Kem C. Gardner Policy Institute , 2017) According to this estimate the population of Garfield County could be 7,509 people.

Development

A large percentage of the land in Garfield County is government owned land. Approximately 4% of the land found within the County is privately owned, according to the County General Plan. Sections of three national parks, a national recreation area, and national forest are found in the County. The Bureau of Land Management operates the largest portion of the lands in the county, according to the General Plan. The general plan identifies that "privately-owned lands are generally located at the mouths of canyons where perennial streams flow from the high plateaus. In virtually every case, these lands are subject to natural hazards such as earthquake faults, flood plains, unstable soils, and steep slopes."

The largest use of private land in Garfield County is agriculture. Pasture and rangeland comprise the greatest amount of private agricultural land while irrigated croplands comprise the smallest. Land which is considered urban (cities, towns, industrial sites, cemeteries, airports, golf courses, institutional and public administrative facilities, and roads) makes up a small portion of the County land area. Towns annexing large tracts of unincorporated land increases the amount of urban land over time.

In the unincorporated County there are several planned and ongoing new developments, including:

- Development in the John's and Emery Valleys north of Bryce Canyon City.
- A new mixed development has been proposed in Ticaboo for primarily commercial uses with some residential use.
- Panguitch opportunity zone will cover the entire western portion of the county along Hwy-89 and includes dominantly unincorporated County. Opportunity Zones offer tax incentives for investment in rural areas.

Economy

According to the On the Map tool from the US Census Bureau, in 2018, accommodation and food services provided over 50% of the private sector primary jobs in Garfield County. This is likely due to the County's significant outdoor recreation and tourism attractions, including Bryce Canyon National Park, Grand Staircase-Escalante National Monument, and many other recreation areas. Figure 66 describes the other prominent industries by number of jobs. Retail trade, information, and health care are other industries that employ a larger share of people in Garfield County.

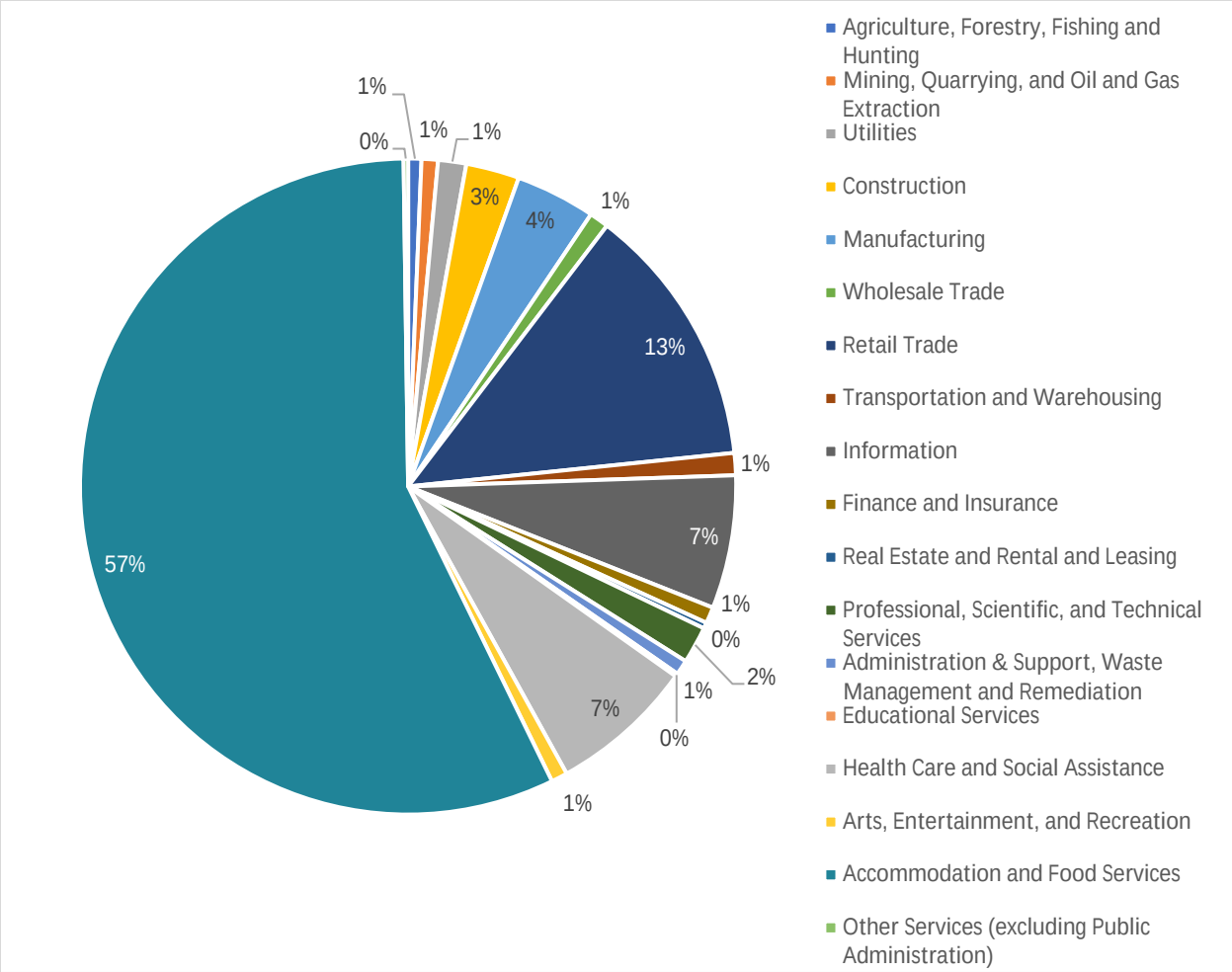


Figure 66: Garfield County Share of Jobs

Source: Garfield County Share of Private Primary Jobs, On the Map, 2018.

Tourism in the County is a large economic driver, but also challenge rural communities in providing adequate resources like emergency response, communications, and resources. This challenge is prominent in recreation areas and the gateway communities that serve them. Traveling the large county to provide such services is also a challenge.

Community Capabilities

An understanding of the planning mechanisms and policies that exist in the community inform mitigation. The analysis of existing plans and policies, community assets, positions and roles that move government actions forward. This plan also includes a description of the unincorporated communities in the county, to better identify challenges or problems which may exist within these communities.

Plans and Policies

The Garfield County General Plan, Amended January 1998, stipulates, "The health, general welfare, and safety of County residents and visitors is one of the primary purposes for local land use plans. Because of this basis, the location and extent of potentially hazardous natural conditions will be identified and disclosed to present and future residents and visitors." Growth as it relates to natural hazard conflicts is

further managed through implementation of policy statements which discourage development within identified FEMA 100-year floodplains, incorporation of wildfire protection measures, and limiting development in areas of known earthquake faults. The plan discusses upgrade of water facilities for flood control, home exposure to wildfire, and the need for water conservation. This plan identified mitigation projects for the 100- year floodplain, earthquake impacts and extent, and requests upgrading water facilities for flood control and drought monitoring.

The Garfield County Code describes in Chapter 154 flood damage and hazard reduction, the special flood hazard area, and use of the FEMA Flood Insurance Rate Map (FIRM) dated 1986. The FIRM is used to set development requirements preconstruction for development that falls in the identified special flood hazard area as well as design and mitigation requirements for these sites. In 2006 Garfield County adopted Wildland Urban Interface Code, which sets standards to prevent spread of wildland fires from plants to structures.

Economic Development Plan, 2020, identifies that tourism and use of public lands and agriculture are some of the drivers of the County's economy. The document also describes existing challenges that the community faces, including electrical connection, communications, limited visitors' services, and wildfire, flood, and drought risks.

Resource Management Plan, 2017, discusses areas of critical concern, cultural and natural resources in the County. The management of these areas influences the impacts of fire, severe weather, drought, and floods on these resources. There are several mitigation action items identified in this plan, including management of ditches and canals for flood control, fire fuels reduction, reseeding burned areas, and road improvements for weather.

The Moderate-Income Housing Plan, 2019, does not directly address hazards, although it recognizes that there are several areas in the county that are unbuildable due to steep slopes, soil, flooding, and other physical hazards to a site.

The Utah Geological Survey has documented plans and reports which include Garfield County and recreation areas that are in the County. One such report described that the following hazards have been identified as risks to the Glen Canyon National Recreation Area (GCNRA): flooding and debris flows, rockfall, landslides, soils susceptible to erosion, gypsiferous soil and rock, expansive soil and rock, collapsible soil, surface faulting, and liquefaction. (Knudsen, Hiscock, Lund, & Bowman, 2017) These hazards pose threats and have caused damage to recreators in the GCNRA in the past.

Community Assets

Garfield County is one of the least densely populated Counties in Utah. Many of the incorporated communities rely on the County for services, including Buildings Officials, Floodplain Management, public works, and law enforcement. Other assets described in this section include government roles and capacity, utilities, schools, and emergency services that serve the unincorporated County.

Government roles

The county employs several staff who work directly or indirectly with natural hazards, mitigation, preparedness, or response and recovery. Several of the staff people serve both the unincorporated and incorporated areas of the county, including law enforcement and public works. The County Planning and Economic Development Director advises the planning commission and the county commission on code

requirements and planning needs for the health and safety of residents and visitors. The County employs a part time Emergency Manager who leverages agencies, contacts, and needs for preparedness, response, and recovery for many events, including natural hazards. Public works mitigates risks though maintenance and repair of County assets and infrastructure. Buildings officials on staff ensure that structures throughout the county are of sufficient standard and act as the floodplain manager.

County capabilities include GIS mapping, develop mutual aid agreements with other agencies and communities, grant writing, and planning.

Funding for Capital improvement and infrastructure projects in the County are typically funded through Capital Improvement Project funding, debt through General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Utilities

Power and gas utilities are provided by Rocky Mountain Power and Garkane throughout the region. Water resources, stormwater, and sewage are managed by local communities. Residents in unincorporated Garfield County use well-water for drinking water and septic systems for waste.

The Ticaboo Utility Improvement District provides power, water, sewer, and solid waste in Ticaboo.

Schools

There are no schools in the unincorporated County.

Emergency Services

Garfield County Emergency and Healthcare Services tend to be in Panguitch City or in other incorporated cities in the region. Services like Hospitals, Fire departments, Emergency Medical Service, and Law Enforcement are critical to the response and recovery from a natural hazard event. The services available in the unincorporated County are described below.

Hospitals

There is one hospital in the County, located in Panguitch City. This hospital serves the entire County. Turnabout Ranch is a residential treatment cent located near Escalante in the unincorporated County.

Fire and EMS

Several fire stations in the County are volunteer departments from individual incorporated cities and towns. These departments can coordinate with the County for training and the agencies may provide service to unincorporated areas. Bryce Canyon National Park, Mammoth Creek Volunteer Fire Department, Panguitch Lake Fire Department, and Ticaboo Resort are the only fire departments located in the unincorporated County. The Garfield County Volunteer Fire Department fire station in Ticaboo serves a 1,500 square mile area and can receive mutual aid from the National Parks Service in Bullfrog or the Hanksville Volunteer Fire Department.

The Color Country Interagency Fire Center leverages several forestry and public lands state and federal organizations to address large fires in the southwest, including Garfield County.

Emergency Medical Services are also local volunteer departments across the region. Communities that do not have EMS locally often rely on neighboring communities or agencies for care. Ticaboo for example, requests emergency medical services response from Wayne County EMS in Hanksville or the

National Parks Service for medical emergencies. These agencies often have long, varied wait times before arriving on scene in Ticaboo. Medical response typically has an average response time of one and a half and two and a half hours, with medical seeing more varied response times.

Law Enforcement

Garfield County Sheriff's Office provides law enforcement throughout the County, including in unincorporated areas. The Emergency Operations Center, County Jail, and Sheriff's Office are all located in Panguitch City.

Garfield County Sheriff's Deputies provide service to a large area. Ticaboo, in the eastern County has received mutual aid from the National Parks Service Law Enforcement and Utah Highway Patrol. The area does not have a dedicated deputy.

Unincorporated Communities

Several unincorporated communities exist in Garfield County which have important vulnerabilities to identify. These areas are gateways to natural resources and recreation, drawing seasonal visitors, vacation homes, and other attributes that create a unique mitigation planning situation.

Panguitch Lake and Mammoth Creek are both largely recreation communities in the western portion of the County. Visitors come to this area to recreate and camp at the Markaguant Plateau. Summer and winter access and recreation make these areas popular year-round. Both communities have a volunteer fire department and are within an hour of Panguitch City.

Ticaboo is the only full-service community for 60 miles and is geographically located on the far eastern side of the County, far from County resources. While the Ticaboo community itself is near one square mile, the community serves recreation for most of the eastern portion of the County. Populations in this community fluctuate seasonally with visitors to the Glen Canyon National Recreation Area and Lake Powell. The Ticaboo Utility Improvement District serves the area with water, waste, and electrical service. Electrical lines are underground, but the utility system is under pressure for reliability due to commercial tourism. Utilities have been impacted in the past from natural hazards, including flooding and extreme temperatures. In Ticaboo's participation in this plan, they described challenges in serving visitors and full-time residents with emergency response, largely due to proximity to the nearest responding agency.

Widtsoe is a rural community north of Bryce Canyon City in the John's Valley area, which in the early 1900s, was a prominent farming area. Drought conditions forced families to leave. Modern Widtsoe has a cemetery, homes, and a school building. (Utah's Bryce Canyon Country, 2012)

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for Garfield County, Utah. This assessment describes the natural hazards considered in this plan which pose risks to unincorporated Garfield County. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 62 summarizes the natural hazards in a list from high to low hazard risk as it pertains to the unincorporated County.

Table 62: Garfield County Hazard Risks

HAZARD	RISK
SEVERE WEATHER	13- High
DROUGHT	14- High
EARTHQUAKE	15- High
WILDFIRE	16- Moderate
LANDSLIDE	17- Moderate
FLOOD	18- Moderate
RADON	19- Low
PROBLEM SOILS	20- Low

The remainder of this section will describe each hazard in greater detail and the variables that contributed to the risk ranking. The section will conclude with a mitigation strategy based on Garfield County's risk assessment.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories. Figure 67 describes the mapped wildfire risk in Garfield County. Wildfire risk is greatest near population centers, watersheds, and roadways as described on the map. This mapping does not factor the other uses of the land and potential vulnerabilities to tourism outside of more populated areas.

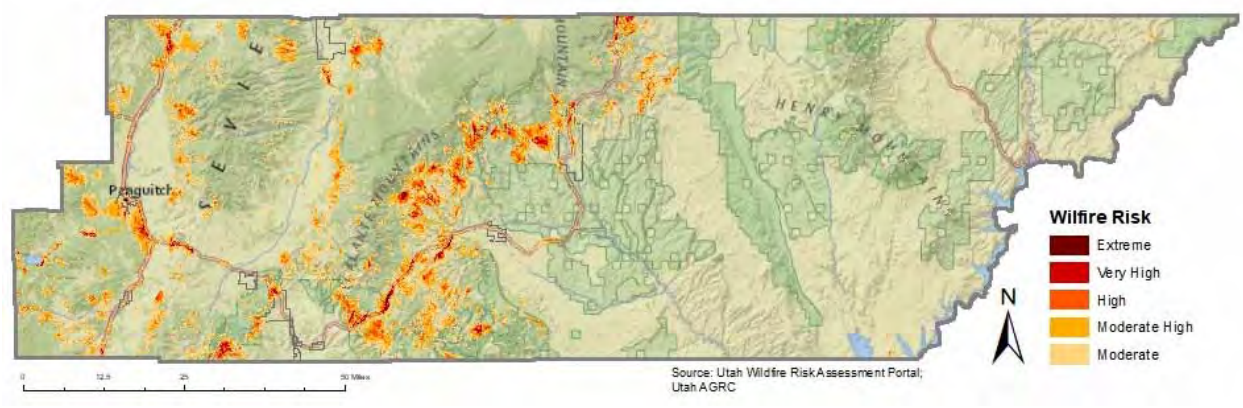


Figure 67: Garfield County Wildfire Risk

Table 63 describes the assets in the unincorporated county that are at moderate to extreme risk to wildfire events. Notably, 36.5% of residential parcels in the unincorporated County are in wildfire risk areas. Roadways are also exposed to wildfire risks throughout the county.

Table 63: Garfield County Wildfire Risk Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
Unknown	36.5%	Unknown	22.7%	N/A	N/A	0.0%

Garfield County understands the wildfire exposure in the County. The General Plan, adopted in 1998 sets wildfire design standards for homes on 40 or more acres and identifies seasonal homes in wildlands are risk for wildfire. The code furthers this commitment to wildfire with the 2006 adoption of Wildland Urban Interface (WUI) codes.

Hazard History

Wildfire is a continuous challenge in the southwest, given the dry, arid climate. Fire starts throughout the region are attributed to both human causes and natural causes, like lightning strikes. Garfield and Iron Counties were impacted by the Brian Head Fire, described in Table 64. The Brian Head Fire was designated a Fire Management Assistance Grant (FMAG) to provide federal funds to support mitigation, management, and control of the fire.

Table 64: Wildfire Hazard History

Fire Name	Year	Acres Burned	Other Impacts	Other Counties Affected
Brian Head Fire (FM-5185-UT)	2017	71,675	26 homes & minor structures destroyed. 1562 people were evacuated from 11 communities. Impacted sage grouse habitat.	Iron and Garfield Counties.

Utah Fire Info documents significant wildland fires in Utah from Fall 2017 to present. There are no documented fires for Garfield County on this database, however several fires have impacted the

counties surrounding Garfield County, including Iron, Beaver, Sevier, Kane, and San Juan Counties. Local description of wildfire events also cites wildfire in the Henry Mountains, which has engulfed the area in smoke and ash. These wildfire byproducts create hazards for air and water quality for residents and visitors to an area.

Wildfires are likely to impact Garfield County in the future as drought conditions create dry fuels and low air moisture. Wildfires can be caused by severe weather events, flood, landslides, and earthquakes. Fires can also trigger or increase risks of landslides or flooding on bare soils.

Earthquake

Southwestern Utah frequently has earthquakes and has several faults capable of producing severe shaking events. Garfield County has segments of the Sevier, Paunsaugant, Aquarius and Awapas Plateau, Bright Angels, and Needles fault zones. Identified quaternary faults and earthquake epicenters are described in Figure 68.

Recorded earthquake events with a magnitude at 4.0 or greater. The largest shaking event in Garfield County has been in the 4.0 to 4.5 range. Earthquakes of this size may cause minor damage, including breaking windows and knocking over items. Fault zones are expected to be the cause of future large earthquakes, although epicenters can be anywhere. Shaking nearest the epicenter typically experience stronger shaking and shaking further from the epicenter lessens in intensity. Earthquakes miles from the epicenter can still be felt and cause damages depending on magnitude.

Figure 68: Garfield County Earthquake Epicenters and Quaternary Faults

According to the Utah Geological Survey, the County may experience strong, very strong, or severe shaking, indicated by the map in Figure 69. The strongest shaking is expected in the west side of the

county.

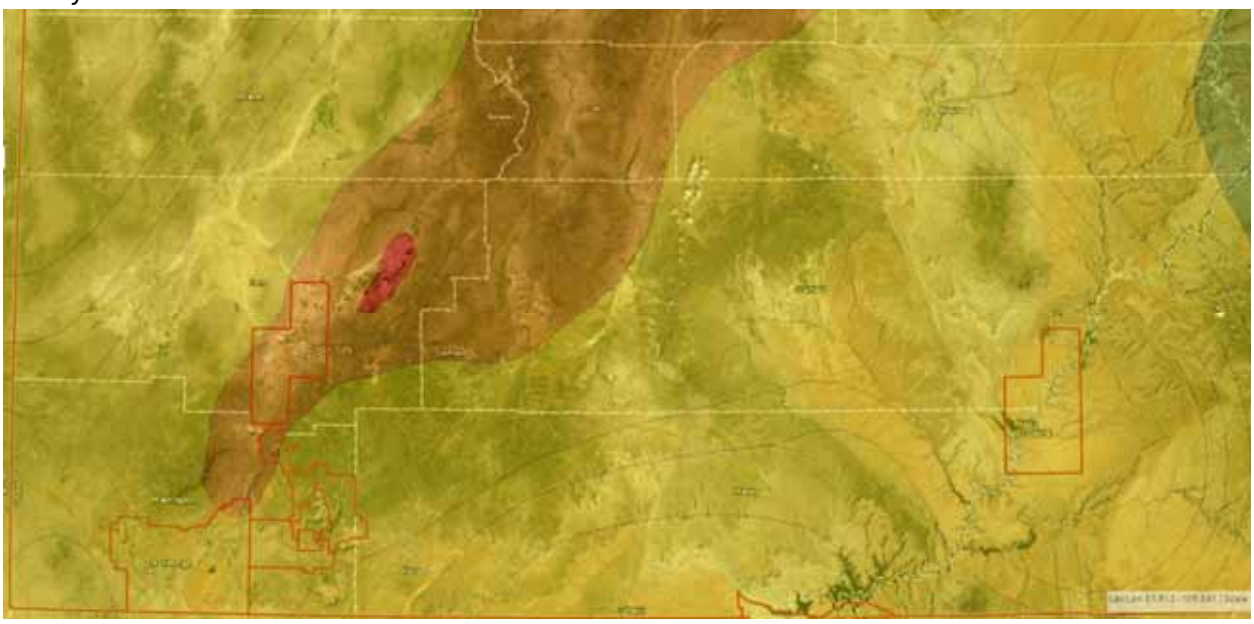


Figure 69: Five County Ground Shaking Hazard

Five County's assessment of earthquake hazard included overlaying community assets within a quarter mile of a mapped faults, summarized by Table 65. In the unincorporated county, less than 2% of residential parcels and less than 6% of road miles are within a quarter mile of a quaternary fault. Road miles are likely to be a significant vulnerability during an earthquake event as losses on roadways can result in isolation for parts of the county, including incorporated and unincorporated communities. Access can be cut of or require significantly longer routes to access certain areas of the County. Areas that are already far from resources are especially vulnerable.

Table 65: Garfield County Quaternary Fault Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
Unknown	1.7%	Unknown	5.6%	N/A	N/A	0.0%

A factor in structures that contribute to risk during an earthquake event is the age of the structure, type of construction, and compliance with modern seismic codes. The State of Utah has adopted the International Building Code, which describes design standards for seismic safety. Such codes have been in use since 1975, and there are some structures throughout the state that have been built with unreinforced masonry. Assessor's data from Garfield County indicate that 15.2% of residential parcels in the unincorporated County were built pre-1975, before the use of seismic codes. These may be unreinforced masonry construction types and may be less stable during a shaking event, contributing to the loss of the structure and damages to users inside and outside of the structure.

Hazard History

Table 66 describes the six earthquake events that have been reported in Garfield County, all with a magnitude between 4.0 and 4.3. This magnitude has the potential for some minor damage, including knocking over items or breaking windows. These earthquake epicenters were primarily in the western

portion of the unincorporated county. Other areas of the county likely felt the shaking during the earthquake events.

Table 66: Garfield County Recorded Earthquake Events

Incident Date	Location	Description
1963	Boulder, Garfield County	A 4.3 magnitude earthquake recorded 14 miles northeast of Boulder.
1966	Antimony, Garfield County	A 4.1 magnitude earthquake recorded 8.6 miles southeast of Antimony.
1991	Escalante, Garfield County	A 4.0 magnitude earthquake recorded 17.2 miles southeast of Escalante.
1994	Antimony, Garfield County	A 4.03 magnitude earthquake recorded 16.3 miles west of Antimony.
2012	Bryce Canyon City, Garfield County	A 4.13 magnitude earthquake recorded 9 miles north of Bryce Canyon City.
2015	Panguitch, Garfield County	A 4.09 magnitude earthquake recorded 1.5 miles northwest of Panguitch.

Source: Utah Seismograph Stations/University of Utah
Earthquakes measured using Local Magnitude (ML)

Earthquakes are difficult to predict and can be damaging to a community. Events occur often in Utah, although normally at lower magnitudes. Earthquakes have the potential to trigger other natural hazard events due to structure and infrastructure damage, including floods, wildfire, and landslides and rockfall. Liquefaction is another byproduct of strong shaking in certain scenarios, the soil becomes like a liquid and can flow or lose integrity, damaging structures, and infrastructure.

Flood

Garfield County has documented exposure to the floodplain and has documented several flooding events, most commonly flash flooding events. Flash flooding often results from severe storms or significant precipitation events.

Figure 70 maps Garfield County's exposure to the floodplain and dam inundation areas. Both the floodplain and dam inundation zones parallel stream and rivers along Highway 89 and SR-22 in the western portion of the County. Mapped floodplain areas tend to be in the west side of the county, but that does not mean that flooding will not occur elsewhere. Flooding events have been documented throughout the county.

Figure 70: Garfield County Floodplain and Dam Inundation Zone

Table 67 documents the assets and resources in the unincorporated county that are exposed to mapped floodplain and dam inundation zones. Road miles are an at-risk asset to flooding in the unincorporated county. Flooded or damaged roads can lead to traffic delays or cut off communities from response and resources. Some unincorporated residences are also exposed to the floodplain. Unfortunately, commercial parcel data was not available for assessment.

Table 67: Garfield County Floodplain and Dam Inundation Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
Unknown	2.2%	Unknown	18.8%	N/A	N/A	0.0%

A challenge identified during this planning process is the density of homes in Panguitch Lake still using septic. Flooding of this area would pose significant health and safety concerns for the water quality of Panguitch Lake. Flooding could impact the existing septic systems in use and damage the water system of Panguitch Lake.

Outdoor recreation has also been identified as a risk to flooding by the Utah Geological Survey in their assessment of the Glen Canyon National Recreation Area. Several people have been killed or injured in this area while exploring canyons when flash flooding hit, and this number is expected to increase as technical canyoneering increases in popularity. (Knudsen, Hiscock, Lund, & Bowman, 2017)

NFIP

Garfield community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding. Flood Insurance Rate Maps were developed for Garfield County in 1986 and had Community Assistance Contact in 9/25/2019 and Community Assistance Visit in 8/20/2019.

Table 68 describes the NFIP participation and claims paid in Garfield County. There are 11 flood insurance policies in the County and two claims made to the NFIP. Total premiums for the 11 policies add to $9,965.

Table 68: Garfield County NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978	Repetitive Losses
$9,965	0	2	11	$3,222,900	2	$10,806	0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Hazard History

Garfield County has experienced several flooding events, often the result of severe weather causing flash flooding. Table 69 describes the events. While some of the events described here may describe impacts to an incorporated city or town in the county, it is likely that the event also had impacts on unincorporated areas of the County.

Table 69: Garfield County Recorded Flood Events

Date	Damages or Injury	Description
8/26/1996	$100,000 in property damage	Significant flash flooding damaged bridges and washed away vehicles in and near Escalante.
8/9/1997	$5,000 in property damage	Flash flooding on the Sevier River closed Highway 89 near Hatch.
9/8/1997	$10,000 in property damage	The SR-12 bridge north of Escalante was submerged three feet under flood waters after the Escalante River flooded.
9/15/1997	$30,000 in property damage	Flash flooding closed SR-12 due to erosion near a bridge.
8/24/1998	$20,000 in property damage, $3,000 in crop damage	Flooding between Henrieville and Escalante closed SR-12 because of debris, water, and rocks on the road.
8/23/2003	$600,000 in property damage, $50,000 in crop damage	Worst flash flooding in Tropic in 40-years. Floodwaters flowed through the center of town and into homes and basements, 30 structures sustained damage, and some propane tanks were swept away in the flood waters.
7/6/2004	$8,000 in property damage	Flash flooding impacted Notom Road, closing the road for 24-hours.
9/8/2008	2 injuries, 2 fatalities	A rain event created dangerous flash flooding situations in the Glen Canyon National Recreation Area slot canyon Egypt 3. Analysis estimates that flood depth exceeded 20 feet.
7/20/2010	$50,000 in property damage	Paria River flooded basements in Tropic and overtopped a bridge to residential neighborhoods.
8/16/2010	$10,000 in property damage	Flash flooding on Twenty-five Mile Wash caused road damage.
8/19/2010	$20,000 in property damage	Flash flooding impacted Capitol Reef National Park, flooding several roads, including Notom-Bullfrog road.
6/19/2011	$50,000 in property damage	Flooding on the Sevier River impacted several roads and bridges in Hatch.
7/27/2011	$15,000 in property damage	Flash flooding reported along SR 95, moving trees and boulders onto the road. Damage to SR 276 toward Bullfrog also was reported.
8/19/2012	$10,000 in property damage	Flash flood near 25-mile wash damaged nearby roads.

9/2/2013	$30,000 in property damage	Heavy rain caused flash flooding in some Panguitch neighborhoods and agricultural areas, damaging yards and fields.
9/11/2013	$300,000 in property damage	Sever storm flooded washes, drainages, and moved debris and boulders on SR-12 near Escalante. Most roads were closed for over a day. Across Garfield County road damage from flooding was $320,000 by the end of September, with much of that cost attributed to a single storm event.
9/14/2013	$30,000 in property damage	Flash flooding damaged SR 95.
7/15/2014	$5,000 in property damage	Flooding on SR-12 blocked the roadway with 4-foot-deep debris.
8/20/2014	$5,000 in property damage	A thunderstorm caused flash flooding in Panguitch and nearby washes, impacting streets and homes in the area.
9/5/2014	$5,000 in property damage	Flash flooding in Harris Wash stranded hikers and washed-out roads near Hole-in-the-Rock Road.
9/27/2014	2 injuries, $50,000 in property damage	Rainfall created flash flooding near Kodachrome Basin State Park. The waters carried a car that fell off a bridge 150-yards. The bridge was lost in the storm and closed the park for an extended time.
10/5/2015	$5,000 in property damage	Flash flooding washed out Hole-in-the-Rock-Road.
8/5/2017	$2,000 in property damage	Heavy rain caused debris flow from the Brian Head burn scar, impacting SR-143 and White Bridge Campground.

Source: NOAA Storm Database

Flash flooding events have also been reported in the eastern portion of the County in Ticaboo, causing damages to a sewer main and tearing a mobile home from its anchoring, moving it 100 yards in the flood waters. While these events may not have been detailed on the NOAA Storm Database, they were damaging to the community residents and potentially the visitors recreating in the area.

Flood impacts from this record indicate that roadways and roadway users are vulnerable to flooding. Events that close bridges and roads can separate communities from resources, supplies, and essential services. Outdoor recreators in the County can also be at risk to flooding in canyons and on trails. Flooding events seem to impact residences and structures infrequently. This may be due to the low-density nature and high percentage of public lands in the County.

Garfield County is at a moderate risk to floods due to the potential for increase in severity and the documented history and damages. Climate impacts flooding risks, and as storms are projected to decrease in frequency, but increase in severity in the coming decades, it is possible that southwestern Utah will see an increase in the severity of floods. Increased risk of wildfires also creates flooding concerns, as burn scars can turn to debris flows as vegetation cannot hold the soil in place. Flooding trigger landslides, as changes in soil moisture on steep slopes can lead to landslides, debris flows, and rockfall.

Landslide

Landslide and rockfall hazards are prominent in southwestern Utah, with a geography marked by steep slopes, cliffsides, and mesas. Garfield County is one of the four Utah counties impacted by one of the largest surface landslides, the Markagunt Gravity Slide, which is estimated to have occurred millions of years ago and impacted what is now the western portion of Garfield County. (Robert F. Biek,

2016)Landslide and rockfall are common in wilderness settings, but as structures are built in susceptible areas, more people, property, and assets are exposed to the effects of landslides.

Garfield County has widespread exposure to moderate and high landslide susceptible areas, as seen in Figure 71. Nearly every incorporated city has some exposure to landslide susceptible areas somewhere in the community. The unincorporated County is exposed to landslide risks.

Figure 71: Garfield County Landslide Susceptibility

Source: Utah Geological Survey

Table 70 describes the exposure of people, property, and assets to landslide susceptible areas. Forty-three percent of residential parcels in the unincorporated county are at moderate to high susceptibility to landslides. Residential parcels built on or under steep slopes and cliffs are vulnerable to landslides and pose a significant threat to property owners. Properties identified as vulnerable to landslides typically are concentrated along Highway 89, west of Panguitch and Hatch, near Panguitch Lake, along Johns Valley Road, State Road 12, and in the Henry Mountains area. Increased growth and development in the county could contribute to greater exposure to landslides and rockfall for residents over time.

Sixty percent of roadways in the unincorporated County are susceptible to landslides. Landslides on roadways can injure or kill road users, block traffic, and damage roadways among other consequences. Significant time and expense can be required to clear landslides and repair the roadways. Landslide events on roadways can limit access to County resources, response, and supplies for rural or remote communities.

Table 70: Garfield County Landslide Susceptibility Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
Unknown	43.2%	Unknown	60.3%	N/A	N/A	0.0%

Source: Utah Geological Survey, UDOT, Garfield County Assessor, AGRC

Expected growth in the County in the coming decades can place more populations, infrastructure, and property at risk to landslide events. Recreation areas increasing in popularity also experience landslides, as described in the Utah Geological Survey's description of natural hazard exposure of the Glen Canyon National Recreation Area.

Hazard History

Landslides and rockfall frequently occur in the Five County region, causing damage to infrastructure, structures, and other property. Table 71 describes the landslide events and impacts reported in Garfield County.

Table 71: Garfield County Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
1940	Panguitch & Circleville, Garfield County	Unknown	Unknown	Debris flow near Panguitch and Circleville.
1943	Garfield County	Unknown	Unknown	Rockslide in Garfield and Kane County.
1983	Garfield County	$345,000	Unknown	Landslide in Garfield County likely because of the record rainfall of that year. https://ugspub.nr.utah.gov/publications/misc_pubs/MP-88-3.pdf
1984	Garfield County	Unknown	Unknown	Landslide in Garfield County.
2011	Garfield County	Unknown	Unknown	NCDC Landslides from Sheldus.
2017	Garfield County	$2,000	None reported.	Heavy rain on the Brian Head Fire burn scar caused flooding and debris flows. A front loader was needed to remove the boulders from SR-143.
	Garfield County	Unknown	Unknown	A landslide impacted SR-12, removing a chunk of the roadway, and impacting traffic flow into Bryce Canyon National Park. The reconstruction project is estimated at $8 Million. The soil type has caused past damage to this segment of road.

Source: (St. George News, 2020) (St. George News, 2017) (Brophy, 2019)

Landslide hazards can be caused by precipitation or runoff, especially on land that is exposed and not covered by vegetation. The landslide in 2017 following the Brian Head fire is an example of this phenomenon as fire can change the landscape and vegetation on a site. Events like flooding can also contribute to landslide hazards. In turn, Landslides can contribute to flooding hazards, especially when a landslide blocks a waterway, causing water to pool. Changes in climate patterns will likely contribute to landslide hazards as severe storms and wildfires increase in severity.

Drought

The Five County Region has experienced seven periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe

weather.

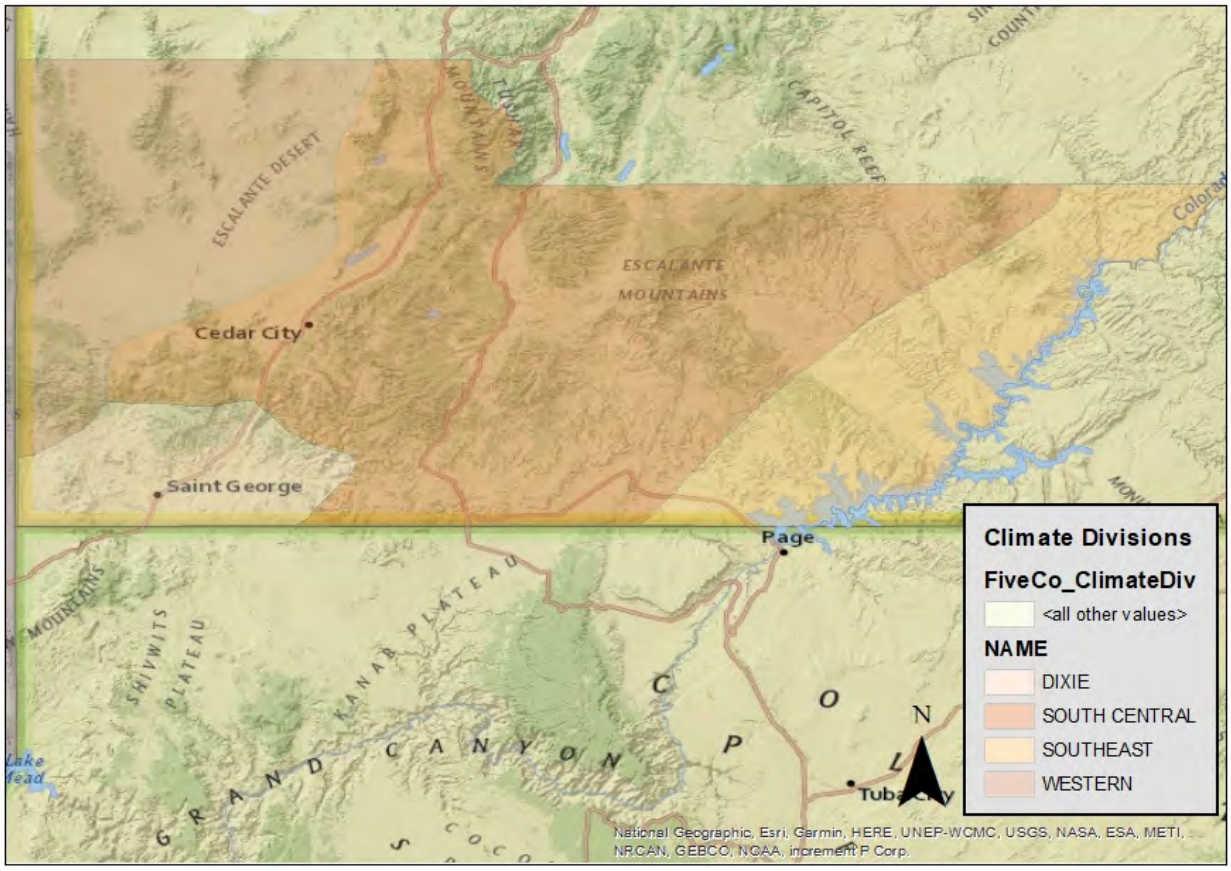


Figure 72: Five County Climate Divisions

Climate divisions were historically used to track long term climate patterns for a region. The division measured temperature and precipitation across a region to track patterns over an area. Figure 72 shows that Garfield County predominantly includes the South-Central region, although the Southeast region is also included in the County. Figure 73 describes the annual precipitation averages for the South-Central Region. As observed in this table, the region has been trending toward more sporadic precipitation years, with longer stretches of observed drought conditions between 1895 and 2019.

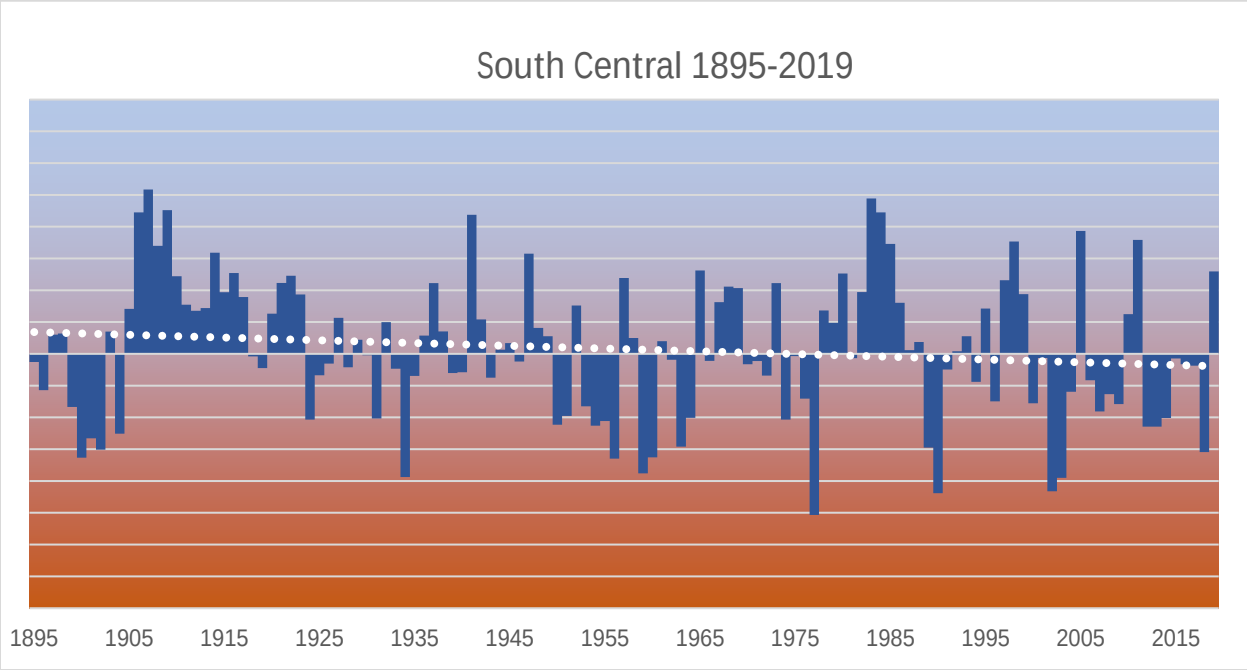


Figure 73: Southcentral Climate Division precipitation by year

Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community. Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah, including Garfield County, is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 74. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

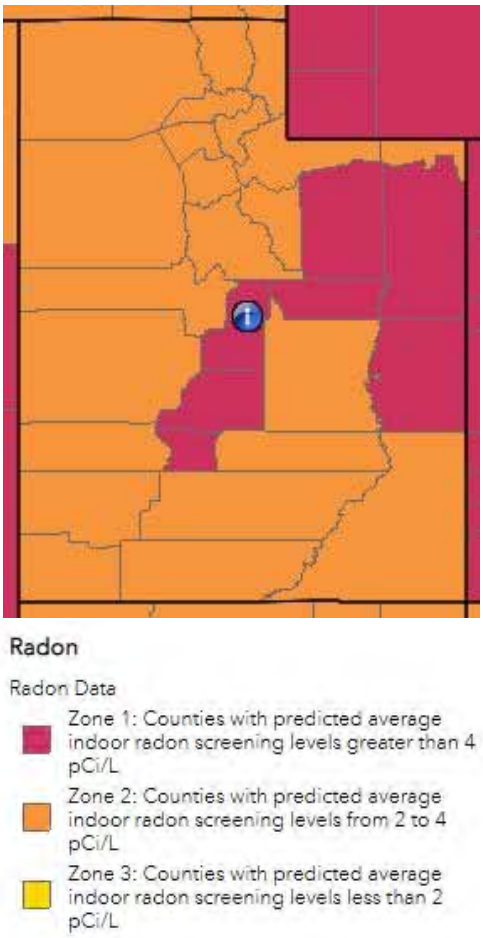


Figure 74: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 72 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 72: Garfield County Short Term Radon Testing Reported

County	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

Garfield	59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather events are frequent and impactful in the Southwest. Weather events in the southwest tend to occur seasonally in the summer and winter. Severe weather occurs during thunderstorms and winter storms, including high winds, heavy rain or snow, hail, lighting, and tornados. Other events include severe temperatures, heat and cold, which can be impactful to people, property, and industry, like agriculture and tourism.

Table 73 describes the severe weather events that resulted in injury or death that have impacted Garfield County. Several deaths are attributed to extreme heat in the southwest region. While these deaths may have been reported in neighboring communities or counties, the heat event that caused them likely impacted the entire region, exposing hundreds of outdoor users and visitors as well as laborers to extreme temperatures and increased risk. Increased visitation of outdoor spaces will likely compound this vulnerability. Other notable hazard events include the high number of high wind events and the respective cost attributed to that hazard in the County. Tornados, while infrequent in this area, can cause significant damage, especially as this event was placed in the County Seat and most populace community in Garfield County.

Table 73: Garfield County Severe Weather Record

Date	Hazard	Injury / Damage	Description
3/28/1996	High Wind	$1,000 in damage	High winds reported across the state with gusts ranging between 43 and 59 MPH.
9/8/1997	Hail	$10,000 in damage	¾ inch hail fell on Panguitch Lake, causing roof damage. Hail was reported nearly three inches deep on the ground in some areas.
9/14/1997	Hail	$7,000 in damage	Hail approximately one inch in diameter was reported near Escalante.
9/25/1997	Heavy Rain	$2,000 in damage	High winds and rain caused 400 trees to fall across the region, including the Dixie National Forest.
5/26/1998	High Winds	$700 in damage	High winds reported in Sevier County peaked at 84 MPH and caused damage in Garfield County.
8/26/2000	Lightning	1 injury	A man was struck by lightning while standing under a tree. He suffered head injury and burns.
7/12/2005	Heat	1 death	High temperatures reached 110 Fahrenheit in the Glen Canyon area and is the likely cause of a hikers death.
7/1/2013	Heat	3 deaths	Three people were killed in southern Utah likely due to high heat near 100 degrees. One person was killed in Grand Staircase-Escalante National Monument, and two others on a Kane County trail.
7/21/2013	Heat	1 death	A heat event across southern Utah killed a person hiking in Kane County.

8/15/2013	Heat	1 death	A woman died in Capitol Reef National Park from heat exhaustion. Temperatures were above 90 degrees Fahrenheit.
9/21/2014	Hail & High Wind	$2,000 in damage	Hail from a thunderstorm measured 1¾ in diameter reported near Cannonville, damaging a greenhouse. In the city, strong wind bent a steel flagpole which was buried in cement.
2/18/2016	High Winds	$50,000 in damage	Winds of 87 MPH reported near Brian Head. The winds closed Brian Head and Eagle Point resorts and impacted the southwest region.
9/22/2016	Tornado	$300,000 in damage	A tornado caused EF0 and EF1 severity damages to businesses and homes in Panguitch. The most severe of the damage was removing a business roof. The community was without power following the event.

Source: NOAA Storm Database, 2020.

Ticaboo has described their exposure to severe weather events, including damages to water systems from lightning strike. While snow is not a frequent hazard in the area, when it does occur, the community is essentially shut down waiting for UDOT to clear the roads. Winter weather and extreme cold in the area has been known to damage piping, resulting in a loss of water access.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Washington County from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Problem Soils

Problem soils are a challenge for construction, infrastructure, and development. The County Code addresses potential challenges from problem soils through the planning commission, who can request an assessment by an engineer or geologist to describe the suitability of the soil on a site preconstruction. Reports that indicate a hazard on a site, the planning commission and building official will set a special condition for the hazard to be reduced or eliminated. If the condition cannot or will not be met the application for construction will be denied.

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated in Figure 75. Expansive soils have been identified in the eastern portion of the county, and in the central/southern area of the county near Escalante, Bryce Canyon City, and Tropic.

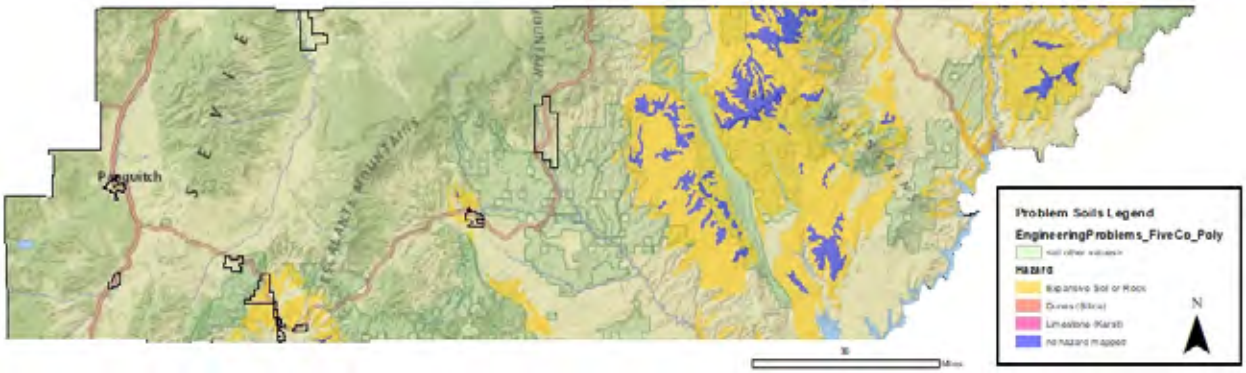


Figure 75: Garfield County Mapped Problem Soils

Table 74 shows the exposure of Garfield County assets, infrastructure, and parcels to mapped problem soils. Expansive soil and rock are prevalent in the Unincorporated County and impact road miles and residences. Over time these structures and infrastructure may see impacts of problem soils if unmitigated. As expansive soils swell when wetted and shrink when dry damage to underground infrastructure, roadways, and structures from this action is possible.

Table 74: Garfield County Problem Soil Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
Unknown	2.2%	Unknown	18.1%	N/a	N/a	0.0%

Source: UDOT, Garfield County Assessor, AGRC, Utah Geological Survey

Problem soils have limited data to report a historical record. These hazards are more of a constant state in the landscape that becomes a challenge with development. Updated mapping of problem soil hazards in the region could provide greater understanding of the challenges, especially as the population in the County grows. Most of the residential parcels that lie in a mapped problem soil area are near the boundary of incorporated cities. As the County has indicated that second homes and vacation rentals in the unincorporated county are a challenge, growth and visitation to the area may create additional challenges from problem soils.

Mitigation strategy & actions

Several Garfield County Plans identify goals, objectives, programs, or projects that mitigate natural hazard risks. The Five County AOG staff compiled strategies from other plans which may integrate in this planning process. Please indicate below whether the action is **complete, incomplete and still needed, incomplete and not needed, or unsure** next to each item in Table 75.

Table 75: Hazard Mitigation Related Actions from Community Plans

Plan	Objective/Goal/Action Item	Progress?
General Plan	Hatch Facilities Needed or Desired- Water facility and equipment upgrades needed or desired in the next ten years: recently installed a new water system; provide flood control throughout the town and maintain the water system.	Incomplete
	Identify 100-year flood plains beginning with the Federal Insurance Rate Maps prepared for the county and avoid development in such areas. If such development is deemed necessary, the owner will be required to document that adequate mitigation measures will be in place prior to occupancy	Still need
	Identify the location and extent of earthquake faults which may impact county residents. The technical assistance of the Utah Geological Survey will be requested in this regard.	Unknown
Economic Development Plan	Develop infrastructure to protect water supply, including culinary supply storage and distribution, agricultural storage and distribution, and remote area livestock/wildlife water facilities. Survey municipal water supply status and identify issues and corrective measures.	Unknown
	A multiple purpose reservoir near Escalante (upper wide hollow) that would increase retention and availability of irrigation water, conserve culinary water and enhance recreational opportunities. Upper Wide Hollow Reservoir. Update engineering analysis; initiate development of a funding strategy.	Unknown
	Systematic restoration of vegetation. 11 county intergovernmental restoration initiative aimed at increased environmental health, decreased fire risk for communities, structures, and culinary and irrigation water supplies. Protect businesses affected by drought is of particular concern: Forest products Livestock production Tourism	Unknown

Garfield County participated in the 2017 iteration of the Five County Multijurisdictional Natural Hazard Mitigation Plan and identified several actions to include in their mitigation strategy. Providing a progress report on identified actions is a requirement for each program cycle. Please indicate whether the following actions are **complete, incomplete, and still needed, incomplete and not needed, or unsure** in Table 76**.**

Table 76: Garfield County 2016 Mitigation Strategy Progress

Hazard	Action	Progress
Problem Soil #1	Address Problem Soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report	Progress ongoing, Still Needed
Problem Soil #2	Through mapping, identifying areas which contain collapsible and expansive soils. Require soils testing at the building/construction level and ensure that engineer's recommendations are followed.	Progress ongoing, Still Needed
Landslide #1	Increase public education related to landslide hazards by distributing Utah Geological Survey (UGS) landslide informational brochures to local municipality level emergency management, engineering, and planning departments.	Still needed
Landslide #2	Drafting/updating zoning and /or landslide ordinance to prevent development of structures near debris flows, landslides, and rockfall areas.	Still needed
Landslide #3	Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Still needed
Wildfire #1	Mailings, printed information, public service announcements	Still needed
Wildfire #2	Continue to place strategic fuel breaks throughout the focus area.	Still needed
Wildfire #3	Encourage landowner mitigation and defensible space work.	Still needed
Wildfire #4	Compliment fuels reduction work being done by the Parks Service and Forest Service onto private lands.	Still needed
Wildfire #5	Prevent fires on private lands, which may spread onto federal lands.	Still needed
Wildfire #6	Enhance existing wildfire training programs, equipment procurement, and firefighting resources for wildfire suppression.	Still needed
Wildfire #7	Optimize the Wildland-Urban Interface Program	WUI Codes adopted. Still needed
Wildfire #8	Forest Health through harvesting timber.	Still needed
Wildfire #9	BLM & Pinion/Juniper Conditioning	Still needed
Flood #1	Nonstructural measures appear to be the most prudent option for the County to implement. Zoning to prevent development of structures near all rivers, creeks, and lakes (100' minimum setback).	Still needed
Flood #2	Address flood control by requiring subdivision proposals to have a storm water drainage system on case-by-case basis.	Still needed
Flood #3	Clear debris and other material from all waterways.	Still needed
Flood #4	Construct flood mitigation improvements to prevent disruptive flooding.	Still needed
Flood #5	Voluntarily participate in the FEMA Community Rating System (CRS) which will help to keep communities more safe, reduce flood insurance rates, and improve floodplain management activities.	Still needed
Earthquake #1	Continued dedication/vigilance in enforcing the seismic standards established in the International Building Code (IBC).	Still needed

Earthquake #2	Utilize the Earthquake Risk Map provided in this plan as a tool to assess earthquake risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study.	Still needed
Earthquake #3	At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	Still needed

A mitigation strategy was developed for the unincorporated County during the planning process, with consultation and participation from the local planning team, described in Table 77, following coordination with the Local Planning Team. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in the planning process section.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Table 77: Garfield County Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
Multi-Hazard #1	5	Improve countywide communication capabilities.	Extend and harden radio communications throughout the County, including to Ticaboo.	L	5-years	M	Garfield County	Garfield County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
Drought #1	2	Improve water development in municipalities.	Support local development of new water resources.	M	Ongoing	L	Municipalities & Garfield County	Municipalities & Garfield County
Drought #2	2, 6	Protect natural water sheds and critical water equipment in wildlands.	Continue maintenance on existing watershed protection zones which were implemented to address impacts from wildfire, landslides, flooding, and severe weather on watersheds serving the County.	H	Ongoing	M	Garfield County	Garfield County
Drought #3	2, 6	Protect natural water sheds and critical water equipment in wildlands.	Coordinate with incorporated cities and towns to develop new watershed protection zones to mitigate natural hazard impacts on water quality.	L	Ongoing	M	Garfield County	Garfield County
Drought #4	1, 2, 4, 6	Identify best practices to develop waste systems.	To lessen potential impacts on water quality, Garfield County will coordinate with existing and future development in the unincorporated County to address septic density.	H	Ongoing	L	Garfield County	Garfield County
Radon #1	1, 2	Reduce radon risk in public facilities	County coordination with Garfield County School District to provide Radon Testing at k-12 public schools.	M	2-years	L	Garfield County & Garfield County School District	Garfield County & Garfield County School District

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
Severe Weather #1	1, 2	Reduce impacts of flash flooding and debris flows at popular outdoor recreation areas.	Add and expand culverts to accommodate precipitation and flooding within the Burr Trail and Hole in the Rock Road to reduce road damage and entrapment events due to washouts.	M	5 years	H	Garfield County	Garfield County
Severe Weather #2	2	Collect data to inform mitigation at Ticaboo.	Complete a stormwater drainage study for the Ticaboo community.	M	5-years	M	Garfield County	Garfield County
Problem Soil #1	2	Reduce damage from problem soils sink and swell actions.	Address Problem Soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report	M	Ongoing	L	Private funds/developer, County or City government operating budget, Utah Geological Survey operating budget.	Garfield County
Problem Soil #2	2	Reduce damage from problem soils sink and swell actions.	Through mapping, identifying areas which contain collapsible and expansive soils. Require soils testing at the building/construction level and ensure that engineer's recommendations are followed.	L	Ongoing	L	Garfield County	Garfield County and Utah Geological Survey
Landslide #1	3	Inform residents and visitors of the risks of landslide and	Increase public education related to landslide hazards by distributing Utah Geological Survey	H	Ongoing	L	Garfield County	Garfield County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
		rockfall present in the County.	(UGS) landslide informational brochures to local municipality level emergency management, engineering, and planning departments.					
Landslide #2	2	Update policies to protect new development and infrastructure from landslide risks.	Drafting/updating zoning and /or landslide ordinance to prevent development of structures near debris flows, landslides, and rockfall areas.	M	2-years	L	Garfield County	Garfield County with partner in Utah Geological Survey
Landslide #3	2	Update policies to protect new development and infrastructure from landslide risks.	Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	M	Ongoing	L	Local Developer	Garfield County, Local Developers, Utah Geological Survey.
Wildfire #1	3	Inform residents of defensible space tactics and interface risks.	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas using mailings, printed information, public service announcements	H	Ongoing	L	Garfield County	Garfield County, State and Federal government
Wildfire #2	1, 2, 6	Reduce fuels near residences and infrastructure.	Continue to place strategic fuel breaks throughout the focus area.	M	Ongoing	M	State and federal loans and grants as available.	Community and local government entities; private property owners.
Wildfire #3	1, 3,	Inform residents of	Encourage landowner	H	Ongoing	L	State and federal	Community and local

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
	4, 6	defensible space tactics and interface risks.	mitigation and defensible space work through public engagement.				loans and grants as available.	government entities; private property owners.
Wildfire #4	1, 2, 3, 4, 6	Reduce fuels near residences and infrastructure.	Compliment fuels reduction work being done by the Parks Service and Forest Service by working with private land owners to identify and implement defensible space needs.	M	Ongoing	L	State and federal loans and grants as available.	Community and local government entities; private property owners.
Wildfire #5	1, 3, 4, 6	Inform residents of defensible space tactics and interface risks.	Prevent fires on private lands, which may spread onto federal lands through fuels reduction and defensible space tactics.	M	Ongoing	L	Garfield County, State and federal loans and grants as available.	Garfield County; private property owners.
Wildfire #6	5	Ensure adequate equipment and current trainings for all fire departments.	Enhance existing wildfire training programs, equipment procurement, and firefighting resources for wildfire suppression.	M	Ongoing	L	State CIB funding, Federal Wildfire Grant programs, Garfield County	Federal Government
Wildfire #7	1, 2, 3, 4, 6	Reduce fuels near residences and infrastructure.	Optimize the Wildland-Urban Interface Program	M	Ongoing	L	Garfield County	Garfield County, BLM, Forest Service, Fire districts.
Wildfire #8	1, 2, 3, 4, 6	Reduce fuels near residences and infrastructure.	Protect Forest Health through harvesting timber.	M	Ongoing	L	Garfield County, Federal and State funds as available	Garfield County, BLM, Forest Service, Fire districts.
Wildfire #9	1, 2, 4, 6	Reduce fuels near residences and infrastructure.	Coordinate actions with ongoing BLM & Pinion/Juniper Conditioning	M	Ongoing	L	Garfield County, Federal and State funds as available	Garfield County, BLM, Forest Service, Fire districts.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
Wildfire #10	1, 2, 6	Reduce fuels near residences and infrastructure.	Address wildfire through vegetation treatment on private and County owned lands.	M	Ongoing	L	Garfield County	Garfield County
Flood #1	1, 2	Assess and update policies to protect structures and infrastructure from flood.	Nonstructural measures appear to be the most prudent option for the County to implement. Zoning to prevent development of structures near all rivers, creeks, and lakes (100' minimum setback).	H	Ongoing	L	Garfield County, State and Federal flood and planning grant programs	Garfield County
Flood #2	1, 2	Assess and update policies to protect structures and infrastructure from flood.	Address flood control by requiring subdivision proposals to have a storm water drainage system on case-by-case basis.	H	Ongoing	L	Private funds/developer	Garfield County
Flood #3	6	Protect natural drainages and waterways.	Clear debris and other material from all waterways.	M	Ongoing	M	Public/private property owners.	Private property owners, irrigation companies, Garfield County.
Flood #4	1, 2, 4	Protect natural drainages and waterways.	Construct flood mitigation improvements along the Paria River between Bryce Canyon and the County boundary with Kane County to prevent disruptive flooding.	M	Ongoing	L	Garfield County, State and Federal funds	Garfield County, State and Federal Governments.
Flood #5	1, 2	Assess and update policies to protect structures and	Voluntarily participate in the FEMA Community Rating System	L	Ongoing	L	Garfield County, State and	Garfield County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies
		infrastructure from flood.	(CRS) which will help to keep communities safer, reduce flood insurance rates, and improve floodplain management activities.				Federal funds	
Earthquake #1	1, 2	Enforce local policies.	Continued dedication/vigilance in enforcing the seismic standards established in the International Building Code (IBC).	H	Ongoing	L	Garfield County	Garfield County
Earthquake #2	1, 2	Collect data to inform mitigation needs.	Utilize the Earthquake Mapping to assess earthquake risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study.	M	Ongoing	L	Private funds/developer	Garfield County; Private property owner; Utah Geological Survey
Earthquake #3	4	Collect data to inform mitigation needs.	At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	L	3-5 years	M	Garfield County	Local, jurisdictional level; Private property owner; Utah Geological Survey

Source: Local Planning Team

Antimony

The Town of Antimony is a rural community on SR-22 in the northwestern portion of the County. The community is located near the border of Garfield County and Piute County. The Town is outside of Otter Creek State Park, which is a site for community celebrations, including the Fourth of July fireworks on the reservoir.

Community Characteristics

Antimony Town is a rural agricultural community. The town has a small population of full-time residents. The tables below further discuss the population, development, and local economy of the town.

Demographics

Antimony has a population of 86 as of the 2018 American Community Survey, described in Figure 76. The population change since the 2010 census indicates a population decline of 29.5%, according to the American Community Survey, shown in Figure 77. The population has generally been in decline, except from 2000 to 2010, where the population saw growth and then remained steady for a decade.

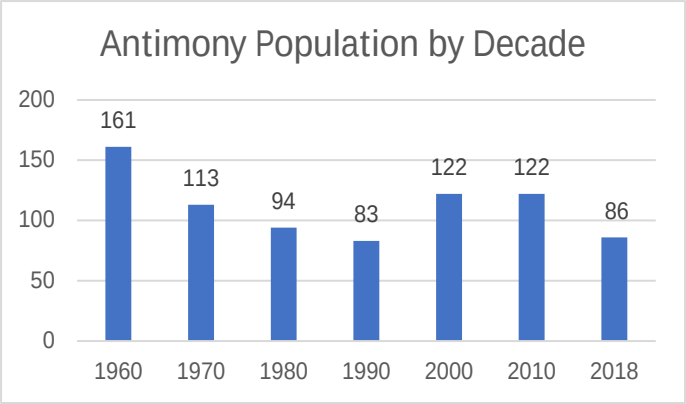


Figure 76: Antimony Population by Decade

Source: US Census Bureau

According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Antimony, the population by 2065 may be near 125 people.

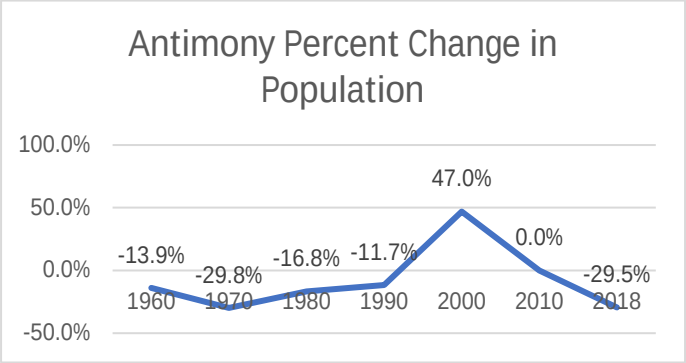


Figure 77: Antimony Percent Change in Population

Source: US Census Bureau

Development

Antimony Town has experienced limited growth in development, seeing only eight total approved building permits since 2019. All eight building permits were for residential uses, according to the town clerk.

Economy

According to the US Census on the Map tool, only one private primary job is in Antimony, in the retail sector. The data excludes public services, which likely occupies a share of the community jobs. The population compared to the number of jobs indicates outflow of the workforce, which is verified by On the Map inflow outflow data, estimating that 37 people living in Antimony are employed outside the community. The estimated commute time from the 2018 American Community Survey Table DP03 shows a mean commute to work of 28.7 minutes.

Community Capabilities

The community is governed by a volunteer elected town council and a mayor. Antimony Town has a clerk to assist with general government operations. Law enforcement is provided by the County Sheriff's Office in Panguitch.

The town residents rely on spring water, provided by the Town of Antimony for culinary water. Other utilities in the community are provided by private companies, including:

- Electrical service- Garkane Energy
- Communications- South Central Communications.

Gas is not a utility service available to the community.

Plans and Policies

The community did not provide plans or ordinances which relate to natural hazards for this plan update.

Risk Assessment

Antimony experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Antimony to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 78 displays the relative risks of hazards in Hatch.

Table 78: Antimony Town Hazard Risk

HAZARD	RISK
DROUGHT	1- High
SEVERE WEATHER	2- High
EARTHQUAKE	3- Moderate
LANDSLIDE	4- Moderate
WILDFIRE	5- Moderate
FLOOD	6- Low
RADON	7- Low

A detailed description and mapping of each of the natural hazards that impact Antimony can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Antimony Town include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Antimony is at risk to drought, wildfire, flooding, landslides, severe weather, earthquake, and radon.

Wildfire

Antimony Town is surrounded by agricultural lands, wildlands, and open space. Given the arid environment, Antimony is at risk to wildfire. The wildfire risk is greatest along SR 22 through the center of the community and on the southern end of the community. There has not been a significant wildfire event that has affected Antimony, according to FEMA and the Utah Department of Natural Resources, although this lack of past events does not mean that a wildfire cannot occur.

Figure 78 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near antimony that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Risk to wildfires is in the central and southern area of the community, along SR 22.

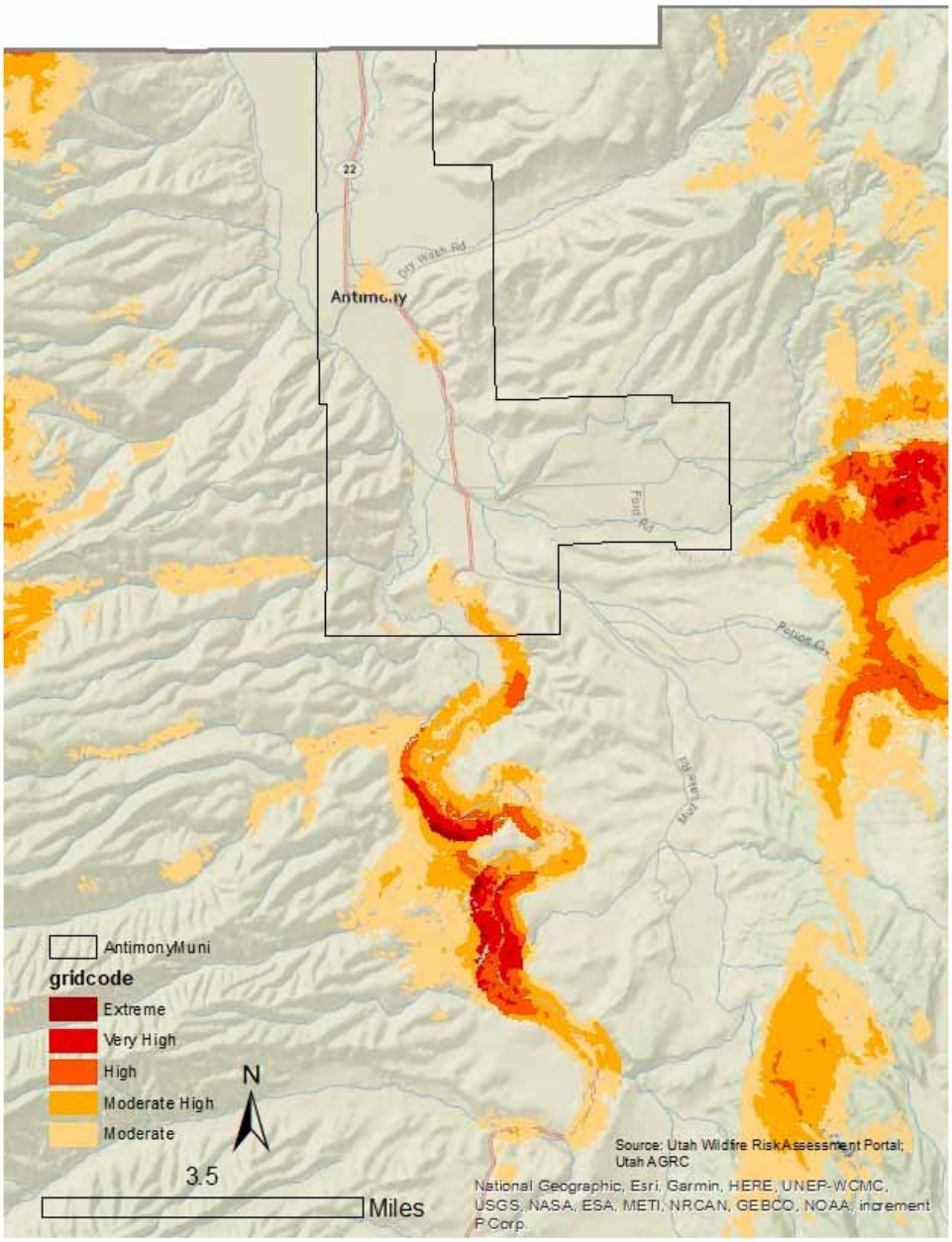


Figure 78: Antimony Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 79 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Antimony Town. Critical facilities impacted by natural hazards can cause additional vulnerability to a community, as prominent meeting spaces and response is impacted during the event. Antimony Town's 20.5% of residential parcels are exposed to wildfire risk areas with 4.4% of road miles exposed, especially SR 22 through the community.

Table 79: Antimony Wildfire Risk

Antimony Town Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	20.5%	Unknown	4.4%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, impacting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Antimony and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah and the Great Basin area has significant seismic activity, reporting several earthquakes annually. These earthquakes tend to be small and barely felt in communities, however several faults in the state have the potential to produce severe earthquakes. There are no mapped Quaternary Fault lines in Antimony Town, with the closest being the Paunsaugunt fault approximately 1.25 miles east of the city, as seen in Figure 79. The Aquarius and Awapa Plateau faults lie east of the Paunsaugunt fault, approximately 5 miles from Antimony. Earthquakes can happen throughout the state. Although fault lines tend to be the most common cause of large earthquakes, they can still occur and cause impacts in areas such as Antimony.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Antimony Town has 43.5% of residential parcels have a building constructed before 1975 on the site. Tax rolls indicate that the critical facilities in the community are both constructed pre-1975, placing them at potential higher risk to earthquake impacts. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

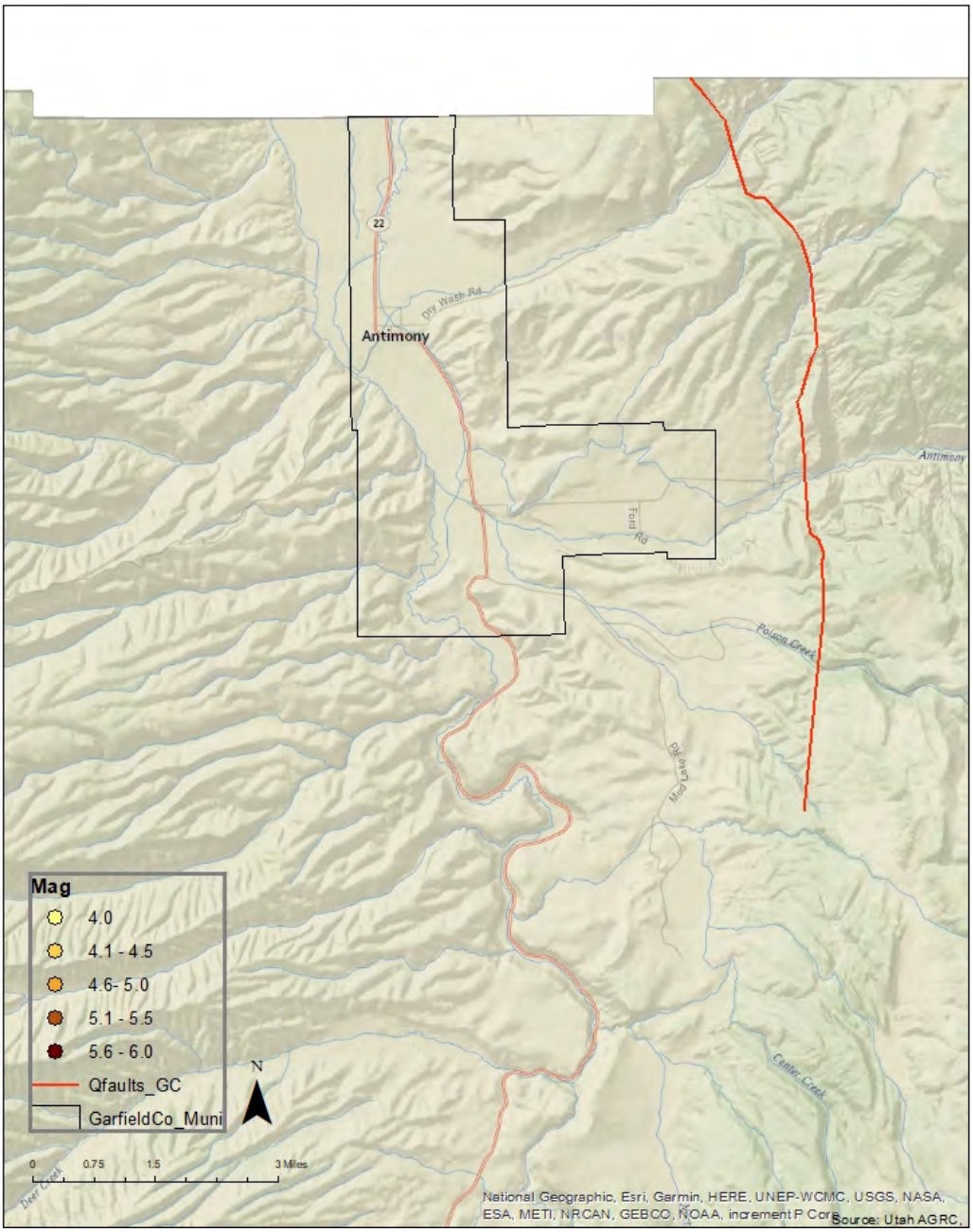


Figure 79: Antimony Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Hazard History

Earthquake epicenters of 4.0 or greater have not been reported in Antimony, UT, although two epicenters have been reported in the unincorporated county near the town. Table 80 describes the events of 4.0 and greater which have occurred near Antimony which may have impacted them.

Table 80: Antimony Earthquake History

Earthquake Epicenters		
Year	Location	Magnitude (4.0 +)

1966	8.6 miles southeast of Antimony, Garfield County	4.1
1994	16.3 miles west of Antimony, Garfield County	4.03

Source: University of Utah Seismology Stations

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Antimony Town.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 80 describes the flood and dam inundation exposure in Antimony. As illustrated in the map, Antimony has the potential for Dam inundation in the northwest area of the community. Dam inundation will likely follow the creek that parallels SR 22 through town, which could cause impacts. The floodplain appears to have minimal mapping.

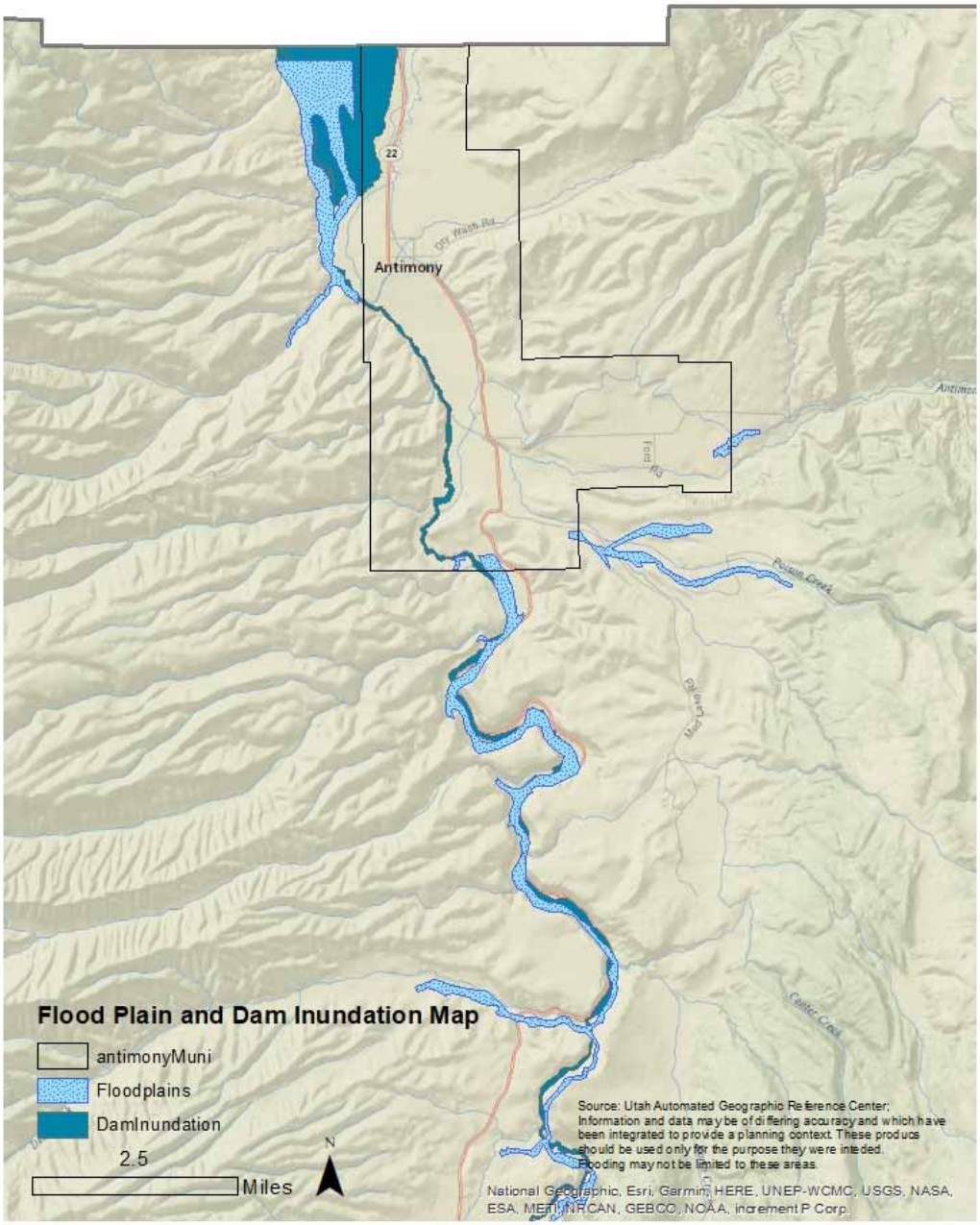


Figure 80: Antimony Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 81 further examines the exposure to identified flood risk areas in Antimony, by observing community assets and structures that are in at-risk areas. The table shows that 10.2% of residential parcels are exposed to flood risk zones. Local road miles are the roadways which interact with the floodplain in the town boundary. Outside the town limits, SR 22 interacts with flood and dam inundation areas. Roadways in the floodplain can limit access for response and recovery, in addition to regular supplies and community needs.

Table 81: Antimony Floodplain and Dam Inundation Exposure

Antimony Town Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	10.2%	Unknown	2.4%	N/A	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

The local planning team discussed specific experienced and concerns from flooding, especially runoff from storms and snowpack from the mountains East of town. In the community, there is a drainage ditch lies directly behind an elementary school and city office building and community center. The ditch often fills with debris. When the drainage ditch fills with water, debris in the ditch block the normal flow path and cause flooding. A past flooding incident washed out a bridge that crosses the drainage ditch.

National Flood Insurance Program

The Antimony community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Flood Insurance Rate Maps were developed for Antimony in 1976. The community does not participate in the NFIP.

Hazard History

It is likely that flooding events will continue to impact Antimony with seasonal severe storms. While the community has only experienced one reported flood events with impacts. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 82 describes the documented flooding event in Antimony.

Table 82: Antimony Flood Event History

Date	Damages or Injury	Description
7/23/2002	None Reported	Rain produced flash flooding south of Antimony, causing water to pool six inches to one foot deep on the road.

Source: NOAA Storm Event Database, 2021

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides

or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. Antimony does not have a record of landslides impacting the town. The community is in a valley between two mountainous areas. While Antimony has not experienced a landslide in the town boundary, landslides in the nearby Black Canyon have blocked the primary access road to Antimony.

Figure 81 maps the landslide susceptible areas in Antimony. The map describes landslide susceptible areas in the community, primarily along hillsides and cliffs in the city boundaries. There are also some segments that appear to interact with SR 22.

Figure 81: Antimony Landslide Susceptibility Exposure

Source: Utah Geological Survey

Table 83: Antimony Landslide Susceptibility Exposure describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Antimony describe that 7.0% of all roadways are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate Hatch from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period.

Twenty-three percent of residential parcels are in an area considered to be susceptible to landslides. Landslides and rockfall in southwestern Utah have impacted residents and property in the past, leading to property damage, injury, and death.

Table 83: Antimony Landslide Susceptibility Exposure

Antimony Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	23.9%	Unknown	7.0%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

To date, landslides have not been reported causing impacts in Antimony. Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Agriculture is prominent in Antimony, and drought impacts have the potential to impact the local economy.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. In Antimony, there is a concern where wildfires from dry fuels moving to structures. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 82. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

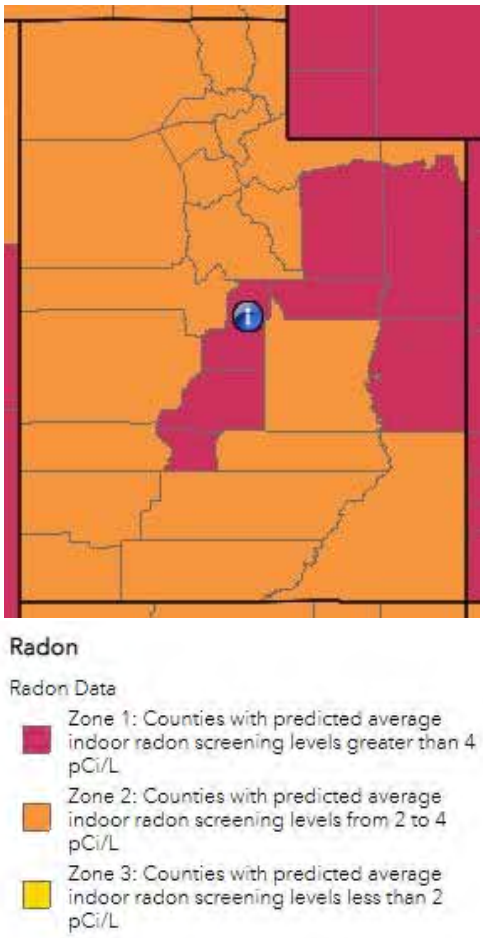


Figure 82: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 84 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 84: Garfield County Short Term Radon Testing Reported

County	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
Garfield	59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Antimony, however our analysis assumes that severe weather events will impact the whole of Antimony Town residents, facilities, infrastructure, businesses, and property.

Antimony has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Antimony, which can produce hail, high winds, rain, and lightning.

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. One total weather has been recorded with impacts to Antimony between 1950 and 2020, which includes a thunderstorm which downed a tree, damaging two vehicles. High winds took shingles off roofs in the area. This storm produced gusts of 60 MPH recorded at the St. George Airport. Other county events likely impacted Antimony and should be reviewed in the County section of this hazard plan.

Severe weather will continue to impact Antimony as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the county on behalf of Antimony Town, which requires that all construction has a geologic study pre-construction. Antimony's local planning team expressed minimal impacts from problem soils and could not point to buildings being damaged due to problem soils. They did describe blue clays have been found in the soils locally, which can be challenging to construction and development.

Figure 83 illustrates where mapped problem soil areas are in Garfield County, primarily in the east central portion of the County, with some expansive rock in the Bryce Canyon area and Escalante Area. No problem soils are currently mapped for Antimony.

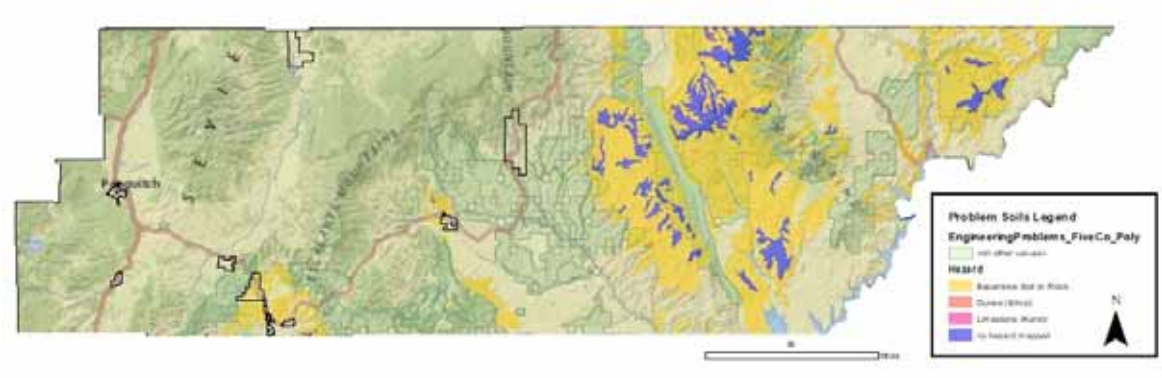


Figure 83: Garfield County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region. These maps are not currently available for Garfield County.

Summary

Antimony is exposed to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Limited risk currently exists for problem soils throughout the community. Vulnerabilities identified through this process highlight that roadways and homes, in addition to potential economic impacts from supply chain delays or impacts on agriculture industry in the area following a natural hazard event.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Antimony Town has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Antimony Town and are listed in Table 85 with a description of their progress.

Table 85: 2016 Antimony Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Prevent snow melt and high intensity precipitation events from flooding property, and roads, and to protect nearby water lines.	Routinely clearing debris and sediment build-up from washes and creeks	Annual	Town operating budget	Incomplete, County is responsible for creeks and washes.

Source: 2017 Five County Association of Governments NHMP

The Antimony planning team identified actions to include in the community mitigation strategy. Each action in Table 86 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 84: Regional Plan Goals.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 84: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Antimony has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 86, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 86: 2022 Antimony Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	3	Protect agricultural economy in the area.	Encourage agricultural interests to pursue crop insurance to protect against drought.	H	2-3 years	L	Antimony Town	Antimony Town

Flood #1	2, 6	Protect town critical facilities	Increase drainage and absorption capacities in the stormwater detention basin behind the school and town hall.	M	5-years	M	Antimony Town	Antimony Town
Flood #2	4	Improve available flood risk data	Coordinate with Garfield County and FEMA for floodplain map updates.	L	Ongoing	L	FEMA, Garfield County, Antimony Town	Antimony Town
Earthquake #1	2	Protect town facilities and equipment from earthquake impacts.	Anchor rooftop-mounted equipment at the town office.	M	5-years	L	Antimony Town	Antimony Town
Severe Weather #1	5	Ensure the operation of critical facilities during and after a hazard event.	Purchase generators to operate equipment at the town Fire Station.	M	5-years	M	Antimony Town, CDBG	Antimony Town, Fire Department, Garfield County
Wildfire #1	1, 2, 4, 6	Reduce fuel loads in and surrounding the community.	Coordinate with state and local partners to complete fuels mitigation in the community.	M	Ongoing	L	Antimony Town	Antimony Town, BLM, Garfield County, Forest Service.
Wildfire #2	1, 2, 3	Address potential in town fire hazards.	Develop standard in town ordinances to protect propane tanks or other external fuel sources.	M	3-years	L	Antimony Town	Antimony Town

Radon #1	1, 3	Inform residents of Radon Hazard.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing, annually	L	Antimony Town, Department of Environmental Quality	Antimony Town.

Source: Local Planning Team

Boulder

Boulder Town is in central Garfield County, with significant connections to nearby national and state parks. The Town is located between Capitol Reef and Bryce Canyon National Parks, with nearby Escalante-Grand Staircase National Monument to the southeast. In the Town is the Anasazi Indian State Park which documents the history of the Puebloan cultures of the region and is a draw to tourists for the community.

Pioneer settlers first arrived in the late 1800s and used the area around Boulder for grazing. Settlement began in 1889 and the town incorporated in 1958. At the time of settlement, the primary economy was ranching and mining in the area. Overtime, the economy shifted as the community grew and improved transportation routes provided easier access to the region.

Demographics

As of the 2018 American Community Survey, the Boulder population is 178 people, seen in Figure 85. While this community has seen growth over the past 50 years, the 2018 estimate shows population loss of 21%, described in Figure 86. The most recent census is not yet available to include in this document.

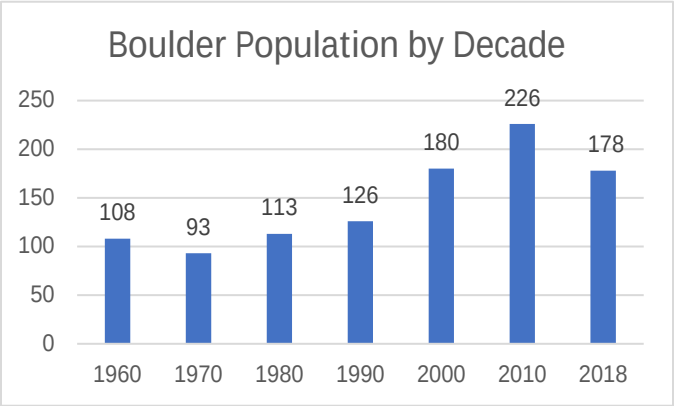


Figure 85: Boulder Population by Decade

Source: US Census Bureau

Population projections for Garfield County have been completed by the Kem C. Gardner Institute, which forecasts a 45% increase in the County's population between 2015 and 2065. If Boulder Town grows at approximately the same rate, the population is estimated to be near 189 by 2065.[2]

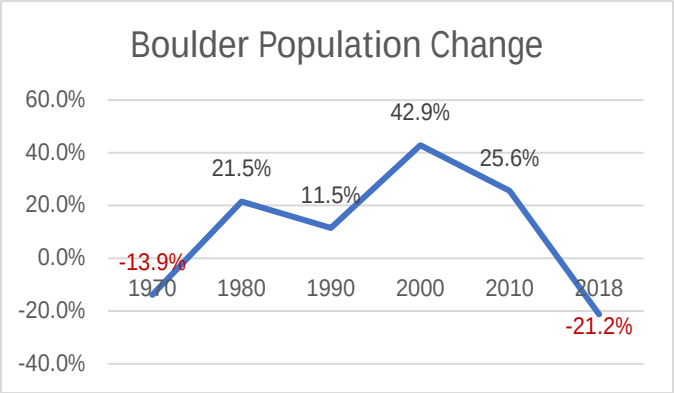


Figure 86: Boulder Population Change by Decade

Source: US Census Bureau

Development

The Town of Boulder has seen modest growth in the past 3-5 years, with the water company reporting approximately seven to ten new connections per year. The subdivision below the power plant and lower Boulder are where most of the new development is occurring. The town also has seen the addition of a new RV park.

Economy

Boulder's planning team describe tourism, agriculture, and local businesses as the primary economic drivers in the community. The US Census tool "On the Map" indicates that 75% of jobs in Boulder Town

[2] This estimate is derived using the 2015 ACS estimate for Boulder Town, which is 130 people to ensure that an accurate estimate of growth is provided. This population then applied the 45% forecast to arrive at 189 persons.

are in the Accommodation and Food Services industry, followed by retail trade[3], illustrated in Figure 87. The share of accommodation and food service jobs are significant in the community and point to the prominence of the tourism industry as visitors come to the community for amenities while visiting state and national outdoor areas. Mining and agriculture still maintain a foothold in the community economy.

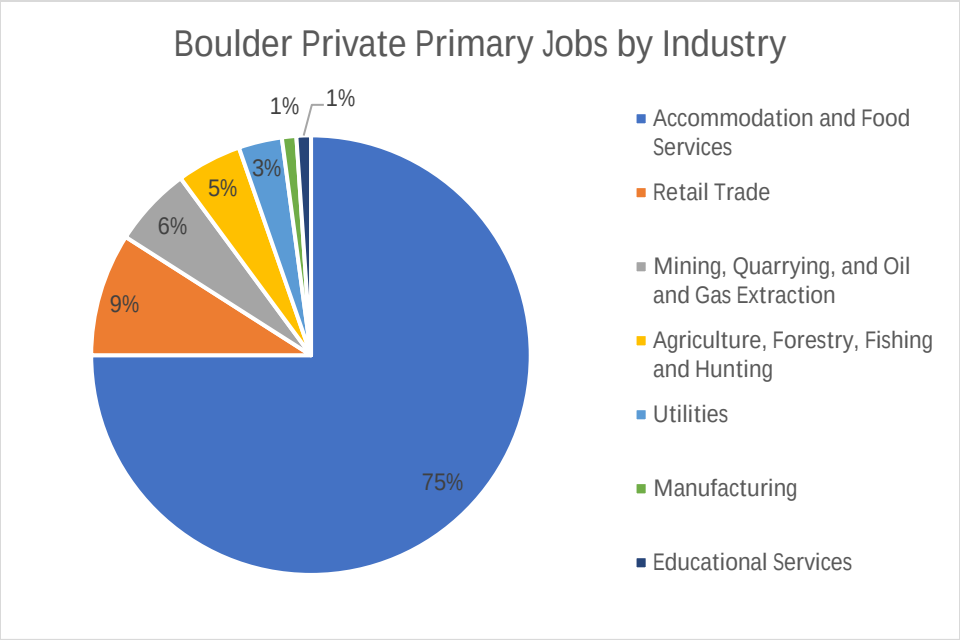


Figure 87: Boulder Share of Private Primary Jobs by Industry

Source, On the Map accessed 5/14/2021

Community Capabilities

According to the Boulder Town General Plan, the local government consists of a volunteer mayor, four council members, a five-person Planning Commission, and a board of adjustments. Residents of Boulder Town can find community information and public notices on the Community Bulletin Board, and at boulder.utah.gov.

The community has several volunteer-based emergency services, including a fire department, search and rescue, and ambulance. Law Enforcement services are provided to Boulder Town by Garfield County.

Several volunteer boards of community members address important local matters. The local Wildfire Council meets monthly or as needed to address the community wildfire risk through local action, Community Wildfire Preparedness Plan updates, and seeking new data and information.

Community Assets

The community has the Town Park, Boulder Elementary School, the Volunteer Fire Department, Community Center, Post Office, Garkane Energy, South Central Communications, and Boulder Farmstead Water Company. Boulder residents use individual septic systems for wastewater.

[3] The OnTheMap tool uses private primary jobs for this estimate. A worker that has more than one job will have their highest paying job counted in this estimate.

There is one cell tower, and the community set fiberoptic lines in 2012. These services were placed by South Central Communications.

Plans and Policies

Boulder local plans and policies describe community priorities and goals and indicate where certain types of development or uses should exist in the community. Some more specialized plans like the Community Wildfire Plan and Emergency Operations Plan describe how to prepare for and respond to natural hazard events in the community. Each the plans and policies are summarized below, to show existing natural hazard mitigation measures or actions.

General Plan

Boulder Town assembled a General Plan detailing community goals and objectives for development, economies, housing, and open space. This plan describes the importance of maintaining natural topography and protecting natural landforms in the community. One item in the plan details the need for public information regarding conservation, fire safety, earthquake, and other disasters. The plan also describes planned objectives including potentially laying utilities underground and requiring soil and environmental analysis on a site predevelopment.

Ordinances

Boulder subdivision and zoning ordinances include natural hazards and appropriate buildable spaces. Ordinances identify requirements for building or prohibit construction in spaces with topographical features that may be high risk, including steep slopes, flood plains, sensitive areas. Some provisions also allow the town council or planning commission to require on site improvements like flood, drainage, and fire protection improvements provided by the applicant for subdivision construction. Final applications may be required to present this information and inspections may be required. Engineers will be called to inspect public infrastructure in Boulder, including flood, drainage, and fire protection services and Subdivision applicants may be required to provide this infrastructure to new development. For Stormwater controls, the town bars curb and gutters from use unless approved by council.

Community Wildfire Preparedness Plan

The Boulder Community Wildfire Preparedness Plan (CWPP), established in 2018, indicates the mitigation, preparedness, and response needs and objectives for Boulder Town for fire safety. The CWPP describes challenges faced in Boulder based on its proximity to forest land, certain fuel types, and the homes in wildland interface areas. The plan and certain goals are further described in the wildfire section of this chapter. The Wildfire Council is currently engaging in an update of this plan, but as it is not complete, this Five County NHMP update refers to the data included in the 2018 iteration of the Boulder CWPP.

Emergency Operations Plan

The Boulder Emergency Operations Plan describes town response and recovery from certain natural hazard and emergency events. This plan was assembled in 2008 and references the Garfield County plan for certain descriptions of natural hazard events. This plan identifies how residents will be informed of a hazard event and what the Chain of Command will be for organizing a response. The emergency events indicated as potential risks to Boulder town in this plan include: Flooding, Earthquake, Severe Weather, Severe Winter Storm, Landslides, Hazardous Material Spills, and Terrorism.

Risk Assessment

Boulder Town experiences and is at risk to the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping. The Boulder Town planning team describes wildfire as one of their greatest natural hazard risks to the community, given the significant amount of open space surrounding the community and risk areas within the town.

Five County has worked with Boulder to develop a ranking the highest risk hazards based on probability and local exposure of the hazard. Exposure identifies where in the community this hazard is experienced and is illustrated using mapping and narrative. Five County assessments for Boulder Town include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Probability of future occurrence in the community considers the historic record and the geography of the area. The probability of an event occurring is described in the hazard descriptions below. This risk assessment is based on local insight and input, available data, Table 87 displays the relative risks of hazards in Boulder Town.

Table 87: Boulder Town Hazard Risk

HAZARD	RISK
SEVERE WEATHER	1- High
WILDFIRE	2- High
DROUGHT	3- High
FLOODING	4- Moderate
LANDSLIDE	5- Moderate
EARTHQUAKE	6- Low/Moderate
RADON	7- Low
PROBLEM SOILS	8- Low

A detailed description and mapping of each of the natural hazards that impact Boulder town can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in lowering the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Wildfire

Wildfire is one of the natural hazards that Boulder Town sees as its greatest risk, given its proximity to forested land and highly flammable fuel types in the area. While there have been no recorded wildfire events that have impacted this community, the residents and local governments have taken steps to lower their risk and prepare for a wildfire event. The community wildfire council meet as needed to discuss and address identified local risks and planned mitigation efforts, and the community participates in Community Wildfire Preparedness Planning.

Boulder has fuel types including pinyon, juniper, sage, and a growing tumbleweed infestation that can create fast moving fires in certain conditions. There is also significant forestland surrounding the community from nearby Dixie National Forest, Escalante Grand Staircase National Monument, and National Parks.

An assessment conducted by the Five County Association of Governments identifies the wildfire risk in Boulder, using Utah Wildfire Risk Assessment Portal wildfire risk data, developed by the Oregon Department of Forestry. Figure 88 illustrates the Boulder wildfire risk map, which shows that much of SR-12 and the northwest section of the community have the greatest risk to wildfire.

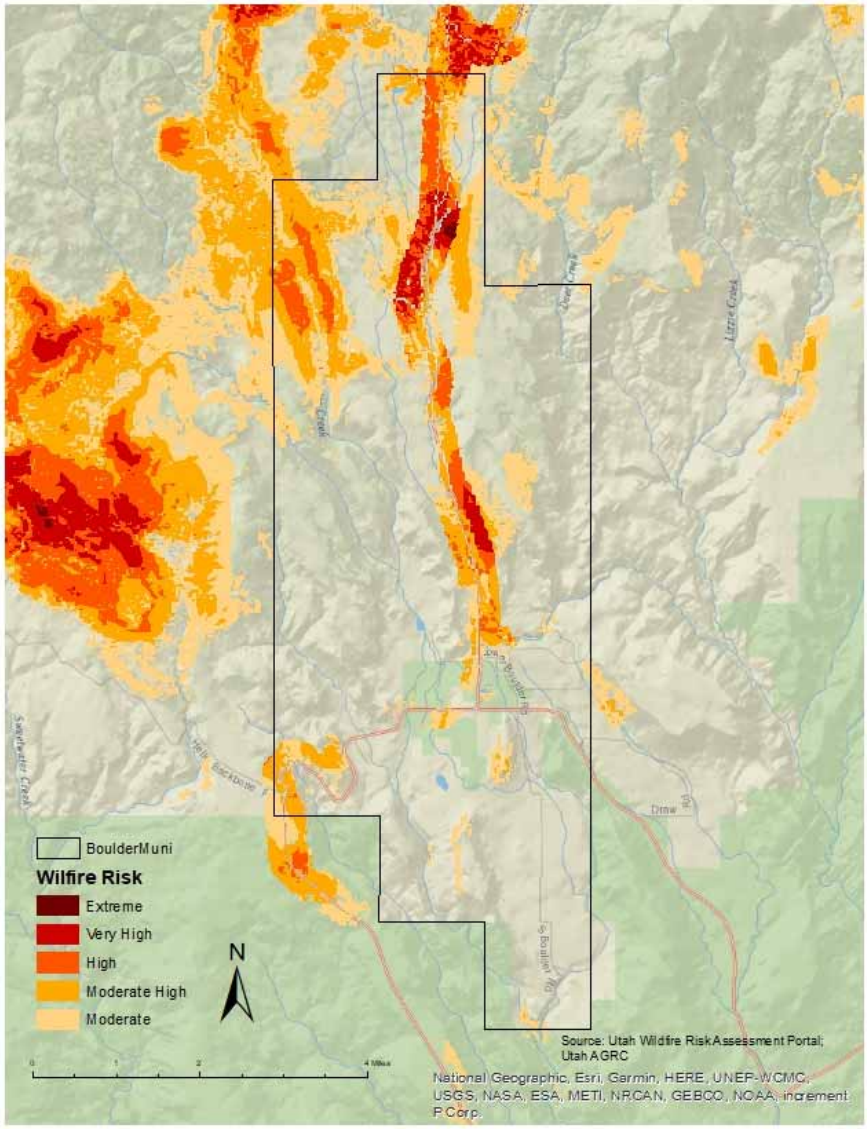


Figure 88: Boulder Town Wildfire Risk

Source: Oregon Department of Forestry.

In Five County's analysis, there are several areas in which assets, infrastructure, people, and property fall within identified wildfire risk areas. Table 88: Boulder Town Wildfire Exposure describes the percentage of local assets that may be exposed to wildfire. The miles of roadway and residential parcels in the community have the greatest exposure to wildfire risk, indicating that travel and resources entering and exiting town and residents and local economies are vulnerable to wildfires. There are no identified critical facilities in the wildfire risk area.

Table 88: Boulder Town Wildfire Exposure

Boulder Exposure to Wildfire						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			

0.0%	Unknown	41.3%	41.3%	55.4%	N/A	Unknown

Source: Oregon Department of Forestry, Utah AGRC

Utah Fire Info documents significant wildland fires in Utah from Fall 2017 to present. There are no large, documented fires for Boulder Town, although several areas in Southwestern Area have observed impacts from large wildfires and there is the potential that Boulder Town sees these impacts. Wildfires are likely, especially as drought conditions create dry fuels and low air moisture. Wildfires can be caused by severe weather events, flood, landslides, and earthquakes. Fires can also trigger or increase risks of landslides or flooding on bare soils.

Flood

Boulder has experienced floods primarily because of severe storms that cause flash floods, although there was a dam break from Spectacle Lake Dam that flowed through town.

The community described that there are several bridges in and near the community that cross waterways, one being the Boulder Creek and the other Escalante River. Local observations indicate that there have been occasions when creek waters flow high and may impact these bridges. The Utah Department of Transportation (UDOT) maintains these bridges and updates safety assessments on bridges across the state.

Five County analysis references mapped floodplains and dam inundation zones. Boulder has minimal interaction with the floodplain, as seen in Figure 89. The dam inundation zone runs north and south through a portion of the community.

Table 89 describes the community assets and resources that fall in the flood and dam inundation zones.

Table 89: Boulder Town Flood Exposure

Boulder Exposure to Flood & Dam Inundation					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
Unknown	10.1%	10.1%	9.7%	N/A	Unknown

Source: Utah AGRC

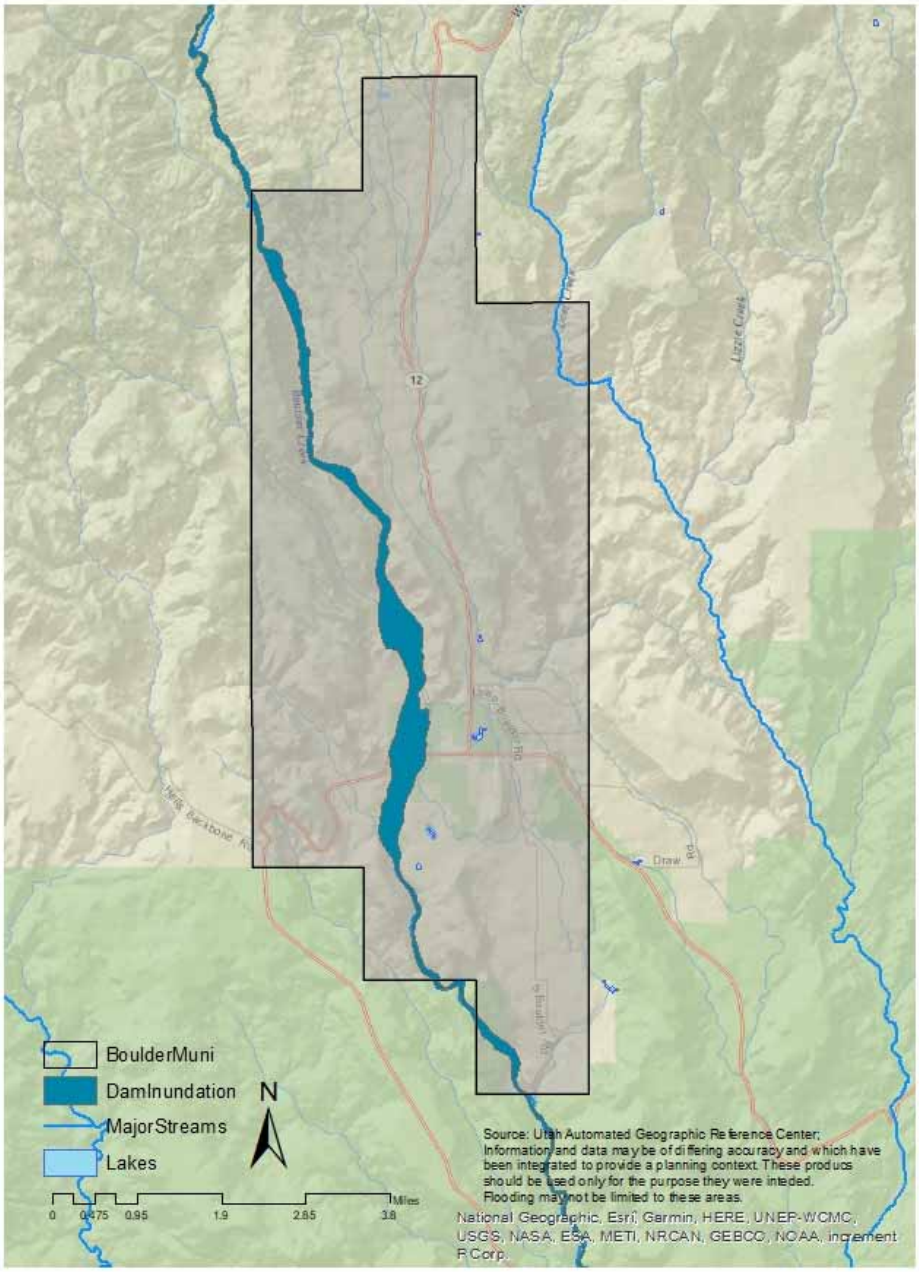


Figure 89: Boulder Town Floodplain and Dam Inundation Zone Map

As described in the Hazard Identification Chapter of this plan, flood occurrences are not limited to the mapped floodplain and can impact properties throughout Boulder town.

NFIP

The Boulder Town community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and

businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Boulder Town does not currently participate in the NFIP.

Hazard History

Flooding events occur in Boulder Town often as the result of severe weather as flash flooding. Six events have been reported by NOAA in Table 90.

Table 90: Boulder Reported Flood Events

Date	Damages or Injury	Description
9/16/2001	None reported	Flash flooding washed closed and partially washed out a road following a heavy rain and hailstorm between Boulder and Burr Trail.
9/2/2010	None reported	Flash flooding occurred at the southern end of Capitol Reef National Park, leaving Burr Trail Road impassible.
7/29/2014	None reported	Flash flooding was reported at Capitol Reef National Park along Pleasant Creek, South Draw Road, and the Sheets Gulch area.
8/4/2014	None reported	Thunderstorms on August 14 and 15 resulted in flash floods in Capitol Reef National Park and Grand Staircase-Escalante National Monument along Pleasant Creek, Sheets Gulch, and Cottonwood Wash.
10/5/2015	$5,000 in damages.	Flash flooding was reported in Deer Creek and Calf Creek and part of Hole-in-the-Rock Road washed out.
8/4/2019	None reported	Heavy rainfall and flash flooding was recorded in Escalante, Capitol Reef National Park, and elsewhere throughout Southern Utah.

Source: NOAA Storm Database

Flood impacts from this record indicate that roadways and roadway users are vulnerable to flooding, especially in and near recreation areas. Events that close bridges and roads can separate communities from resources, supplies, and essential services. Outdoor recreators can also be at risk to flooding in canyons and on trails.

Boulder Town is at a moderate risk to floods due to the potential for increase in severity and the documented history and damages. Climate impacts flooding risks, and as storms are projected to increase in severity in the coming decades, it is possible that southwestern Utah will see an increase in the severity of floods. Increased risk of wildfires also creates flooding concerns, as burn scars can turn into debris flows when flooded, as vegetation cannot hold the soil in place. Flooding trigger landslides, as changes in soil moisture on steep slopes can lead to landslides, debris flows, and rockfall.

Landslide

The mountainous and cliff side topography common in the southwest is where landslides occur. Despite its location, Boulder Town does not have a record of landslides impacting the community. Understanding the potential risks of landslides on the community, Boulder Town has adopted an ordinance which prohibits development in identified steep slope areas, which can limit exposure to landslides.

An assessment of Landslide Susceptibility, completed by the Utah Geological Survey, has been used to understand where in Boulder may be at risk to Landslides. The Five County Association of Governments observed areas that were marked with a moderate to high landslide susceptibility and included them in Figure 90 below, which illustrates the areas of the community that may be at elevated susceptibility to landslides.

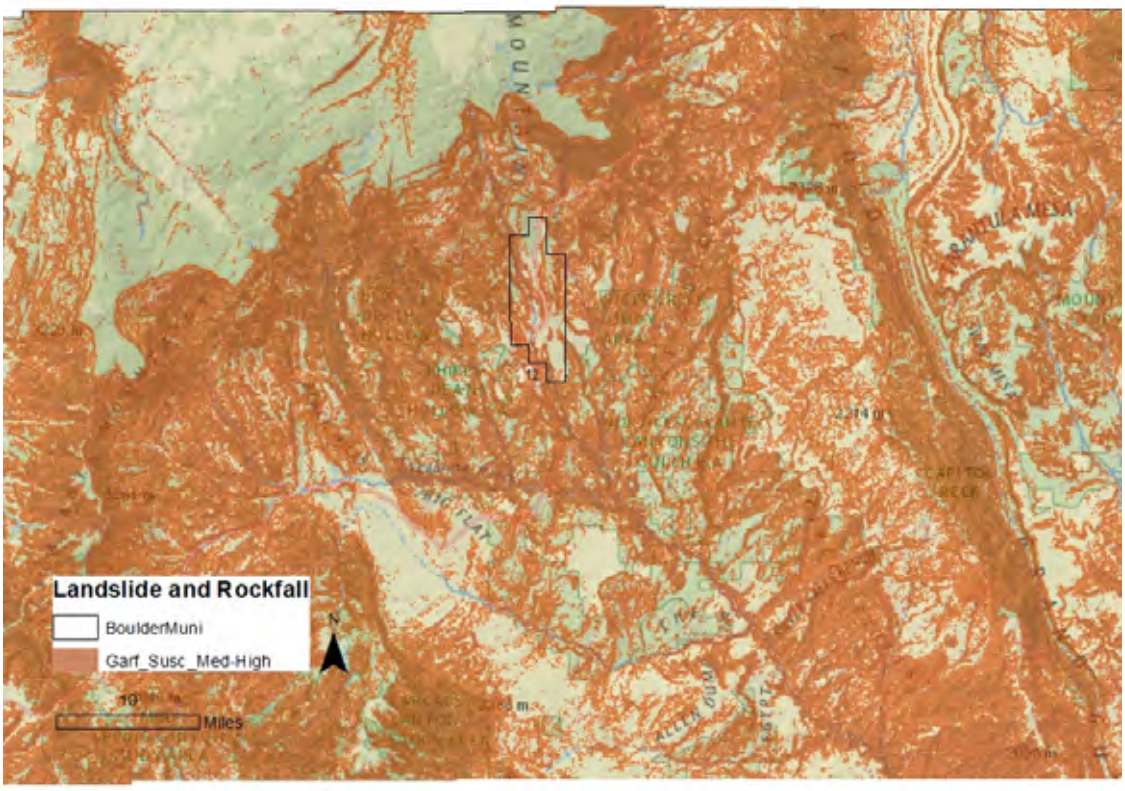


Figure 90: Boulder Town Landslide Susceptibility

Source: Utah Geological Survey, Utah AGRC

In Five County's assessment, we compared where community assets, resources, and property exist relative to the landslide susceptible areas, described in Table 91. Essentially roadways are at greatest risk to landslides in Boulder Town.

Table 91: Boulder Town Landslide Exposure

Boulder Exposure to Landslide					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
0.0%	0.0%	0.0%	48.3%	N/A	N/A

Source: Utah Geological Survey, Utah AGRC

Events like flooding and severe weather can contribute to landslide hazards. In turn, Landslides can cause flooding hazards, especially when a landslide blocks a waterway, causing water to pool. Changes in climate patterns will likely contribute to landslide hazards as severe storms and wildfires increase in severity.

Earthquake

Given that there are no fault lines mapped in Boulder town, there are no community assets or infrastructure within a quarter mile of a fault in town, as seen in Figure 91. This does not mean that there is no risk to Earthquakes in Boulder. Strong to very strong shaking possible for this area if a strong earthquake occurs on one of the Southwestern faults.

A factor that contributes to earthquake risk is the type of construction, and compliance with modern seismic codes in structures. The State of Utah has adopted the International Building Code, which describes design standards for seismic safety. Such codes have been in use since 1975, and there are structures throughout the state that have been built before these codes went into effect, with unreinforced masonry. Several structures in Boulder Town are recorded as being built before 1975, before seismic standards were enforced in the building codes in Utah. These structures can have a greater potential for damage during a shaking event than modern construction. In Boulder Town, nearly 25% of residential parcels have construction that took place before 1975.

Figure 91: Garfield County Earthquake Epicenters and Quaternary Faults

Source: Utah Geological Survey, Utah AGRC

Hazard History

The closest epicenter was recorded 14-miles north of Boulder town, with no earthquakes documented in the town boundary.

Earthquakes are difficult to predict and can be damaging to a community. Events occur often in Utah, although normally at lower magnitudes. Earthquakes have the potential to trigger other natural hazard events due to structure and infrastructure damage, including floods, wildfire, and landslides and rockfall. Liquefaction is another byproduct of strong shaking in certain scenarios, the soil becomes like a liquid and can flow or lose integrity, damaging structures, and infrastructure. Liquefaction data was not available for an assessment of Boulder.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Drought will continue to be a concern in southwestern Utah.

While Boulder has experienced drought experiences, there were no identified instances of past impacts on the community or its economic sectors. Boulder's economy centers on agriculture and tourism, which can both be susceptible to drought impacts. Drought can contribute to hot and dry conditions, especially in summers that pose challenges to these industries. Crops may be lost, or damaged, and dry conditions can contribute to increased risks of wildfire in the area.

Tourists, especially those in the backcountry can experience issues with access to water sources outdoors and can be susceptible to dehydration or heat related illness. The perception of poor recreation conditions, (low water levels for boat or watersport activities for example) or the perception of risk (wildfire) associated with drought conditions can deter travelers and recreationists from visiting at risk areas, according to a report completed by the National Integrated Drought Information System (NIDIS), in partnership with the University of Colorado. The report can be accessed at https://www.drought.gov/sites/default/files/2020-09/drought-and-outdoor-recreation-report-9-16-20.pdf.

Drought may also impact local water systems and resident. Water systems can have difficulty recharging in drought conditions, even when underground. This can translate to residential water use and the need to conserve water during times of drought.

With Boulder's concern for wildfire impacts on the community, drought is of particular concern, as drought conditions can lead to dry fuels and contribute to rapidly burning fires in some instances. Reduced water supply can also impact a community's ability to respond effectively to fire situations.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Boulder, however our analysis assumes that severe weather events will impact the whole of Boulder residents, facilities, infrastructure, businesses, and property.

Boulder Town is a high elevation desert area, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Locals describe past snowstorms that caused residents roofs to cave-in, and rain fall that caused flash flooding.

Hazard History

NOAA reports five severe weather incidents for Boulder, UT between 1950 and 2020, one lightning strike and four thunderstorms, detailed in Table 92. The lightning strike resulted in the death of a camper. No property damages have been documented by NOAA, although locally there have been reported damages following severe weather events.

Table 92: Boulder Severe Weather Record

Date	Injury/Damage	Description
7/21/2012	1 death	A thunderstorm produced lightning, with a strike killing a man recreating on the west side of Boulder Mountain.
3/31/2013	None Reported	Thunderstorm produced high winds with a peak gust of 60 MPH reported at Boulder Summit.
5/14/2015	None Reported	Thunderstorm produced hail and damaging wind with a peak wind gust of 60 MPH at Boulder Summit.

9/14/2017	None Reported	Thunderstorm caused strong wind and flash flooding across southern Utah, with peak wind gust recorded at Henry Mountain with gust of 70 MPH.
6/13/2019	None Reported	Damaging winds and hail reported during a thunderstorm, with peak gusts of 62 MPH reported at Boulder Summit.

Source: NOAA Storm Database, accessed 5/14/2021.

Severe weather will continue to impact Boulder town, as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the Boulder flooding section of this assessment.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Boulder from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 92. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

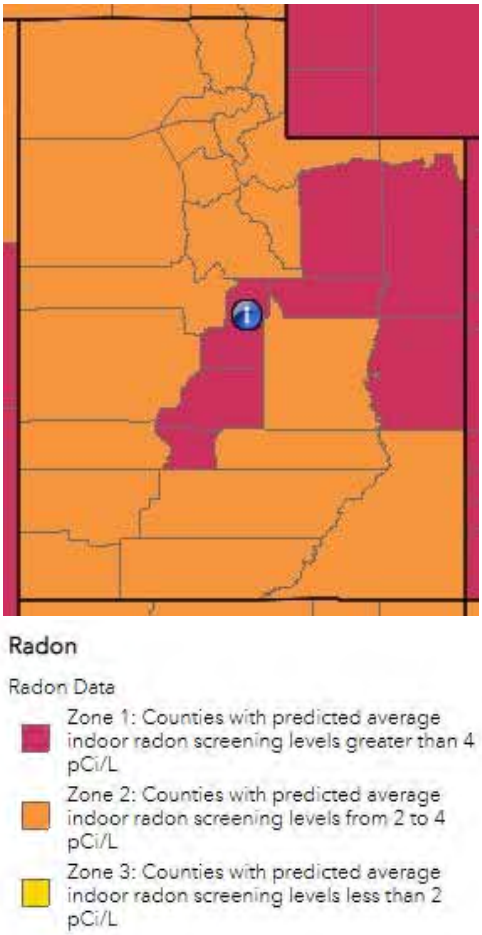


Figure 92: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the

public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 93 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 93: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

There are no mapped problems soil potential in Boulder Town, although the community has indicated in the General Plan that they would consider Geological studies for certain areas of the community to avoid certain hazards. Figure 93 shows the mapped problem soils near Boulder from Utah Geological Survey data from 2011. While there are not mapped problem soils in the community, geological or engineering study of new development can inform potential needs for mitigation on a site for many geologic hazards.

More recent problem soil mapping efforts have not included Boulder Town in the study boundary. Additional mapping and data that includes communities like Boulder Town would offer improved opportunity to mitigate natural hazard risks and understand risks to property and development.

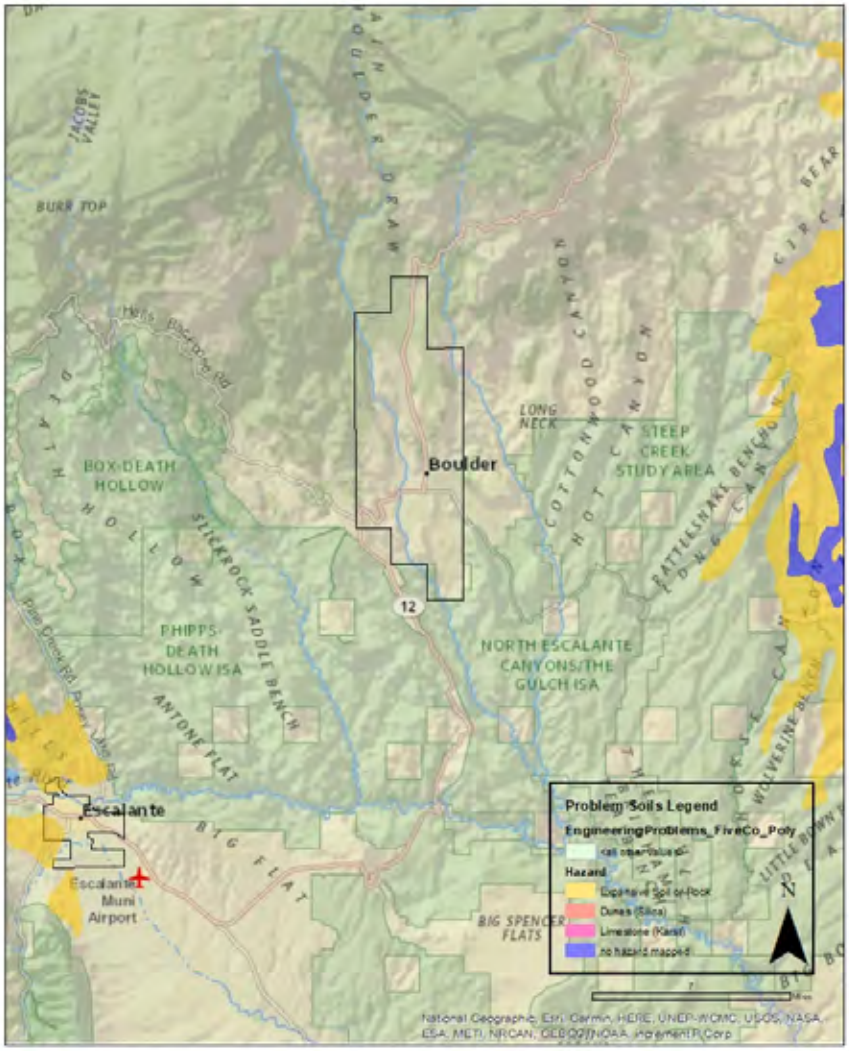


Figure 93: Boulder Town Problem Soil Map

Source: Utah Geological Survey, Utah AGRC

Mitigation Strategy

The mitigation strategy is an outline for Boulder to address the risks and vulnerabilities identified in this planning process. The strategy includes a list of actions, estimated timeline, funding opportunities, and responsible parties to complete the actions outlined in the strategy. Communities can include the actions in upcoming plan updates or code amendments, existing or future projects in the community for implementation.

Progress on 2016 Mitigation Strategy

Boulder Town participated in the 2016 iteration of the Five County Natural Hazard Mitigation Plan and identified two actions to mitigate natural hazard risks in the community. The natural hazard plan is intended to be iterative and documents progress from previous planning efforts. Table 94 describes the progress made on actions from the 2016 mitigation strategy.

Table 94: 2016 Boulder Mitigation Strategy Progress

Action Number	Objective	Action	Timeline	Funding Source	Progress
Landslide #1	Prevent damage to property and environment from landslides through zoning and development standards.	Adopt a zoning ordinance that prohibits development on slopes exceeding 30% average grade or on sensitive lands. Including the prevention of excavating or grading in areas of sensitive lands, hillside, and Mesa Tops Overlay District prior to final approval by the proper officer or body. Information will be required for development in areas of slope exceeding 15% average grade.	1-Year / Ongoing	Town Operating Budget	Complete
Wildfire #1	Educate property owners and citizens about actions that they can take to reduce risk to property, and the risks of wildfire.	Organize the local Fire Academy to inform residents of wildfire danger, and educate citizens about fire mitigation systems, defensible spaces, etc. Hand out fire safety materials. The town will also keep hydrants clear of weeds and debris.	Ongoing / Annual	Town Operating Budget	Complete

2022 Mitigation Strategy

The Boulder Town local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 95. These actions have been identified and discussed during planning meetings based on the risk assessment. Boulder considers landslide a greater risk to areas outside of the community, including the road into and out of the community, and thus mitigation strategies have not been included for landslides.

Each action in Table 95 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 94.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 94: Regional Plan Goals

Table 95: 2022 Boulder Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Potential Funding	Responsible Party
Multi Hazard #1	4, 5	Prepare for emergency and hazardous events.	Education of the Emergency Operations Plan (EOP), including: · Public education about evacuation/shelter locations. · Emergency Response Teams training about EOP operations, to include County responders in the area.	M	1-years	L	Boulder Town	Boulder Town
Multi Hazard #2	4, 5	Prepare for emergency and hazardous events.	Establish an agreement with Boulder Churches to use these spaces as evacuation and	L	1-years	L	Boulder Town	Boulder Town, Local church organization s

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Potential Funding	Responsible Party
			shelter for area residents and visitors during an emergency.					
Severe Weather #1	1, 3	Protect residents & visitors from extreme temperatures.	Amend EOP ordinance to include daytime shelter locations during extreme heat and cold temperature events prevalent to the area.	L	1-years	L	Boulder Town	Boulder Town
Wildfire #1	1, 2	Reduce wildfire risk.	Adopt WUI codes to strengthen community information and ability to regulate and reduce wildfire risks.	M	Complet ed	L	Boulder Town	Boulder Town
Wildfire #2	1, 2	Reduce wildfire risk.	Update Community Wildfire Preparedness Plan.	M	Ongoing	L	Boulder Town	Boulder Town & Boulder Wildfire Council
Wildfire #3	1, 2, 3, 6	Engage residents in wildfire mitigation on personal property.	Organize community clean up and education days with residents and property owners. Include mechanical thinning and cleanup of fuels on wildland interface areas along boundaries of City.	H	Ongoing	L	Boulder Town	Boulder Town & Boulder Wildfire Council
Wildfire #4	4, 6	Coordinate with local property owners to mitigate property.	Establish partnership with Irrigation Water Company for the maintenance of drainage ditches to reduce wildfire fuels growing in ditches.	M	Ongoing	M	Boulder Town; Irrigation Water Company .	Boulder Town; Irrigation Water Company.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Potential Funding	Responsible Party
Flood #1	2, 4	Protect critical access routes from flooding impacts.	Assessment of Boulder Creek Bridge in partnership with UDOT and Garfield County to address stability concerns due to flooding. Steps in the assessment include: · Review existing UDOT assessments of bridge structures; · Share observed floods impacting these bridges with UDOT; · Coordinate with UDOT for additional structural assessment or retrofit of bridges if needed.	M	5-years	H	Boulder Town, UDOT	Boulder Town, Garfield County, UDOT Potential Partner: Escalante City
Flood #2	4, 6	Coordinate with local property owners to mitigate property.	Establish partnership with Irrigation Water Company for the evaluation of drainage capacity and maintenance of ditches to reduce flooding risk to residents.	M	Ongoing	L	Boulder Town; Irrigation Water Company .	Boulder Town; Irrigation Water Company.
Earthquake #1	3, 4, 5	Inform residents of earthquake vulnerability and risks.	Register for and participate in the Great Shakeout event annually.	M	1-year	L	Boulder Town	Boulder Town
Drought #1	3	Inform residents of drought risks and conservation practices.	Provide public education in partnership with the private culinary and irrigation water companies to inform residents on water challenges and drought conditions locally, including the need for waterwise use.	H	Ongoing	L	Boulder Town	Boulder Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Potential Funding	Responsible Party
Problem Soils #1	1, 2	Collect data to inform mitigation activities.	Coordinate with the Utah Geological Survey to better understand the extent that Problem Soils are a risk to development in the community. May include new mapping of the area.	L	Ongoing	L	Boulder Town, Utah Geological Survey	Boulder Town, Utah Geological Survey
Radon	3	Inform residents of radon risks and mitigation.	Coordinate with Garfield County to inform residents of radon risk and in home mitigation.	H	Ongoing, annually	L	Boulder Town, Garfield County	Boulder Town, Garfield County, Utah Dept. of Environmental Quality.

Source: Local Planning Team

Bryce Canyon City

The Bryce Canyon City is a community in south-central Garfield County. The community is located north of Bryce Canyon National Park and east of Red Canyon National Forest. The area sees significant visitation as a gateway to the national park. The city was incorporated in 2007.

Bryce Canyon City has a population of 201 as of the 2018 American Community Survey and has seen a population decline of 21.2% since the 2010 Census.

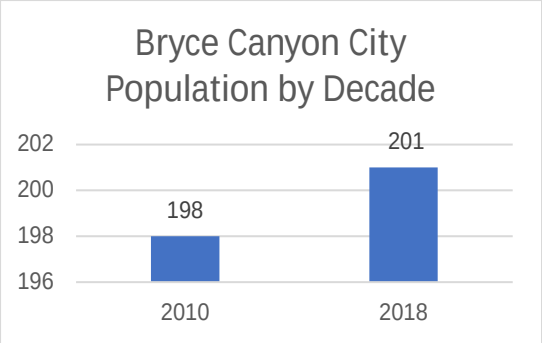


Figure 95: Bryce Canyon City Population by Decade

Source: US Census Bureau

According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Antimony, the population by 2065 may be near 290 people. In addition to these permanent residents, this area of Garfield County sees significant annual visitation, for the National Park and other recreation assets in the area. The community general plan estimates that the average population, including visitors is approximately 7,500 during peak summer months (Bryce Canyon City, 2019).

According to the US Census on the Map tool, most jobs in Bryce Canyon City are in the Accommodation and Food Services Industry, illustrated by Figure 96. Given the proximity to prominent outdoor recreation attractions, tourism is a driver of the community here. Interesting industries present in the community include professional, scientific, and technical services and Information. The data excludes public services, which likely occupies a share of the community jobs.

Figure 96: Bryce Canyon City Share of Private Primary Jobs by Industry

Source: US Census, OnTheMap, 2021

Development

The town has reported limited development in the past several years, with one new apartment complex constructed since the last plan was developed.

Community Capabilities

The community is governed by a volunteer elected town council and a Mayor. Bryce Canyon City has a clerk to assist with general government operations. Law enforcement is provided by the County Sheriff's Office in Panguitch.

The town residents rely on wells for drinking water. Other utilities are provided by Garkane Energy or Rocky Mountain Power.

Plans and Policies

Bryce Canyon City engages in planning activities which address or relate to hazard mitigation planning. To summarize the objectives, policies, and implemented activities, Five County Staff summarized the plans which describe mitigation.

General Plan

Bryce Canyon City's General Plan (2019) describes several community goals and objectives related to mitigation of severe weather and flooding. The community has a strategy that requires developers to design a site to be compatible with severe weather, including natural vegetation capable of surviving in this environment. This strategy addresses both drought and severe weather locally. Flooding requirements call for streetscapes to be built with vegetation and curb and gutter, which can address storm water and flooding events. In addition to the direct strategy to mitigate hazards, the community seeks balance with natural systems and open lands, historic preservation, and planning to meet future infrastructure demands.

Risk Assessment

Bryce Canyon City experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Bryce Canyon City to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 96 displays the relative risks of hazards in the community.

Table 96: Bryce Canyon City Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
WILDFIRE	3. Moderate

EARTHQUAKE	4. Moderate
FLOOD	5. Low
LANDSLIDE	6. Low
RADON	7. Low

A detailed description and mapping of each of the natural hazards that impact Bryce Canyon City can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Bryce Canyon City include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Bryce Canyon City is surrounded open space. Given the arid environment, Bryce Canyon City is at risk to wildfire. There has not been a significant wildfire event that has affected Bryce Canyon City, according to FEMA and the Utah Department of Natural Resources, although this lack of past events does not mean that a wildfire cannot occur.

Figure 97 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Bryce Canyon City that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Risk to wildfires is in the central area of the community, likely due to the concentrations of local assets and population in this area.

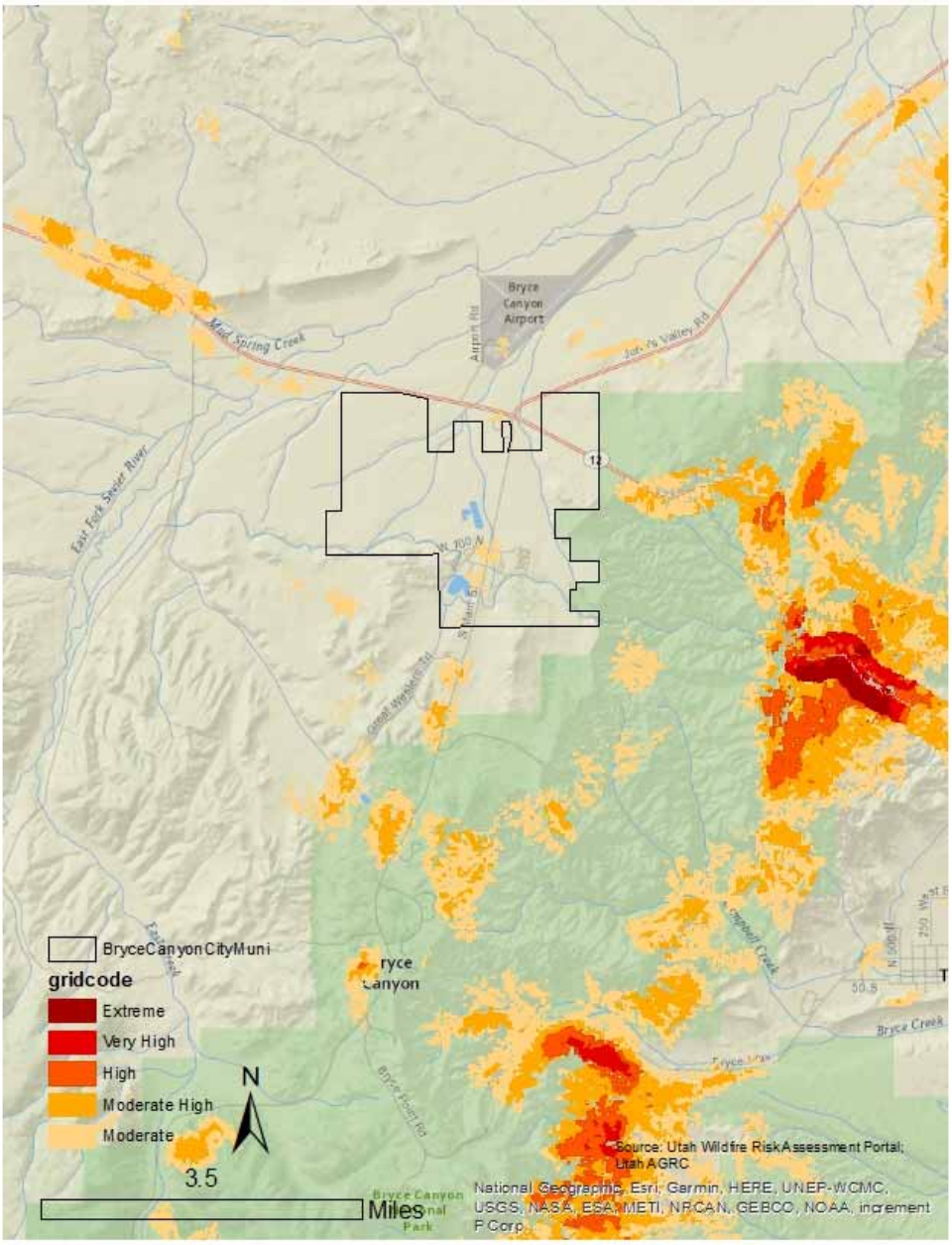


Figure 97: Bryce Canyon City Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 97 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Bryce Canyon City. Bryce Canyon City's 35.5% of residential parcels are exposed to wildfire risk areas with 2.0% of road miles exposed. Structures where people live and visit, and conceivably those that house commercial endeavors are vulnerable to wildfire based on this analysis. Critical facilities are not recorded in a wildfire risk area, which can result in a safer community and protection of community assets.

Table 97: Bryce Canyon City Wildfire Risk

Bryce Canyon City Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	35.5%	Unknown	2.0%	N/A	0.0%

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Bryce Canyon City and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah and the Great Basin area has significant seismic activity, reporting several earthquakes annually. These earthquakes tend to be small and barely felt in communities, however several faults in the state have the potential to produce severe earthquakes. There are no mapped Quaternary Fault lines in Bryce Canyon City, with the closest being the Sevier-Toroweap faults approximately 10-miles west of the city and the John's Valley Fault 10 miles to the north, as seen in Figure 98. Earthquakes can happen throughout the state. Although fault lines tend to be the most common cause of large earthquakes, they can still occur and can cause impacts in areas, including Bryce Canyon City.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Bryce Canyon City has 5.9% of residential parcels have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

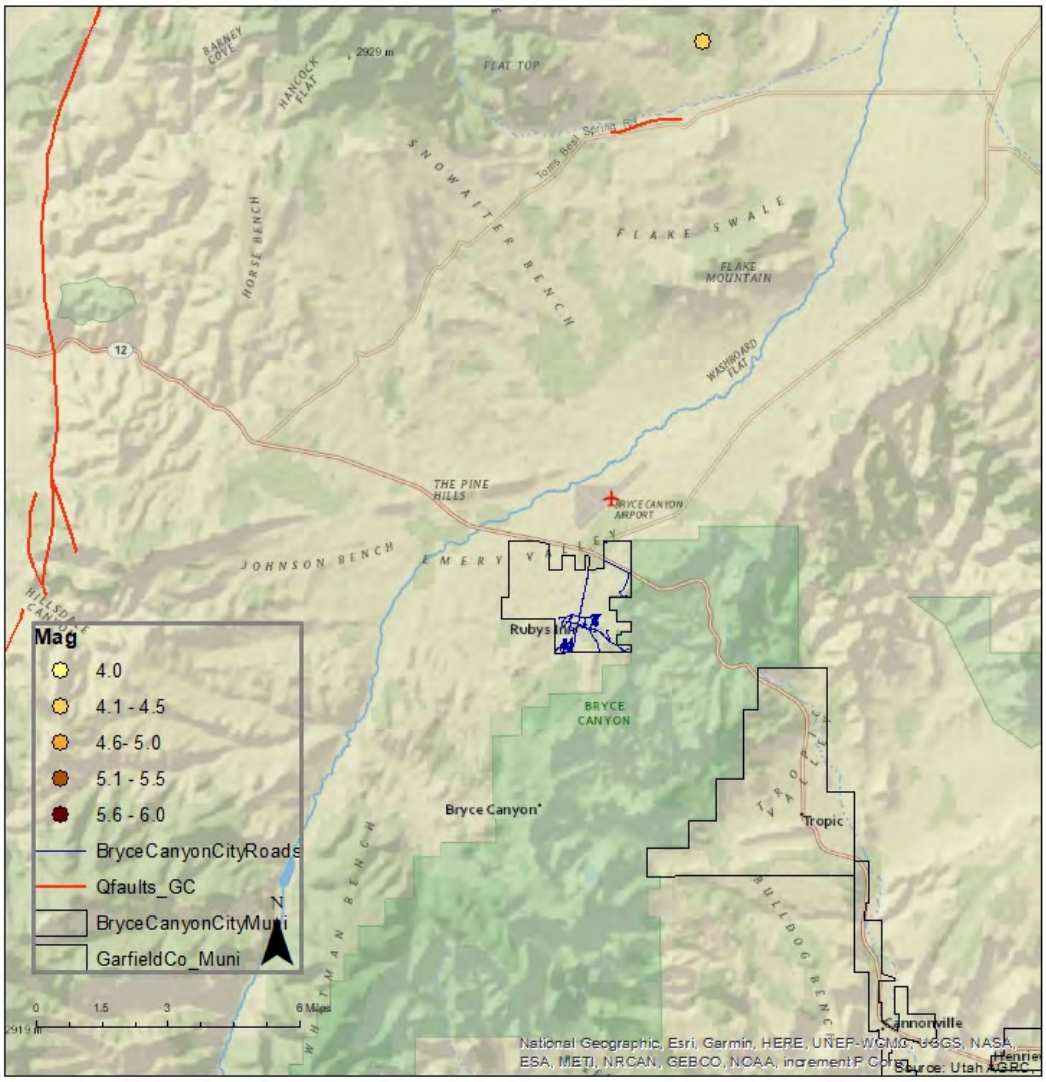


Figure 98: Bryce Canyon City Earthquake Epicenters and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Hazard History

Earthquake epicenters of 4.0 or greater have not been reported in Bryce Canyon City, UT, although one epicenter have been reported in the unincorporated county approximately 11 miles north of the City. Table 98 describes the events of 4.0 and greater which have occurred near Bryce Canyon City.

Table 98: Bryce Canyon City Earthquake Epicenter Record

Earthquake Epicenters		
Year	Location	Magnitude (4.0 +)
2012	9 miles north of Bryce Canyon City, Garfield County	4.13

Source: University of Utah Seismology Stations

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a

potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Bryce Canyon City.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 99 describes the flood and dam inundation exposure in Bryce Canyon City. As illustrated in the map, Bryce Canyon City includes mapped floodplain in the city boundaries, with dam inundation impacting the area north of the city boundary.

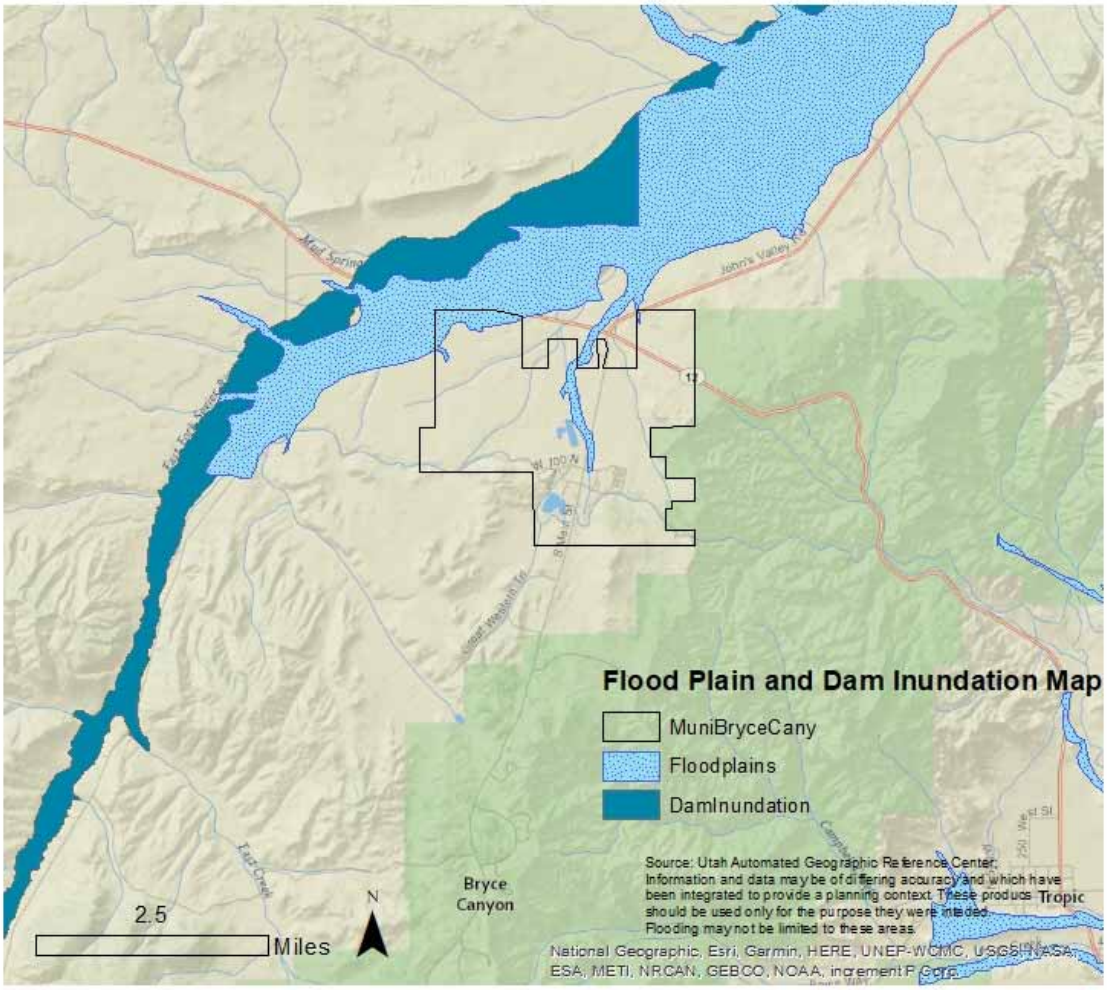


Figure 99: Bryce Canyon City Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 99 further examines the exposure to identified flood risk areas in Bryce Canyon City, by observing community assets and structures that are in at-risk areas. The table shows that 0.0% of residential parcels are exposed to the floodplain or dam inundation zones. Local road miles are the roadways which interact with the floodplain are access roads to the community.

Flooding on such access roads can lead to transportation delays, and impact response during an emergency event.

Table 99: Bryce Canyon City Floodplain and Dam Inundation Exposure

Bryce Canyon City Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
N/A	Unknown	0.0%	Unknown	2.6%	N/A	0.0%

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Bryce Canyon City property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Flood Insurance Rate Maps were developed for the unincorporated county in 1986. Bryce Canyon City is not listed in the FEMA Community Status Report and does not participate in the NFIP. The City does not have a floodplain manager.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. There are no severe flooding events reported for Bryce Canyon City, although flooding is a possibility in this area. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Events in neighboring communities may have also impacted Bryce Canyon City but did not include documentation. Refer to those communities' section or to the unincorporated County section for further information.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 100 maps the landslide susceptible areas in Bryce Canyon City. The map describes landslide susceptible areas in the community.

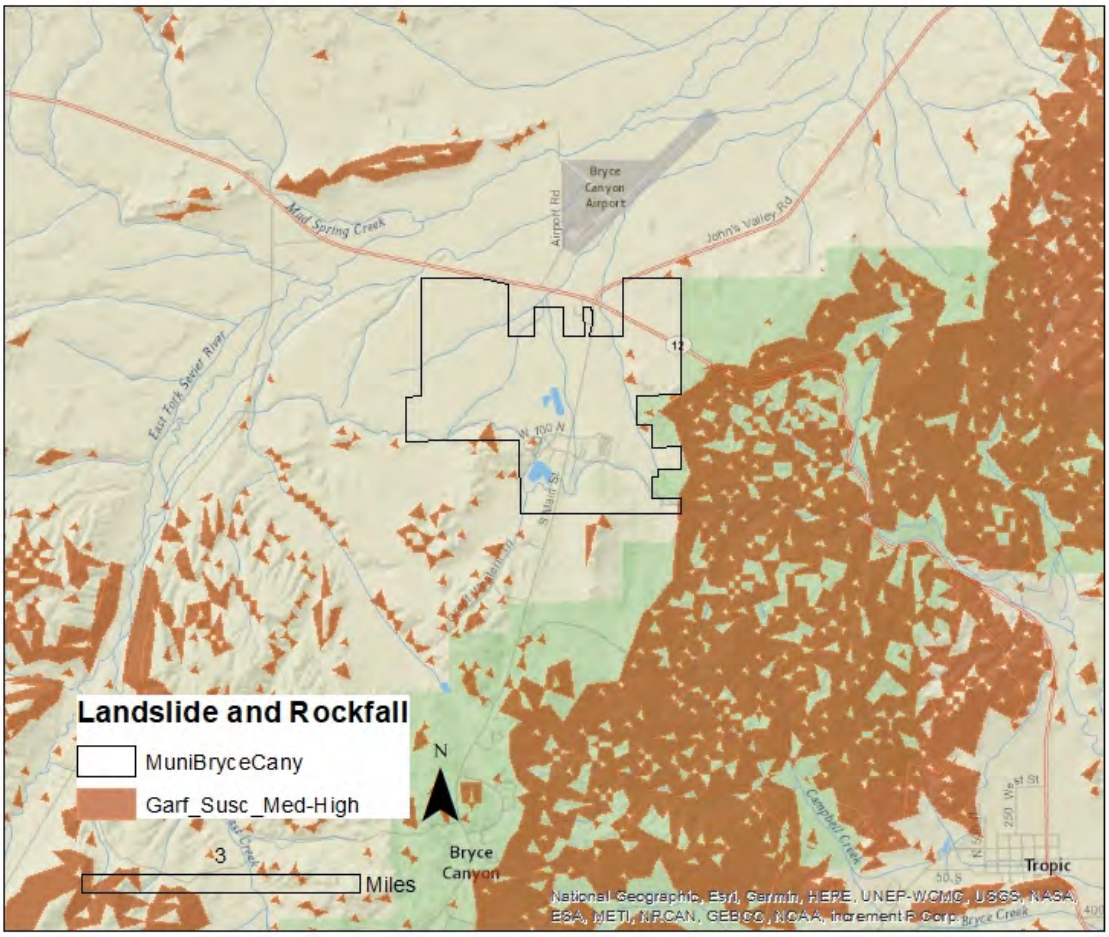


Figure 100: Bryce Canyon City Landslide Susceptibility Exposure

Source: Utah Geological Survey

Bryce Canyon City itself sees minimal exposure to landslide susceptible areas, other than a few intown hillsides. Table 100 describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Bryce Canyon City describe that 0.3% of road miles are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate the community from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period.

No residential parcels are not presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 100: Bryce Canyon City Landslide Susceptibility Exposure

Bryce Canyon City Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
N/A	Unknown	0.0%	Unknown	0.3%	N/A	0.0%

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

To date, landslides have not been reported causing impacts in Bryce Canyon City, however the county has reported landslides which may have impacts on the city and its economy. In 2017, a landslide impacted SR-12, removing a chunk of the roadway, and impacting traffic flow into Bryce Canyon National Park. The reconstruction project is estimated at $8 Million. The impacted section of road had previously been affected by landslide that required repair.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are the primary economic drivers in Bryce Canyon City. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 101. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

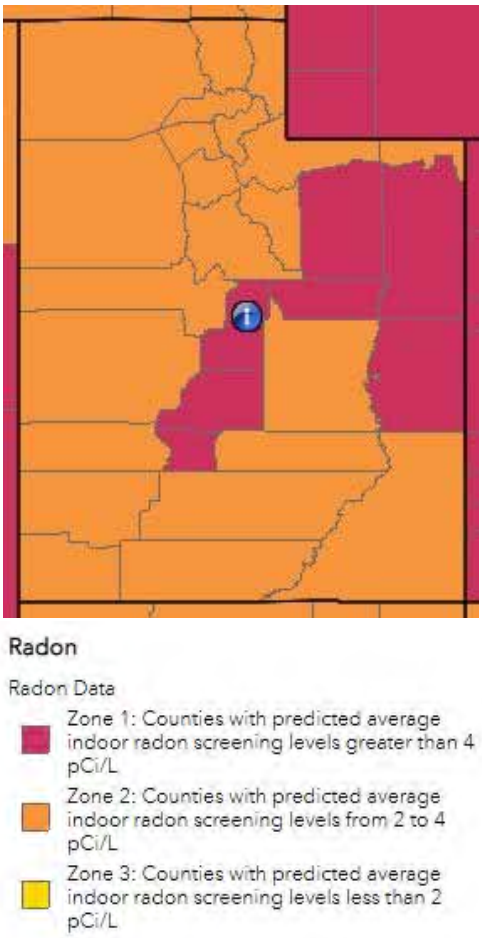


Figure 101: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 101 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 101: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Bryce Canyon City, however our analysis assumes that severe weather events will impact the whole of Bryce Canyon City residents, facilities, infrastructure, businesses, and property.

Bryce Canyon City has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Bryce Canyon City, which can produce hail, high winds, rain, and lightning.

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Seven total weather events have been recorded with impacts to Bryce Canyon City between 1950 and 2020, which are documented in Table 102. Other county events likely impacted Bryce Canyon City and should be reviewed in the County section of this hazard plan.

Table 102: Bryce Canyon City Severe Weather Record

Date	Property Damage/Injury	Description
8/16/2000	1 Injury	A Bryce Canyon National Park visitor was struck by lightning while standing under a tree and recovered after treatment.
8/18/2011	1 Death	A Bryce Canyon National Park visitor was struck by lightning while under a tree during a thunderstorm.
5/15/2012	None reported	Bryce Canyon reported high winds recording a gust of 70 MPH associated with a thunderstorm impacting the state.
7/4/2013	3 Deaths	Extreme heat contributed to the death of three hikers across Garfield and Kane Counties.
7/22/2013	1 Death	Extreme heat contributed to the death of a hiker in Kane County.
5/14/2015	None reported	Bryce Canyon reported wind gusts of 67 MPH associated with a storm system affecting southern Utah.
9/13/2016	None reported	Bryce Canyon reported wind gusts of 67 MPH associated with a storm system across the state of Utah.

Source: NOAA Storm Database

Lightning and high winds are common severe weather events in Bryce Canyon City and have the potential to cause damage, injury, and death. Extreme heat is also a challenge throughout the Southwest and while the deaths reported did not occur in Bryce Canyon City, the City and nearby recreation areas likely also saw extreme heat in the area during these events.

Severe weather will continue to impact Bryce Canyon City as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the County on behalf of Bryce Canyon City, which requires that all construction has a geologic study pre-construction. Figure 102 illustrates where mapped problem soil areas are in Garfield County, primarily in the east central portion of the County, with some expansive rock near Tropic and Escalante. No problem soils are currently mapped for Bryce Canyon City.

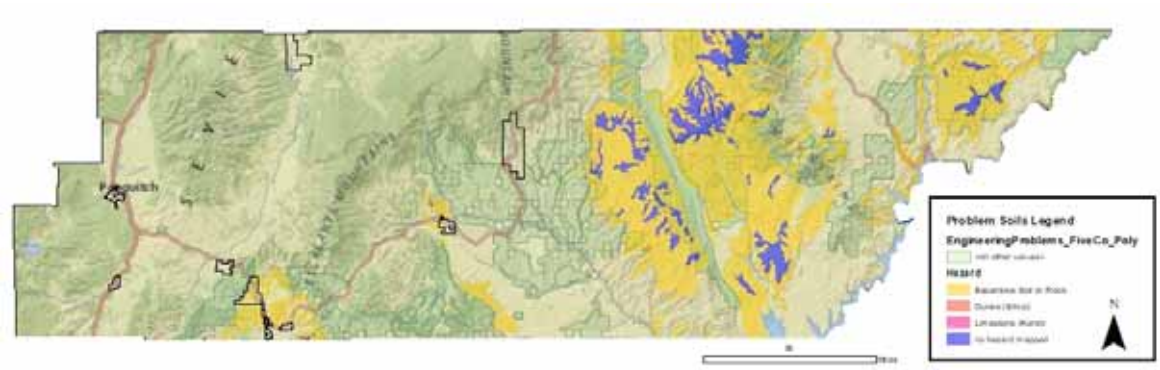


Figure 102: Garfield County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

Summary

Bryce Canyon City is exposed to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Limited known risk currently exists for problem soils throughout the community. Vulnerabilities identified through this process highlight that roadways and homes, in addition to potential economic impacts from supply chain delays, access or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have historically been impacted by severe weather and landslides and have the potential to be impacted by flooding, drought, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Bryce Canyon City has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Bryce Canyon City and are listed in Table 103 with a description of their progress.

Table 103: 2016 Bryce Canyon City Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Severe Weather #1	Protect life and property from severe weather events (E.g. severe winter storms and severe heat), and provide back up electricity in the event of a long-term power outage.	Encourage all businesses and critical facilities to have enough backup generators to efficiently provide for life sustaining essentials until the power is restored. E.g. power for an oxygen concentrator for those in need. Encourage businesses and tourism departments to provide emergency preparedness material to visitors.	1 year/ongoing	Operating budgets of businesses and Bryce Canyon City	Completed. Several restaurants, hotels, and businesses have generators. Fire and wells have generators.
Wildfire #1	The potential spread of wildfire into Bryce Canyon City	Mechanical thinning and cleanup of fuels on wildland interface areas along boundaries of City.	Ongoing mitigation annually	US Forest Service	Ongoing. Forest service has done some mechanical clearing and controlled burns. City constantly engages in mitigation in city owned forest areas.

Source: 2017 Five County Association of Governments NHMP

The local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 104. These actions have been identified and discussed during planning meetings based on the risk assessment.

To develop the 2022 iteration of the natural hazard mitigation plan, high level goals were determined to guide the planning process across the region. Regional plan goals are listed in Figure 103 and have been included in Table 104 to align with local mitigation strategies. The elements included in the mitigation strategy are defined as follows:

- Hazard- Provides a description of the hazard being addressed and the action number for each action. The numeration does not indicate the local priority.
- Goals- identifies the regional plan goal(s) supported by the action.
- Objective- identifies a local purpose for the action.
- Action- Summarizes a specific need in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to fund implementation.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 103: Regional Plan Goals

Table 104: Bryce Canyon City 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	1	The potential spread of wildfire into Bryce Canyon City.	Mechanical thinning and cleanup of fuels on wildland interface areas along boundaries of City.	H	Ongoing, annually	M	US Forest Service, Bryce Canyon City	Bryce Canyon City Fire Department, US Forest Service
Wildfire #2	3	Coordinate with property owners near forested areas to address wildfire risks.	Public information campaign to property owners vulnerable to fire. Inform about	H	Ongoing, annually	M	Bryce Canyon City	Bryce Canyon City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			Firewise program participation.					
Drought #1	1, 6	Use local scaping techniques to prioritize drought tolerant vegetation.	Assess City landscaping and water ordinances for needed drought restrictions for future commercial and residential development. May include restricting certain types of vegetation, requiring a percentage of limiting permissible amount of grass on a lot, etc.	M	2-years	L	Bryce Canyon City	Bryce Canyon City
Severe Weather #1	2, 5	Identify locations for residents to gather and get information.	Inform residents that the Fire station is the command and information center during severe weather and power outage events.	H	Ongoing, annually.	L	Bryce Canyon City	Bryce Canyon City Fire Department
Earthquake #1	1, 3, 4	Identify and retrofit unreinforced masonry in occupied structures in Bryce Canyon City.	Inventory private properties for potential unreinforced masonry. Coordinate with private property owners to inform them of seismic safety and structural and nonstructural options.	L	1-year, ongoing	L	Bryce Canyon City	Bryce Canyon City

Source: Local Planning Team

Cannonville

Cannonville Town is a rural community in south-central Garfield County near the Kodachrome Basin State Park and Bryce Canyon National Park. The community was settled by Mormon pioneers in 1876.

Cannonville has a population of 294 as of the 2018 American Community Survey and has seen a population increase of 76.0% since the 2010 Census, illustrated in Figure 105. According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Cannonville, the population by 2065 may be near 426 people.

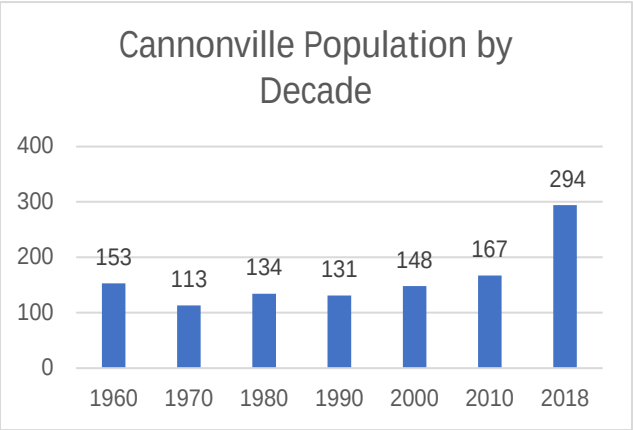


Figure 104: Cannonville Population by Decade

Source: US Census Bureau

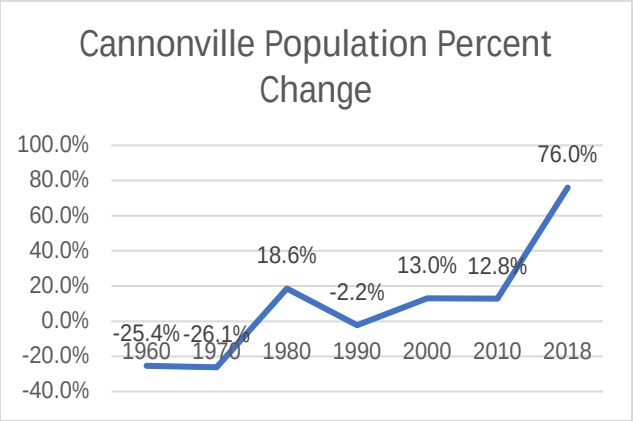


Figure 105: Cannonville Population Percent Change

Source: US Census Bureau

Economy

According to the US Census on the Map tool, most jobs in Cannonville are in the manufacturing industry, illustrated by Figure 106. Given the proximity to prominent outdoor recreation attractions, accommodation and food services make up approximately one quarter of the jobs in the community. The data excludes public services, which likely occupies a share of the community jobs.

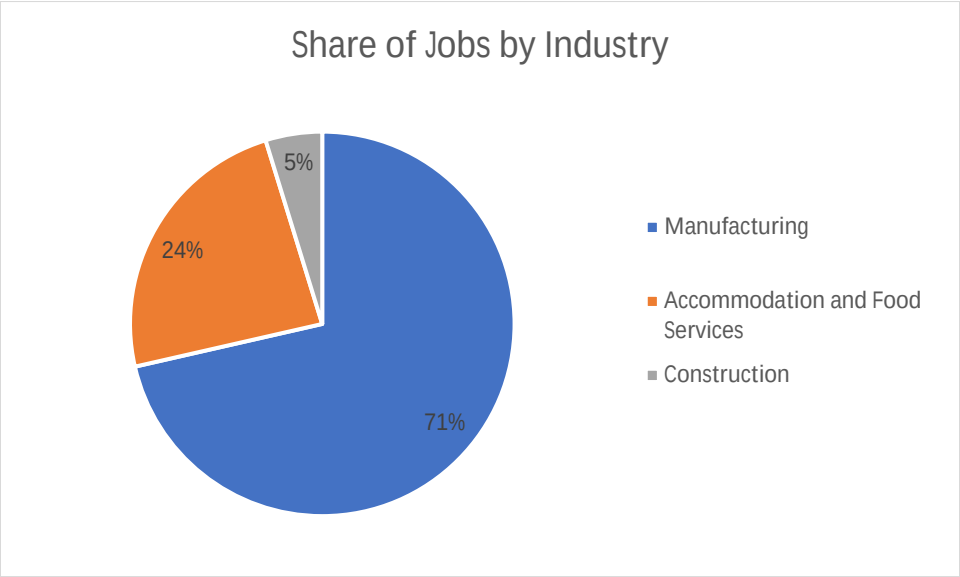


Figure 106: Cannonville share of private primary jobs by industry.

Source: US Census, OnTheMap, 2021

Development

The community is seeing development on the south end of the town in the past several years. New homes and several rental cabins have been added to the community.

Community Capabilities

The community is governed by a volunteer elected town council and a Mayor. A Town staff includes a clerk. Town water services are provided by the town of Cannonville. Law enforcement and EMT services are provided by the County Sheriff's Office in Panguitch.

Other utilities offered locally are provided by Garkane Gas, Dominion Energy, South Central Communications, and other providers.

Plans and Policies

No plans were made available for this plan update.

Risk Assessment

Cannonville Town experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Cannonville to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 105 shows the relative risks of hazards in the community.

Table 105: Cannonville Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOODING	3. Moderate
LANDSLIDE	4. Moderate
WILDFIRE	5. Moderate
EARTHQUAKE	6. Moderate
PROBLEM SOILS	7. Low
RADON	8. Low

A detailed description and mapping of each of the natural hazards that impact Cannonville can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Cannonville include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Cannonville Town is surrounded open space. The community has an arid climate environment and like much of the Southwest, there is a fire risk. There has not been a significant wildfire event that has affected Cannonville, according to FEMA and the Utah Wildfire Info tracker, although this lack of past events does not mean that a wildfire cannot occur.

Figure 107 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Cannonville that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Cannonville has

minimal exposure to moderate or greater risk wildfire areas, except for the northern portion of the town, along SR-12.

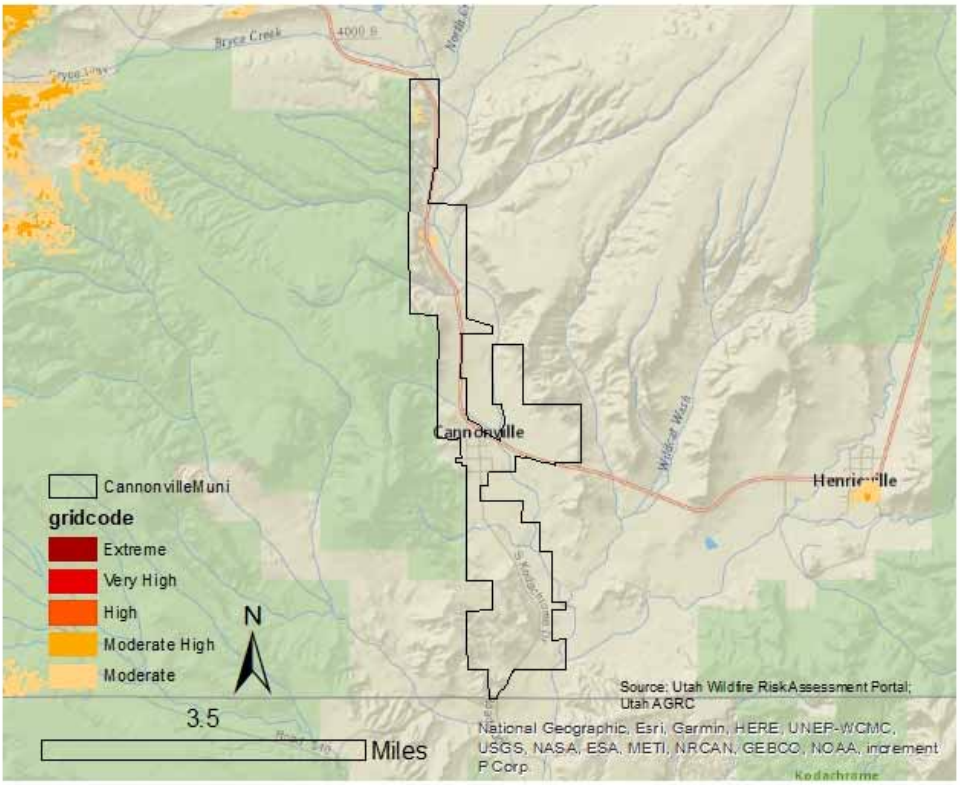


Figure 107: Cannonville Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 106 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Cannonville. Residential parcels and Critical facilities are not recorded in a wildfire risk area, which can result in a safer community and protection of community assets. A very small portion of road miles are within a moderate to extreme wildfire risk area.

Table 106: Cannonville Wildfire Risk

Cannonville Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	0.1%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Cannonville, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. There are no mapped Quaternary Fault lines in Cannonville, with the closest being the Sevier-Toroweap faults approximately 20 miles west of the city and the John's Valley Fault 18 miles to the north, as seen in Figure 108. Earthquakes can happen throughout the state. Fault lines tend to be the most common cause of large earthquakes which can cause impacts in areas miles away.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Thirty-five percent of Cannonville residential parcels have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Figure 108: Garfield County Earthquake Epicenters and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Hazard History

There have not been recorded earthquake epicenters in or near Cannonville.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Cannonville.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 109 describes the flood and dam inundation

exposure in Cannonville. As illustrated in the map, Cannonville includes mapped floodplain throughout the city boundaries, but does not interact with a mapped dam inundation zone.

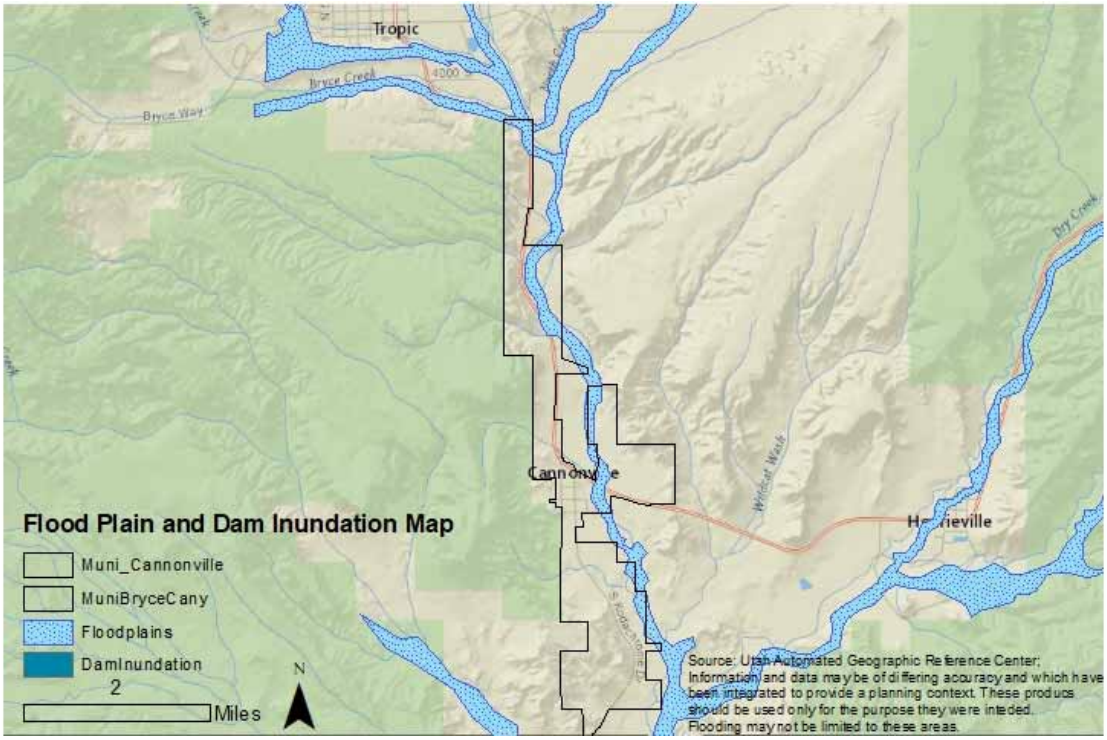


Figure 109: Cannonville Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 107 further examines the exposure to identified flood risk areas in Cannonville, by observing community assets and structures that are in at-risk areas. The table shows that 2.4% of residential parcels are exposed to the floodplain or dam inundation zones. Local road miles are the roadways which interact with the floodplain are access roads to the community, estimated at 10% of road miles. Flooding on such access roads can lead to transportation delays, and impact response during an emergency event.

Table 107: Cannonville Floodplain and Dam Inundation Exposure

Cannonville Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	2.4%	Unknown	10.0%	N/A	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Cannonville property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following

flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Flood Insurance Rate Maps were developed for the unincorporated county in 1986. Cannonville is not listed in the FEMA Community Status Report and does not participate in the NFIP.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 108 describes the flooding events which impacted Cannonville.

Table 108: Cannonville Reported Flood Events

Date	Damage/Injury	Description
9/15/1997	$30,000 damages reported	Flash flooding occurred along the Paria River.
7/20/2010	None Reported	The Paria River flooded in Tropic, sending a flood wave downriver to the Utah/Arizona border.
7/16/2013	None Reported	Flash flooding along the Paria River impacted several roads, covering with water and mud.
9/21/2014	None Reported	Thunderstorm flooded several Cannonville roads.
9/27/2014	$50,000 damages reported	Heavy rain caused flooding on the Paria River near Kodachrome Basin State Park. A bridge into the park collapsed due to the floodwaters, causing a vehicle on the bridge fell into the river and floated down river and closing most of the state park. The occupant of the vehicle escaped and recovered after medical treatment.
7/24/2017	None Reported	Flash flooding occurred on several creeks, which are tributaries of the Paria River.
7/28/2017	None Reported	Flash flooding occurred on several creeks, which are tributaries of the Paria River.
8/23/2018	None Reported	A thunderstorm caused flooding in the Paria River and flash flooding in Cannonville.

Source: NOAA Storm Database

Events in neighboring communities may have also impacted Cannonville but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 110 maps the landslide susceptible areas in Cannonville. The map describes landslide susceptible areas in the community.

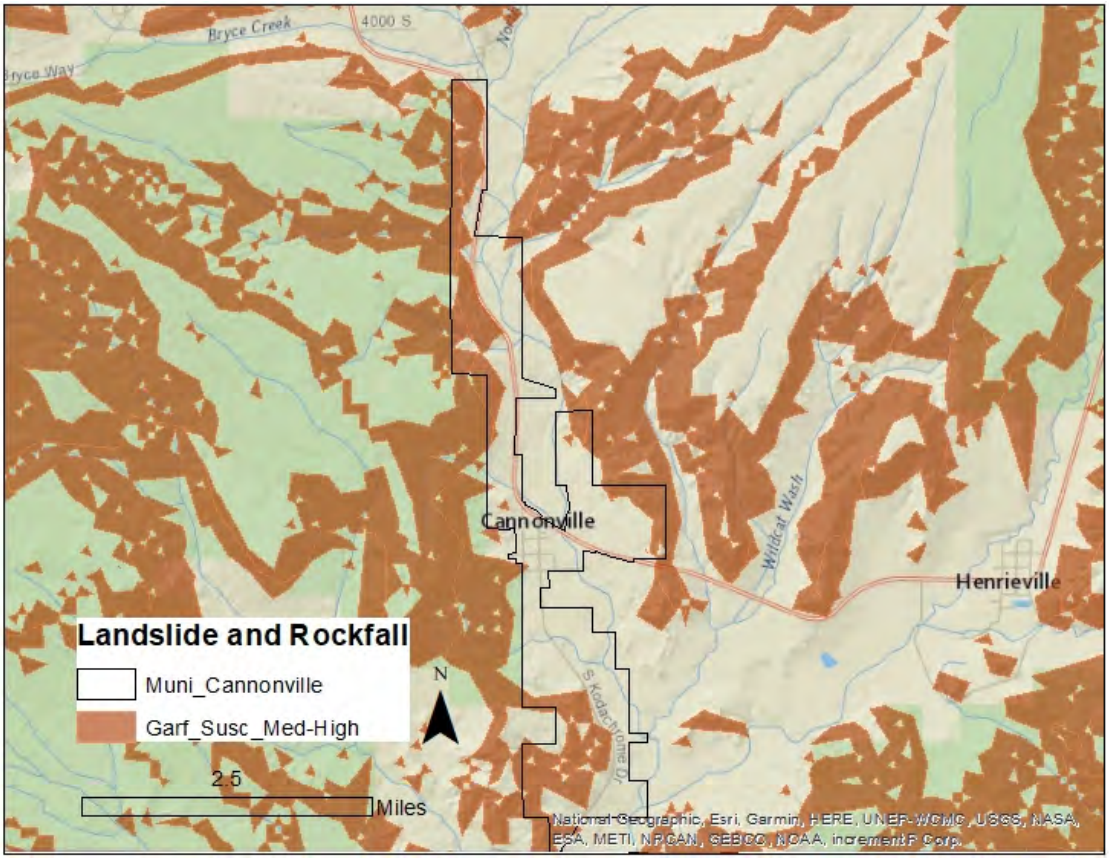


Figure 110: Cannonville Landslide Susceptibility Exposure

Source: Utah Geological Survey

Cannonville has some exposure to landslide susceptible areas, especially on the west side of the community. Table 109 describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Cannonville describe that 31% of road miles are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate the community from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. This is especially true of major connector roads like highways.

No residential parcels are presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 109: Cannonville Landslide Susceptibility Exposure

Cannonville Exposure to Landslide Susceptible Areas				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks

	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	31.0%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

To date, landslides have not been reported causing impacts in Cannonville.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the local economy in Cannonville. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 111. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

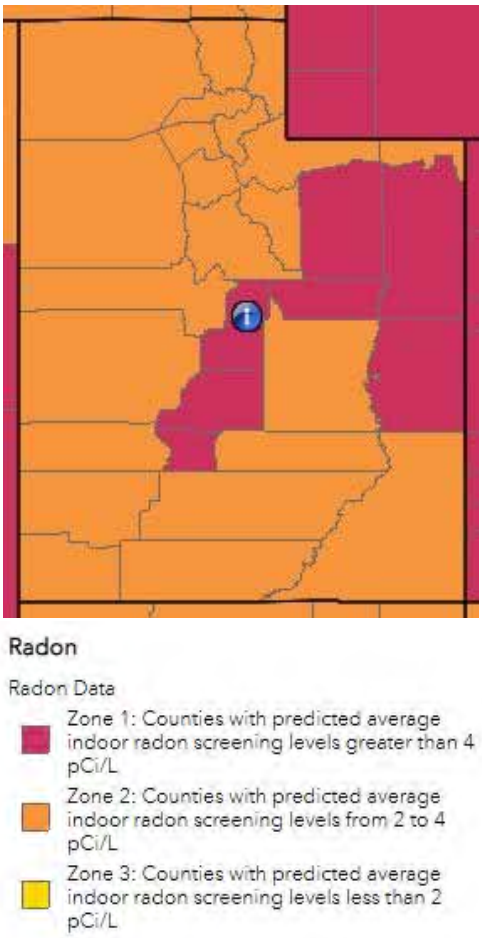


Figure 111: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 110 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high average. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk to users and residents.

Table 110: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Cannonville, however our analysis assumes that severe weather events will impact the whole of Cannonville residents, facilities, infrastructure, businesses, and property.

Cannonville has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Cannonville, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Thirteen total weather events have been recorded with impacts to Cannonville between 1950 and 2020, which are documented in Table 111. Other county events likely impacted Cannonville and should be reviewed in the County section of this hazard plan.

Table 111: Cannonville Severe Weather Record

Date	Property Damage/Injury	Description
9/25/1997	None Reported for Cannonville	The Remnants of Hurricane Nora created thunderstorm conditions in southwest Utah. Heavy rain created high stream flows on the Paria River.
12/7/2009	None Reported	Kodachrome Basin receives 14 inches of snow during a winter storm.
1/22/2010	None Reported	Kodachrome Basin receives 11 inches of snow.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
9/21/2014	$1,000 reported	A thunderstorm produced golf ball sized hail and strong winds. Reported damages include wind damage to a steel flagpole, bent in the wind and a greenhouse damaged by hail.
2/24/2015	None Reported	16 inches of snow fell at Kodachrome Basin during a winter storm.
2/27/2015	None Reported	11 inches of new snow fell at Kodachrome Basin.
3/3/2015	None Reported	23 inches of snow fell from March 1 to March 3 at Kodachrome Basin State Park.
1/31/2016	None Reported	Statewide winter storm brought 11 inches of snow to Kodachrome Basin.
8/23/2018	None Reported	A thunderstorm produced quarter-sized hail.
1/7/2019	None Reported	7.8 inches of snow was recorded in Kodachrome Basin State Park.
2/20/2019	None Reported	5 inches of snow fell in Kodachrome Basin State Park.

Source: NOAA Storm Database

Winter storms and hail common severe weather events in Cannonville based on the record of historic weather events. These hazards have the potential to cause damage, injury, and death. Extreme heat is also a challenge throughout the Southwest and while the deaths reported did not occur in Cannonville, the town and nearby recreation areas likely also saw extreme heat in the area during these events.

Severe weather will continue to impact Cannonville as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the County on behalf of Cannonville, which requires that all construction has a geologic study pre-construction. Figure 112 illustrates where mapped problem soil areas are in Cannonville. The community has expansive soils and rocks mapped. These soils are reactive to water content, causing the soil to expand when whetted. Unmitigated problem soil areas can damage property or infrastructure built on top of it.

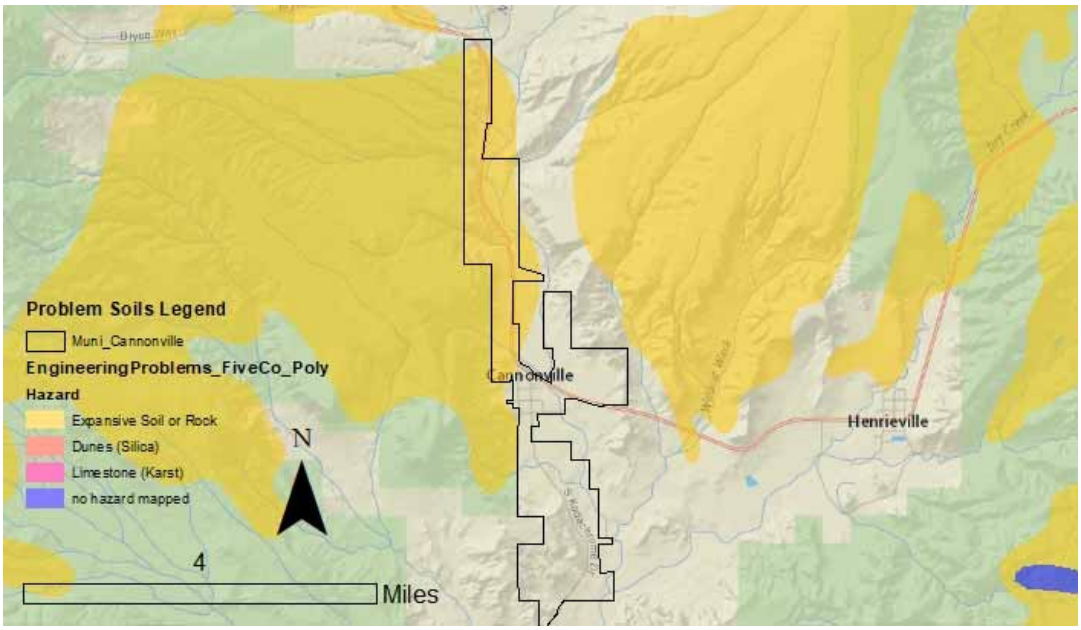


Figure 112: Cannonville Problem Soils Map

Source: UGS, AGRC

Five County compared the existing parcels, critical facilities and infrastructure to these mapped problem soil areas and summarized findings in Table 112. The table shows that 34% of the road miles and 22% of residential parcels are exposed to mapped expansive soil and rock areas. These areas could see changes in the soil during or following storms or runoff events, which impact the roadways, infrastructure, and buildings. Undeveloped land that falls in a mapped problem soil area could require mitigation during construction to reduce risks.

Table 112: Cannonville Problem Soil Exposure

Cannonville Exposure to Problem Soils

Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	22.6%	Unknown	34.0%	N/A	N/A

Source: Utah Geological Survey, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Cannonville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have historically been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Cannonville has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Cannonville and are listed in Table 113 with a description of their progress.

Table 113: Cannonville 2016 Mitigation Strategy Progress

Hazard	Objective	Action	Timeline	Funding Source	Progress
Severe Weather #1	Protect vulnerable populations from the impacts of severe winter storms.	Identify specific at-risk populations that may be exceptionally vulnerable in the event of long-term power outages. Organize outreach to vulnerable populations, including establishing and promoting accessible heating centers in the community	1 year	Town Operating Budget	Community engagement ongoing. Still needed.

Source: 2017 Five County Association of Governments NHMP

The Cannonville Town planning team identified actions to include in the community mitigation strategy. Each action in Table 114 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 113.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to fund implementation.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 113: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, the town has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 114 which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 114: Cannonville 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	1, 2	Improve water storage capabilities.	Construct a new 300,000-gallon water tank storage and 1 mile of transmission lines.	H	2-years	H	Utah Division of Drinking Water, CIB, CDBG	Cannonville Town
Flood #1	1, 2	Reduce flooding in the town.	Assess and restore/repair existing drainages and culverts.	M	Ongoing	L	Cannonville Town, County, UDOT	Cannonville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #2	1	Prevent flooding of residential properties.	Complete the installation of curbs and gutters in the Town. Remaining areas without curb and gutter are on side streets.	M	Ongoing	L	CDBG, CIB, Cannonville	Cannonville Town
Severe Weather #1	1, 3	Reduce impacts caused by power outages on the town's vulnerable residents.	Identify specific at-risk populations that may be exceptionally vulnerable in the event of long-term power outages. Organize outreach to vulnerable populations, including establishing and promoting accessible heating centers in the community.	H	1-year, ongoing	L	Cannonville Town Budget	Cannonville Town
Problem Soil #1	1, 2	Plan for mitigation in future development.	Update annexation policy to reflect standards for problem soils in identified areas.	L	2-years	L	Cannonville Town	Cannonville Town
Landslide #1	2, 4	Understand risks, vulnerabilities, and needed action to protect water infrastructure.	Work with BLM to assess and stabilize the slope failure under the old water tank to protect existing town infrastructure on the site.	M	5-years	M	BLM, Cannonville Town, County	BLM, Cannonville Town, County.
Wildfire #1	2, 6	Protect drainages from debris and excessive fuel load.	Clear fuels and debris on hillsides and drainages.	M	Ongoing	L	Cannonville Town	Cannonville Town, Volunteer Fire Department.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #2	1, 3, 4, 6	Protect residents from fire hazards. Inform residents of wildfire hazard risks.	Identify residential properties in need of fuels mitigation and coordinate with the property owner to reduce the fuels.	M	Ongoing	L	Cannonville Town	Cannonville Town, Volunteer Fire Department.
Earthquake #1	3	Protect residents from earthquake hazards. Inform residents of earthquake hazard risks.	Inform residents of earthquake risks and structural and nonstructural retrofit options.	H	Ongoing	L	Cannonville Town	Cannonville Town
Earthquake #2	2, 5	Secure equipment and facilities critical to town operation and emergency response.	Assess and implement nonstructural retrofits at the town's firehouse, well and filtration house, and town office.	M	3-years	M	Cannonville Town	Cannonville Town, Fire Department, Water Department.
Radon #1	3	Inform residents of radon hazard locally.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing	L	Cannonville Town	Cannonville Town

Source: Local Planning Team

Escalante

Located in South Central Utah, Escalante is a gateway to outdoor recreation, found between Capitol Reef and Bryce Canyon National Parks and just miles away from Escalante-Grand Staircase National Monument. The community is connected by Highway 12 to the rest of Garfield County and the state.

The Escalante Valley has a semi-arid climate. The area receives an average 25.6 inches of snow fall annually and relies on the groundwater and streams to cultivate agriculture and provide for the cities and towns in the area. The community is surrounded by mountains and sandstone canyons, with the Escalante River flowing through the northern portion of the city, all contributing to the unique geography.

Escalante has a population of 810 and has seen 1.6% growth since the 2010, as described in Figure 115. The population has remained stable since the 1990 census.

According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is applied to Escalante, the population by 2065 is expected to be near 1,100 people.

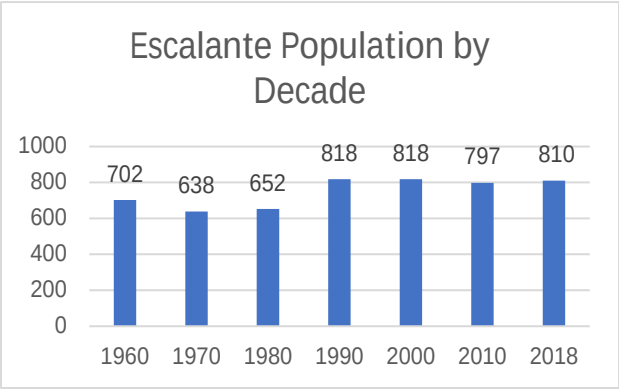


Figure 114: Escalante Population by Decade

Source: US Census Bureau

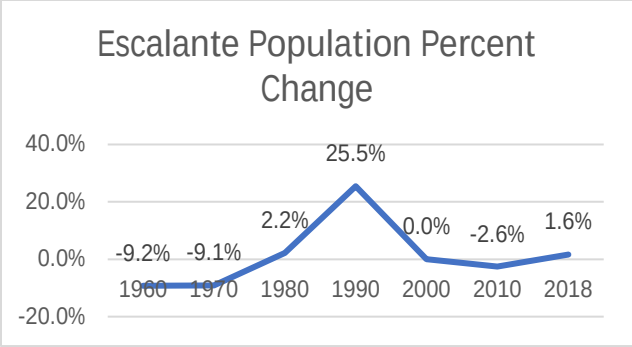


Figure 115: Escalante Population Percent Change

Source: US Census Bureau

Escalante City has several shops and a grocery store along Hwy-12 Main Street through the city. Escalante also draws tourists annually to visit nearby state and national parks and recreation areas. According to the US Census Bureau, On the Map, there are 233 jobs[4] in Escalante. Figure 116: Escalante Share of Jobs by Industry describes the jobs by industry sector in Escalante. Most jobs in the community are in Information, Retail Trade, and Accommodation and Food Service industries. Industries that do not support private sector jobs in Escalante have not been included in this table.

[4] Defined as private primary jobs which are the highest paying private sector job per worker.

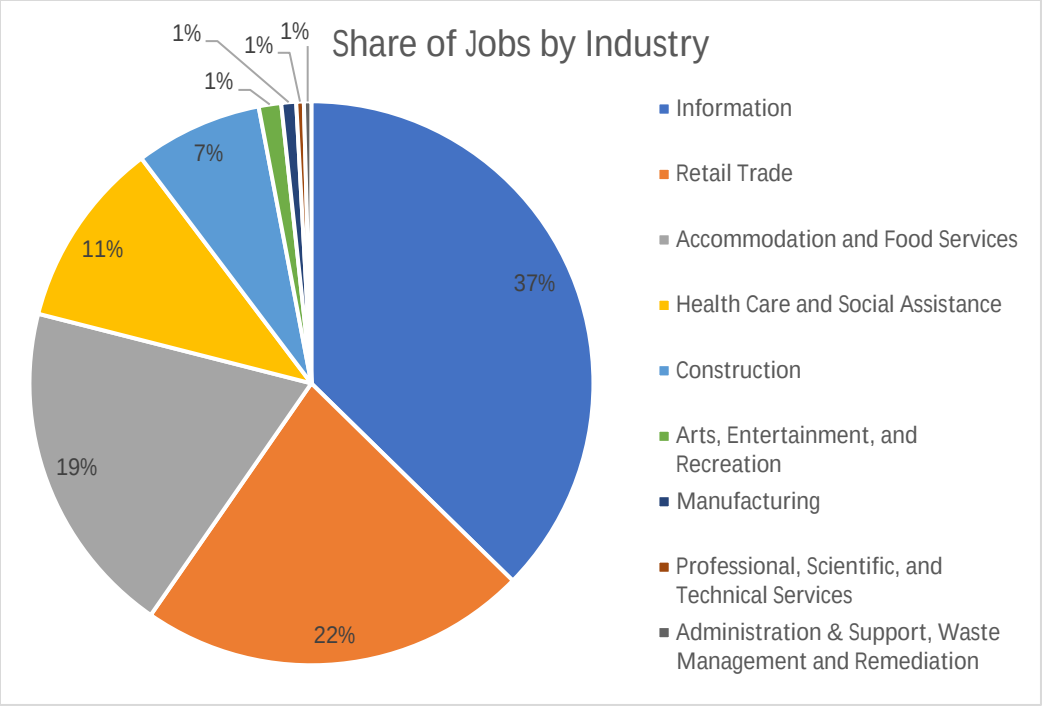


Figure 116: Escalante Share of Jobs by Industry

Source: US Census Bureau, On the Map, accessed 3/1/2021.

Community Capabilities

Escalante City is governed by a Council and Mayor. The Council consists of five elected members who each oversee a specific service within the city, including sanitation, airport and storm drainage, streets, water, and buildings and recreation. An eight-person planning, and zoning commission and five-person board of adjustments are also elected bodies that serve the Escalante City. The city staff consists of a recorder, treasurer, and public works staff.

Services provided by or in the community include a fire department, income based medical clinic, and senior center. Several churches of various denominations have a presence in the community, which act as a gathering place for residents and a venue where resources and information can be shared. Many services, such as law enforcement, are provided by Garfield County through an intergovernmental agreement.

Community Assets

Escalante City uses two water systems to provide water to the community, sourced from a well and springs. Gas and electric utilities are provided by Garkane Energy.

Critical facilities in the city include a ranger station, fire station, police station, two schools, and a medical clinic. These facilities provide essential services to the city and surrounding area. There are also several cultural and community buildings in the community, including one community center on the historic registry.

Escalante has 28 miles of roadways in the community, with the primary access to the city being US Highway 12, which is the Main Street through the city. The Utah Department of Transportation services Highway 12 through the city, but city roads are maintained by Escalante City.

The Escalante Municipal Airport serves Garfield County and Escalante. It connects visitors to the area with transportation and serves several federal agencies including the Bureau of Land Management and US Forest Service. This asset serves public safety as a central location for search and rescue and other operations for those in and near the community.

Development

The community has planned two new subdivisions, one will have five lots and the other will have three lots. There has been minimal new development in the City since the previous update.

Plans and Policies

Escalante has plans and policies that relate to hazard mitigation to preserve public health and safety in the community. The community ordinances are available on the city website and describe special flood hazard area development requirements and restrictions, weed and tree removal requirements, stormwater, and drought condition water restrictions. Some items indirectly related to natural hazards include noxious weed and dead tree removal, which are concerns for wildfire and severe weather events. Dry or dead vegetation is highly flammable and can cause risk to people and property. During severe weather events, dead or dangerous trees can topple or have limbs remove which result in risks to people, property, and infrastructure below.

Risk Assessment

Escalante experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Escalante City to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 115 displays the relative risks of hazards in Escalante. The local planning team indicated that problem soils, landslide, and radon were significantly low risks and did not develop actions to include in the mitigation strategy.

Table 115 Escalante City Hazard Risk

HAZARD	RISK
FLOODING	1- High
SEVERE WEATHER	2- High
DROUGHT	3- High
WILDFIRE	4- Moderate
EARTHQUAKE	5- Moderate

PROBLEM SOILS	6- Low
LANDSLIDE	7- Low
RADON	8- Low

A detailed description and mapping of each of the natural hazards that impact Escalante City can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in lowering the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Escalante City include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Escalante is surrounded by wildlands and open space. Given the arid environment, Escalante is at risk to wildfire, just as the other cities and counties in the region. The focus of the wildfire risk is at the edges of the city in the Wildland Urban Interface (WUI) and along Highway-12 in and out of the city. There has not been a significant wildfire event that has affected Escalante, according to FEMA and the Utah Department of Natural Resources, although this lack of past events does not mean that a wildfire cannot occur.

Figure 117 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Escalante that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Risk to wildfires is in the northwest area of the community, along Highway 12.

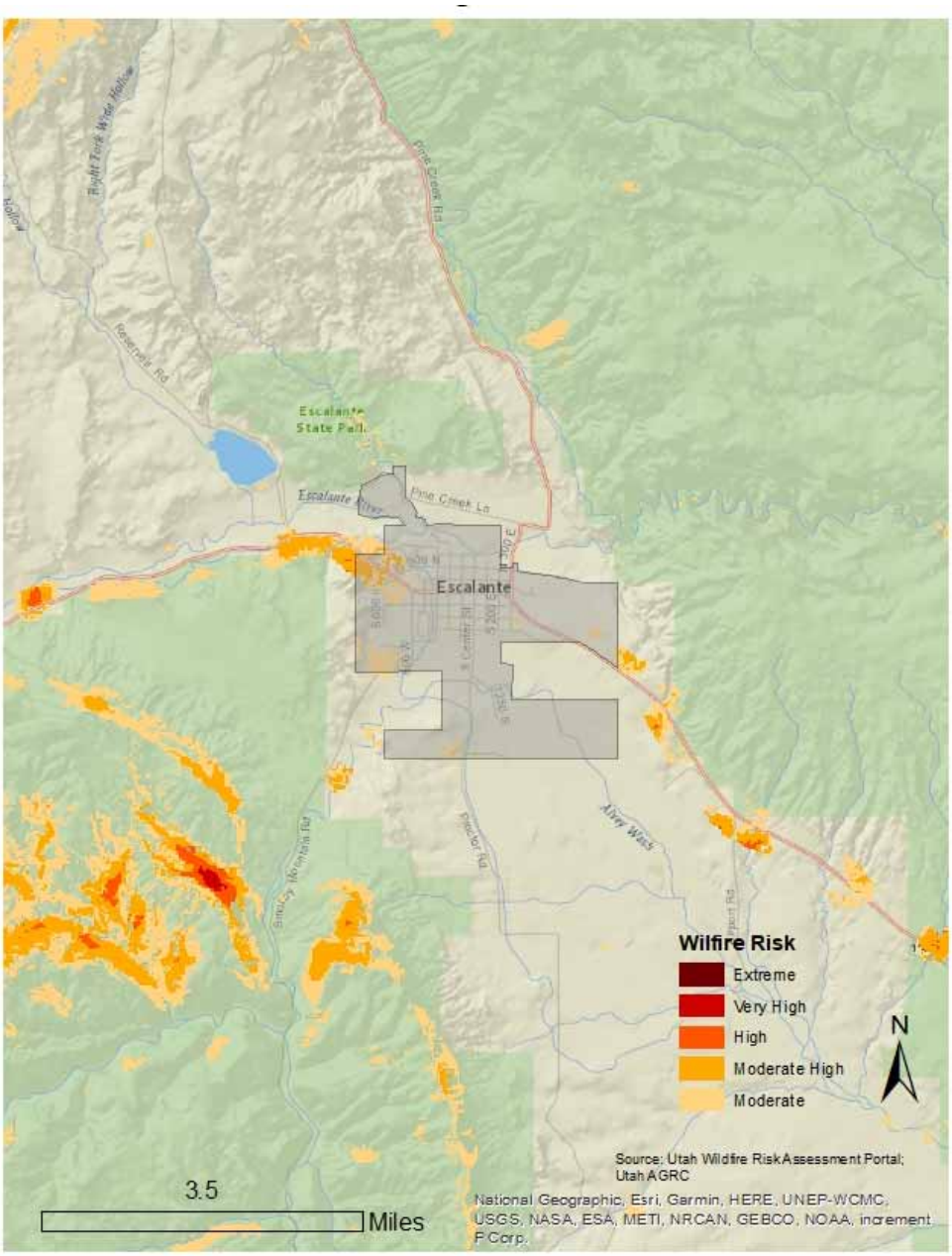


Figure 117: Escalante Wildfire Risk Exposure

Source: Oregon Department of Forestry, AGRC.

Table 116 Escalante Wildfire Riskfurther describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, residential parcels, and miles of roadway in Escalante City. Critical facilities impacted by natural hazards can cause additional vulnerability to a community, as prominent meeting spaces and response is impacted during the event.

Table 116 Escalante Wildfire Risk

Escalante City Exposure to Wildfire Risk

Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
16.7%	Unknown	10.3%	Unknown	16.0%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

Large wildfires have not been reported for Escalante City, but there is the potential for a wildfire to have either direct or indirect impacts on the community.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Escalante. It is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah and the Great Basin area is an area with significant seismic activity, reporting several earthquakes annually. These earthquakes tend to be small and barely felt in communities, however several faults in the state have the potential to produce There are no mapped Quaternary Fault lines in or near Escalante City, with the closest being the Sevier Fault in Western Garfield County, as seen in Figure 118 Garfield County Faults and Earthquake Epicenters. None the less, Escalante has recorded an Earthquake event at 4.0 magnitude. Earthquakes can happen throughout the state, although fault lines tend to be the most common cause of large earthquakes, they can still occur and cause impacts in areas such as Escalante.

Figure 118 Garfield County Faults and Earthquake Epicenters

Source: Utah Geologic Survey, University of Utah Geology Department

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Escalante City has 46.3% of residential parcels and 16.7% critical facilities that have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event. Although commercial parcel data was not available for this plan update, the planning team identified several community and commercial buildings that were also constructed pre-1975 or are unreinforced masonry construction.

Hazard History

Escalante has experienced one earthquake epicenter with a magnitude of at least 4.0 near the municipal boundaries, as described in Table 117.

Table 117: Escalante Earthquake Epicenters

Year	Location	Magnitude
1991	17.2 miles southeast of Escalante, Garfield County	4.0

Source: University of Utah Geology Department, 2017 FCAOG NHMP.

Flood

Escalante has a 1999 floodplain ordinance for approving development permits in the floodplain, with the goal to leave floodplain areas undeveloped to mitigate and reduce risks to property and users of the space. Approved development must meet specific requirements to minimize the flood risk at the site and those surrounding. The floodplain is defined by the 1979 Flood Insurance Rate Maps which are on file at the City. City ordinance further identifies that the streets department is the responsible party for water flowing on streets, sidewalks, or other public thoroughfares.

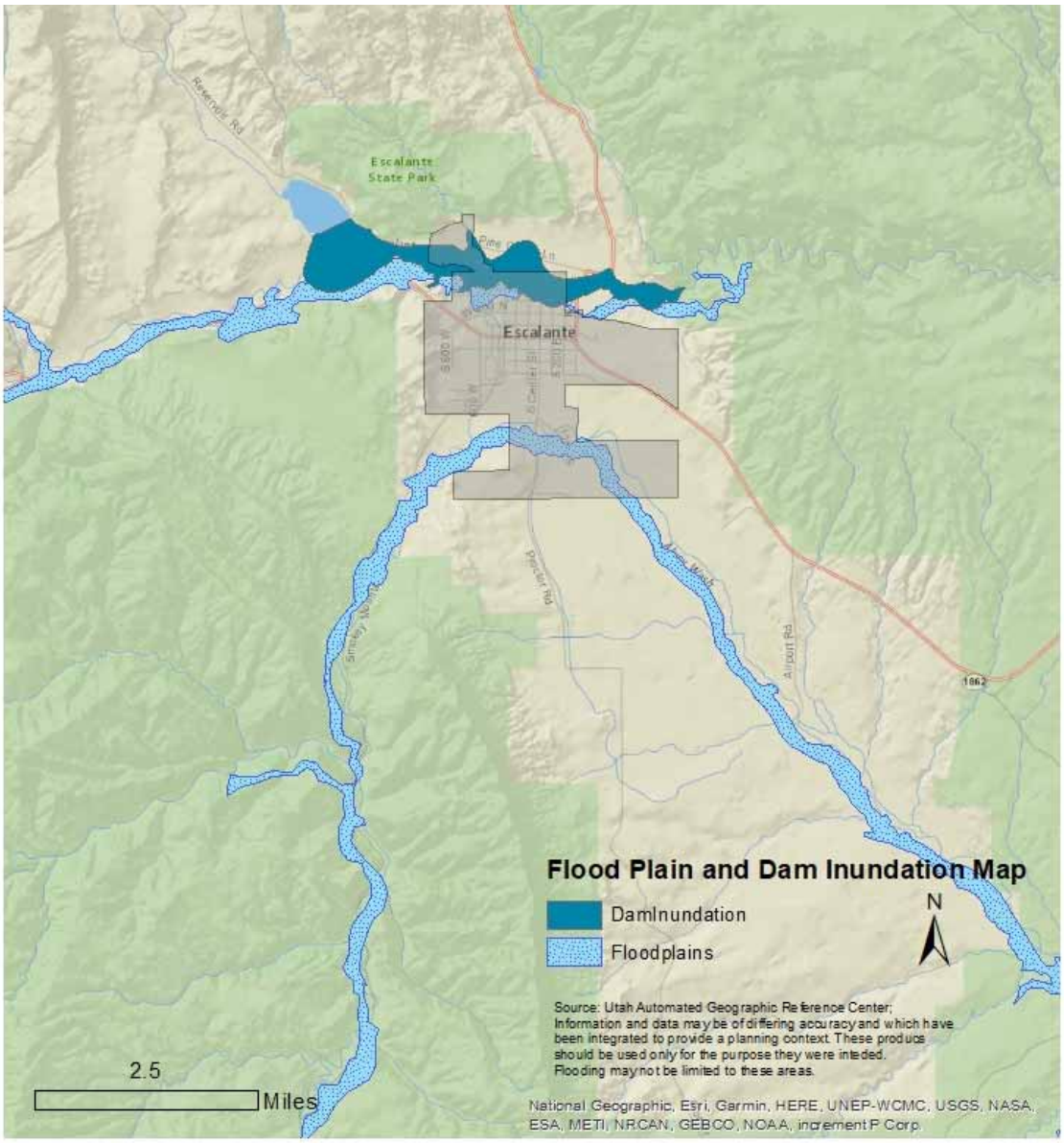


Figure 119: Escalante Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

Figure 119: Escalante Floodplain and Dam Inundation describes the flood and dam inundation zones in Escalante. The area north of Highway 12, where the Escalante River and Wide Hollow Reservoir are considered flood risk areas as well as Alvey Wash in the southern end of the community.

Table 118 further examines the exposure to identified flood risk areas in Escalante, by observing community assets and structures that are in at-risk areas. Less than 10% of residential parcels and road miles are in mapped floodplains or dam inundation areas in Escalante.

Table 118: Escalante Floodplain and Dam Inundation Exposure

Escalante City Exposure to Floodplain and Dam Inundation Zones				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks

	Commercial	Residential	Total			
0.0%	Unknown	9.3%	Unknown	9.7%	N/A	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

The Escalante community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Flood Insurance Rate Maps were developed for Escalante in 1979, but there is not a record of any policies or claims paid for damaged property in the community. Escalante is listed as a participating community in the National Flood Insurance Program.

Hazard History

Flooding is a frequently occurring event in Escalante and flooding often impacts areas, property, and residents outside of the floodplain. Flash flooding events are among the most frequently occurring hazards in Escalante, often following severe storm events. Recent occurrences reported by the local planning team left the airport vulnerable and risked damaging waterlines in the community. Documented damages from flooding events are attributed to flash flooding at $125,000, 2 injuries, and 2 deaths recorded from 34 events. The events that caused damages or injury are summarized in Table 119.

Table 119: Escalante Reported Flooding Events

Date	Damage/Injury	Description
8/26/1996	None Reported	A flash flood on the Escalante River was caused by a thunderstorm. Damages include a bridge to the Escalante Petrified State Park. Two people in a pick-up truck were nearly drowned in the Alvey Wash.
9/9/1997	$10,000 in damage	Flooding on the Escalante River and Alvey Wash. The Bridge on SR-12 was three feet underwater during the event.
9/10/2008	Two people killed and Two people injured	Flash Flooding recorded near the Escalante River in the Glen Canyon National Recreation area. It is estimated that the flood depth exceeded 20-feet according to NOAA.
8/19/2012	$10,000 in damage	a large flash flood near 25 Mile Washed damaged roads
9/5/2014	$5,000 in damage	A thunderstorm caused flash flooding along Harris Wash and hikers were stranded. Some roads near Hole in the Rock Road were washed out.

Source: NOAA Storm Database, 2020.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest is where landslides occur. Despite its location, Escalante does not have a record of landslides impacting the community. The local planning team did express concern with landslide along roadways in the county that connect the community to the rest of the county. Landslide or losses on roadways could limit access to the community for emergency services, resources, and general transportation. Figure 120 maps the landslide susceptible areas in Escalante. Escalante City is not considered high-risk to Landslides in the community.

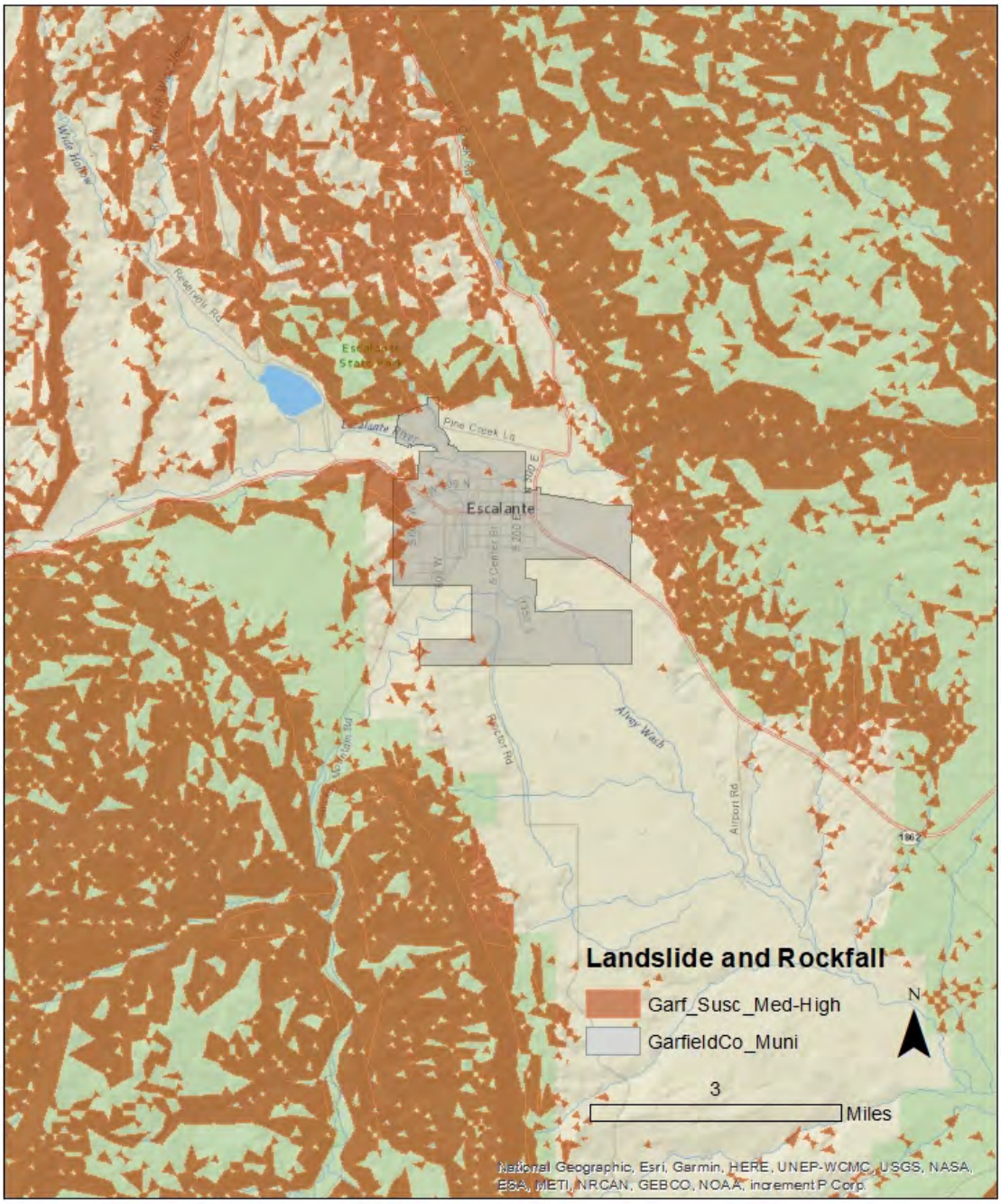


Figure 120: Escalante Landslide Susceptibility

Source: Utah Geological Survey

Table 120 shows that community assets exposure to moderate to high landslide susceptible areas is low within the municipal boundary. The local planning team describes some landslide risk along Highway-12 outside of the city. Landslides on the roadway have the potential to separate Escalante from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. The local planning team indicated that the Utah Department of Transportation is engaging in the mitigation of landslides and debris flow on roadways in and out of the city, however, there is still the potential for rockfall along the roadway from cliffsides.

Table 120: Escalante Landslide Susceptibility Exposure

Escalante City Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	4.5%	Unknown	9.6%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

No landslides have been reported in Escalante City.

Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area. Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the city includes wells and spring water.

Escalante's economy includes agriculture and tourism, which can both be susceptible to drought impacts. Drought can contribute to hot and dry conditions, especially in summers that pose challenges to these industries. Crops may be lost, or damaged, and dry conditions can contribute to increased risks of wildfire in the area.

Tourists, especially those in the backcountry can have less access to water sources outdoors and can be susceptible to dehydration or heat related illness. The perception of poor recreation conditions, (low water levels for boat or watersport activities for example) or the perception of risk (wildfire) associated with drought conditions can deter travelers and recreationists from visiting at risk areas, according to a study done by the National Integrated Drought Information System (NIDIS), in partnership with the University of Colorado, which can be accessed at https://www.drought.gov/sites/default/files/2020-09/drought-and-outdoor-recreation-report-9-16-20.pdf.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Escalante, however our analysis assumes that severe weather events will impact the whole of Escalante residents, facilities, infrastructure, businesses, and property.

Escalante is a semi-arid area, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Hail, strong wind, rain and thunderstorms, and extreme temperatures are among the weather hazards that frequently impact Escalante and the southwestern region of Utah.

Hazard History

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Five total weather events list impacts to Escalante between 1950 and 2020, including hail and thunderstorms and are described in Table 121. Only one event caused financial damage, a 1997 hailstorm which resulted in $7,000 in damages. Severe weather events can trigger or worsen other natural hazards, including flooding, landslides, and wildfires.

Table 121: Escalante Reported Severe Weather Events

Date	Damage/Injury	Description
9/14/1997	$7,000 in damage	One inch diameter hail fell over Escalante.
8/14/2001	None Reported	A severe thunderstorm produced heavy rain and one-to-1.5-inch hail in Escalante.
8/21/2011	None Reported	A thunderstorm produced ¾ inch hail and caused flash flooding along the Escalante River.
8/4/2019	None Reported	Over an inch of rain fell in less than an hour during a rainstorm, causing flash flooding around Escalante.
6/6/2020	None Reported	Quarter sized hail was reported in Garfield County.

Source: NOAA Storm Events Database

Severe weather will continue to impact Escalante as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the county on behalf of the City of Escalante, which requires that all construction has a geologic study pre-construction. Escalante's local planning team expressed minimal impacts from problem soils and could not point to buildings being damaged due to problem soils.

Figure 121 illustrates where mapped problem soil areas are in Escalante, primarily on the north, west, and south borders of the city. Looking to the data available from the Utah Geological Survey, seen in Table 122, 17.2% of road miles and 12.5% of residential parcels are in mapped areas which have problem soils, namely expansive soils, and rocks. The occurrence of problem soils on the municipality boundary point to potential future needs for problem soil mitigation if new development occurs in these identified areas.

Table 122: Escalante Problem Soil Exposure

Escalante City Exposure to Problem Soils

Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	12.5%	Unknown	17.2%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC

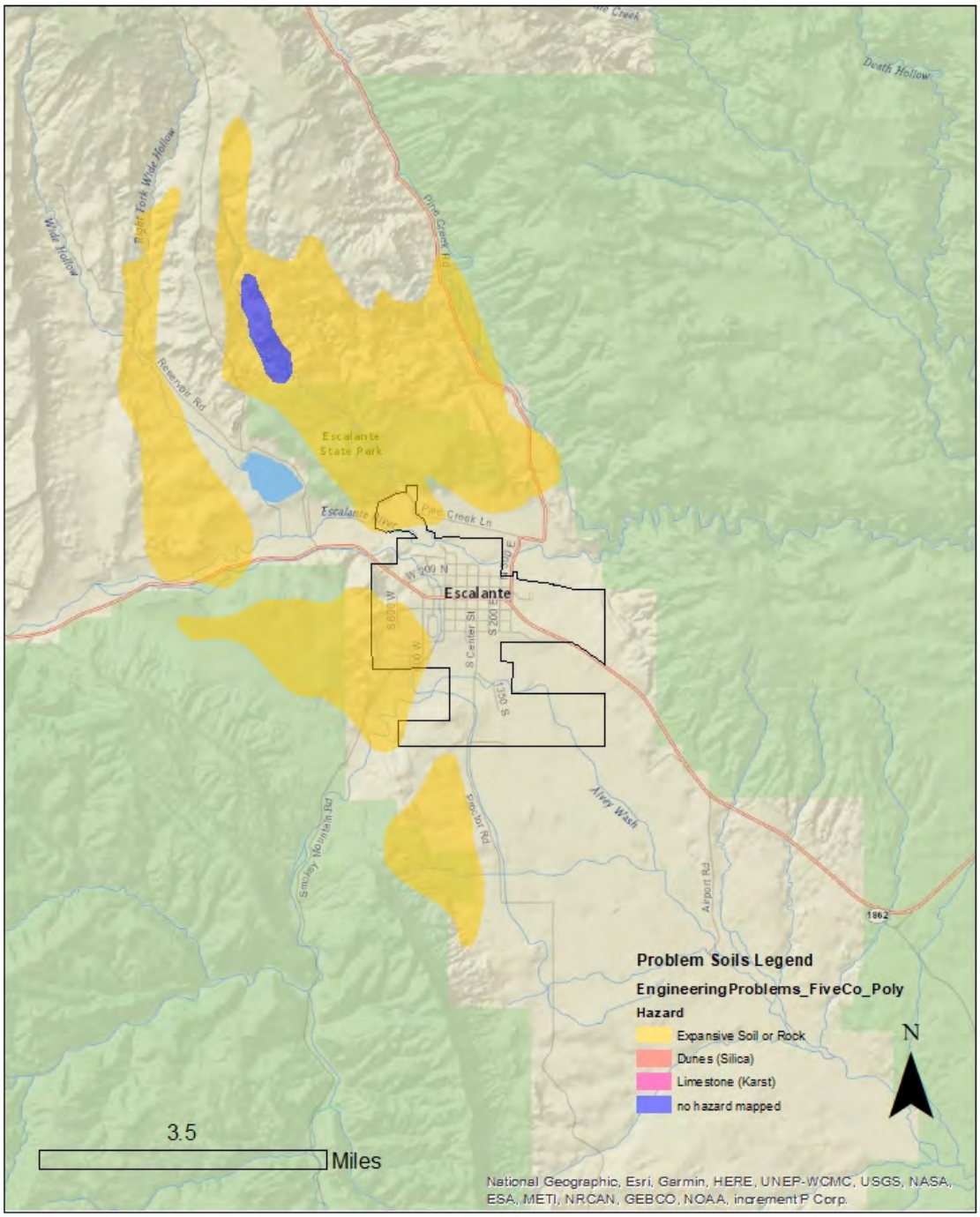


Figure 121: Escalante Problem Soil Exposure

Source: Utah Geological Survey, AGRC.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Mitigation Strategy and Actions

Escalante City participated in the 2016 iteration of the Five County Association of Governments Natural Hazard Mitigation Plan process. In this plan they identified one actions to address the hazard risks in the community. This mitigation strategy has been summarized in Table 123, with a column identifying progress on action.

Table 123: Escalante actions identified in 2016 NHMP.

Strategy	Objective	Action	Timeline	Estimated Cost	Funding Source	Progress
Flood #1	Prevent high intensity precipitation events from flooding property in town.	Construct proper drainage as addressed in the Storm Water Master plan to prevent flood damage to property.	phased over 10 years	$800,000 to $1 Million	Local Government Operating budget, CIB, CDBG, FEMA	This action has not been completed and is still needed, but the stormwater drainage plan needs to be updated.

Source: 2016 Five County Multi-Jurisdictional Natural Hazard Mitigation Plan

Five County Association of Governments worked with the local planning team to develop a mitigation strategy, using the identified risks in this plan. Strategy development also referred to previous strategies to ensure that new actions continue progress already made toward risk reduction. The local planning team coordinated to identify potential actions based on community context and need seen through experience with natural hazard events and known community risks and vulnerabilities described in this plan. The community determined that problem soils, radon, and landslides were a significantly low risk to Escalante and have not included these hazards in the strategy.

The actions in Table 124 were determined by the planning team for the mitigation strategy in this plan update during a meeting. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 122
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to fund implementation.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 122: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, the City has assembled several actions, addressing each of the natural hazards that the community is at risk to.

Table 124: Escalante Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Organization
Flood #1	2	Use planning to inform mitigation actions.	Update the Stormwater Drainage Plan	H	3-5 Years	M	Local Government Operating budget, CIB, FEMA	Escalante City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Organization
Flood #2	2	Use planning to inform mitigation actions.	Implement actions identified in updated Stormwater Drainage Plan.	L	phased over 10 years	M	Local Government Operating budget, CIB, CDBG, FEMA	Escalante City
Earthquake #1	1, 2	Assess structural safety of historic community structures.	Engineers' assessment and seismic retrofit of Community Center	M	5 Years	M	State and Federal Historic Tax Credit, Preservation Utah, Utah Historic Buildings Grant, FEMA, Municipal Budget, CDBG	Escalante City
Wildfire #1	3, 4, 5, 6	Protect residential property from wildfire hazards.	Coordinate "slash and clean-up days" as part of the ongoing city beautification clean up days. Partner with fire department to educate and assist residents in Wildland interface areas or high-risk wildfire areas with fuels reduction on their property.	M	Ongoing	L	Municipal Budget, Fire Department	Escalante City, Escalante Fire Dept.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Organization
Drought #1	1, 2, 6	Conserve water resources.	Develop an ordinance to limit the timing for outdoor watering, per the goals and implementation section of the Water Conservation Plan.	H	1-2 years	L	Municipal Budget	Escalante City
Drought #2	2	Secure water infrastructure to prevent losses from damage or aging infrastructure.	Upgrade the source flow meters at the chlorinator building and well house, per the goals and implementation section of the Water Conservation Plan.	M	5 Years	M	Municipal budget, CDBG, CIB	Escalante City
Drought #3	2	Secure water infrastructure to prevent losses from damage or aging infrastructure	Upgrade the water storage tank water-level monitoring system, per the goals and implementation section of the Water Conservation Plan.	M	5 Years	H	Municipal budget, CDBG, CIB	Escalante City
Drought #4	3	Inform the public about water conservation.	Educate the public about water conservation measures, per the goals and implementation section of the Water Conservation Plan.	H	Ongoing	L	Municipal budget	Escalante City & local utility company
Drought #5	3	Inform the public about	Encourage xeriscaping and	H	Ongoing	L	Municipal budget	Escalante City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Organization
		water conservation.	use of drought tolerant plants.					
Severe Weather #1	2	Continue operations during power outage events.	Purchase generator for City office to limit impacts during power outage due to storm.	L	2-years	M	Municipal budget	Escalante City

Source: Local Planning Team

Hatch

Hatch Town is a rural community on Highway 89. The community has ample access to outdoor recreation activities, located near Bryce Canyon National Park and the Sevier River. The town maintains a rural way of life, with nearby agricultural lands, local businesses on main street, and neighborhoods. Outside of the municipal boundary, the community is

Demographics

As of the 2018 American Community Survey, Hatch has a population of 167, described Figure 123. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area. Hatch's population showed decline until the 1990s, after which the population began to grow again. The average change in population in Hatch between 1960 and 2010 is -8.1%, with the change each decade demonstrated in Figure 124.

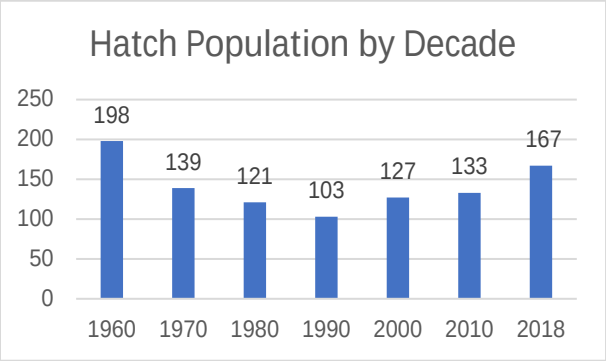


Figure 123: Hatch Population by Decade

Population projections for the county have been completed by the Kem C. Gardner Institute, which describe that Garfield County's population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Hatch, the population by 2065 may be near 250 people.

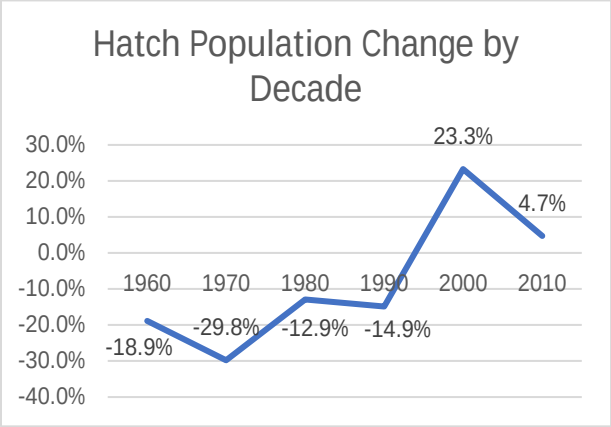


Figure 124: Hatch Population Change by Decade

A population projection using historic population estimates for Hatch presents a more conservative growth in population for Hatch. US Census data for the 1990, 2000, and 2010 census' indicate that the average population growth has been 4.4% each decade. Using this average, we can estimate that if growth patterns continue, Hatch will have a population near 253 people by 2065.[5]

Economy

Businesses in and around the community include several lodges and restaurants. Garkane Propane has a location on the north end of the community along Highway 89. The economy, like much of the County, appears to be tourism based, with a large share of jobs in the accommodation and food services industry.

[5] The assumption uses 2015 ACS population estimates table DP05, which indicates that Hatch had an estimated population of 175 people.

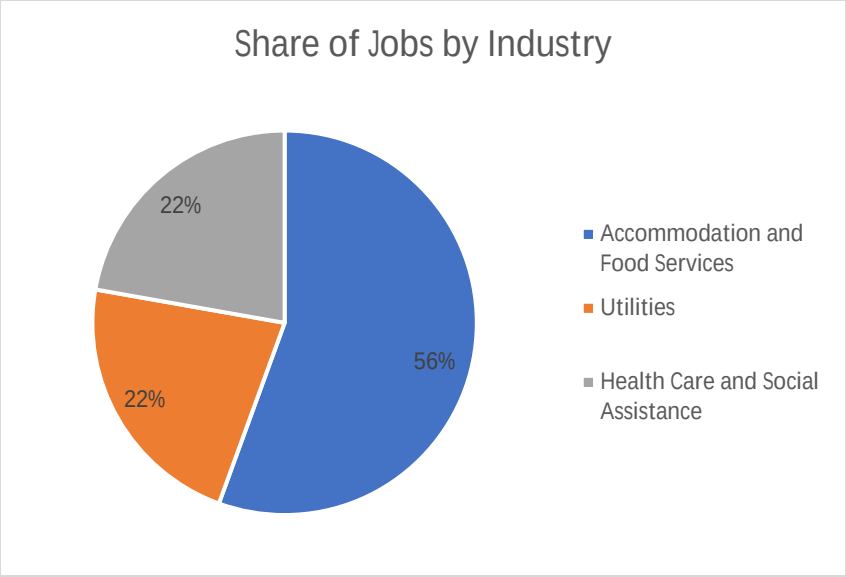


Figure 125: Hatch Share of Private Primary Jobs by Industry

Source: US Census Bureau, On the Map, accessed 5/14/2021

According to the US Census on the Map tool, accommodation and food services, utilities, and health Care and social assistance are the only private jobs in Hatch, seen in Figure 125. This data excludes public services, like local government, which would occupy a share. The data from On the Map indicates that tourism is a focus of the Hatch Town economy and that workers likely commute to neighboring cities or towns for work. Based on the age of resident in Hatch, the community may be a popular home for retirement age people in the southwest.

Development

Hatch Town is a rural community, surrounded by public lands and agriculture. More than ten years ago, the community annexed unincorporated land which was supposed to be subdivided and developed. The subdivision and proposed development never occurred, and the community now has a large tract of land inside the boundaries, which has remained unoccupied. Since this annexation, minimal new development has occurred. In the past five years, a handful of single-family homes were constructed in the community. Otherwise, new small businesses have moved into existing storefronts in the community.

Community Capabilities

The community is governed by a volunteer elected town council and a Mayor. Hatch Town has a clerk to assist with general government operations. Law enforcement is provided by the County Sheriff's Office in Panguitch. Emergency services are available in Hatch. A volunteer fire department operates in Hatch Town and the County supports an EMT service with ambulances and an EMT staff.

Hatch provides water utilities to residents in the town boundaries. Other utilities are provided by public companies, including:

- Electricity- Garkane Power
- Gas- Blackburn Propane, Garkane Propane, or Amerigas

Plans and Policies

The community did not provide plans or ordinances which relate to natural hazards for this plan update.

Risk Assessment

Hatch experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Hatch to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 125: Hatch Hazard Risk shows the relative risks of hazards in Hatch. The town elected to not develop actions for landslide, problem soils, and radon due to their relative low risk to the community.

Table 125: Hatch Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOODING	3. High
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Low
PROBLEM SOILS	7. Low
RADON	8. Low

A detailed description and mapping of each of the natural hazards that impact Hatch Town can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hatch Town include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Hatch Town is surrounded by wildlands and open space. Given the arid environment, Hatch is at risk to wildfire. The wildfire risk is highest in the center of the city and along Highway-89 in and out of town.

Figure 126 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Hatch that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Risk to wildfires is in the northern and southern area of the community, along Highway 89. The downtown area of Hatch also has some risk to wildfire.

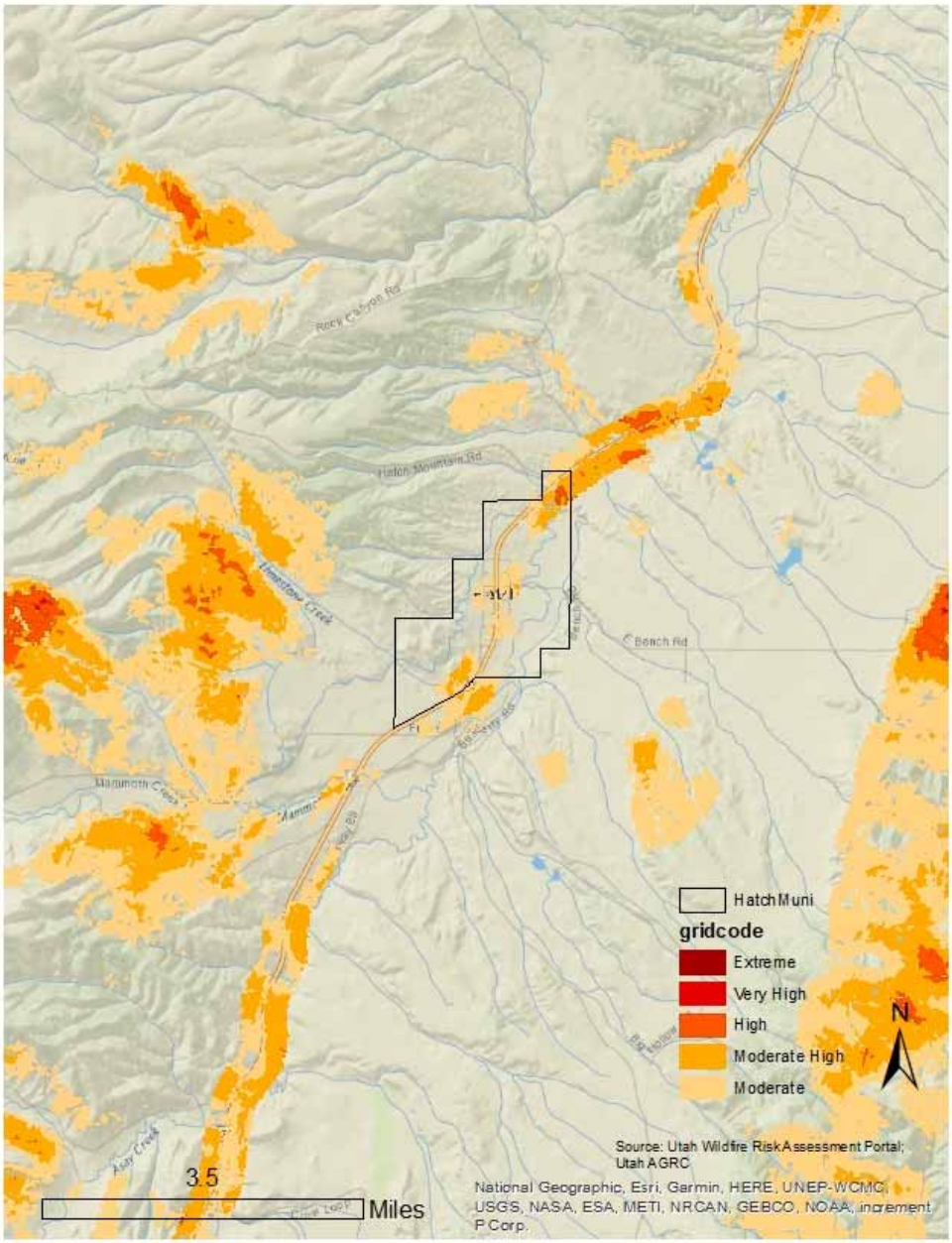


Figure 126: Hatch Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 126 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities,

residential parcels, and miles of roadway in Hatch Town. Critical facilities impacted by natural hazards can cause additional vulnerability to a community, as prominent meeting spaces and response is impacted during the event.

Table 126: Hatch Wildfire Risk

Hatch Town Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	65.2%	Unknown	1.7%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hatch Town's residential parcels have significant exposure to wildfire risk, with 65.2% exposed. The only identified critical facility in Hatch, the Volunteer Fire Department is not in an identified wildfire risk area.

The land surrounding Hatch town is dominantly public lands managed by the Bureau of Land Management. The BLM has engaged in fuels mitigation activities and vegetation restoration in the area, to mitigate wildfires. The community has pursued in the past a grant for wildfire public education about defensible space, but the grant was not awarded to Hatch.

Hazard History

There has not been a significant wildfire event that has affected Hatch, according to FEMA and the Utah Wildfire Info Database, although this lack of past events does not mean that a wildfire cannot occur in future. The local planning team described a 1989 fire that started several miles south of Hatch. The Brian Head Fire of 2017, which primarily impacted Iron and Garfield Counties, also impacted the community with smoke and ash.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, impacting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Hatch, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah and the Great Basin area has significant seismic activity, reporting several earthquakes annually. These earthquakes tend to be small and barely felt in communities, however several faults in the state have the potential to produce severe earthquakes. There are no mapped Quaternary Fault lines in Hatch

Town, with the closest being the Sevier Valley Hills faults and folds three miles north of the city and the Sevier/Toroweap fault zone to the east, as seen in Figure 127.

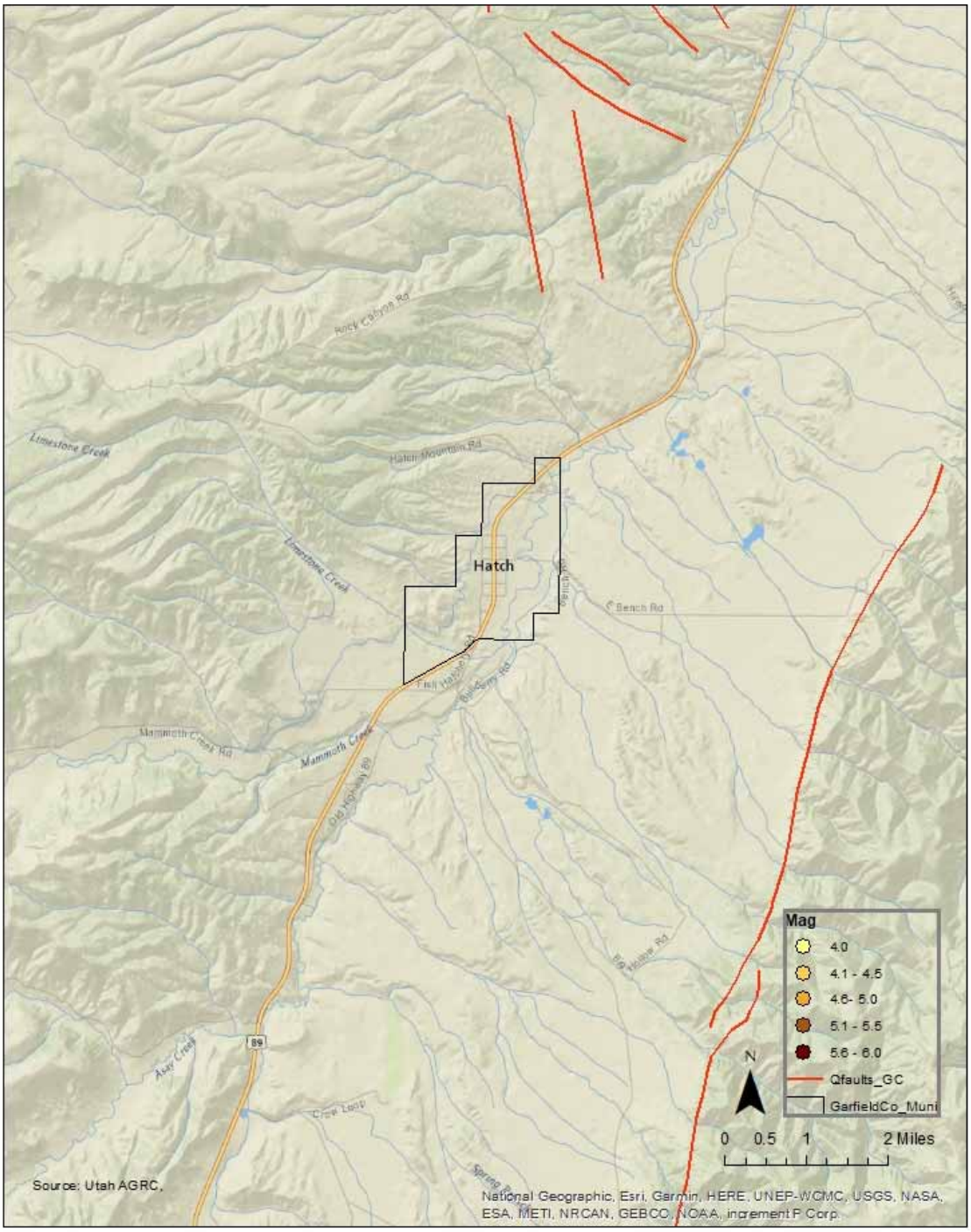


Figure 127: Hatch Town Faults and Earthquake Epicenters

Source: Utah Geologic Survey, University of Utah Geology Department

There are no quaternary faults identified in the town boundaries, although they are observed outside of town, as described in Figure 127.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Hatch Town has 43.5% of residential parcels have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Hazard History

Earthquake epicenters of 4.0 or greater have not been reported in Hatch, UT, although epicenters have been reported in nearby Panguitch. Earthquakes can happen throughout the state, although fault lines tend to be the most common cause of large earthquakes, they can still occur and cause impacts in areas such as Hatch.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Hatch Town.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 128 describes the flood and dam inundation exposure in Hatch. As illustrated in the map, Hatch does not have mapped dam inundation zones in the community.

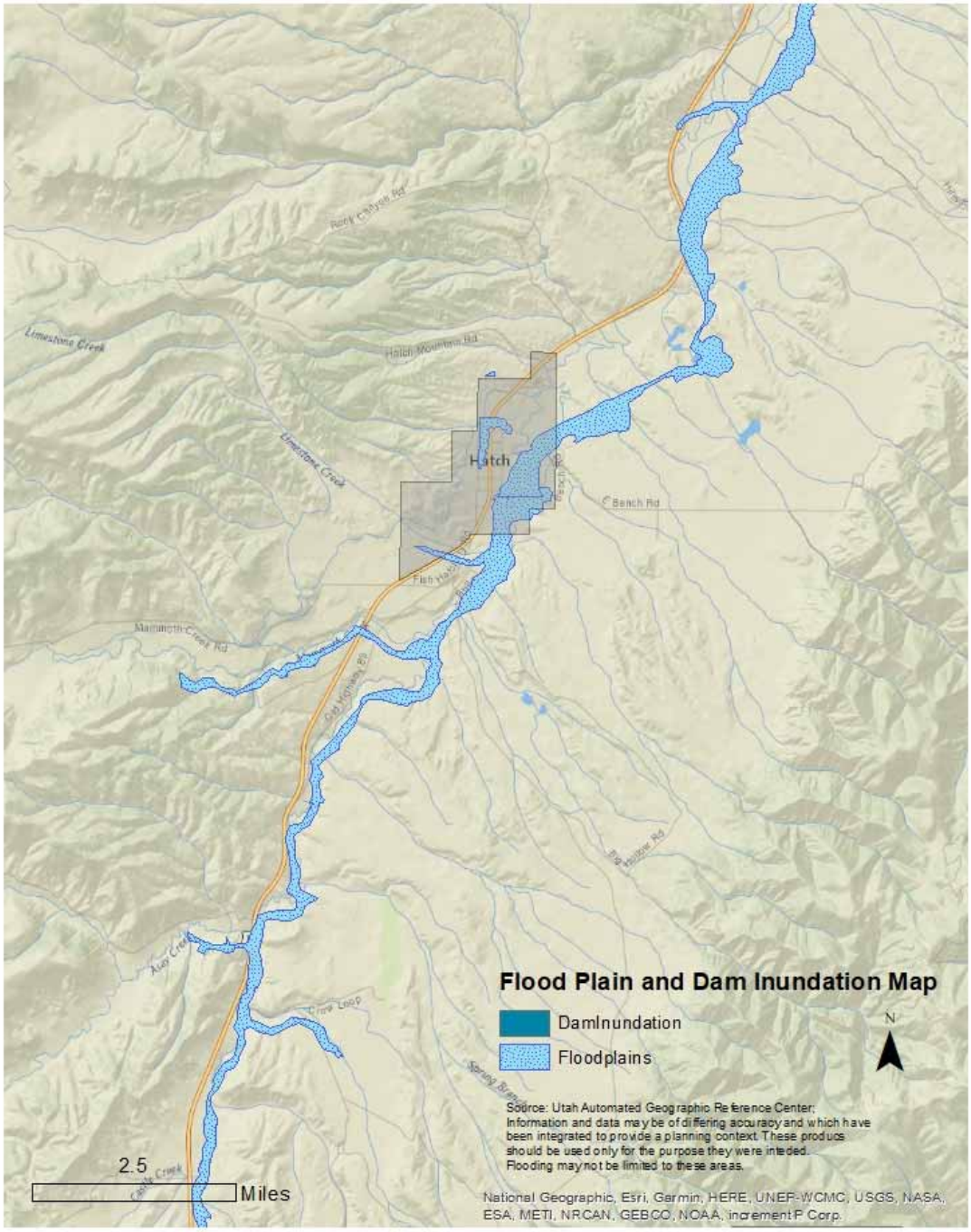


Figure 128: Hatch Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 127 further examines the exposure to identified flood risk areas in Hatch, by observing community assets and structures that are in at-risk areas. The table shows that 28.3% of residential parcels are exposed to the floodplain. Road miles are also exposed, notably Highway 89, which interacts with the mapped floodplain at several locations in and outside of the city. Roadways in the floodplain can limit access for response and recovery, in addition to regular supplies and community needs.

Table 127: Hatch Floodplain and Dam Inundation Exposure

Hatch Town Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	28.3%	Unknown	11.3%	N/A	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

The Hatch community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Flood Insurance Rate Maps were developed for Hatch in 1979. Table 128 describes the number of policies and claims recorded in Hatch as of July 23, 2020. There is one policy in the community with coverage in the amount of $176,000. No claims have been paid since 1979.

Table 128: Hatch Town NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$995	0	1	1	$176,000	0	$0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Hatch Town had a Community Assistance Contact (CAC) on October 2, 2019. The community does not participate in the Community Rating System.

Hazard History

It is likely that flooding events will continue to impact Hatch with seasonal severe storms. While the community has only experienced two reported flooding events with impacts, observed reports of impacts and hazards from other communities indicate that flooding is likely to continue to impact this area. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the city. Table 129 describes the documented flooding events in Hatch that have caused damages or injury.

Table 129: Hatch Flood Event History

Date	Damages or Injury	Description
8/9/1997	$5,000	Flash Flood along the Sevier River closed Highway 89 north of Hatch.
6/17/2011	$50,000	Flood from Snow melt and heavy rain. Which lead to flooding along the Sevier River. Low-lying roads and bridges in Hatch were impacted, including the Old Hatch Bridge.

Source: NOAA Storm Event Database, 2021

This history indicates that roadways and infrastructure have been impacted by past flooding events. Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest is where landslides occur. Hatch does not have a record of landslides impacting the community. The community is in a valley between two mountainous areas. Figure 129 maps the landslide susceptible areas in Hatch. The map describes significant landslide risk areas outside the city limits, with some areas identified as landslide susceptible inside the city boundary.

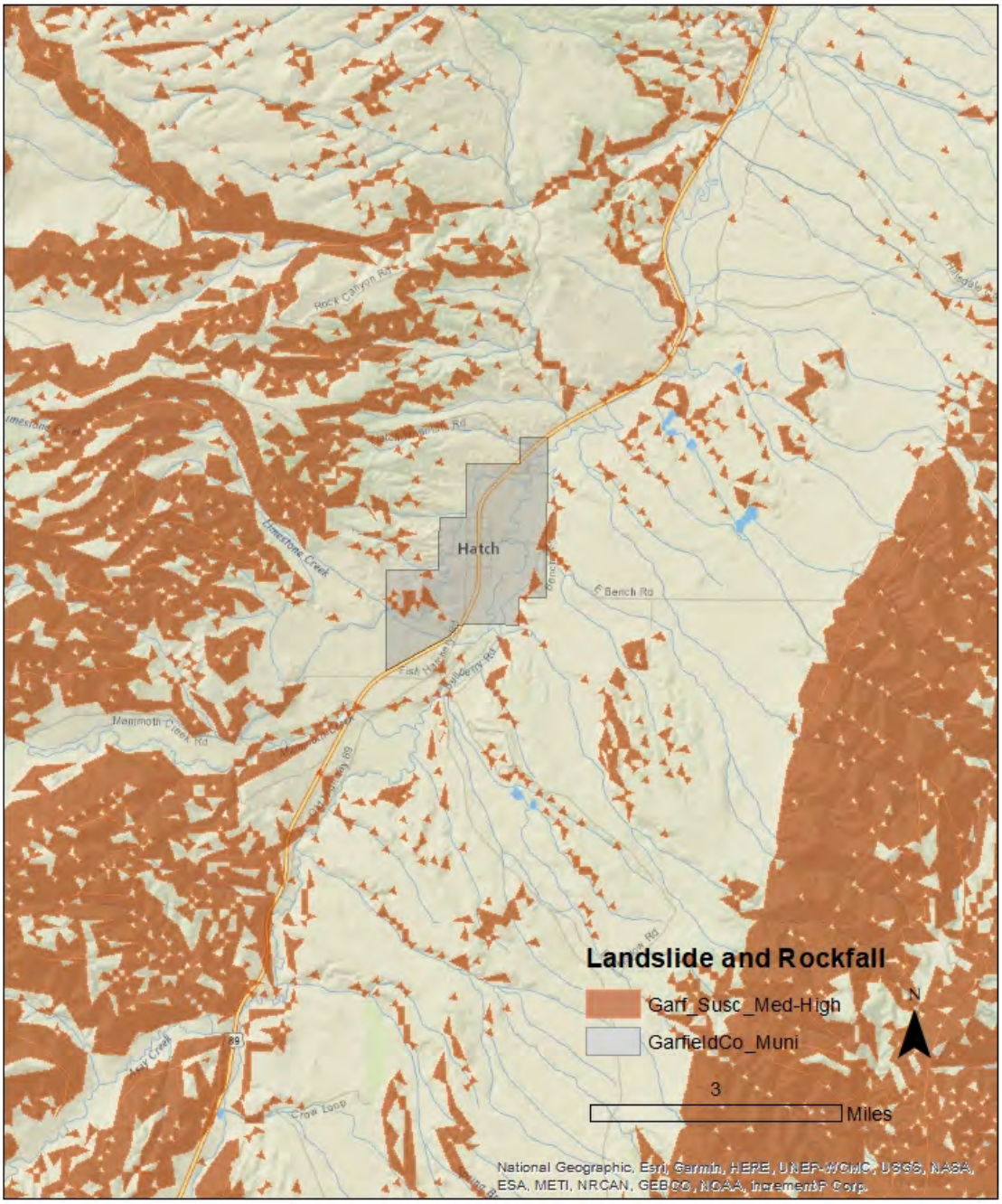


Figure 129: Hatch Landslide Susceptibility

Source: Utah Geological Survey

Table 130 describes the exposure of certain community assets, and it is observed that exposure is low on all measures. The mapped landslide susceptibility compared to community asset locations in Hatch describe that 1.9% of all roadways are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate Hatch from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. Highway-89 seems to have minimal if any exposure to the moderate and high landslide susceptible areas in Hatch Town boundaries.

Table 130: Hatch Landslide Susceptibility Exposure

Hatch Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	1.9%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Present exposure and the historic record indicate that landslides are presently a low-risk hazard to Hatch, however, future growth of the community toward the east or in the southwest sector of the community could place residences, businesses, property, and infrastructure at risk.

Hazard History

The local planning team described debris flows occurring during or after seasonal flash floods, which are generally located in the agricultural zones of the community. Hatch has not reported landslide events which caused damages or injury.

Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area. Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the city includes wells and spring water.

Hatch's economy includes agriculture and tourism, which can both be susceptible to drought impacts. Drought can contribute to hot and dry conditions, especially in summers that pose challenges to these industries. Crops may be lost, or damaged, and dry conditions can contribute to increased risks of wildfire in the area. In Hatch, the community irrigates agricultural land through flood irrigation from the Sevier River.

Tourists, especially those in the backcountry can have less access to water sources outdoors and can be susceptible to dehydration or heat related illness. The perception of poor recreation conditions, (low water levels for boat or watersport activities for example) or the perception of risk (wildfire) associated

with drought conditions can deter travelers and recreationists from visiting at risk areas, according to a study done by the National Integrated Drought Information System (NIDIS), in partnership with the University of Colorado, which can be accessed at https://www.drought.gov/sites/default/files/2020-09/drought-and-outdoor-recreation-report-9-16-20.pdf.

Water quantity and quality are vulnerabilities to communities experiencing drought conditions. Hatch Town has seen impacts to their water utilities, including declining water quantity in both the well and the Sevier River. To address ongoing drought conditions and their impacts on the community, Hatch town has implemented outside watering restrictions.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 130. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

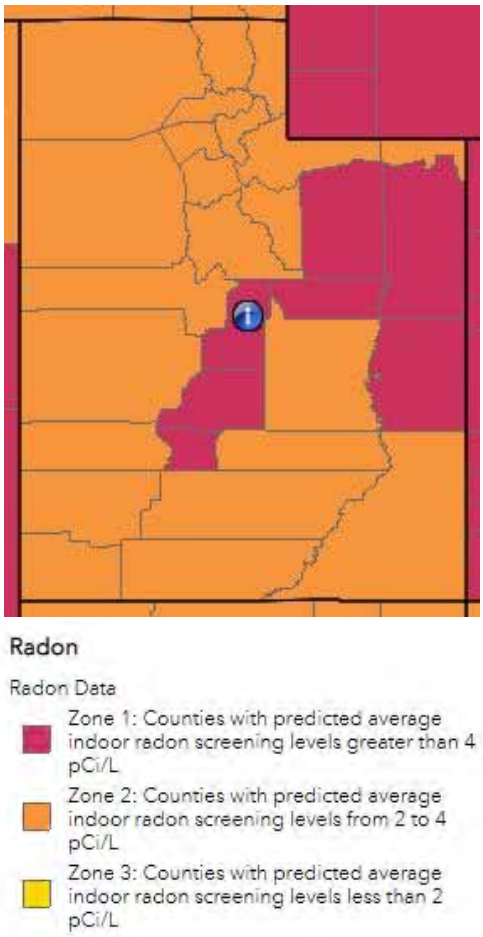


Figure 130: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 131 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high average. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk to users and residents.

Table 131: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Hatch, however our analysis assumes that severe weather events will impact the whole of Hatch residents, facilities, infrastructure, businesses, and property.

Hatch has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Hail, strong wind, rain and thunderstorms, and extreme temperatures are among the weather hazards that frequently impact Hatch and the southwestern region of Utah.

Hazard History

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Two total weather events have been recorded with impacts to Hatch between 1950 and 2020. Table 132 describes the severe weather events which have been recorded for Hatch. Other county events likely impacted Hatch and should be reviewed in the County section of this hazard plan.

Table 132: Hatch Severe Weather Record

Date	Damage/Injury	Description
9/8/1997	$10,000	A thunderstorm produced large hailstones and caused roof damage in the area around Panguitch Lake.
6/17/2011	$50,000	Heavy rain fall caused the Sevier River to flood, impacting the Town of Hatch and Old Hatch Bridge.

Source: NOAA Storm Database

Severe weather will continue to impact Hatch as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the county on behalf of Hatch Town, which requires that all construction has a geologic study pre-construction. Hatch's local planning team expressed minimal impacts from problem soils and could not point to buildings being damaged due to problem soils.

Figure 131 illustrates where mapped problem soil areas are in Garfield County, primarily in the east central portion of the County, with some expansive rock in the Bryce Canyon area and Escalante Area. No problem soils are currently mapped for Hatch.

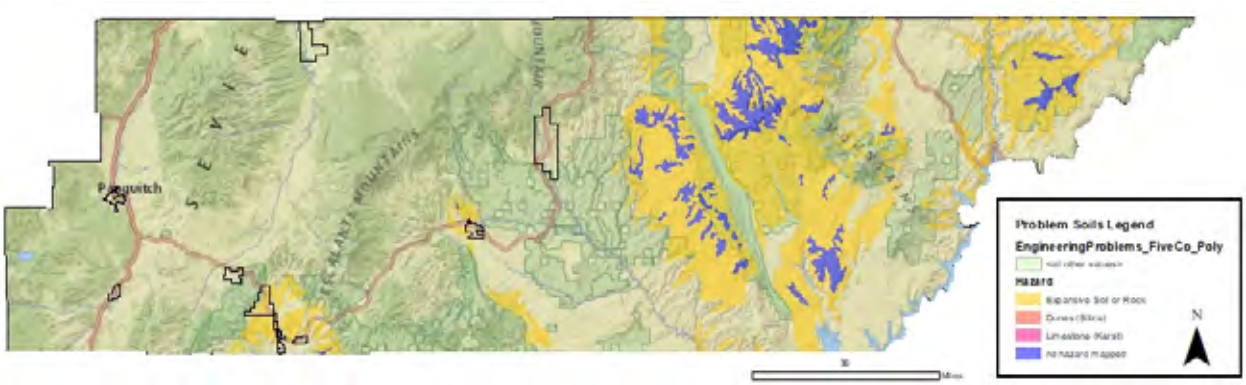


Figure 131: Garfield County Mapped Problem Soils

Source: AGRC

UGS has developed new mapping for other communities, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although County building permits may require a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Hatch is exposed to wildfire, earthquake, flooding, drought, severe weather, and radon. Limited risk currently exists for landslides and problem soils throughout the community. The community has engaged in activities to mitigate risks in the past, including work and partnership with the Bureau of Land Management to address wildfire, UDOT projects to address flood on Highway 89. Vulnerabilities identified through this process highlight that roadways and homes, in addition to potential economic impacts from supply chain delays or impacts on industry such as tourism in the area following a natural hazard event.

Mitigation Strategy and Actions

The mitigation strategy is an outline for Hatch to address the risks and vulnerabilities identified in this planning process. The strategy includes a list of actions, estimated timeline, funding opportunities, and responsible parties to complete the actions outlined in the strategy. Communities can include the actions in upcoming plan updates or code amendments, existing or future projects in the community for implementation.

Progress on 2016 Mitigation Strategy

Hatch Town participated in the 2016 iteration of the Five County Natural Hazard Mitigation Plan and identified two actions to mitigate natural hazard risks in the community. The natural hazard plan is intended to be iterative and documents progress from previous planning efforts. Table 133 describes the progress made on actions from the 2016 mitigation strategy.

Table 133: 2016 Hatch Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Prevent snow melt and high intensity precipitation events from flooding property and roads.	Perform regular drainage system maintenance, such as sediment and debris clearance from culverts	Annual	Town operating budget	Cleaning of irrigation ditches, culverts, and drainage ditches are managed by the irrigation companies or UDOT (for culverts on Highway 89) as needed. This action is not needed in future strategies.
Flood #2	Prevent flooding and property damage to homes and businesses in Hatch during high precipitation events.	Construct flood control measures that are addressed in the town drainage study. Specifically curb and gutter to prevent flooding during high precipitation events.	5 Years	Hatch, FEMA, CIB, CDBG	Hatch has applied for funding for curb and gutter. This action is still needed.

Source: 2017 Five County Association of Governments NHMP

2022 Mitigation Strategy

The Hatch Town local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 134. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 132.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to fund implementation.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 132: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, the town has assembled several actions, addressing each of the natural hazards that the community is at risk to.

While developing this mitigation strategy, Hatch Town determined that earthquake hazards were best addressed by Garfield County, as Garfield County provides building inspection services to the town. Ordinances requiring securing of equipment in or on a building to mitigate earthquake hazards would be implemented and monitored by the County Building Inspector. Hatch has not included radon, problem soils, or landslide in their mitigation strategy due to the identified low risk in the community.

Table 134: 2022 Hatch Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Potential Funding Source	Responsible Party
Earthquake #1	2	Assess and take actions to preserve historic town	Assess and seismic retrofit the old schoolhouse, which currently	M	5-years	M	Hatch Town, Preservation Utah, State and Federal tax Credit.	Hatch Town Daughters of the Utah Pioneers

		owned facilities.	operates as the Daughters of the Utah Pioneers Museum.					
Flood #1	1, 2	Reduce street flooding which impacts yards and property.	Construct flood control measures that are addressed in the town drainage study, including curb and gutter to prevent flooding during high precipitation events.	H	5-years	M	Hatch Town, FEMA, CIB, CDBG	Hatch Town
Flood #2	2	Reduce street flooding which impacts yards and property.	Develop a retention basin at wash north of the town.	M	5-years	M	CIB, Hatch Town	Hatch Town
Flood #3	2	Reduce street flooding which impacts yards and property.	Construct a piped water diversion of stormwater in the northeast portion of town to address flooding in that area of town.	M	5-years	M	CIB, CDBG, Hatch Town	Hatch Town
Drought #1	2	Conserve town water resources.	Adopt tiered water conservation policy, which links increased conservation with measurable drought, water quantity, and/or water quality metrics.	M	ongoing	L	Hatch Town	Hatch Town
Drought #2	3	Conserve town water resources.	Engage in public education with residents to promote water conservation and smart water use.	H	ongoing	L	Hatch Town, Irrigation Companies	Hatch Town

Severe Weather #1	2, 5	Ensure town offices can function during severe weather events.	Purchase and install a generator at the Town Hall and designate the building as an emergency meeting place, giving residents shelter and resources during emergencies and power outages.	L	3-years	M	Hatch Town	Hatch Town
Wildfire #1	3, 5, 6	Encourage residents to participate in fuels mitigation on personal property.	Add educational element about defensible space and fire mitigation to the annual community clean up. Coordinate with the town fire department to identify vulnerable landowners and provide targeted information and assistance in creating defensible space at homes.	M	1-year, ongoing	L	Hatch Town	Hatch Town Hatch Fire Department
Wildfire #2	4, 5	Ensure safety and fuels mitigation at utility facilities.	Coordinate with utility companies that house large propane tanks in town to develop: 1. Posted signage with contact information for use during in emergencies at each tank. 2. A shared and documented method for response to emergencies	M	1-year	L	Hatch Town Garkane Blackburn	Hatch Town Garkane Blackburn

			at the propane tanks.					

Source: Local Planning Team

Henrieville

Henrieville Town is a rural community in south-central Garfield County near the Kodachrome Basin State Park and Bryce Canyon National Park. Located on SR-12, the community is on the boundary of Garfield County, near Kane County. The nearest community is Cannonville, 3.5 miles west.

Population

Henrieville has a population of 242 as of the 2018 American Community Survey as described in Figure 133. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

Henrieville has seen growth in population primarily between 2000 and 2010, at a rate of 44.7%, described in Figure 134. The average population change for each decade has been 14.0% since 1960, referencing the populations documented at each census.

According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Henrieville, the population by 2065 may be near 354 people. In addition to these permanent residents, this area of Garfield County sees significant annual visitation, for the National and State Park and other recreation assets in the area. It is unknown how many visitors come to Henrieville at the time of this writing.

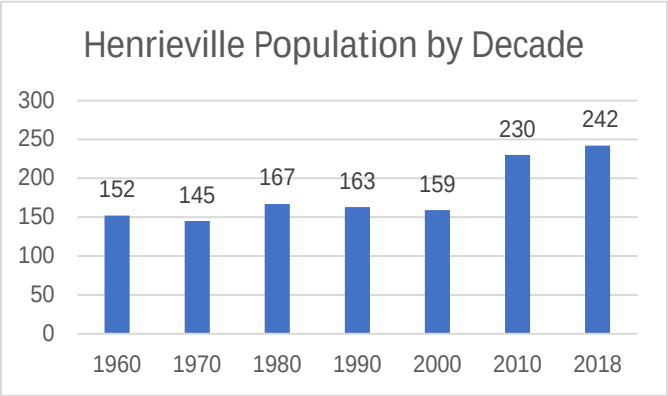


Figure 133: Henrieville Population by Decade

Source: US Census Bureau

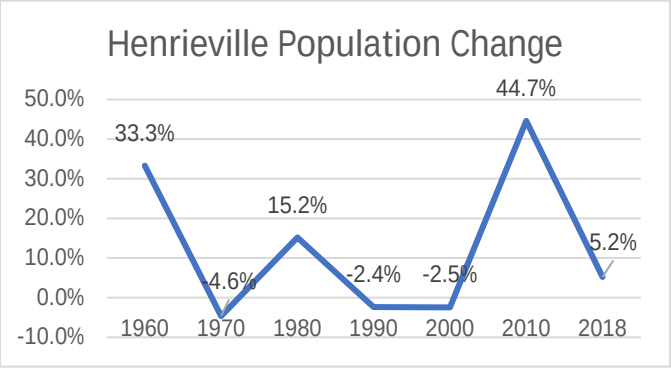


Figure 134: Henrieville Population Percent Change

Source: US Census Bureau

Economy

According to the US Census on the Map tool, all private primary jobs in Henrieville are in the healthcare and social assistance industry. The data excludes public services, which likely occupies a share of the community jobs. An assessment by OnTheMap also describes that over 50 people who live in Henrieville work outside of the community, as of 2018.

Development

Minimal new development has been added to the community. A subdivision originally created approximately ten years ago has developed three homes since its division. Main Street is the focus of the community with renovations to existing properties.

One item highlighted by the community is that there are few options for rental housing.

Community Capabilities

The community is governed by a volunteer elected town council and a mayor. Law enforcement is provided by the County Sheriff's Office in Panguitch. The community has one fire station and a volunteer fire department which serves local response and fire suppression.

The town supports a water utility for residents. All other utilities are provided by third party entities, including:

- Garkane Energy
- South Central Communications

Plans and Policies

No plans were made available for this plan update.

Risk Assessment

Henrieville Town experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Henrieville to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 135 displays the relative risks of hazards in the community.

Table 135: Henrieville Risk Assessment

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOODING	3. High
WILDFIRE	4. Moderate

EARTHQUAKE	5. Moderate
RADON	6. Low
LANDSLIDE	7. Low
PROBLEM SOILS	8. Low

A detailed description and mapping of each of the natural hazards that impact Henrieville can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Henrieville include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Henrieville Town is surrounded open space. The community has an arid climate environment and like much of the Southwest, there is a fire risk. There has not been a significant wildfire event that has affected Henrieville, according to FEMA and the Utah Wildfire Info tracker, although this lack of past events does not mean that a wildfire cannot occur.

Figure 135 maps areas of moderate to extreme wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Henrieville that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Henrieville has exposure to moderate or greater risk wildfire areas, in the downtown area along SR-12, according to the mapping.

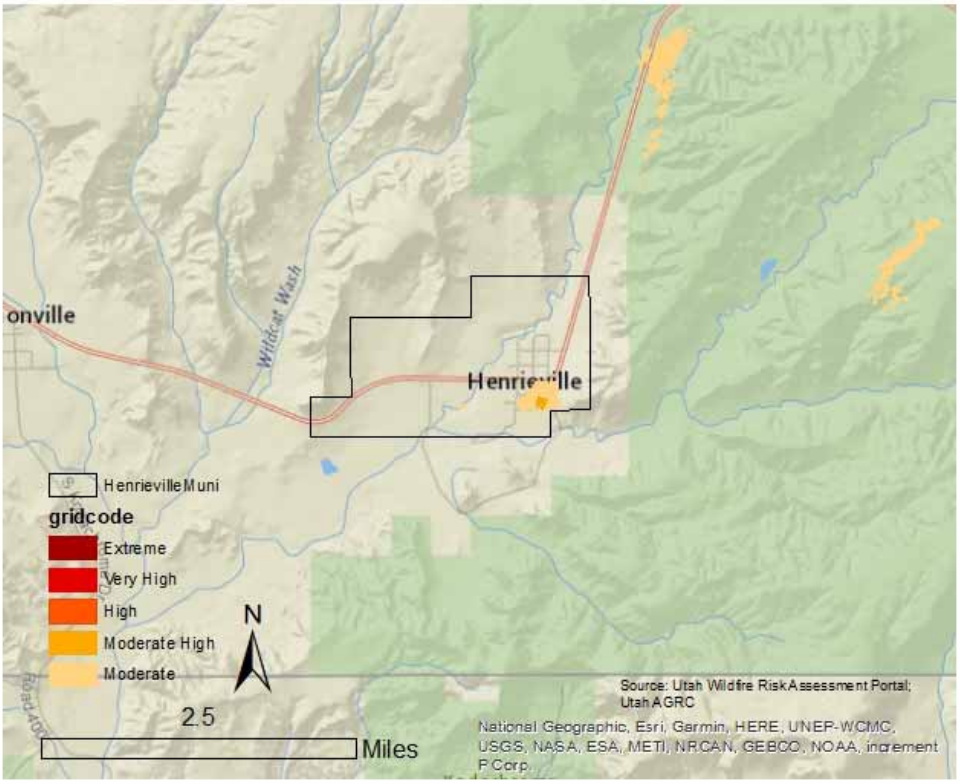


Figure 135: Henrieville Wildfire Risk

Table 136 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Henrieville. Critical facilities are not recorded in a wildfire risk area, which can result in a safer community and protection of community assets. A very small portion of road miles are within a moderate to extreme wildfire risk area. Residences appear to have the greatest relative risk to wildfires, at 15.8%.

Table 136: Henrieville Wildfire Risk

Henrieville Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	15.8%	Unknown	4.4%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Henrieville and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. Figure 136 shows the map of Garfield County earthquake epicenters and quaternary faults. There are no mapped Quaternary Fault lines in Henrieville, with the closest being the Sevier-Toroweap faults approximately 24-miles west of the city and the John's Valley Fault 22-miles to the north. Earthquakes can happen throughout the state. Fault lines tend to be the most common cause of large earthquakes which can cause impacts in areas miles away.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Forty-one percent of Henrieville residential parcels have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Figure 136: Garfield County Earthquake Epicenters and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Hazard History

There have not been recorded earthquake epicenters in or near Henrieville.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Henrieville.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 137 describes the flood and dam inundation exposure in Henrieville. As illustrated in the map, Henrieville includes mapped floodplain throughout the city boundaries, but does not interact with a mapped dam inundation zone.

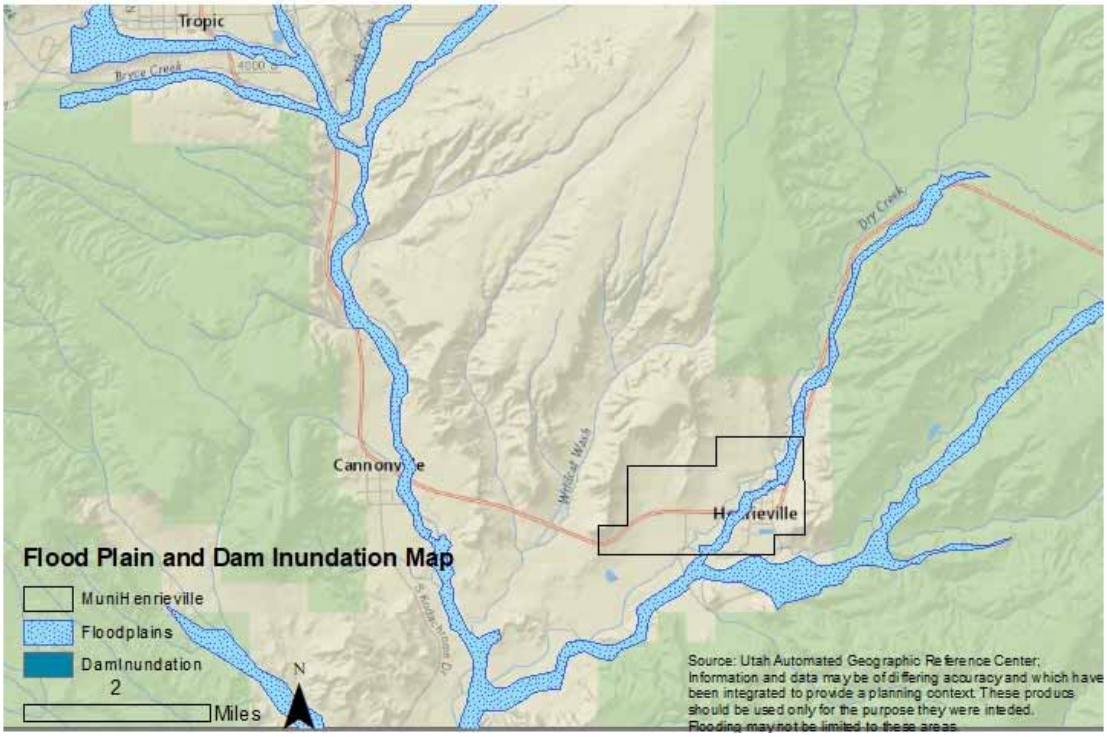


Figure 137: Henrieville Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 137 further examines the exposure to identified flood risk areas in Henrieville, by observing community assets and structures that are in at-risk areas. The table shows that 30.5% of residential parcels are exposed to the floodplain or dam inundation zones. Local road miles are the roadways which interact with the floodplain are access roads to the community, estimated at 13.1% of road miles. Flooding on such access roads can lead to transportation delays, and impact response during an emergency event.

Table 137: Henrieville Floodplain and Dam Inundation Exposure

Henrieville Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	30.5%	Unknown	13.1%	N/A	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Henrieville property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Henrieville has participated in the NFIP and their Flood Hazard Base Maps were first identified in 1975. They have participated in the program since September 25, 1979 when their Flood Insurance Rate Maps (FIRMs) were completed. Despite mapping and participation in the program, no policies exist in the community, nor is there a record of claims paid, as described in Table 138.

Table 138: Henrieville NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$0	Unknown	Unknown	0	$0	Unknown	Unknown

Source: FEMA Repetitive Losses/BCX Claims, NFIP Insurance Report, and Community Status Book: Utah.

The town does not have to provide a floodplain manager at this time.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 139 describes the flooding events which impacted Henrieville.

Table 139: Henrieville Flood Hazard History

Date	Damage/Injury	Description
9/15/1997	$30,000	Heavy rainfall lead to flooding on Paria River and Henrieville Creek, closing SR12 due to bridge damage. Henrieville measured 1.75 inches of rainfall.
8/24/1998	$23,000	Flooding from the Escalante River closed SR12 due to water, rocks, and debris on the roadway.
8/8/2001	None reported	Heavy rain caused flash flooding in Henrieville with water flowing on several roads.

Source: NOAA Storm Database

Events in neighboring communities may have also impacted Henrieville but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that

severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 138 maps the landslide susceptible areas in Henrieville. The map describes landslide susceptible areas in the community.

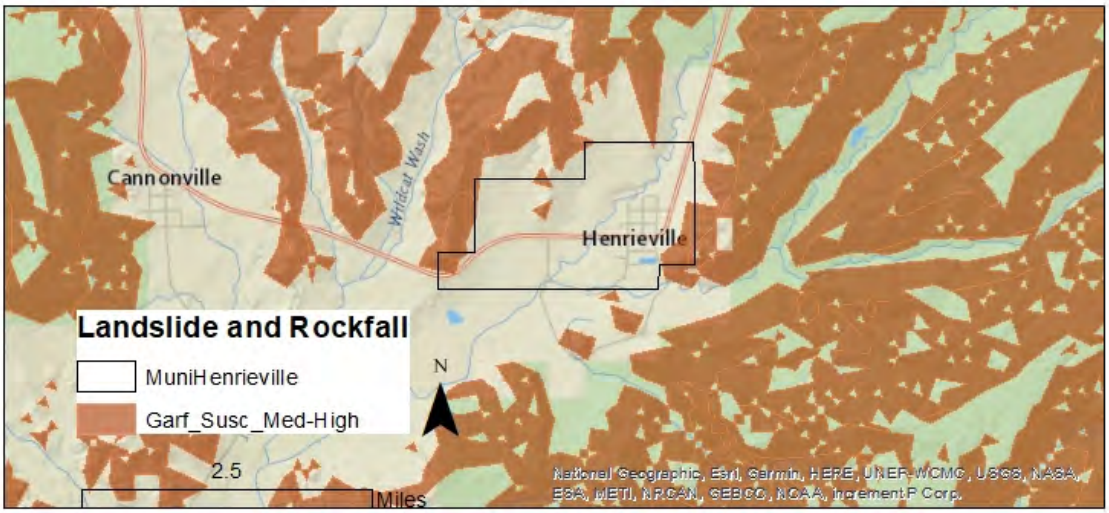


Figure 138: Henrieville Landslide Susceptibility

Source: Utah Geological Survey

Henrieville has some exposure to landslide susceptible areas, especially on the west side of the community. Table 140 describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Henrieville describe that 1.0% of road miles are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate the community from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. This is especially true of major connector roads like highways.

No residential parcels are presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 140: Henrieville Landslide Susceptibility Exposure

Henrieville Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	1.0%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

Locally, landslides are observed primarily outside of the developed area, near agricultural lands. Landslides have not been reported causing damages or injury in Henrieville Town.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather

can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area. In Henrieville, the community has experienced drought and has rationed water to address drought locally.

Drought can have impacts on local air and water quality, as dry soil and burned smoke and ash blow in the wind. Also, low water flow can breed waterborne illnesses, algae, and other organisms hazardous to human health if consumed or exposed to humans. Further the dry soil and ash from the dry conditions or wildfires can enter riparian areas, impacting water quality.

Economies like agriculture and tourism may be impacted by drought. Dry conditions can damage crops or livestock. Communities that rely on visits from tourists for their economic base may see fewer visits to the area if there is a perception that risk is high for drought related hazards or that drought has impacted the recreation amenities in the area.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 139. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

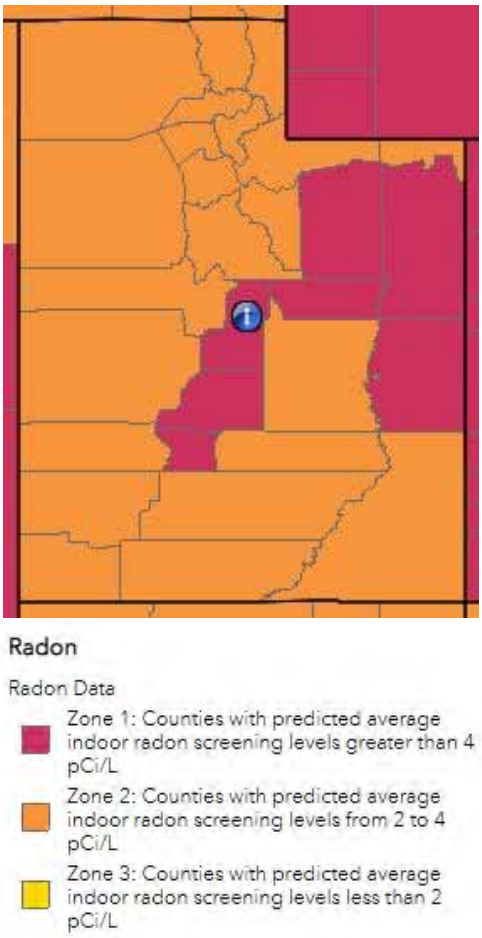


Figure 139: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 141 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 141: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Henrieville, however our analysis assumes that severe weather events will impact the whole of Henrieville residents, facilities, infrastructure, businesses, and property.

Henrieville has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorm is a weather hazard that frequently impacts Henrieville, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Eleven total weather events have been recorded with impacts to Henrieville between 1950 and 2020, which are documented in Table 142. Other county events likely impacted Henrieville and should be reviewed in the County section of this hazard plan.

Table 142: Henrieville Severe Weather Record

Date	Property Damage/Injury	Description
9/29/2000	None Reported	Two thunderstorms produced ¾ inch and 1 inch diameter hail on Henrieville.
12/7/2009	None Reported	Kodachrome Basin receives 14 inches of snow during a winter storm.
1/22/2010	None Reported	Kodachrome Basin receives 11 inches of snow.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
2/24/2015	None Reported	16 inches of snow fell at Kodachrome Basin during a winter storm.
2/27/2015	None Reported	11 inches of new snow fell at Kodachrome Basin.
3/3/2015	None Reported	23 inches of snow fell from March 1 to March 3 at Kodachrome Basin State Park.
1/31/2016	None Reported	Statewide winter storm brought 11 inches of snow to Kodachrome Basin.
1/7/2019	None Reported	7.8 inches of snow was recorded in Kodachrome Basin State Park.
2/20/2019	None Reported	5 inches of snow fell in Kodachrome Basin State Park.

Source: NOAA Storm Database

Winter storms and hail common severe weather events in Henrieville based on the record of historic weather events. These hazards have the potential to cause damage, injury, and death. Extreme heat is

also a challenge throughout the Southwest and while the deaths reported did not occur in Henrieville, the town and nearby recreation areas likely also saw extreme heat in the area during these events.

Severe weather will continue to impact Henrieville as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the County on behalf of Henrieville, which requires that all construction has a geologic study pre-construction. Figure 140: Henrieville Problem Soils Map illustrates where mapped problem soil areas are in Henrieville. The community has expansive soils and rocks mapped. These soils are reactive to water content, causing the soil to expand when whetted. Unmitigated problem soil areas can damage property or infrastructure built on top of it.

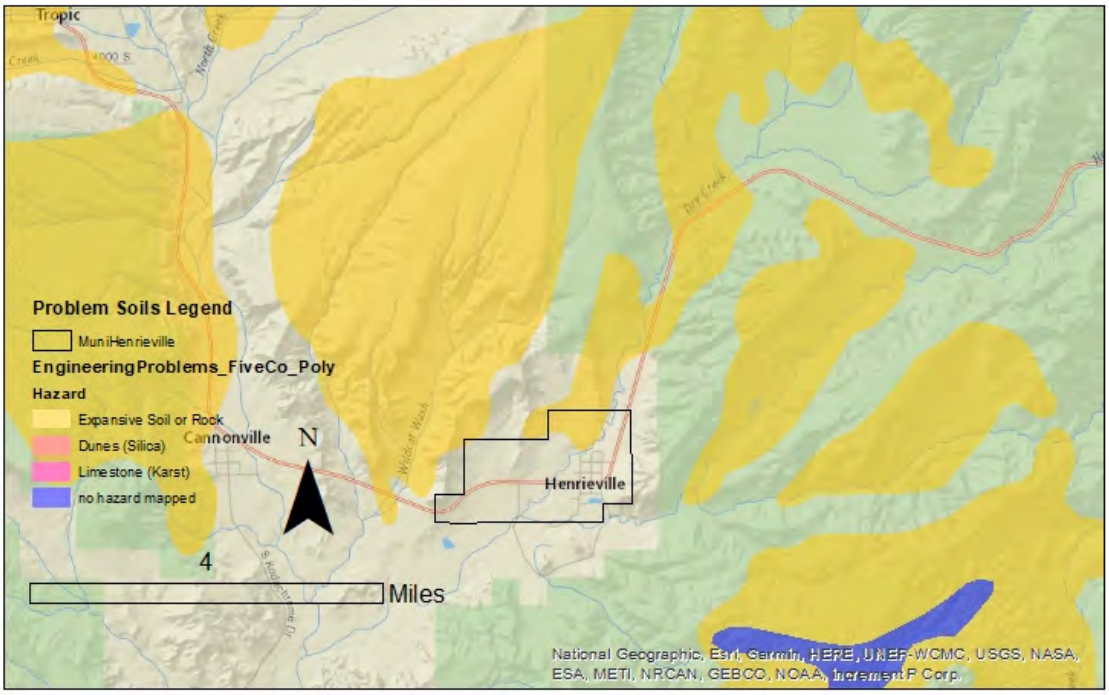


Figure 140: Henrieville Problem Soils Map

Source: UGS, AGRC

Five County compared the existing parcels, critical facilities and infrastructure to these mapped problem soil areas and summarized findings in Table 143 and found that 4% of the road miles are exposed to mapped expansive soil and rock areas. These areas could see changes in the soil during or following storms or runoff events, which impact the roadways, infrastructure, and buildings. Undeveloped land that falls in a mapped problem soil area could require mitigation during construction to reduce risks.

Table 143: Henrieville Problem Soils Exposure

Henrieville Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	4.0%	N/A	N/A

Source: Utah Geological Survey, AGRC

Residential parcels are not presently identified in a mapped problem soil area. Future growth could place new residential development in an area with problem soil concerns. UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts. There are no known reports of challenges with problem soils impacting structures in the community. Sites where the County required soils testing may document where problem soils have been found and mitigation methods in the building permit application.

Summary

Henrieville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. The community's critical facility was not identified in any of the hazard risk areas. Future construction or development in the community should consider the identified natural hazard risks to minimize their exposure to natural hazards.

The economy, which includes a significant number of healthcare jobs could be impacted during a hazard event, although it is unclear whether these jobs are patient care, or some other capacity related to healthcare. Patient care may see damage to their own facilities and infrastructure which can impact the quality of care. During or following an event, they are likely to see a greater than normal need. Other healthcare capacity could see a stall in their workflow if infrastructure is impacted during a hazard event.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Henrieville has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

2016 Mitigation Strategy

Previous mitigation plans have identified strategies planned by Henrieville and are listed in Table 144 with a description of their progress. The town has identified that the development of code for snow loads on roofs are still needed and this action has been included in the 2022 strategy.

Table 144: 2016 Henrieville Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Severe Weather #1	Protect buildings and infrastructure from the impacts of winter storms.	Ensure the development and enforcement of building codes for roof snow loads.	1 year/Ongoing	Town Operating Budget	Still Needed.

Source: 2017 Five County Association of Governments NHMP

2022 Mitigation Strategy

The local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 145. These actions have been identified and discussed during planning meetings based on the risk assessment.

The elements included in the mitigation strategy are defined as follows:

- Hazard- describes the natural hazard the action is intended to address and numbers the actions to easily differentiate between actions. The numeration does not indicate the local priority.
- Goals- identifies the regional plan goal that the action supports. Regional plan goals are listed in Figure 141.
- Objective- identifies a local purpose for the action.
- Action- Summarizes a specific need in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 141: Regional Plan Goals

- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Table 145: Henrieville 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2	Develop and protect water sources.	Develop secondary water system in the town in phases. Phase 1- construct well house infrastructure for the drilled well. Phase 2- connect well infrastructure to existing town water tower.	M	5-10 years	H	Division of Drinking Water, CIB, CDBG	Henrieville Town
Drought #2	3	Inform residents of natural hazard risks and actions to mitigate on personal property and through changed behaviors.	Continue to inform residents on water saving measures, using information from the Utah Division of Water Resources.	H	ongoing	L	Henrieville Town Operating Budget	Henrieville Town
Severe Weather #1	1	Protect buildings and infrastructure from the impacts of winter storms.	Develop and enforce building codes for roof snow loads.	H	1 year, ongoing	L	Henrieville Town Operating Budget	Henrieville Town
Severe Weather #2	5	Protect buildings and infrastructure from the impacts of power outages.	Purchase and install propane generators at firehouse to ensure access to firehouse during severe weather events.	H	2-years	M	Henrieville Town, Fire Department	Henrieville Town, Fire Department

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #3	2	Protect buildings and infrastructure from the impacts of power outages.	Installing and maintaining surge protection on critical electronic equipment.	H	1-year	L	Henrieville Town Operating Budget	Henrieville Town, Fire Department
Earthquake #1	5	Protect critical facilities from the impacts of earthquake to minimize potential damage and ensure ability to respond.	Brace generators at the fire house.	L	1-year	L	Henrieville Town Operating Budget	Henrieville Town
Earthquake #2	2	Protect critical facilities from the impacts of earthquake to minimize potential damage and ensure ability to respond.	Anchor rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc) at the town office and facilities.	H	1-year	L	Henrieville Town Operating Budget	Henrieville Town
Wildfire #1	3, 4, 6	Inform residents of natural hazard risks and actions to mitigate on personal property and through changed behaviors.	Develop a community yard cleanup day which includes public education from the fire department and town council about defensible space around homes.	M	1-year, ongoing	L	Henrieville Town Operating Budget	Henrieville Town, Fire Department
Wildfire #2	1	Set standards for the protection of people and property.	Protecting propane tanks or other external fuel sources.	L	1-year	M	Henrieville Town Operating Budget	Henrieville Town, Fire Department
Flood #1	1	Conduct community planning and policy making to protect residents,	Adopt an ordinance for floodplain requirements in development.	M	1-year	L	Henrieville Town Operating Budget	Henrieville Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		property, and infrastructure.						
Flood #2	2, 4	Improve infrastructure on critical roadways to ensure adequate community access.	Work with the County to replace bridges south of the Town.	M	3-5 years	H	Henrieville Town Operating Budget, Garfield County, UDOT	Henrieville Town, Garfield County, UDOT
Flood #3	2	Improve town infrastructure which will limit the extent of community impacts from natural hazards.	Increase drainage capacity of existing town retention basins.	M	5-years	M	Henrieville Town Operating Budget	Henrieville Town, Garfield County
Landslide #1	1	Conduct community planning and policy making to protect residents, property, and infrastructure.	Update local annexation policy to describe requirements for areas subject to landslide hazards.	L	1-year	L	Henrieville Town Operating Budget	Henrieville Town
Radon #1	3	Inform residents of natural hazard risks and actions to mitigate on personal property and through changed behaviors.	Provide radon risk, testing, and mitigation information to residents.	H	1-year, ongoing	L	Henrieville Town Operating Budget	Henrieville Town
Problem Soils #1	4	Collect data to improve policy making opportunities.	Work with Garfield County and the Utah Geological Survey to update problem soil	L	3-years	M	Henrieville Town, Garfield County, UGS	Henrieville Town, Garfield County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			mapping of the area.					

Source: Local Planning Team

Panguitch

Panguitch is the County Seat of Garfield County and is the most urban community in Garfield County. Panguitch is in the valley between the Markagunt, and Pausaugunt Plateaus and the name is a Native American Paiute word meaning "Big Fish". Panguitch was first settled in March 1864 when four Mormon families braved the rugged terrain of Utah's untamed south central canyon lands. Facing starvation, harsh winters, and tension with the local Native tribes, these pioneers risked survival to establish a community where their beliefs and lifestyle could thrive. The first settlement of the community was hesitantly abandoned in 1866 during the Black Hawk War conflict, and pioneers returned to the settlement in 1871.

The downtown is a National Historic District and has maintained its rural, western aesthetic, using the original facades on buildings. Panguitch history describes pioneer settlers adjusting to long, cold winters of southcentral Utah.

Community Characteristics

Panguitch is in a mountainous region of southcentral Utah. The elevation is over 6,000 feet, making it one of the colder communities in the region. Although it is still considered a desert, the community receives winter snow and is subject to hot summer days, although cooler than lower elevation neighbors. Several lakes dot the landscape around the community, which is a hub for outdoor recreation in the area.

Demographics

Panguitch has a population of 1,773 as of the 2018 American Community Survey and has seen a population increase of 16.6% since the 2010 Census, according to the American Community Survey. According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Panguitch, the population by 2065 may be near 2,570 people.

Economy

Panguitch has strong local business and tourism which contribute to the community. According to the US Census On the Map tool, most jobs in Panguitch are in either the retail trade or accommodation and food services industries, illustrated by Figure 142: Panguitch Share of Private Primary Jobs by Industry. Given the proximity to prominent outdoor recreation attractions, accommodation and food services make up approximately one quarter of the jobs in the community. Garfield County's Intermountain Hospital and Clinic is also located in the community, which makes up a significant portion of the jobs in the community. The data excludes public services, which likely occupies a share of the community jobs.

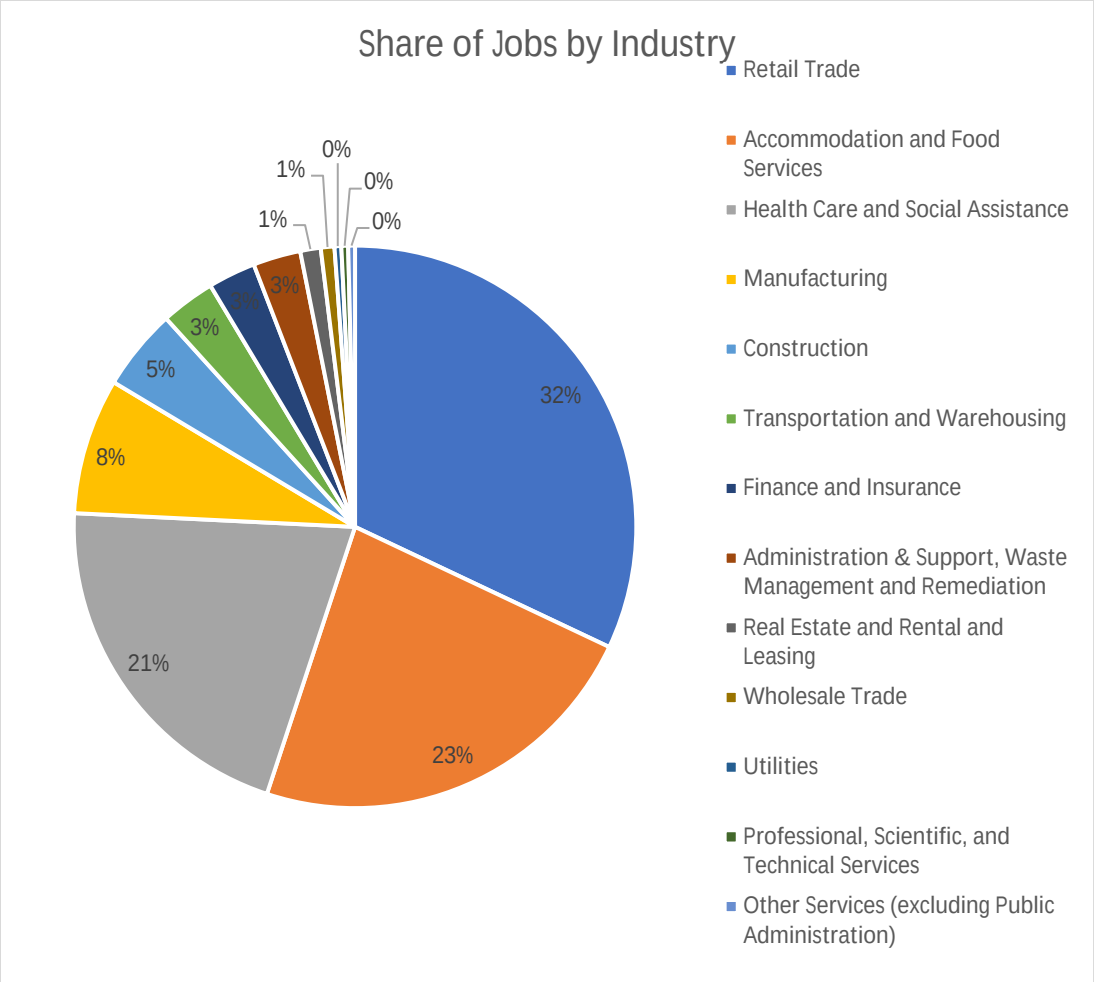


Figure 142: Panguitch Share of Private Primary Jobs by Industry

Agriculture, farming, and cattle ranching are also major drivers in the Panguitch community, although most farms are not located within the city boundaries itself, and thus not included in the table above. This industry is integral to individual and community livelihood, as well as being a historical norm for the area. Many in the town work for or benefit from nearby farms and ranches.

Development

Panguitch has had a number of new subdivisions that have been or currently being developed in the past three years. These developments have added additional homes and population growth in the city. There was recently an annexation along the southern limits of the city boundary, which added additional buildable land.

Community Capabilities

The community is governed by a volunteer elected city council and a Mayor. The community does have staff to support government and city operation. The City Streets Department handles construction of maintenance of roadway infrastructure including curb and gutter, drainage, and flooding issues.

The building inspector enforces the Uniform Building Code, inspects buildings structures, and infrastructure on a site to ensure it is safe, and reviewing permits to confirm that the development

either safe from flooding or that the construction has mitigated flood risks on the site, using one of three approved methods by the City.

Panguitch City provides the culinary and secondary water supply to its citizens. Rocky Mountain Power provides power, South Central Communications provides the communication systems, and Questar Gas provides natural gas.

The Culinary Water System is described in a recently completed Capital Facilities Plan as in need of additional infrastructure to meet the future needs of the town. Further there have been historic events like weather and fire, which have negatively impacted the system and contributed to damages. These items will be further discussed in the respective hazard section and the plans and policies section of this plan.

Law enforcement is provided by the Garfield County Sheriff's Office in Panguitch and likewise, Emergency Medical services are provided by the county. The Panguitch City Fire Department serves the city and surrounding area with fire suppression support.

The Garfield County Hospital, located in Panguitch, serves the entirety of Garfield County as the only hospital and is vital to the county and city to accommodate residents and the ample visitors to the area for tourism.

Plans and Policies

Panguitch city engages in planning and policy making to protect the public and provide for the general health and welfare of the community. The plans and policies assessed in developing this hazard plan include the municipal ordinances and a capital facilities plan.

Municipal Ordinances

The local municipal code describes several ordinances which attempt to mitigate natural hazard risks to residents and property. Ordinances describe requirements for development to prevent geologic hazard and flooding impacts, storm drainage standards to reduce flooding risks, removal of weeds or situations that cause a fire or other hazard. Ordinances also indicate requirements for building permits and other city applications which may entail documentation of flood exposure of a development or report on geologic hazard potential on a site, including landslide, problem soils, or earthquake. For more information, please refer to the City ordinances.

Disaster Response Plan

The Panguitch City Disaster Response Plan provides employees with expectations to continue city operations and assume additional functions in the response of an emergency event. The plan describes reporting mechanisms for staff and tasks which will be assumed. The plan also provides resource agencies at all levels of government, contact information, control of emergency operations, safe meeting areas, and other response and recovery focused mechanisms.

Capital Facilities Plan

The capital facilities plan was developed for Panguitch City in 2020 and describes the culinary water, transportation, sanitary sewer, and irrigation water facilities needs. The document describes several situations where natural hazards either impact capital facilities or which capital facilities need repair and reinforcement to withstand the natural environment in the Panguitch area. Specific descriptions of

vulnerabilities in capital facilities due to natural hazards will be described in the respective natural hazard section.

Risk Assessment

Panguitch experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with Panguitch to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 146 displays the relative risks of hazards in the community.

Table 146: Panguitch Hazard Risk

HAZARD	RISK
DROUGHT	High
SEVERE WEATHER	High
FLOODING	High
WILDFIRE	Moderate
EARTHQUAKE	Moderate
RADON	Low
LANDSLIDE	Low
PROBLEM SOILS	Low

A detailed description and mapping of each of the natural hazards that impact Panguitch can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Panguitch include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

According to FEMA and the Utah Wildfire Info tracker, there has not been a significant wildfire event in Panguitch City, although this lack of past events does not mean that a wildfire cannot occur. The Brian Head Fire in 2017 was the most recent large fire to impact Garfield County. Panguitch saw SR 143 closed during the blaze and impacted nearby Panguitch Lake residents and homes in the unincorporated County.

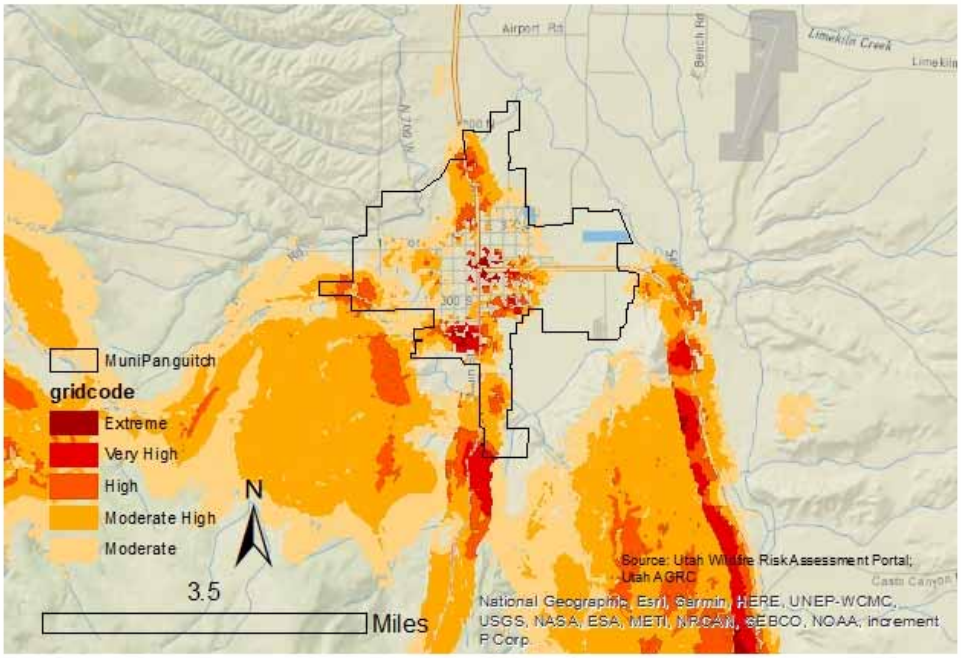


Figure 143: Panguitch Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Figure 143 shows the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Panguitch that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. Panguitch has mapped extreme risk in the core of the city and on the southern end of the community. Roadways out of the community also are mapped at a moderate to high risk to wildfire, likely because these areas are where essential assets exist in the community.

Table 147 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Panguitch. A significant portion of residential parcels and all community parks are in an area considered moderate to extreme risk to wildfire. Fewer road miles and one critical facility in the community are exposed. These highlight vulnerabilities to residents and spaces where residents congregate, in addition to access to neighborhoods and portions of the community.

Table 147: Panguitch Wildfire Risk

Panguitch Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
10.0%	Unknown	67.9%	Unknown	20.7%	N/A	100.0%

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

Panguitch City has not experienced significant wildfires within the city boundaries, but the Brian Head Fire, described in Table 148 had significant impacts on the community, including threatening and

damaging their culinary water system, damaging transmission pipes from springs. Following the blaze, significant rainfall caused localized flooding and debris flows. Panguitch City saw their culinary water system impacted by the fire, as ash and debris washed into the system. The County and Panguitch City have worked to protect these watershed zones to prevent future impacts.

Table 148: Wildfire hazard history

Fire Name	Year	Acres Burned	Description	Counties Affected
Brian Head Fire (FM-5185-UT)	2017	71,675	26 homes & minor structures destroyed. 1,562 people were evacuated from 11 communities. Impacted sage grouse habitat.	Iron and Garfield Counties.

Source: FEMA

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Panguitch and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. While there are no faults running through the city, Panguitch has several faults adjacent to the community, as seen in Figure 144. Earthquakes can happen throughout the state, although fault lines tend to be the most common cause of large earthquakes which can trigger impacts in areas miles away.

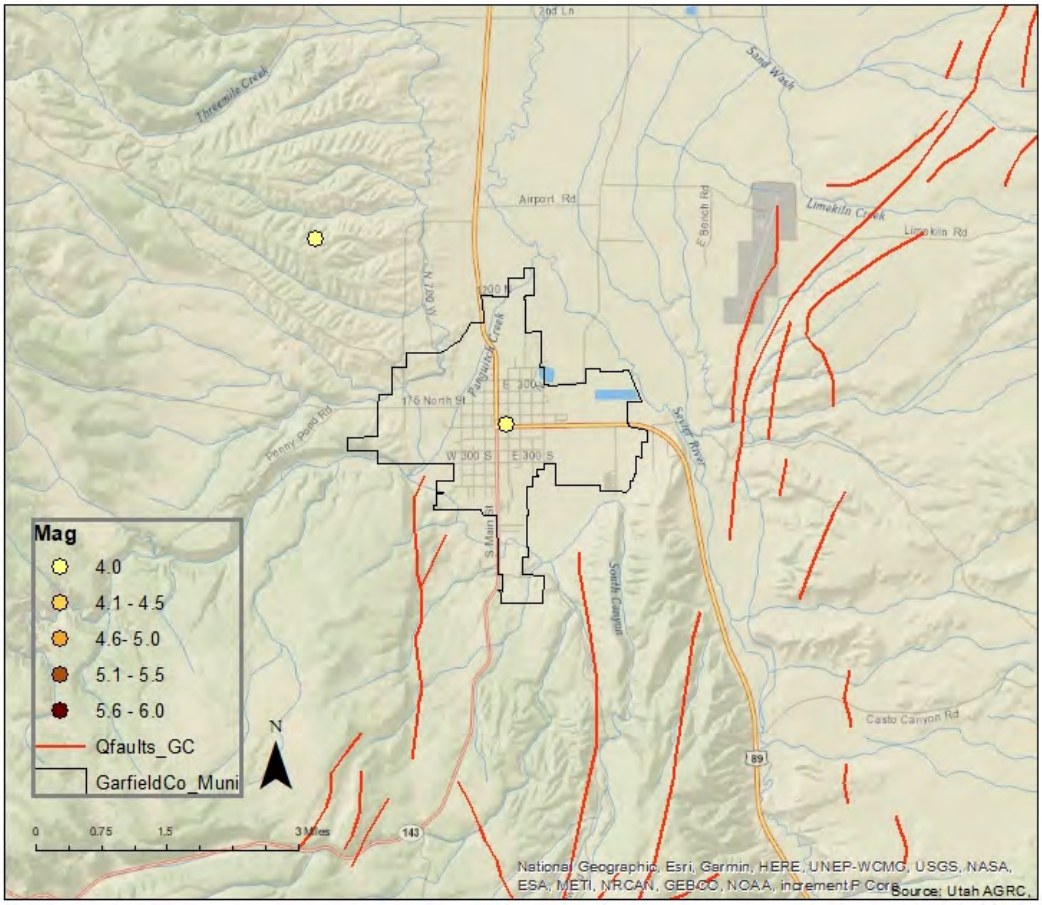


Figure 144: Panguitch Earthquake Epicenters and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Five County analysis to understand local exposure to earthquakes involves computing the community assets which exist within a quarter mile of a fault. While there are no faults in the community, some community assets like roads and residences are in within a quarter mile of a fault. Table 149 describes this exposure. Less than one percent of road miles and residential parcels are exposed to a fault in Panguitch.

Table 149: Panguitch Quaternary Fault Exposure

Panguitch Exposure within a Quarter-Mile of a Quaternary Fault				
Critical Facilities	Residential Parcels	Road Miles	Parks	Rail Miles
0.0%	0.3%	0.4%	0%	N/A

Source: Utah Geological Survey, Garfield County Assessor, UDOT, AGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Fifty-six percent of Panguitch residential parcels and 20% of parcels containing critical facilities indicate that there is a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Hazard History

Two earthquake epicenters have been reported for Panguitch Utah. Table 150 describes the event history.

Table 150: Panguitch Earthquake Epicenter Record

Date	Location	Magnitude
1953	Panguitch	4.05
2015	1.5 miles northwest of Panguitch	4.09

Source: University of Utah Geology Department

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Panguitch.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 145 describes the flood and dam inundation exposure in Panguitch. As illustrated in the map, Panguitch includes mapped floodplain throughout the city boundaries, but does not interact with a mapped dam inundation zone.

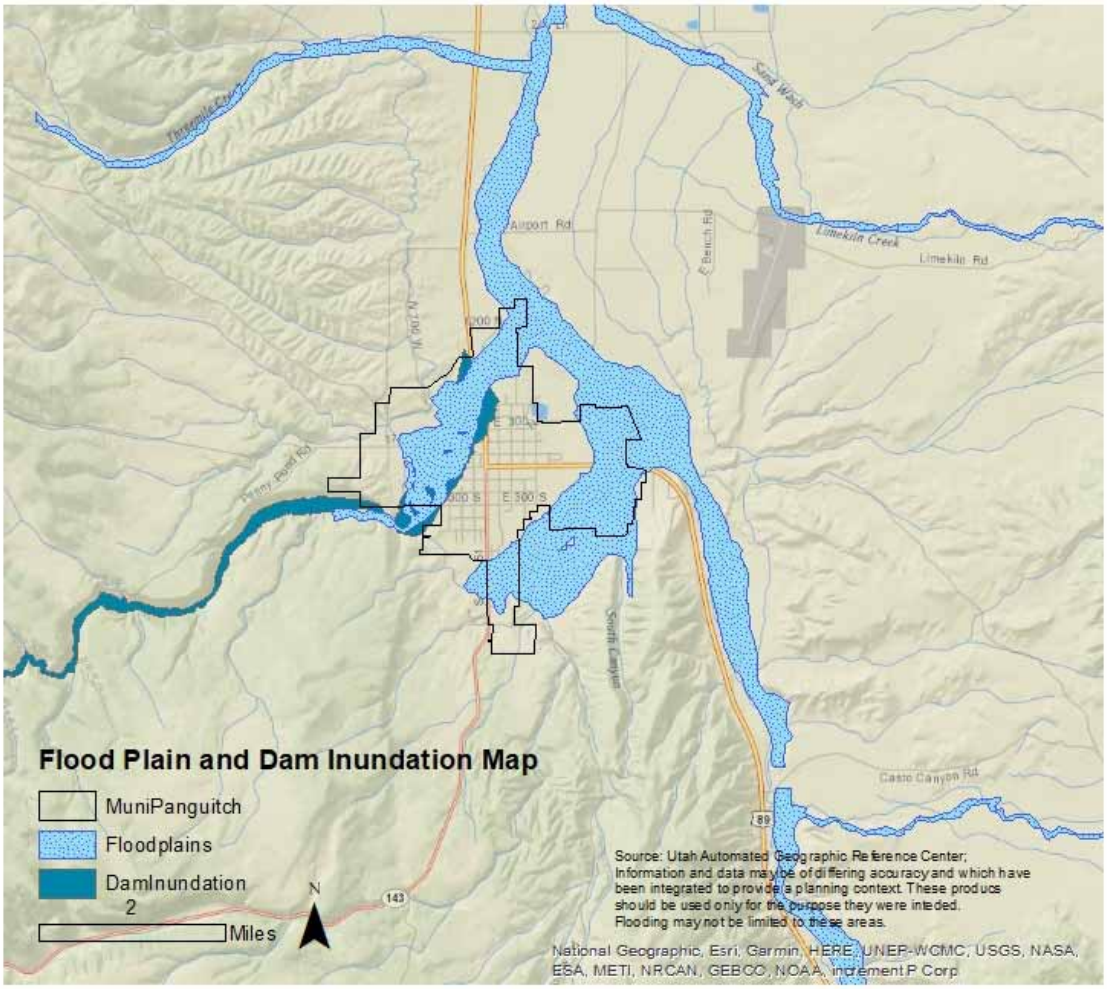


Figure 145: Panguitch Floodplain and Dam Inundation Map

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 151 further examines the exposure to identified flood risk areas in Panguitch, by observing community assets and structures that are in at-risk areas. The table shows that nearly one third of residential parcels and road miles are exposed to the floodplain or dam inundation zones. Flooding on access roads can lead to transportation delays, and impact response during an emergency event. One critical facility is in a floodplain or dam inundation zone. Critical facilities in hazard areas are community vulnerabilities as the ability to respond or provide community information can be impacted.

Table 151: Panguitch Floodplain and Dam Inundation Exposure

Panguitch Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
10.0%	Unknown	32.7%	Unknown	32.4%	N/A	66.7%

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Panguitch City property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 152 describes the community participation in the NFIP. Flood Insurance Rate Maps were developed for Panguitch in August 1979. There is only one flood insurance policy in the community and no claims or payments have been made to policy holders in the community.

Table 152: Panguitch NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978	Repetitive Losses
$1,639	0	1	1	107,700	0	$0	0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 153 describes the flooding events which impacted Panguitch.

Table 153: Panguitch Reported Flood Events

Date	Damage/Injury	Description
8/8/2003	None reported	Flash flooding closed Highway 20 and Highway 89 after boulders and mud were washed onto the road.
8/23/2003	None reported	Flash flooding reported in Highway 89 in Circleville Canyon.
9/2/2013	$30,000	A severe storm caused flash flooding in agricultural areas of Panguitch, damaging yards and fields.
8/20/2014	$5,000	Strong thunderstorms caused flooding on Panguitch streets and in homes.
2017	Unknown	Flooding of the culinary water system following the Brian Head Fire.
3/1/2019	$100,000	Winter storm caused flooding in southwestern Panguitch, washing out roads and flooding homes.

2019	Unknown	Subdivisions experienced major damage due to major winter thaw.
2021	Unknown	Significant flooding at the city park.

Source: NOAA Storm Database, local planning team.

Roadways in and out of the community have historically been impacted by flooding events. While damages may not have occurred, closures can have an impact on a community with delays and limited access. Further, impacts to agricultural areas can damage crops and while this may not be the largest portion of the community's economy, it can have an effect.

Events in neighboring communities may have also impacted Panguitch but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 146: Panguitch City Landslide Susceptibility Exposure maps the landslide susceptible areas in and surrounding Panguitch.

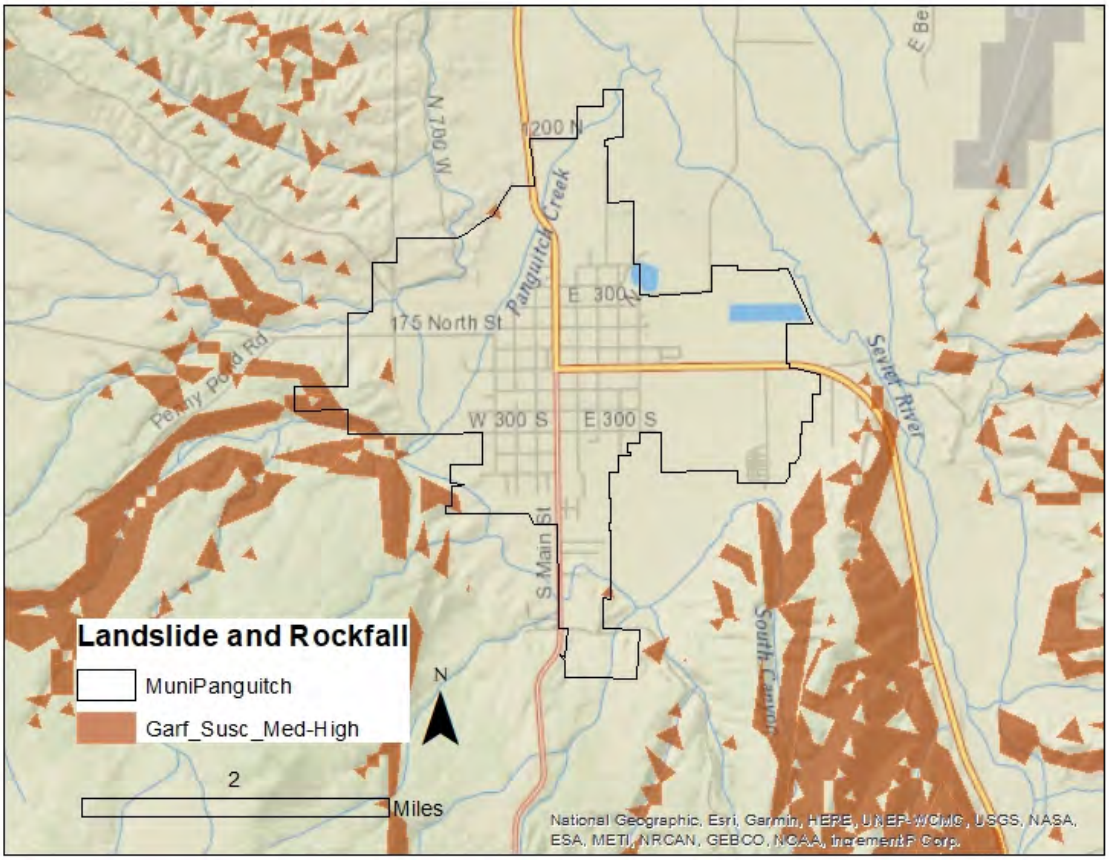


Figure 146: Panguitch City Landslide Susceptibility Exposure

Source: Utah Geological Survey

Panguitch has some exposure to moderate and high landslide susceptible areas, especially on the west side of the community. Table 154 describes the exposure of certain community assets to landslide susceptible areas. The mapped landslide susceptibility compared to community asset locations in Panguitch describe that 1.9% of road miles are in a moderate to high landslide susceptible zone. Landslides on the roadway have the potential to separate the community from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible or damaged for an extended period. This is especially true of major connector roads like highways.

No residential parcels, critical facilities, or parks are presently mapped in landslide susceptible areas. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 154: Panguitch Landslide Susceptibility Exposure

Panguitch Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	0.0%	Unknown	1.9%	N/A	0.0%

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

To date, landslides have not been reported in Panguitch. Severe storms on the Brian Head Fire burn scar caused landslides, where debris and ash flowed down creeks and washes with the runoff onto roadways and into communities. During one 2017 event State Road 143 was covered with mud and debris following a debris flow from the burn scar.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Tourism and related industries are pieces of the economy in Panguitch. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought. Further drought conditions can impact the health of recreators to an area, as dry conditions while hiking, biking, or engaging in other activity, can be hazardous. Panguitch Lake and the Sevier River are major attractions to the area which have both impacted by drought in 2020 and 2021.

The community surrounding Panguitch City, and many residents of the city rely on agriculture, farming, and ranching as their livelihood. Immediate impacts from drought in the area on this industry include damaged crops and reduced yield. In 2021, farmers across Utah had to adjust to drought conditions which impacted their outputs. Community members who are not themselves farmers or ranchers may also see the impacts of drought locally, as long-term impacts include economic impacts on a community through the availability and cost of food locally.

Drought may also impact the local culinary water supply through reduction, which can also impact water quality long term. The City's capital facilities plan has identified several actions which increase the local water supply and supporting conservation within the culinary water system. Actions include replacing pipes, adding new wells, and increasing water tank capacity. Conservation and efforts to reduce leaks will be essential to the city providing safe and adequate water supply to the community. Further heightened risks to other hazards, like wildfire, which have already impacted the community's water supply is a risk locally.

Drought is connected to other natural hazards, like wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 147. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

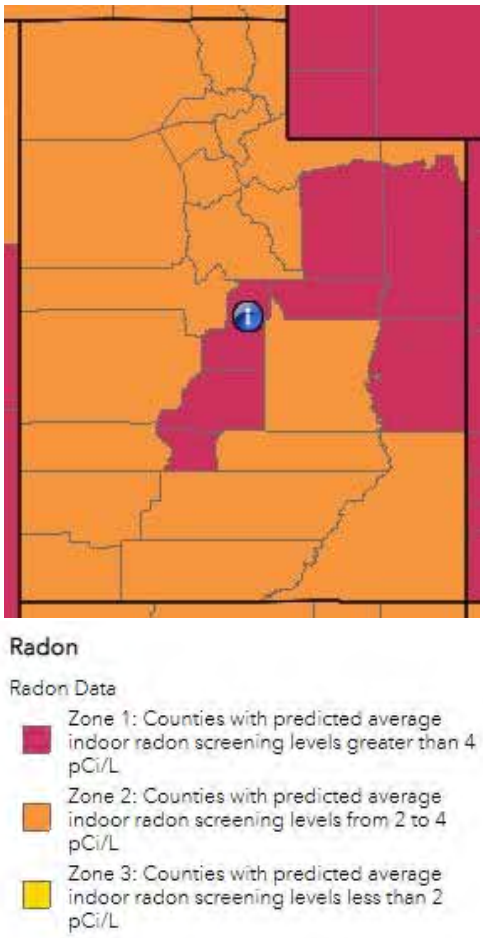


Figure 147: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 155 describes the reported findings for the County. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 155: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests

59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Panguitch, however our analysis assumes that severe weather events will impact the whole of Panguitch residents, facilities, infrastructure, businesses, and property.

Panguitch has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Panguitch, which can produce hail, high winds, rain, and lightning.

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. Six total weather events have been recorded with impacts to Panguitch between 1950 and 2020, which are documented in Table 156. Other county events likely impacted Panguitch and should be reviewed in the County section of this hazard plan.

Table 156: Panguitch Severe Weather Record

Date	Property Damage/Injury	Description
9/8/2000	None reported	A tornado was observed on Highway 20 near Panguitch and lifted after 5-minutes in open country.
6/2/2005	None reported	County Sheriff's reported a funnel cloud. Thunderstorm winds removed a shed roof.
6/28/2013	None reported	A thunderstorm produced high winds near Panguitch.
8/26/2016	None reported	A tornado touched down near Panguitch during a thunderstorm event.
9/22/2016	$500,000+	A tornado touched down in Panguitch, damaging businesses, homes, vehicles, power poles, and trees. Damage includes removing the roof of a building.
7/10/2017	None reported	A tornado was documented near Panguitch Lake.

Source: NOAA Storm Database, local planning team

Tornado and strong wind events are the primary reported severe weather event in Panguitch based on the record of historic weather events. These hazards have the potential to cause damage, injury, and death. Extreme heat is also a challenge throughout the Southwest and while the deaths reported did not occur in Panguitch, the town and nearby recreation areas likely also saw extreme heat in the area during these events.

Severe weather will continue to impact Panguitch as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. Flooding events which occur because of severe weather are reported in the flooding section of this assessment.

Problem Soils

Problem soils are a challenge for construction, infrastructure, and development. Problem soils are subject to expansion, compression, solution, or collapse when exposed to water, depending on the content of the soil. The changes in the soil structure and occupied space can damage or impact infrastructure built on top of the problem soil.

Five County used Problem Soil Susceptibility data from the Utah Geological Survey that describes the extent of mapped problem soils for the county, illustrated by Figure 148. The map identifies that problem soils have not been mapped in Panguitch.

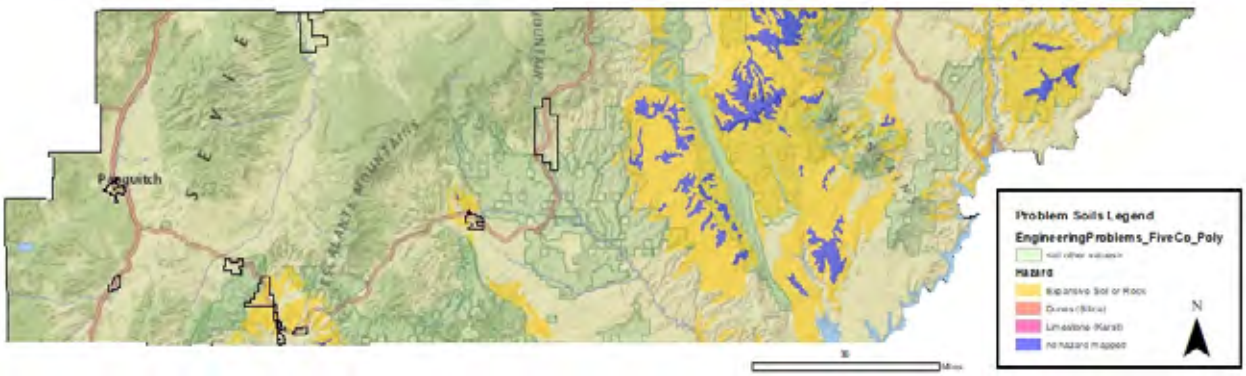


Figure 148: Garfield County Mapped Problem Soils

Source: UGS, AGRC

Panguitch City's ordinances indicate that council may call on a developer to show whether a site has hazards, including soil hazards. There may be identified challenges with problem soils experienced locally, which were not mapped. Further, UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

The community has cited no experience with clay or other problem soils.

Summary

Panguitch is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have historically been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Panguitch has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Panguitch and are listed in Table 157 with a description of their progress.

Table 157: 2016 Panguitch Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Reduce flood damage to homes and property at the community level.	Reduce flood risk by clearing debris and other material from all waterways.	Annually	Municipality Operating Budget	The creek is the only waterway in Panguitch and is not cleaned annually. This action is still needed.

Source: 2017 Five County Association of Governments NHMP

The Panguitch City planning team identified actions to include in the community mitigation strategy. Each action in Table 158: 2022 Mitigation Strategy includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are in Figure 149.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 149: Regional plan goals

To address the risks and vulnerabilities identified in this chapter, Panguitch has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 158 which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 158: 2022 Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of Radon Hazard	Provide radon risk, testing, and mitigation information to residents.	H	Annual, ongoing	L	Panguitch City, Utah DEQ	Panguitch City
Flood #1	1, 2	Address stormwater flooding risks.	Increase the size of culverts to ensure culverts are not blocked by sediment as described in the Capital Facilities Plan.	M	5-years	M	Panguitch City, CDBG, CIB	Panguitch City
Flood #2	3	Inform residents of Flood Insurance options	Encourage residents to purchase flood insurance.	L	Annual, ongoing	L	Panguitch City	Panguitch City
Flood #3	4	Improve floodplain mapping data	Work with Garfield County, State of Utah, and FEMA to update flood maps	M	5-years	L	Panguitch City	Panguitch City
Flood #4	1, 2	Increase absorption capacity on new development.	Adopt limits to the percentage of allowable impervious surfaces within developed parcels.	L	3-years	L	Panguitch City	Panguitch City
Flood #5	1, 2	Increase stormwater infrastructure on new development.	Require developers to construct on-site retention basins for excessive stormwater and as a potential fire fighting source.	M	3-years	L	Panguitch City	Panguitch City, Developers.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #6	1, 2	Maintain and repair existing stormwater infrastructure.	Assess the local need to increase drainage capacities with retention basins, relief drains, spillways, drain widening/dredging or rerouting, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, or channel redirection.	M	5-years	M	Panguitch City, CDBG, CIB	Panguitch City
Flood #7	2, 3, 4	Coordinate to address flood risks.	Work with local utility providers, Rocky Mountain Power and Questar Gas, to ensure mechanical devices are above expected flood levels.	M	5-years	M	Panguitch City	Panguitch City, Utility providers
Flood #8	1, 2, 5	Secure critical infrastructure from flood.	Assess and inventory low-lying bridges in the community. Raise bridges where necessary, above expected flood levels.	L	5- 10 years	H	Panguitch City, Garfield County, UDOT	Panguitch City, UDOT, Garfield County.
Flood #9	2, 6	Enhance levels of flooding resistance and protection to the Panguitch City culinary water spring sites	Enhance fire and flood protection by using fire and flooding mitigation measures.	H	Ongoing, annually	L	Panguitch City	Panguitch City, U.S. Forest Service

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2	Secure critical water infrastructure and supply.	Replace the transmission waterline from the Delong-Indian Hollow Springs to address a worn protective coating and eroded steel.	M	5- 10 years	H	Division of Drinking Water, CIB, Utah Board of Water Resources, USDA Rural Development , USDA ECWAG, USDA Community Facilities Direct Loan & Grant	Panguitch City, Division of Drinking Water
Drought #2	2	Secure critical water infrastructure and supply.	Develop a new well to meet projected water needs as the community grows, as described in the Capital Facilities Plan for the community.	M	5- 10 years	H	Division of Drinking Water, CIB, Utah Board of Water Resources, USDA Rural Development , USDA ECWAG, USDA Community Facilities Direct Loan & Grant	Panguitch City, Division of Drinking Water
Drought #3	2	Secure critical water infrastructure and supply.	Plan and design new water storage tank for emergency water storage and to store water from newly drilled well.	M	5- 10 years	H	Division of Drinking Water, CIB, Utah Board of Water Resources, USDA Rural Development , USDA ECWAG, USDA Community Facilities Direct Loan & Grant	Panguitch City, Division of Drinking Water

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #4	2	Secure critical water infrastructure and supply.	Install a digital meter system on the culinary water system, as described in the Capital Facilities Plan.	H	5- 10 years	M	Division of Drinking Water, CIB, Utah Board of Water Resources, USDA Rural Development , USDA ECWAG, USDA Community Facilities Direct Loan & Grant	Panguitch City, Division of Drinking Water
Earthquake #1	1, 2, 4	Secure critical facilities function during earthquakes.	Requiring bracing of generators, elevators, and other vital equipment in hospitals.	M	5-years	L	Local hospital	Local hospital
Earthquake #2	2	Secure critical facilities function during earthquakes.	Anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc) at city facilities.	H	3-years	L	Panguitch City	Panguitch City
Earthquake #3	2	Secure critical facilities function during earthquakes.	Using flexible piping when extending water, sewer, or natural gas service.	M	5-years	M	Panguitch City, utility providers	Panguitch City, utility providers
Earthquake #4	1, 2	Secure critical facilities function during earthquakes.	Installing window film to prevent injuries from shattered glass at city facilities.	H	3-years	L	Panguitch City	Panguitch City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #5	3	Inform residents of earthquake hazards.	Developing an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.	H	Annually, ongoing	L	Panguitch City	Panguitch City
Earthquake #6	1, 2	Develop codes to protect new structures and infrastructure.	Requiring new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	L	2-years	L	Panguitch City	Panguitch City.
Earthquake #7	3	Inform residents of earthquake hazards.	Educating homeowners on safety techniques to follow during and after an earthquake.	H	Annually, ongoing	L	Panguitch City	Panguitch City
Severe Weather #1	3	Inform residents of extreme temperature and severe weather hazards.	Educate residents and visitors of the dangers of extreme temperatures (hot and cold) and severe weather events and the steps they can take to protect themselves during an event.	H	Annually, ongoing	L	Panguitch City	Panguitch City
Severe Weather #2	3	Provide area visitors information about natural hazards.	Developing a lightning brochure for distribution by recreation equipment retailers or outfitters.	H	Annually, ongoing	L	Panguitch City	Panguitch City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #3	2	Secure critical facilities function during earthquakes.	Installing and maintaining surge protection on critical electronic equipment.	H	1-year	L	Panguitch City	Panguitch City
Severe Weather #4	1, 2	Enforce code and building best practices.	Discouraging flat roofs in areas that experience heavy snows.	H	Ongoing	L	Panguitch City	Panguitch City
Severe Weather #5	1, 2	Enforce code and building best practices.	Require or encourage wind engineering measures and construction techniques.	H	Ongoing	L	Panguitch City	Panguitch City
Severe Weather #6	1, 2	Enforce code and building best practices.	Use anchor bolts, Laminated or impact-resistant glass, Reinforced pedestrian & garage doors, Window shutters, Waterproof adhesive sealing strips, Interlocking roof shingles, etc.	H	Ongoing	L	Panguitch City	Panguitch City
Landslide #1	6	Protect hillsides using natural systems.	Apply soil stabilization measures, such as planting soil stabilizing vegetation, on steep publicly owned slopes	L	Ongoing	M	Panguitch City	Panguitch City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #2	1, 2	Protect critical infrastructure from landslide damage or disruption.	Using debris-flow measures that may reduce damage in sloping areas, such as stabilization, energy dissipation, and flow control measures.	M	5-years	M	Panguitch City	Panguitch City
Landslide #3	1, 2	Protect critical infrastructure from landslide damage or disruption.	Establishing setback requirements and using large setbacks when building roads near slopes of marginal stability.	L	2-years	L	Panguitch City	Panguitch City
Landslide #4	2	Protect critical infrastructure from landslide damage or disruption.	Installing catch-fall nets for rocks at steep slopes near roadways in landslide prone areas.	M	5-years	M	Panguitch City, UDOT, Garfield County	Panguitch City, UDOT, Garfield County
Problem Soils #1	4	Improve available data to inform mitigation decision making.	Work with Garfield County and the Utah Geological Survey to update problem soil mapping of the area.	M	5-years.	M	Panguitch City, Garfield County, UGS	Panguitch City, Garfield County, UGS
Problem Soils #2	1, 2	Protect new residents & development from the impacts of problem soils.	Restrict development in areas where soil is considered unsuitable for development.	M	2-years	L	Panguitch City	Panguitch City
Wildfire #1	1, 2	Enhance levels of fire resistance and protection to the community	Finalize and adopt Panguitch City Community Wildfire Protection Plan and incorporate into the City Risk Management Plan.	H	2-years	L	Panguitch City, Utah DNR	Panguitch City, Fire Department

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #2	1, 2	Enhance levels of fire resistance and protection to the community	Adopt a Wildland Urban Interface Code.	H	2-years	L	Panguitch City	Panguitch City
Wildfire #3	1, 2	Enhance levels of fire resistance and protection to the community	Identify the risks of wildland/urban interface fires in the area	M	Ongoing	L	Panguitch City	Panguitch City, Fire Department, DNR, BLM
Wildfire #4	1, 2	Enhance levels of fire resistance and protection to the community	Inventory local risk and identify strategies to reduce the risks to homes and businesses in the community during a wildfire. Implement identified strategies.	M	3-years	L	Panguitch City	Panguitch City, Fire Department
Wildfire #5	1, 2, 3, 4, 6	Enhance levels of fire resistance and protection to the community	Enhance fire protection through: -Improved fire prevention and public education -Improved coordination within the community -Development of long-term strategies -Adopting Firewise Landscaping mitigation measures.	M	Ongoing	L	Panguitch City	Panguitch City, Fire Department

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #6	1, 2	Enhance levels of fire resistance and protection to the community	Using zoning and/or a special wildfire overlay district to designate high-risk areas and specify the conditions for the use and development of specific areas.	M	3-years	L	Panguitch City	Panguitch City, Fire Department
Wildfire #7	1, 2	Enhance levels of fire resistance and protection to the community	Encouraging the use of non-combustible materials (i.e., stone, brick, and stucco) for new construction and renovations in wildfire hazard areas.	L	1-years	L	Panguitch City	Panguitch City
Wildfire #8	1, 2	Enhance levels of fire resistance and protection to the community	Protect propane tanks or other external fuel sources.	L	1-years	L	Panguitch City	Panguitch City
Wildfire #9	4	Enhance levels of fire resistance and protection to the community	Coordinate with local utility providers to mitigate hazardous fuels around utility infrastructure.	M	Ongoing, Annually	L	Panguitch City, utility providers	Panguitch City, utility providers
Wildfire #10	1, 2	Enhance levels of fire resistance and protection to the community	Encourage the use of defensible, survivable space, and fire wise construction in the urban / wildland fire interface areas.	M	Ongoing, annually	L	Panguitch City	Panguitch City, Fire Department

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #11	2, 6	Enhance levels of fire resistance and protection to the Panguitch City culinary water spring sites	Enhance fire and flood protection by using fire and flooding mitigation measures.	M	Ongoing, annually	L	Panguitch City	Panguitch City, U.S. Forest Service
Multi-Hazard #1	3, 4	Inform visitors of the natural hazard risks in the area.	Providing educational materials to local businesses/hotels for visitors use to understand natural hazard risks while recreating.	L	Ongoing	L	Panguitch City	Panguitch City

Source: Local Planning Team

Tropic

Tropic Town is located on Scenic Byway-12 on the southeast side of Bryce Canyon National Park and has access to several nearby recreation areas. The community sits near 6,000 feet in elevation and tends to see cooler overall temperatures than some of the region's lower elevation communities.

Demographics

Tropic town has a population of 596 as of the 2018 American Community Survey, as described in Figure 150. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

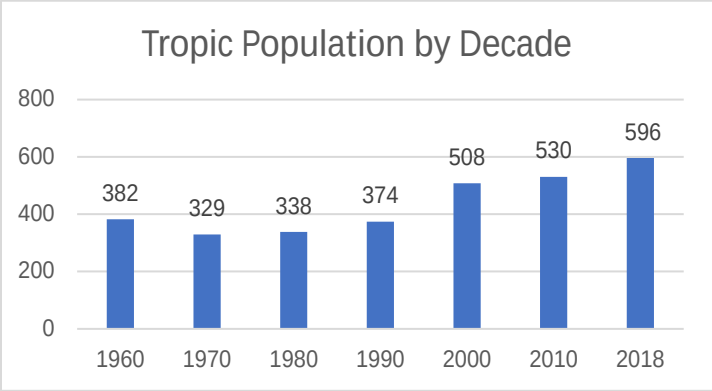


Figure 150: Tropic Population by Decade

Source: US Census Bureau

Tropic has seen growth in population since 1980, with the largest growth seen between 1990 to 2000, at 35.8%, described in Figure 151. The average population change for since 1960 has been 3.1% each decade, referencing the populations documented at each census.

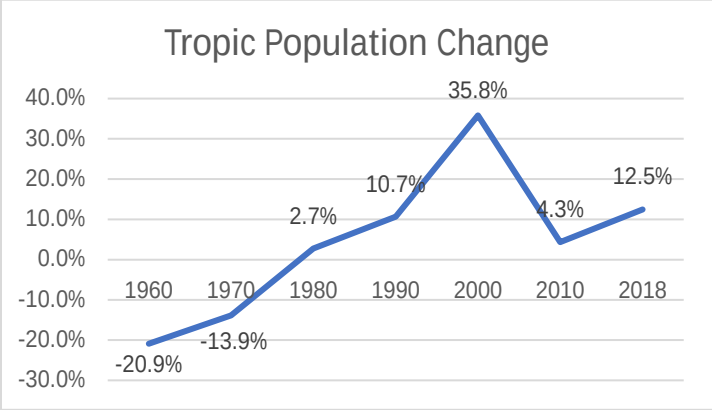


Figure 151: Tropic Population Change

Source: US Census Bureau

According to the Kem C. Gardner Institute, the Garfield County population is expected to increase by 45% between 2015 and 2065. If this estimate is reflected in Tropic, the population by 2065 may be near 950 people[6].

Economy

According to the US Census OnTheMap tool, most jobs in Tropic are in the Accommodation and Food Services, as illustrated in Figure 152. Given the proximity to outdoor recreation amenities, it is likely that these accommodation jobs are related to the area's tourism. One quarter of jobs in the community fall into construction, professional, healthcare, and social assistance, transportation, and retail trade. Community websites also describe ranching as a portion of the economy for this area, although it is not reflected in the OnTheMap data (Bryce Canyon Country, 2014).

[6] This estimate is created using the 2015 ACS population estimate for Tropic, which was 655, and adding 45% of this population estimate to the population for that year.

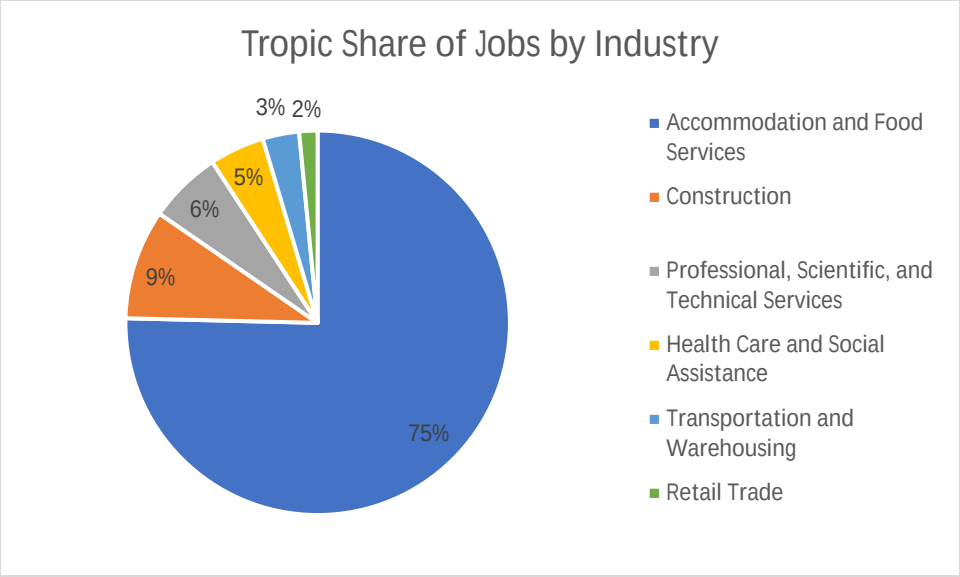


Figure 152: Tropic Share of Private Primary Jobs by Industry

Source: US Census, OnTheMap, 2021.

Development

Tropic has recently ended a development moratorium, which was in place to address the ongoing community concerns with the ability of existing water and sewer utilities to support growth. While the moratorium recently ended, the community continues to have concerns about the availability of water to support development. No significant commercial or residential development can be reported in the past several years in the community.

Community Capabilities

The community is governed by a volunteer elected town council and a mayor. Law enforcement is provided by the County Sheriff's Office in Panguitch. There are city staff who support public works, animal control, clerk/recorder, and office manager/treasurer roles in the city. A local planning commission assists the mayor and council in decisions relating to local land use and development.

A volunteer fire department provides emergency response to Tropic, in addition to neighboring communities of Cannonville, Henrieville, and Bryce Canyon City. The community also has a volunteer search and rescue, local emergency preparedness committee, and community emergency response team.

Tropic Town provides water and sewer services to residents in the community. Other local utility providers include:

- AmeriGas Propane
- Garkane Energy
- Hughes Waste haulers
- South Central Communications

Plans and Policies

Tropic Town has adopted plans and policies to enforce laws, set community goals, and identify potential projects and needs for the community. Many of these activities relate to natural hazards or mitigation. The available plans include the Municipal Ordinances and the General plan. Below a summary of the items related to mitigation are included.

Municipal Ordinances

The Tropic town ordinances detail how during preconstruction phases, site plans and applications should describe any risks to a site from natural hazards. Ordinances also describe zones for fire protection and flood control planning as well as the protection of hillsides and sensitive lands.

General Plan

The General Plan (2020) describes goals, objectives and policies for Tropic Town and includes several which relate to natural hazards or mitigation. Balancing, managing, and protecting open lands, natural areas, and recreation spaces. There is also an interest in preserving historical and cultural areas and assets. The general plan also describes a need for infrastructure to meet future demands of growth. One item describes street paving and pedestrian surfacing to use permeable materials, which is a form of flood and drought mitigation, allowing water to be absorbed into the ground, rather than run down a storm drain. More detailed description of specific goals and policies may be found in the general plan.

Risk Assessment

Tropic Town experiences and is at risk to several of the natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with Tropic to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 159: Tropic Hazard Risk describes the relative risks of hazards in the community.

Table 159: Tropic Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. High
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Moderate
PROBLEM SOILS	7. Low

RADON	8. Low

A detailed description and mapping of each of the natural hazards that impact Tropic can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Tropic include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. Five County is working with Garfield County to acquire commercial parcel data to include in this assessment.

Wildfire

Tropic Town is surrounded open space. The community has an arid climate environment and like much of the Southwest, fire is a risk. There has not been a significant wildfire event that has affected Tropic, according to FEMA and the Utah Wildfire Info tracker, although this lack of past events does not mean that a wildfire cannot occur.

Figure 153 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and near Tropic that are at moderate to extreme risk to wildfire. The measurement to determine risk rating can be found in the Hazard Identification section of this plan. An area of considerable exposure includes the northern portion of the community, along SR-12, and the southwest boundary, both near the Bryce Canyon National Park area.

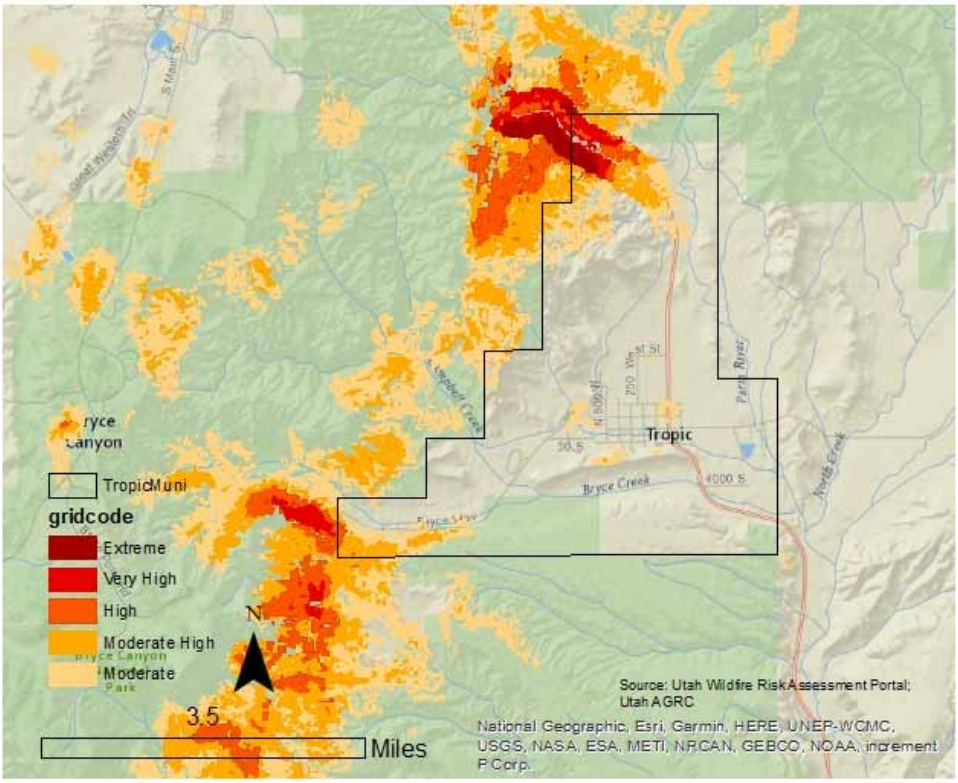


Figure 153: Tropic Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 160 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts residential parcels and miles of roadway in Tropic. Some residences and a school are in moderate to extreme areas of wildfire risk. Only four percent of road miles are within a moderate to extreme wildfire risk area. One of the two community parks has been identified in a wildfire risk area.

Table 160: Tropic Wildfire Risk

Tropic Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	Unknown	6.8%	Unknown	4.0%	N/A	50.0%

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Tropic and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. Figure 154 shows no mapped Quaternary Fault lines in Tropic, with the closest being the John's Valley Fault 13 miles to the north. Earthquakes can happen throughout the state. Fault lines tend to be the most common cause of large earthquakes which can cause impacts in areas miles away.

Figure 154: Garfield County Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Thirty-five percent of Tropic residential parcels have a building constructed before 1975 on the site. These buildings are at a greater risk of severe damage during an earthquake or ground shaking event.

Hazard History

There have not been recorded earthquake epicenters in or near Tropic.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Tropic.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 155 describes the flood and dam inundation

exposure in Tropic. As illustrated in the map, Tropic includes mapped floodplain throughout the city boundaries, but does not interact with a mapped dam inundation zone.

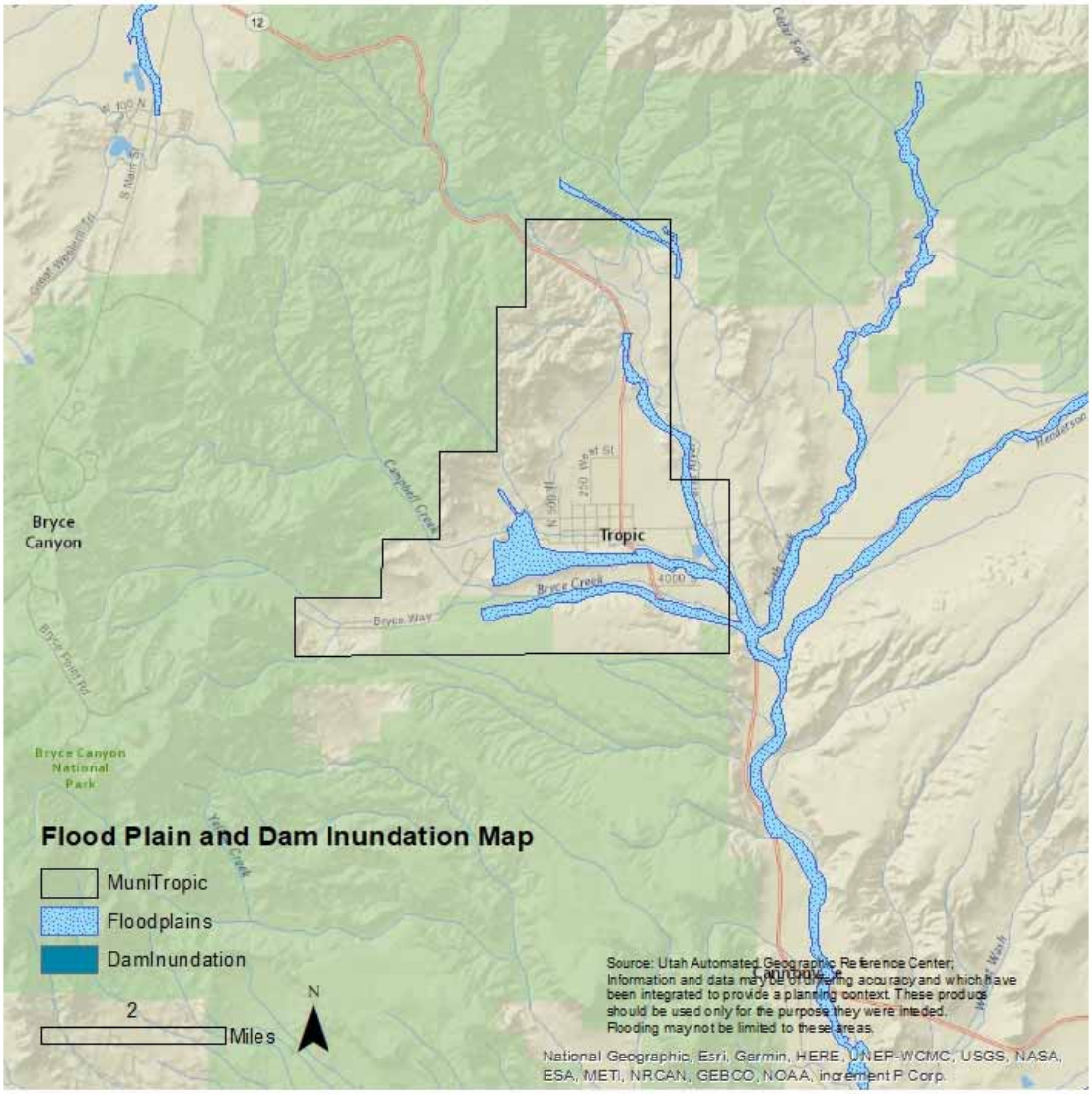


Figure 155: Tropic Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 161 further examines the exposure to identified flood risk areas in Tropic, by observing community assets and structures that are in at-risk areas. Less than 10% of residential parcels, critical facilities, and road miles interact with the mapped floodplain. Flooding on roads can lead to transportation delays, and impact response during an emergency event. One of the community parks is in the floodplain. While structures and infrastructure at the park may see impacts from flooding, maintaining flood susceptible areas as open space can help to protect the community.

Table 161: Tropic Floodplain and Dam Inundation Exposure

Tropic Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	Unknown	5.8%	Unknown	8.3%	N/A	50.0%

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Tropic property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 162describes Tropic's NFIP participation. Flood Insurance Rate Maps were developed for Tropic in December 1979. There is only one flood insurance policy in the community and no claims or payments have been made to policy holders in the community.

Table 162: Tropic NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978	Repetitive Losses
$2,084	0	5	1	$252,000	0	$0	0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 163 describes the flooding events which impacted Tropic.

Table 163: Tropic Reported Flood Events

Date	Damage/Injury	Description
8/9/2001	None Reported	The Paria River flowed over a bridge near Tropic, closing the bridge.
8/23/2003	$650,000 damages reported	Over two inches of rain fell in 90 minutes, causing water and mud to flood homes and basements in the town, damaging approximately 30 structures.
7/20/2010	$50,000 damages reported	The Paria River flooded in Tropic, flooding basements and over residential bridges. The flood wave continued downriver to the Utah/Arizona border.
9/27/2014	$50,000 damages reported	Heavy rain caused flooding on the Paria River near Kodachrome Basin State Park. A bridge into the park collapsed due to the floodwaters, causing a vehicle on the bridge fell into the river and floated down river and closing most of the

		state park. The occupant of the vehicle escaped and recovered after medical treatment.
7/28/2017	None Reported for Cannonville	Flash flooding occurred southeast of Bryce Canyon on several creeks, which are tributaries of the Paria River.
July/August 2021	Unknown	Recurring severe storms produced flooding which impacted Tropic town and its infrastructure, filling culverts and swales with debris, washing out sides of a flood channel, washing out riprap mitigation efforts and exposing waterlines near a spring.

Source: NOAA Storm Database

In the summer of 2021 severe weather events brought flooding over a period of weeks throughout the southwest. Tropic experienced impacts, which are briefly described in Table 163. As these events are so recent, sources which document recorded flooding events have not been updated to include these events, limiting our ability to document reported damages and injury at the time of this writing.

Events in neighboring communities may have also impacted Tropic but did not include documentation of the impacts. Refer to those communities' section or to the unincorporated County section for further information about other flooding events in the area.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 156 maps the landslide susceptible areas in Tropic. The map describes landslide susceptible areas in the community.

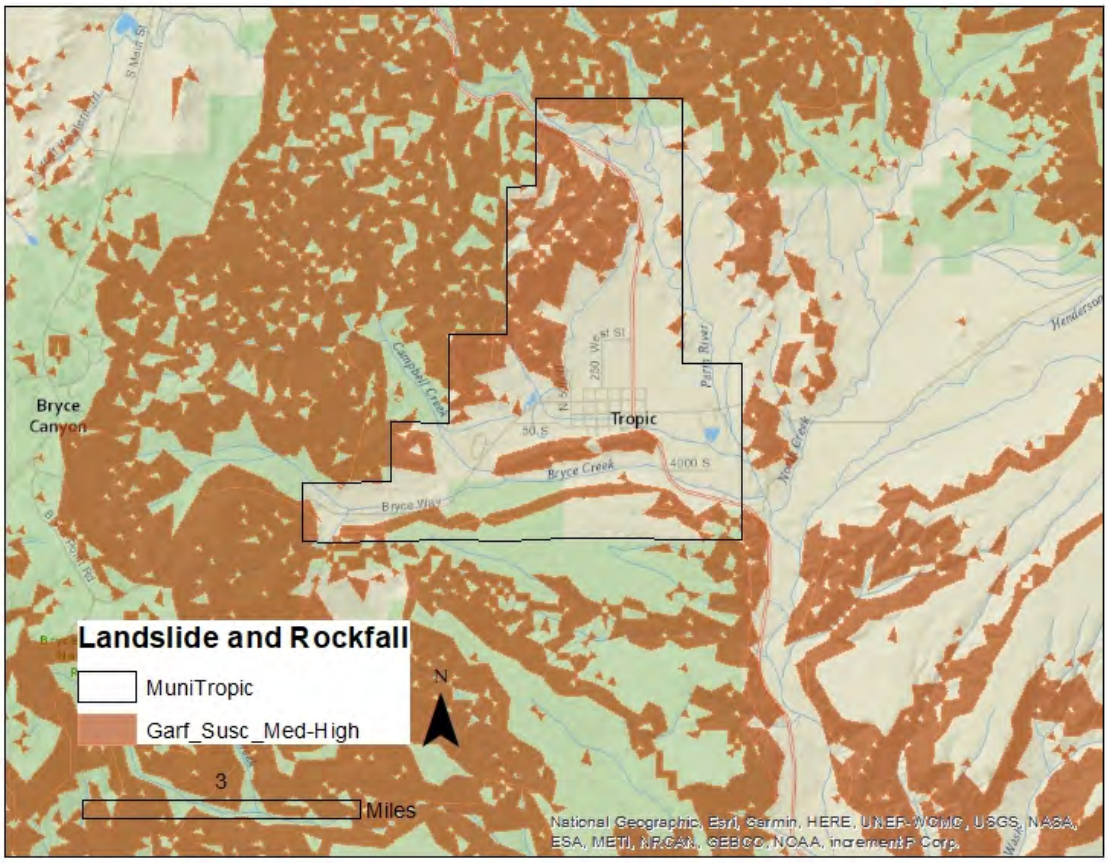


Figure 156: Tropic Landslide Susceptibility

Source: Utah Geological Survey

Tropic has some exposure to landslide susceptible areas, particularly on the west and south sides of the community. Table 164: Tropic Landslide Susceptibility Exposure describes the exposure of certain community assets to landslide susceptible areas and describes that there is limited exposure to areas deemed to have a moderate to high landslide susceptibility in both residential parcels and on road miles. Landslides on the roadway have the potential to separate the community from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. This is especially true of major connector roads like highways. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 164: Tropic Landslide Susceptibility Exposure

Tropic Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			

0.0%	Unknown	7.3%	Unknown	11.7%	N/A	0.0%

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

To date, landslides have not been reported causing impacts in Tropic.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

In Tropic, drought is a concern which has led to the community interest in developing new and securing existing water sources. The community has identified existing sources and are in works to bring to water quality standards and develop storage capacity in line with the state division of water resources requirements. An ongoing feasibility study to store winter water rights in the area is in process and the community will respond to the recommendations from the study on its completion.

Tropic has recently ended a development moratorium, which was in place to address the ongoing community concerns with the ability of existing water and sewer utilities to support growth. While the moratorium recently ended, the community continues to have concerns about the availability of water to support development. Efforts to include xeriscaping and encourage new commercial development to buy shares from irrigation company to support water access are being explored.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are economic drivers in Tropic. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 157: Estimated Indoor Radon Level Zones- Utah. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

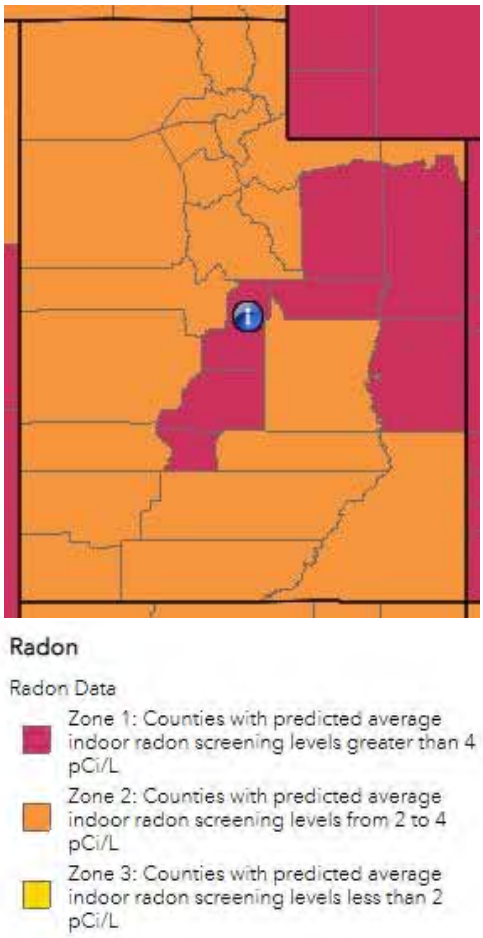


Figure 157: Estimated Indoor Radon Level Zones- Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 165 describes the reported findings. Across Garfield County, the average test result is 6.0 pCi/L of air, a level at which mitigation is necessary. Limited testing reported may contribute to the high reported levels. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to reduce risk.

Table 165: Garfield County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
59.2%	40.8%	32.1 pCi/L	6.0 pCi/L	49

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of residences and other structures to radon gasses. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Tropic, however our analysis assumes that severe weather events will impact the whole of Tropic residents, facilities, infrastructure, businesses, and property.

Tropic has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Tropic, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 32 weather events that have caused damages in Garfield County. One weather event has been recorded in Tropic between 1950 and 2020, which is documented in Table 166. Other county events likely impacted Tropic and should be reviewed in the County section of this hazard plan.

Table 166: Tropic Severe Weather Record

Date	Property Damage/Injury	Description
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
2/24/2015	None Reported	16 inches of snow fell at Kodachrome Basin and nine inches fell in Tropic during a winter storm.

Source: NOAA Storm Database

While Tropic has few reported weather events, it is likely that damaging storms have caused impacts to the community in the past. Severe winter storms are common to this area and can damage homes, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Tropic, the town and nearby recreation areas likely also saw extreme heat in the area during these events which could cause impacts.

Severe weather will continue to impact Tropic as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages. The flooding events because of the weather impacts are reported in the flooding section of this assessment.

Problem Soils

Building permits are approved by the County on behalf of Tropic, which requires that all construction has a geologic study pre-construction. Figure 158illustrates where mapped problem soil areas are in Tropic. The community has expansive soils and rocks mapped within the city boundaries, which can cause challenges to construction and development. These soils are reactive to water content, causing the soil to expand when whetted. Unmitigated problem soil areas can damage property or infrastructure built on top of it.

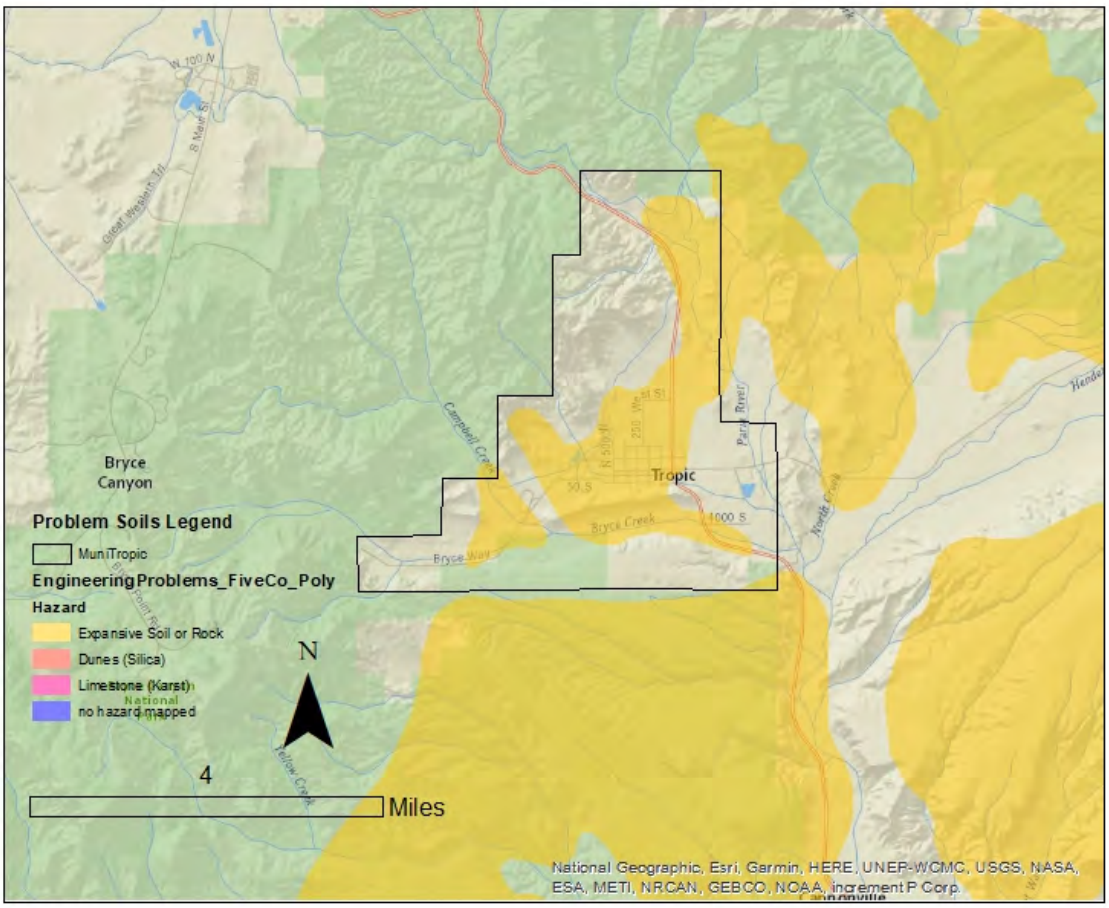


Figure 158: Tropic Problem Soils Map

Source: UGS, AGRC

Five County compared the existing parcels, critical facilities and infrastructure to these mapped problem soil areas and found that mapped problem soil areas interact with Tropic's built environment. Table 167 describes the percent of infrastructure and structures exposed in the community. Exposed areas could see changes in the soil during or following storms or runoff events, which impact the roadways, infrastructure, and buildings. Undeveloped land that falls in a mapped problem soil area could require mitigation during construction to reduce risks.

Table 167: Tropic Exposure to Problem Soils

Tropic Exposure to Problem Soils				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks

	Commercial	Residential	Total			
100.0%	Unknown	88.3%	Unknown	49.2%	N/A	100.0%

Source: Utah Geological Survey, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Tropic is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have historically been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Tropic has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Previous mitigation plans have identified strategies planned by Tropic and are listed in Table 168 with a description of their progress.

Table 168: 2016 Tropic Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Prevent flooding problems through Tropic during high intensity storms	Construct proper drainage as addressed in the Storm Water Master plan to prevent flood damage to property.	Phased as funding becomes available	Town Operating Budget	The community has provided continued maintenance in the existing stormwater system but has not constructed new stormwater infrastructure. This action is still needed.

Source: 2017 Five County Association of Governments NHMP

The Tropic Town local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 169. Each action in the strategy includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 159.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 159: Regional Plan Goals

Table 169: Tropic 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies and Partners
Drought #1	1, 2	Increase available water storage for the town.	Implement actions identified in the current reservoir feasibility study, which is in progress in 2021, which considers the development of a winter water reservoir, which the town holds water rights for.	M	5-years	H	Town Operating Budget, CIB, CDBG	Tropic
Drought #2	2	Secure systems to support	Complete filtration and management system for a	H	5-years	M	Town Operating Budget,	Tropic

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agencies and Partners
		emergency water.	community well to be used as emergency water.				CIB, CDBG	
Drought #3		Reduce outdoor water use.	Encourage drought tolerant, native landscaping in the community.	M	1-year/ongoing	L	Town Operating Budget	Tropic
Severe Weather #1	2	Protect property from roadway and sheet flooding.	Construct proper drainage as addressed in the Storm Water Master plan to prevent flood damage to property.	L	Phased as funding becomes available	M	Town Operating Budget, CIB, CDBG	Tropic
Severe Weather #2	2	Address areas where sedimentation has impacted natural drainages and flood infrastructure.	Repair and expand (where necessary) flood ponds in the community which have filled with sediment and debris, impacting their stormwater capacity.	M	5-years	M	Town Operating Budget	Tropic
Flood #1	4	Coordinate with partners to address flooding which affects the town boundary.	Coordinate with the National Parks Service to address flooding from Bryce Canyon National Park which impact the west side of Tropic.	M	5-years	M	Town Operating Budget	Tropic
Flood #2	2, 6	Repair and secure flood damage which impacts local water supply.	Repair washed out area at the Dr. Good springs. Damages to the area have prevented the community from meeting water exchange obligation with the irrigation company.	H	5-years	M	Town Operating Budget, CIB, CDBG	Tropic

Source: Local Planning Team

Iron County

Iron County is in southwestern Utah bounded by Nevada on the west, Beaver County on the north, Washington County on the south, and Garfield County on the east. Interstate 15 (I-15) bisects the eastern county running north-to-south, connecting Las Vegas to Salt Lake City. State highways 56 from the west, 14 and 20 from the east, and 130 from the north provide excellent access into the surrounding areas.

Historically, Cedar City has been a popular transportation hub for access to some of the National Parks; namely, Zion National Park, Bryce Canyon National Park, and Cedar Breaks National Monument. The center block of the Dixie National Forest lies in eastern Iron County and is accessible through Cedar City and Parowan. Vast expanses of public lands managed by the Bureau of Land Management occupy the northern and western county.

Community Characteristics

Iron County is a rural Utah County with a history of mining and agricultural economies. The County has seen incremental growth in the past several decades and is expected to continue this trend in future years. As population has grown, the County has seen changes in land use and development, including shifts from traditional land uses to residential and commercial use. Further description about the trends in demographics, economy, and development in Iron County can be found in this section.

Demographics

Six incorporated areas in the county are documented in this plan: Cedar City, Enoch, Brian Head, Parowan, Paragonah, and Kanarraville. The unincorporated County sees development in the communities of Cedar Highlands, Summit, Beryl, and Newcastle. According to a Governor's Office of Planning and Budget study, the unincorporated County is expected to grow at a faster rate than the incorporated communities.

The US Census Bureau has documented community population growth over time. Table 170 describes the population by decade since 1960. As can be seen, Cedar City and Enoch are the most populace communities in the County, followed by Parowan, the County Seat. Cedar City's population is likely bolstered by Southern Utah University staff and students.

Table 170: Iron County Population by Incorporated Place

Iron County Population by Incorporated Place							
	1960	**1970**	**1980**	**1990**	**2000**	**2010**	**2020**
Brian Head	N/A	N/A	77	109	118	83	151
Cedar City	7,543	8,946	10,972	13,443	20,527	28,857	35,235
Enoch	N/A	120	678	1,947	3,467	5,803	7,374
Kanarraville	236	204	255	228	311	355	442
Paragonah	300	275	310	307	470	488	536
Parowan	1,486	1,423	1,836	1,873	2,565	2,790	2,996
Unincorporated County	1,230	1,209	3,221	2,882	6,321	7,787	10,555
County Total	10,795	12,177	17,349	20,789	33,779	46,163	57,289

Source: US Census Bureau.

Observing population change in the community can provide an estimate for the rate of population growth in an area. Figure 160 describes the percent change observed in each incorporated place. The countywide total population has increased an average of 21% per decade since 1960. Rapid growth was experienced between 1970 and 2000, especially in the unincorporated county, Kanarraville, Paragonah, and Parowan. Population growth has slowed across the County's communities between 2010 to 2018, all except Brian Head Town, which has seen recent growth. Population decline has been observed in Brian Head and Kanarraville in the past two decades.

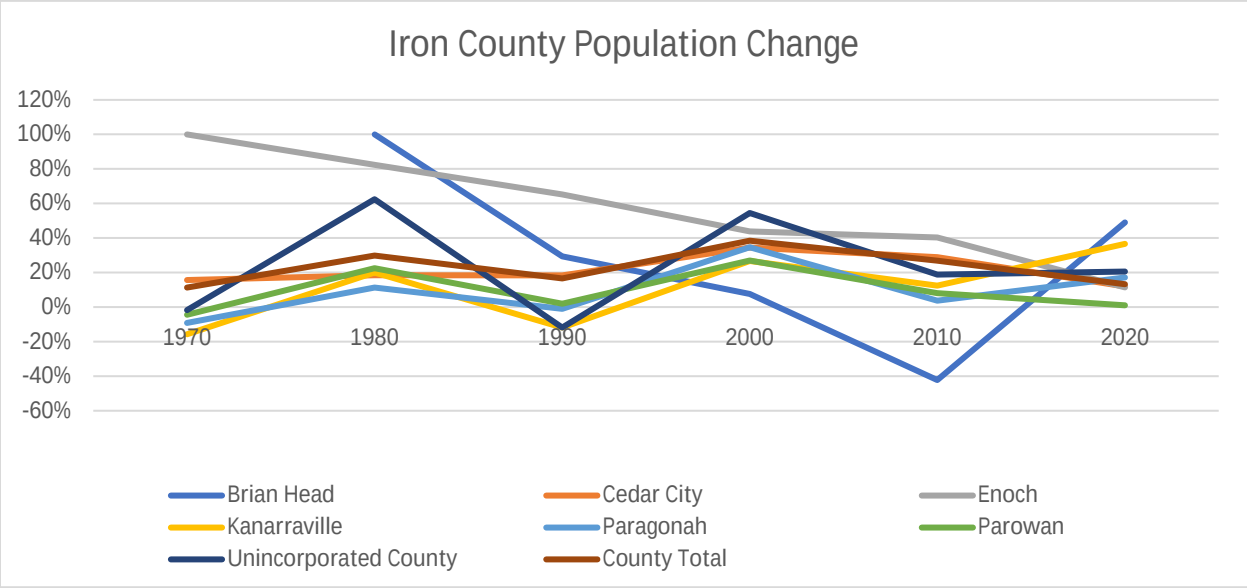


Figure 160: Iron County Population Percent Change

Source: US Census Bureau.

The Kem C. Gardner institute estimates that Iron County will see 81% growth between 2015 and 2065 (Kem C. Gardner Policy Institute , 2017). The estimated total population for Iron County is 89,599 people by 2065. The estimate includes incorporated communities in Iron County, and places Iron County as one of the state's fastest growing Counties.

Geography and Climate

Iron County lies almost entirely within the Great Basin except for some acreage along the south-central county line that drains into the Virgin River. Elevations range from the high point of 11,307 feet at Brian Head to the low point of 5,050 feet northeast of Lund on the county line. The elevations extremes provide for a variety of landscapes, vegetative types, recreational choices, and year-round livestock grazing opportunities. Mountain streams flow from the mountain ranges out onto the valley bottoms where the waters drain in the valley alluvium through free flow or are spread over the land through irrigation.

The county area contains a variety of soil types and conditions. The soils in the county are primarily igneous and sedimentary rocks. Many of the soils on mountain and foothill slopes are shallow or moderately deep and are gravelly, cobble or stony. In the alluvium valleys, soils are very deep and tend to have finer textures. Some timber and woodland products are harvested. The high mountain forests

and the pinyon juniper forests of the lowlands also provide recreational and aesthetic values important to the diversity found in Iron County.

Economy

Coal in the canyons east of Cedar City and iron ore in the mountains to the west brought mining and smelting to Iron County in the 1800s. However, smelting efforts failed because of the lack of economical transportation to large markets. Despite this change, the county has transitioned well into other economic sectors and has become a very strong economic player in the region. Iron County is well known for its Utah Shakespearean Festival, the Utah Summer Games, Southern Utah University, and a distinct manufacturing sector. Manufacturing plays a strong role in this non-urban county. However, trade and services provide the most employment.

Most jobs across the county are concentrated in the Cedar City and Enoch area, although there are some jobs in the unincorporated area near Newcastle and Beryl, and in the incorporated areas of Parowan, Brian Head, and Kanarraville. According to the US Census Bureau OnTheMap tool, the largest share of jobs across the county are in retail trade, manufacturing, and accommodation and food service, illustrated in Figure 161.

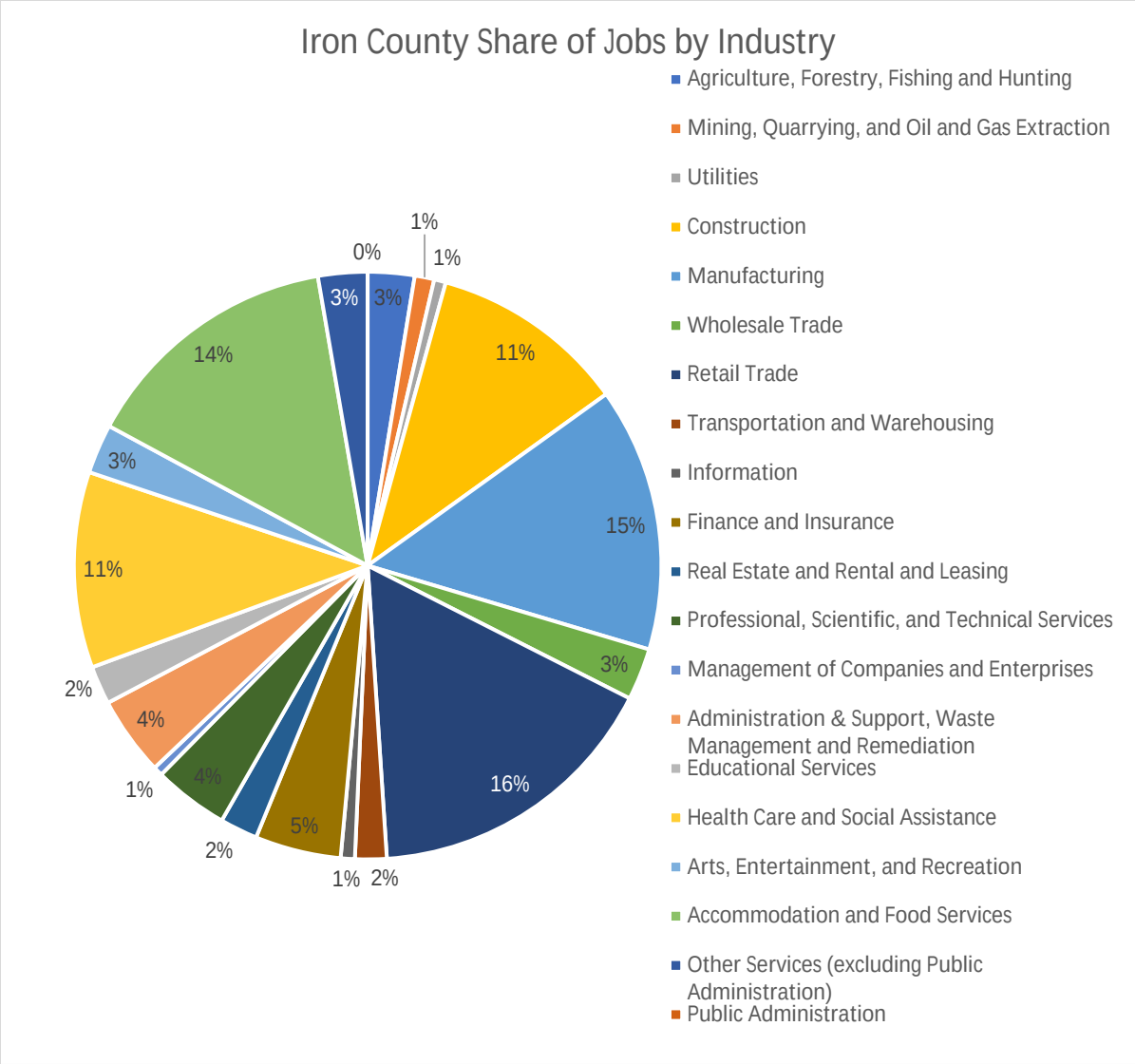


Figure 161: Iron County Share of Private Primary Jobs by Industry

Development

Iron County's 3300 square miles of land is owned and managed by several entities. Figure 162 illustrates the percentage of land managed at different levels of government and Table 171 shows that 75% of Iron County is Federally managed.

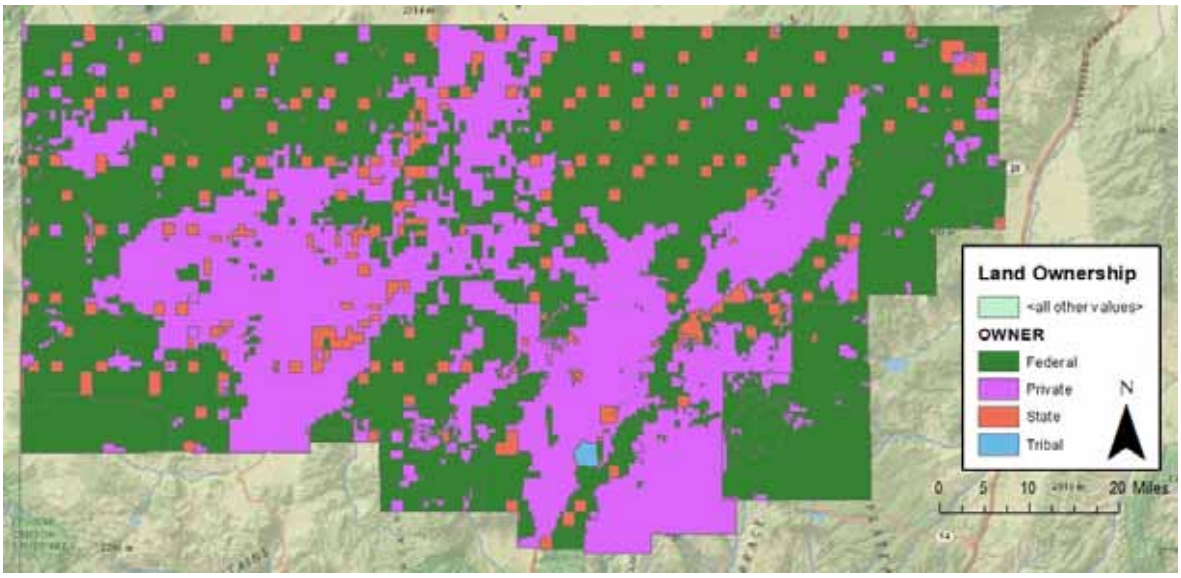


Figure 162: Iron County Land Ownership

Source: SITLA Land Ownership

Table 171: Iron County Land Ownership

Owner	Percent of County Land
Private	21.2%
Federal	75.1%
State	3.6%
Tribal	0.1%

Source: SITLA Land Ownership

Iron County has grown dramatically and is expected to continue growing in the future. Iron County officials have worked to ensure the ratio of land uses will be balanced to meet growth projections. Such planning has enabled the creation/implementation of growth boundary designations to direct anticipated 20-year population projections to areas where services are available. To ensure limited growth in environmentally sensitive areas, the Iron County General Plan policy establishes that, "The County shall also designate a tier for the preservation of rural/environmentally sensitive land outside of the Urban Growth Boundary." This policy has been implemented through adoption (September 2006), of the *Iron County Tier Growth Map*.

Iron County is seeing significant growth in the incorporated communities, but observes

Community Capabilities

Iron County's elected government consists of three commissioners who make policies for the unincorporated County. A County Administrator supports legislative efforts with best practices and information from Iron County staff. County staff include planners, GIS technicians, and buildings officials who can implement adopted legislation and regulations related to planning, zoning, and land use.

Iron County provides emergency response to the unincorporated areas. The Iron County Sheriff's Office provides law enforcement to unincorporated areas. Each of the incorporated jurisdictions has their own law enforcement agency. Fire suppression is provided by several County operated volunteer fire

departments throughout the County. Services include hazardous material response, aircraft firefighting, and other services. A Fire Warden from the county is the official representative to the Utah Division of Forestry, Fire, and State Lands and to Iron County regarding wildfire events. County fire agencies can be found in Beryl, Brian Head, Cedar City, Kanarraville, Newcastle, Paragonah, and Parowan.

The County employs an emergency manager who plans and coordinates hazard mitigation, preparation, response, and recovery. The County has established an emergency operations center as a hub for response with resources to address impacts. There are also four Community Emergency Response Teams in Iron County, which is made up of trained volunteers who will support response efforts during an event.

Iron County provides services to County residents including solid waste removal, roads maintenance, aging services, among others. Utilities, including water, electric, and gas are provided by private companies to County residents.

Plans and Policies

Iron County has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. This section provides an overview of what Iron County is currently doing to address natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

General Plan

The General Plan (1995) documents a goal to minimize damage and hazards from “seismic activity, unstable soils, flooding conditions, and other geologic hazards.” The policies which support this goal call for use of open space, protection of hillsides and flood channels to protect the community from various natural hazards. Policies also set requirements for development to assess for soil stability, steep slopes, and ensure that there is adequate emergency access on a site to respond to a natural hazard, should one occur during the lifetime of the development.

The General Plan also highlights that the county should minimize fire hazards. This includes methods related to development, requiring emergency vehicle access, and requiring water connections to meet fire code. Other policies also call for using controlled burns and landscape buffers to protect structures that may be at risk to fire.

Planning and Zoning Code

The planning and zoning code dictates how land will be used in Iron County and sets requirements for the use of certain lands and purposes. Several codes relate to natural hazards, including restricting development in areas considered to be in the floodplain, steep slopes, soil problems, fault lines, etc. Engineers or geological studies are required for construction at sites deemed to be susceptible to natural hazards and may include a requirement for mitigation on the site by the developer preconstruction.

Subdivision Construction and Design Standards

The Subdivision Construction and Design Standards (2014) set standards for the County's subdivided lots. Standards include but are not limited to addressing stormwater drainage, construction on steep slopes, and cut and fill.

Emergency Operations Plan

The Iron County Emergency Operations Plan (2018) seeks to plan for a county response to a hazard event impacting the community with the goal of protecting life safety, mitigating property damage, and protecting the environment. This plan addresses natural hazards, in addition to technological and civil/political hazards. The plan document describes the responsibilities of government officials during and after a hazard event to provide a response to the public and ultimately lead to recovery phases.

Emergency Preparedness Guide

The Emergency Preparedness Guide (2017) is a public education tool to encourage members of the public to prepare for and understand what actions to take during a natural disaster. The document describes the need for a 72-hour kit and how a resident should prepare for various hazards, including earthquake, flooding, wildfire, and severe weather events.

Resource Management Plan

The County Resource Management Plan (2009) describes the status of existing natural resources and public lands in Iron County and the ways that the County should manage the use of these resources. The document describes an interest in protecting historical and cultural assets, and natural flood channels. The plan describes Iron County's interest in "self-sufficiency in the event of a major emergency", seeking partner organizations and community members to coordinate in response to a major event. The County also emphasizes the use of natural and manmade floodways and riparian areas as recreation areas to mitigate flood risks.

Wildfire is a concern described in the Resource Management Plan, with goals and policies calling for the control of weeds, protection of culinary watersheds, and access and coordination with emergency service and utilities to protect communities.

Risk Assessment

Iron County is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the County to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 172describes the relative risks of hazards in the community.

Table 172: Iron County Hazard Risk

HAZARD	RISK
DROUGHT	1- High
SEVERE WEATHER	2- High
FLOOD	3- Moderate

WILDFIRE	4- Moderate
LANDSLIDE	5- Moderate
EARTHQUAKE	6- Moderate
RADON	7- Low
PROBLEM SOIL	8- Low

A detailed description and mapping of each of the natural hazards that impact Iron County can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in reducing the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Five County assessments for Iron County include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Iron County is a high elevation County with the eastern County including high mountains and a large concentration of communities. The western County includes primarily rolling hills and fields. The community has an arid climate environment, and while it receives more snow and precipitation than the southern counties, fire is a risk.

Figure 163 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Iron County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Iron County experiences moderate to extreme risk to wildfires in the population centers near Cedar City, along I-15 and in the western County.

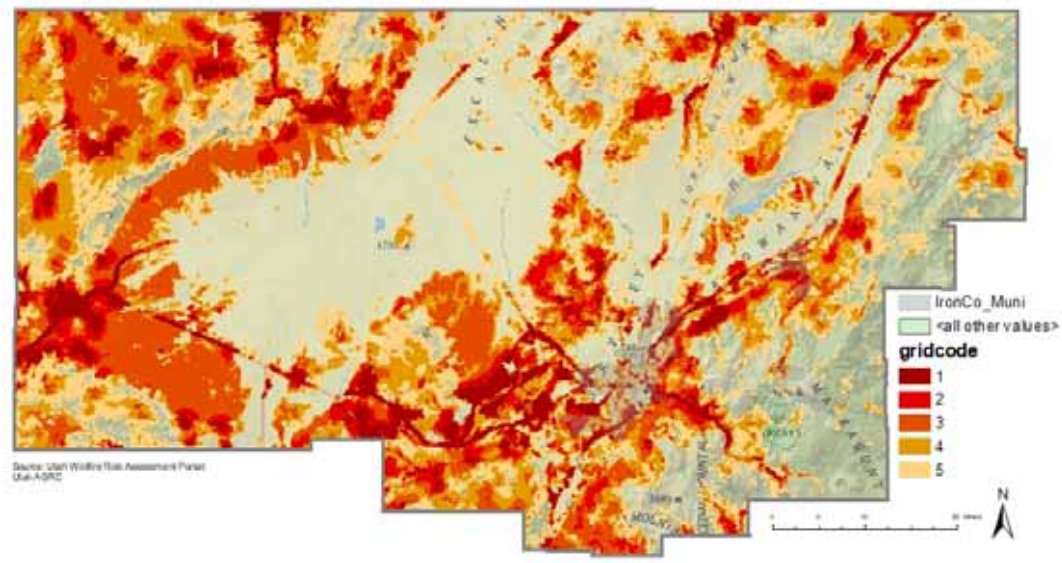


Figure 163: Iron County Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 173: Iron County Wildfire Risk further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels, critical facilities, and miles of roadway and rail in Iron County. Three fire stations and one school are identified critical facilities in the moderate-to-high risk area of the unincorporated county. A high percentage of parcels, road miles, and rail miles are considered at risk to wildfire in Iron County. Wildfire that impacts transportation infrastructure can cause delays in transportation of goods and travel through the region. The population in the unincorporated County sees notable exposure to wildfire risk areas.

Table 173: Iron County Wildfire Risk

Iron County Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
51.4%	84.5%	76.2%	76.5%	67.3%	93.4%	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

Iron County has experienced several recent wildfires which have caused impacts to residents. Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which tracks recent wildfires from 2017 and fires designated under Fire Mitigation Assistance Grant program from FEMA. Table 174 details Iron County fire events which are considered FMAG.

Table 174: Iron County FMAG Designated Fires

Fire Name	Year	Acres Burned	Description	Counties Affected

Brian Head Fire (FM-5185-UT)	2017	71,675	26 homes & minor structures destroyed. 1,562 people were evacuated from 11 communities. Impacted sage grouse habitat.	Iron and Garfield Counties.

Source: FEMA

A recent, large fire was started in Brian Head in 2017, which caused widespread damages, and evacuations in Iron and Garfield Counties. Following the blaze, flash flooding on the burn scar caused damages to roadways, structures, and the landscape.

The Utah Wildfire Info website is a reporting tool which provides updates on current fires and fire mitigation actions throughout the State of Utah. This tool also archives fire reports back to 2017 providing a detailed and recent history of wildfire events. In Iron County, only the Neck Fire has been reported, described in Table 175.

Table 175: Iron County Utah Wildfire Info Recorded Fire Events

Fire Name	Year	Acres Burned	Description	Counties Affected
Neck Fire	2019	17,800	Lightning started fire. Lead to the closure of several unpaved roads.	Iron and Beaver Counties.

Source: Utah Fire Info

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Iron County, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 164 shows the mapped quaternary faults and recorded earthquake epicenters in Iron County.

Quaternary Faults are concentrated in the eastern County, with the Anderson segment of the Hurricane Fault running parallel to I-15.

Earthquakes can happen throughout the state. Fault lines tend to be the most common cause of large earthquakes which can cause impacts in areas miles away. Figure 68 shows the earthquake epicenters are also concentrated in the eastern County.

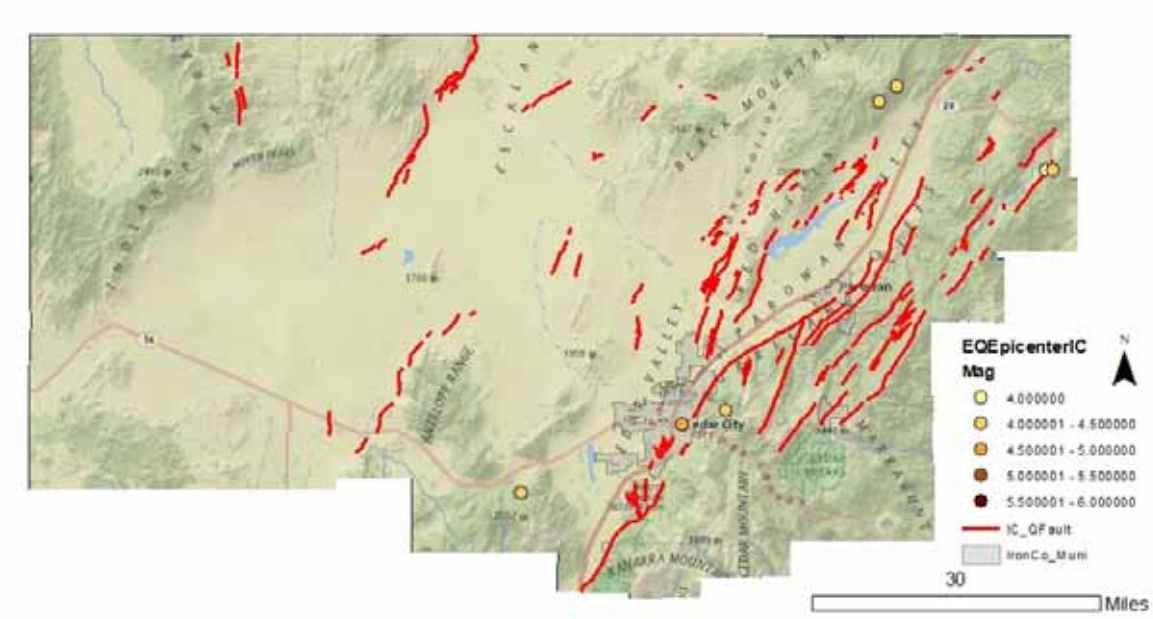


Figure 164: Iron County Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Several fault lines are present throughout Iron County, which interact with assets in the unincorporated County. The summary of the Five County assessment can be found in Table 176. Assets have limited exposure to quaternary faults, however shaking can be felt and cause impacts miles away from the source. Assets more than a quarter mile distance from a fault line are still at risk to earthquakes. Road miles and parcels see the greatest exposure to quaternary faults, which can shift with ground movements, damaging infrastructure.

Table 176: Iron County Quaternary Fault Exposure

Iron County Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	3.9%	4.1%	4.1%	4.7%	0.4%	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Iron County Assessors data does not include dates for construction on a parcel as of the 2019 assessment. Southern Utah has a pride in the pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry.

Hazard History

The University of Utah Geology Departments document seismic activity going back to 1960, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. In this history, Cedar City has recorded six earthquake events since the University of Utah began recording earthquakes at this location. Table 177 describes the earthquake events.

It is important to note that the earthquake epicenters in the map differ slightly from this history, as the source for the map has a slightly different magnitude than the University of Utah reported and this source documents earthquakes as far back as 1940. The data source has been included in appendix x.

Table 177: Iron County Earthquake Epicenter Record

Incident Date	Location	Description
1981	Cedar City, Iron County	A 4.18 magnitude earthquake recorded 7.2 miles southwest of Cedar City.
1991	Paragonah, Iron County	A 4.63 magnitude earthquake recorded 12.2 miles north of Paragonah.
1992	Cedar City, Iron County	A 4.19 magnitude earthquake recorded 2 miles northwest of Cedar City.
1992	Cedar City, Iron County	A 4.17 magnitude earthquake recorded 1.8 miles northwest of Cedar City.
1999	Paragonah, Iron County	A 4.11 magnitude earthquake recorded 13.7 miles north of Paragonah.
2010	Cedar City, Iron County	A 4.12 magnitude earthquake recorded 3.8 miles southeast of Cedar City.

Source: University of Utah Geology

In addition to these reported epicenters, Iron County can experience shaking from events elsewhere in the Southwest. The 1992 earthquake in Washington City produced ground shaking in Cedar City, which is approximately 45 miles away.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Iron County.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 165 describes the flood and dam inundation exposure in Iron County. As illustrated in the map, Iron County's mapped floodplain and dam inundation

zone are located throughout the County.

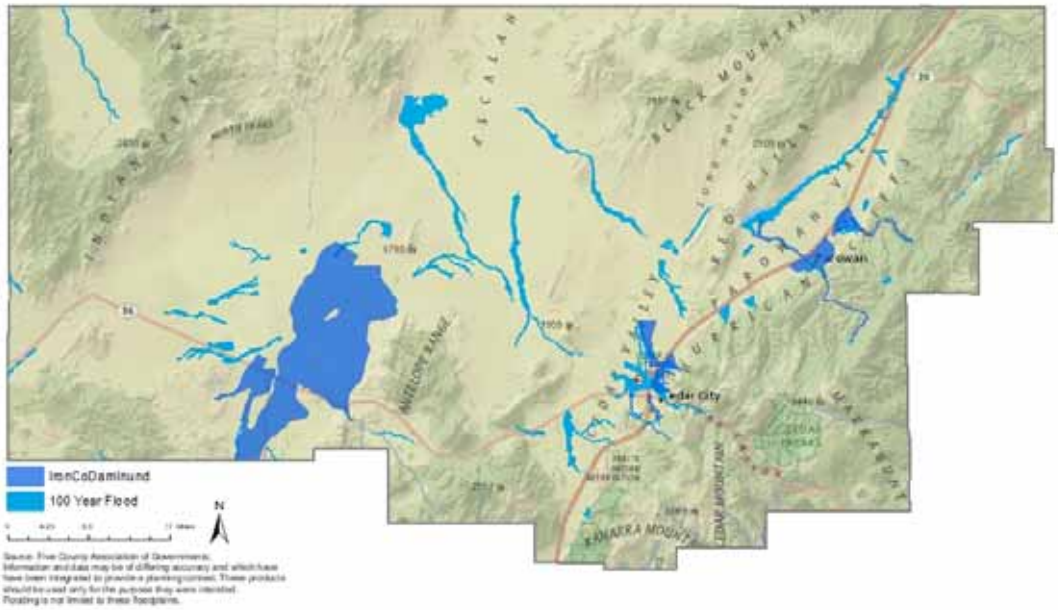


Figure 165: Iron County Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

An assessment of the extent of community assets which interact the mapped floodplain illustrates the potential greatest risks to the community. Table 178 further examines the exposure to identified flood risk areas in Iron County, by observing community assets and structures that are in at-risk areas. Less than 10% of parcels and critical facilities interact with the mapped floodplain. Flooding on roads and rail can lead to transportation delays, and impact response during an emergency event. While structures and infrastructure at the park may see impacts from flooding, maintaining flood susceptible areas as open space can help to protect the community.

Table 178: Iron County Floodplain and Dam Inundation Exposure

Tropic Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	6.2%	4.3%	4.4%	12.8%	20.8%	N/A

Source: Flood Insurance Rate Map, AGRC, Garfield County Assessor.

National Flood Insurance Program

Iron County property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 179 describes Iron County's NFIP participation. Flood Insurance Rate Maps were developed for Iron County in 1986. Two claims in Iron County have been in structures that have repetitive losses, meaning that damages from flooding have been reported two or more times at the site. The community has had Community Assistance Visits and Community Assistance Contacts in 2016 and 2017, respectively.

Table 179: Iron County NFIP Participation

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978	Repetitive Losses
$37,492	0	7	54	$16,379,100	13	$65,130	2

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff. Table 180 describes the flooding events which impacted Iron County.

Table 180: Iron County Reported Flood Events

Date	Damage/Injury	Description
9/8/1997	$40,000	A five-foot wall of water flowed down Red Creek following a severe rainstorm, flooding several streets, yards, and basements in Paragonah.
9/1/1998	$3,000	Heavy rains produced flooding of roads and yards in Cedar City and a washed-out road near Brian Head.
6/23/2000	$55,000	Significant flooding impacted Cedar City. Mud and debris covered Highway 56, west of the city, and washed out some intersections.
7/9/2001	None reported	Debris flowed over the highway through Parowan Canyon.
8/9/2001	$50,000	Portions of Cedar City saw heavy rain and the North Freeway Interchange was several inches under water, causing accidents.
8/13/2001	None reported	Heavy rain in Enoch led to flash flooding.
7/30/2003	$1,000	Street flooding was reported in Modena after a severe storm dumped over an inch of rain in 30 minutes. The Mountains north of Cedar City also reported flash flooding, but with no reported damage or injury.
8/23/2003	$30,000	Highway 143 near Parowan experienced flash flooding and rockslides. People at a nearby recreation site, Yankee Meadow, were stranded during the event. 26 Parowan homes were flooded.
7/14/2004	$5,000	A Monsoon rain produced flash flooding in western Iron County, closing SR-56 for debris removal and repairs.
10/21/2004	$400,000	Heavy rain caused flooding throughout the State of Utah, with the worst of the flooding seen in Iron and Washington Counties. Iron County saw flooding in Cedar City and along Coal Creek. Several homes were flooded.
6/3/2005	None Reported	A flash flood on Coal Creek washed mud and debris on SR-14.

8/8/2005	None Reported	Flooding covered SR-14 with debris and up to two feet of water, closing the road.
7/30/2006	None Reported	Mud and rockslides closed roads in Cedar Breaks.
8/17/2007	None Reported	Heavy rains lead to the closure of Highway 143 between Parowan and Brian Head.
8/26/2007	$10,000	Flash flooding near Modena washed out dirt roads. Several ATVs in the area were lost in the flood.
8/18/2010	None Reported	SR- 143 was flooded with two feet of water after heavy rains.
7/30/2012	None Reported	Flash flooding on Coal Creek.
7/31/2012	None Reported	SR-143 closed after flash flooding of Coal Creek near Brian Head.
8/17/2012	$1,500,000	Flash flooding in Enoch and Cedar City lead to significant damage to homes in the area.
7/27/2013	$400,000	Homes and properties in Cedar City and Enoch were flooded during a severe storm with record breaking rain fall.
9/11/2013	$10,000	A rockslide and flash flood closed Sr-143 between Parowan and Brian Head with boulders on the road.
7/11/2017	None Reported	Flash flooding on the Brian Head burn scar led to a debris flow into Paragonah.
7/24/2017	$20,000	Heavy rain on the Brian Head burn scar caused flash flooding and debris flows, washing out roads near Panguitch Lake.
8/3/2017	None Reported	Heavy rain caused debris to flow on to SR 143 and SR 271 from the Brian Head Fire burn scar. Both roads temporarily closed for cleanup.
8/6/2017	$50,000	Rain on the Brian Head Fire burn scar inundated SR 143, Old Highway 91, and Northbound I-15. Both I-15 and SR 143 were closed to clear debris from roadways. Parowan was also flooded during this event, causing damage to homes.
8/20/2017	None Reported	Flash flooding on Parowan Creek cause the closure of a northbound lane on I-15.
7/9/2018	None Reported	Flash flooding on the Brian Head Fire burn scar closed SR-143.
7/11/2018	None Reported	Heavy rain caused flash flooding and debris flow from the Brian Head Fire burn scar which closed SR-143.
7/13/2018	None Reported	SR 143 was closed after flash flooding caused debris flow on the roadway.
7/19/2018	None Reported.	Flash flooding from a severe storm caused SR-14 to close.
7/14/2021	$270,000	A monsoon produced heavy rain and subsequent flooding which damaged nine homes in Enoch and Summit.
7/15/2021	3 injuries $1,000,000	A monsoon produced heavy rain and subsequent flooding which derailed a Union Pacific train near Lund, injuring operators and washing emergency responders off the road.
7/18/2021	$30,000	A monsoon produced heavy rain and subsequent flash flooding which washed out an access road to Old Iron Town, which was closed until repaired.
7/25/2021	$400,000	A monsoon produced heavy rain and flooding in Parowan, impacting the power plant building. In nearby Paragonah, several homes were flooded and 50 people were stranded in Red Creek Canyon.
7/31/2021	$300,000	A monsoon caused 2.5-foot-deep flood waters in Enoch, flooding several homes.
8/1/2021	$9,000,000	A monsoon created flooding which damaged 300 homes, swept cars from roads, and closed I-15. Several roads were eroded

		during the event and Fiddlers Canyon was reported to be underwater.
8/18/2021	$232,000	A thunderstorm with heavy rain caused flooding on coal creek, which impacted several homes in a Cedar City subdivision. Kanarraville also saw impacts after a dike collapsed producing debris flows across old highway 91.

Source: NOAA Storm Database

Roadways and major connecting highways are regularly impacted by flooding, making roadways impassible with water and debris. Some impacts require reconstruction and repair of the roadway following a flood event. Homes and structures have also been impacted by flooding in the past.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 166 maps the landslide susceptible areas in Iron County. Iron County has high landslide susceptibility in the east and southern portion of the County.

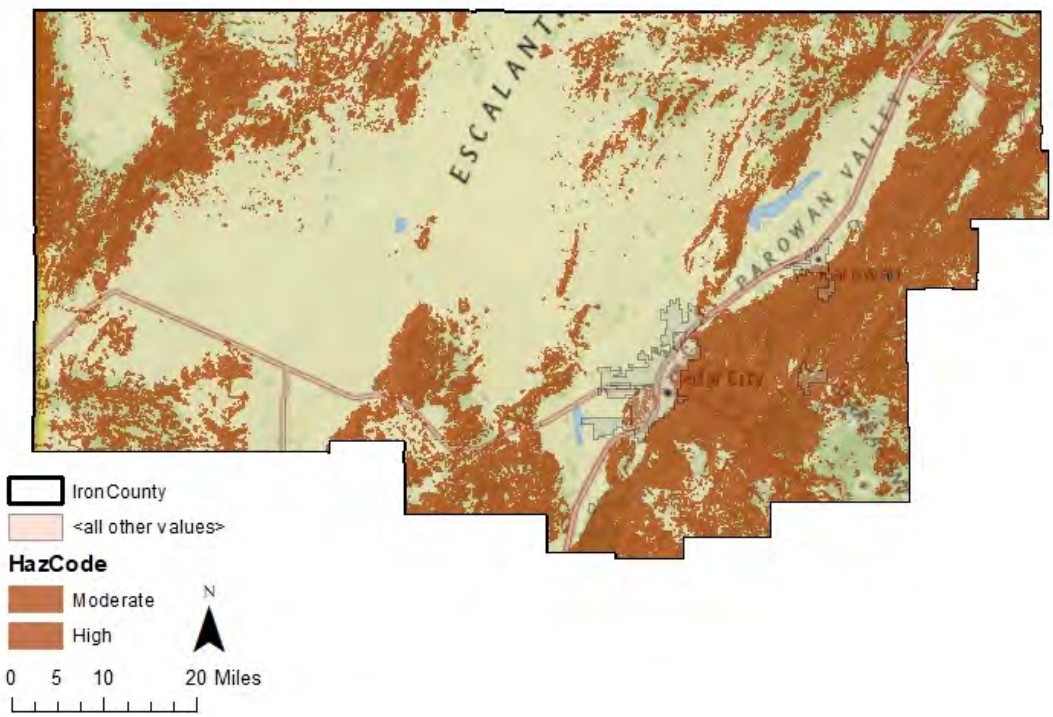


Figure 166: Iron County Landslide Susceptibility

Source: Utah Geological Survey

Iron County has some exposure to landslide susceptible areas, particularly on the west and south sides of the community. Table 181 describes the exposure of certain community assets to landslide susceptible areas. Roadways are the most exposed to landslide susceptible areas. Landslides on the roadway have the potential to separate communities from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. Landslides on busy routes or connecting routes increase the potential for impacts. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 181: Iron County Landslide Susceptibility Exposure

Iron County Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	5.4%	13.2%	13.0%	31.1%	9.1%	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

Iron County has recorded landslide events which have caused impacts, described in Table 182.

Table 182: Iron County Landslide Record

Incident Date	Location	Description
1915	Coal Creek Canyon	Landslide in Coal Creek Canyon.
1930	Enoch	Debris flow near Enoch
1947	Kane or Iron County	Rockslide at Zion National Park
1952	Kane or Iron County	Debris flow at Zion National Park
1955	Kanarraville	Debris flow near Kanarraville.
1961	Cedar City	Debris flow at the Red Hill, near Cedar City.
1983	Iron County	Landslide in Iron County.
1984	Iron County	Landslide in Iron County.
	Iron County	Heavy snow and a mudslide in Iron County.
2011	Iron County	SR-14 Iron County NCDC Landslide from Sheldus.
2017	Iron County	Heavy rain over the Brian Head Fire burn scar caused widespread flash flooding and debris flows, causing $20,000 in damage.
	Iron County	Heavy rain on the Brian Head Fire burn scar caused flooding and debris flows. Debris along I-15 was 1/8 of a mile long, forcing road closure for several hours and causing $50,000 in damage.

Source: Shieldus,

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Iron County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 167. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

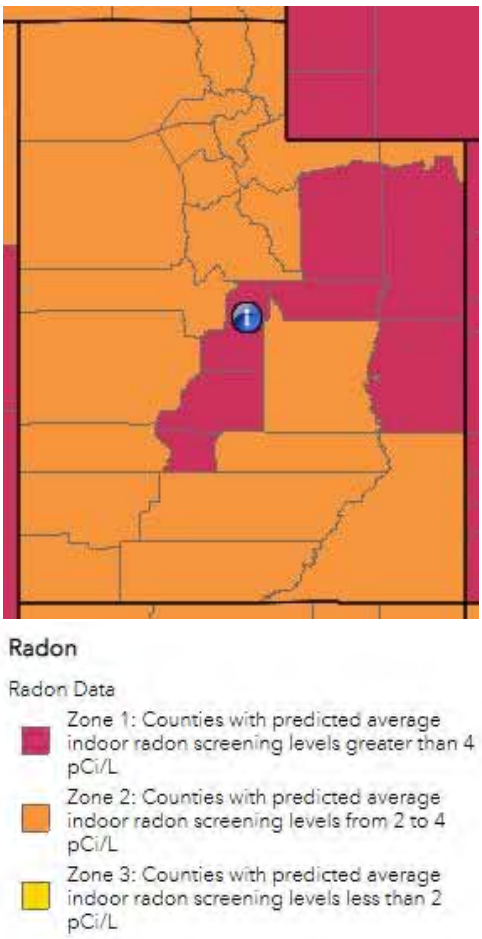


Figure 167: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 183 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 183: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Tropic, however our analysis assumes that severe weather events will impact the whole of Iron County residents, facilities, infrastructure, businesses, and property.

Iron County has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Iron County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 252 severe weather events in Southwestern Utah and Iron County between 1950 and 2020. Thirteen of these events had direct impacts on Iron County, resulting in damage or injury which is documented in Table 184.

Table 184: Iron County Severe Weather Record

Date	Damage/Injury	Description
5/30/1986	$30 reported	A tornado was spotted between Beryl Junction and Enterprise. The storm started a grass fire from downed power lines in Enterprise.
4/12/1997	$10,000	Heavy snow caused traffic accidents. Brian Head saw 11 inches and Cedar City saw 8 inches during the event.
4/2/1998	$14,000 1 Injury	A snowstorm dumped 18 inches on Brian Head Ski Resort and 5" fell in several area towns.
5/26/1998	$4,000	High Winds with gusts between 68 and 84 MPH were reported.
10/15/1998	$100,000	Heavy snow during a winter storm fell throughout Iron County, with 9-10 inches of snow reported at Cedar City, Parowan, and Paragonah and 15 inches at Brian Head.

11/8/1998	$500,000 in damage 10 Injuries	Heavy snow fall caused accidents across the state and likely impacted Iron County.
3/20/2011	$5,000	Strong winds were recorded in Iron County, damaging a roof of a building under construction in Cedar City.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
10/28/2013	$35,000	71 MPH wind gusts reported in Cedar City. High winds damaged trees in Cedar City, including on the Southern Utah University campus.
5/10/2014	$100,000	Heavy snow across Iron County impacted road travel, leading to crashes, slide offs, and a semi-truck rollover on I-15 between Beaver and Cedar City. Power outages were also reported from falling tree limbs onto power lines.
4/14/2015	$10,000	High winds of 61-63 MPH wind gusts downed trees and caused power outages impacting over 3,000 Iron County customers.
2/17/2016	$15,000	Strong winds with 70 MPH gusts knocked down trees, blocking SR-14 and requiring the highway to shut down.
2/18/2016	$50,000	High winds with gusts of 87 MPH led to treefall on ski runs at Brian Head Resort.
3/5/2017	$80,000 10 injuries	Winds with gusts ranging between 65 and 70 MPH impacted Beaver, Iron, and Washington Counties, causing tree damage, and blowing dust creating low visibility on roadways.

Source: NOAA Storm Database

Severe winds and winter storms are common to this area and can damage homes, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Iron County, the County likely saw extreme heat during these events which could cause impacts on residents and visitors.

Severe weather will continue to impact Iron County as weather events are frequently occurring in this region. Monsoon weather, including heavy rain, thunder, and hailstorms can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Iron County requires a soil suitability study to be prepared by a geotechnical engineer before construction. Figure 158 illustrates where the Utah Geological Survey has mapped problem soils for Iron County. Iron County has mapped dunes, limestone deposits, and expansive soils. Expansive soils and limestone are reactive to water content, causing the soil to expand or dissolve when whetted. Dunes are prone to wind blowing. Unmitigated problem soil areas can damage property or infrastructure built on top of it.

Figure 168: Iron County Problem Soils Map

Source: UGS, AGRC

Five County compared the existing parcels, critical facilities and infrastructure to these mapped problem soil areas and found that the mapped problem soil areas interact with Iron County's built environment. Table 185 describes the percent of infrastructure and structures exposed in the community. Exposed areas could see changes in the soil during or following storms or runoff events, which impact the roadways, infrastructure, and buildings.

Table 185: Iron County Exposure to Problem Soils

Iron County Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	1.2%	1.2%	1.8%	1.0%	N/A

Source: Utah Geological Survey, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Iron County is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. The County describes challenges in accessing unincorporated communities, especially those located on steep slopes.

Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

Iron County has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 186 describes progress made on Iron County's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 186: 2016 Iron County Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Problem Soils #1	Lessen the risk to buildings from problem soils	Address problem soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/developer, local government operating budget, Utah Geological Survey operating budget.	Unknown
Problem soils #2	Lessen the risk to buildings from problem soils	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/developer, local government operating budget, Utah Geological Survey operating budget.	Unknown
Problem Soils #3	Lessen the risk to buildings from collapsible and expansive soils.	Through mapping, identify areas which contain collapsible and expansive soils. Require soils testing at the building/construction level and ensure that engineer's recommendations are followed.	Ongoing	Private funds/developer; Local government operating budget.	Unknown

Landslide #1	Increase the level of knowledge related to landslides	Increase public education related to landslide hazards by distributing Utah Geological Survey (UGS) landslide informational brochures to the local municipality level emergency management, engineering, and planning departments, Distribute educational materials to the public.	Ongoing	Local Jurisdiction level	Unknown
Landslide #2	Minimize future landslide damage in the County.	Drafting/updating zoning and/or landslide ordinances to prevent development of structures near debris flows, landslides, and rock fall areas.	Ongoing	Local government operating budget, State and Federal planning grant programs.	Unknown
Landslide #3	To reduce landslide risk as it relates to the built environment.	Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/developer, local government operating budget, Utah Geological Survey operating budget.	Unknown
Landslide #4	To reduce landslide risk as it relates to the built environment.	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/developer, local government operating budget, Utah Geological Survey operating budget.	Unknown
Wildfire #1	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas.	Mailings, printed information, public service announcements.	Ongoing	State and Federal wildfire grant programs	Unknown
Wildfire #2	Ameliorate firefighting and access concerns related to heavy seasonal tourist traffic.	Compliment fuels reduction work being done by the Park Service and Forest Service onto private lands.	Ongoing	Local government operating budget, Special Service District operating budget, private property owner	Unknown

Wildfire #3	Ameliorate firefighting and access concerns related to heavy seasonal tourist traffic.	Prevent fires on private lands which may spread onto federal lands.	Ongoing	Local government operating budget, Special Service District operating budget, private property owner	Unknown
Wildfire #4	Fuel's reduction and defensible space tactics.	Continue to place strategic fuel breaks throughout the focus area.	Ongoing	Local government operating budget, Special Service District operating budget	Unknown
Wildfire #5	Fuel's reduction and defensible space tactics.	Encourage landowner mitigation and defensible space work.	Ongoing	Local government operating budget, Special Service District operating budget	Unknown
Wildfire #6	Provide training, equipment, and resources for fire departments to fight wildfires.	Enhance existing wildfire training programs, equipment procurement, and firefighting resources for wildfire suppression.	Ongoing	State CIB funding, Federal wildfire grant programs	Unknown
Flood #1	Minimize future flood damage in throughout the County.	Nonstructural measures appear to be the most prudent option for the county to implement. Zoning to prevent development of structures near local flood zones and be in compliance with federal set back standards.	Ongoing	Local government operating budget, State and Federal flood and planning grant programs.	Unknown
Flood #2	To reduce flooding risk as it relates to the built environment.	Address flood control at the building/construction level by requiring all subdivision proposals to have a storm water drainage system.	Ongoing	Private funds/developer	Unknown
Flood #3	To reduce flooding risk at the community level.	Clear debris and other material for all waterways.	Ongoing	Related public/private property owners	Unknown
Flood #4	Maintain spring runoff or thundershower waters in the natural and historic Summit Canyon flood channel. Start state 3 and the	By survey, mark upon the ground the natural channel. Then construct and/or open it up so, when necessary, it will convey flood waters. Riprap may be necessary at some locations. Some easements may be necessary.	Within the next 10-years	County Public Works and Engineer's budget	Unknown

	new strategies west of I-15.				
Flood #5	Maintain spring runoff or thundershower waters in the natural and historic flood channel.	By survey, mark upon the ground the natural channel. Then construct and /or open it up so, when necessary, it will convey flood waters. Riprap may be necessary at some locations. Some easements may be necessary.	Within the next 5-years	County Public Works and Engineer's budget	Unknown
Flood #6	Improve floodplain management activities by exceeding the minimum National Flood Insurance Program standards. Decrease flood insurance rates.	Each community will voluntarily participate in the FEMA Community Rating System which will help to keep communities safer, reduce flood insurance rates, and improve floodplain management activities. All jurisdictions not participating.	Ongoing	Local, State, and Federal funds	Unknown
Flood #7	Reduce flooding along SR-18 near the Shoal Creek/Newcastle Bench area.	Build and implement flood control measures to protect people and infrastructure and people.	Unknown	Local, State, and Federal funds	Unknown
Earthquake #1	Promote building safety through non-structural improvements.	Increase public education related to earthquake hazards by distributing Utah Seismic Safety Commission informational brochures to County and City emergency management agencies.	Ongoing	County and City operating budget, Utah Seismic Safety Commission operating budget	Unknown
Earthquake #2	To reduce earthquake risk as it relates to the built environment.	Continued dedication/vigilance in enforcing seismic standards established in the International Building Code (IBC).	Ongoing	County or City government operating budget	Unknown

Earthquake #3	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Utilize the Earthquake Risk Map provided in this plan as a tool to assess earthquake risk as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study.	Ongoing	Private funds/developer	Unknown
Earthquake #4	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	3-5 years	Local government operating budget, Utah Geological Survey operating budget	Unknown

Source: 2017 Five County Association of Governments NHMP

The Iron County planning team identified actions to include in the community mitigation strategy. Each action addresses a natural hazard risk or vulnerability identified in this plan. Each action in Table 187 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Table 187: Iron County 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2	Collect data to inform flood mitigation actions.	Complete flood studies of Summit, Coal Creek, Little Creek, and Parowan Creek.	H	5-years	M	Iron County, NCRS, Cities and Towns	Iron County
Flood #2	1, 2	Establish codes which are targeted to high-risk flood areas.	Set new flood channel set back requirements dependent on expected flood rates throughout the County.	M	1-year	L	Iron County	Iron County
Flood #3	4	Reduce flooding on critical infrastructure.	Coordinate with UDOT to increase flood capacity of stormwater infrastructure under I-15.	L	5-10 years	H	UDOT, NRCS, FEMA, CIB, Iron County.	Iron County, UDOT
Flood #4	1, 2	Restore riparian areas and drainages in the County.	Repair rip rap and re-brace the bank in Right Hand Canyon into Coal Creek.	H	5-years	M	Iron County	Iron County
Flood #5	2, 5	Inform users of capacity of critical infrastructure which crosses riparian areas.	Post gross vehicle weight at the Urie Creek Bridge in Right Hand Canyon.	H	2-years	L	Iron County	Iron County
Flood #6	1, 2	Collect data to inform flood mitigation actions.	Complete floodplain remapping with FEMA	M	Unknown	L	RiskMAP Coordinator, FEMA.	Iron County, RiskMAP Coordinator, FEMA.
Flood #7	2	Reduce flooding on critical infrastructure.	Address flood risk at the Bridge near Lady Bug Nursery in Cedar City.	L	5-years	M	Iron County, Cedar City, CIB, CDBG	Iron County, Cedar City
Flood #8	1, 2	Establish codes which are targeted to high-risk flood areas.	Adopt an ordinance for flood management at Quichipa Lake to	M	2-years	L	Iron County	Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			set estimated elevations and setbacks of different water levels for development.					
Drought #1	2, 6	Develop groundwater infiltration systems.	Develop a dike at Lake Quichipa to direct water to an infiltration pond.	M	2-years	M	Iron County	Iron County
Drought #2	2, 6	Develop groundwater infiltration systems.	Identify recharge areas to increase water recharge capacity. Complete necessary infrastructure to support infiltration.	M	5-years	M	Iron County, Central Iron County Water Conservancy District	Iron County, Central Iron County Water Conservancy District
Drought #3	2, 6	Monitor groundwater infiltration and the aquifer.	Install measuring devices for groundwater recharge.	H	5-years	M	Iron County, Central Iron County Water Conservancy District	Iron County, Central Iron County Water Conservancy District
Drought #4	1, 2, 6	Plan for future water needs and conservation of the aquifer.	Complete a groundwater management plan.	H	5-years	M	Iron County, Central Iron County Water Conservancy District	Iron County, Central Iron County Water Conservancy District
Drought #5	1	Encourage water conservation.	Adopt updated water rights requirements for secondary homes.	H	2-years	L	Iron County	Iron County
Wildfire #1	1, 2	Support local fuels mitigation in the County.	Acquire a woodchipper to support communities in fuels mitigation and creating defensible space.	L	4-years	M	Iron County	Iron County
Wildfire #2	2	Protect water supply and	Set requirements	H	2-years	M	Iron County	Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		infrastructure from fire.	for fuels mitigation surrounding critical County and municipal facilities, including water infrastructure in wildlands.					
Wildfire #3	2	Protect critical infrastructure from fire.	Complete fuels reduction and mulching in the Cedar Valley near critical Class B roads.	H	2-years	M	Iron County	Iron County
Earthquake #1	2	Protect water infrastructure from ground shaking events.	Harden water tanks, pipelines, and other critical water infrastructure identified to cross a mapped quaternary fault.	L	Ongoing	H	Iron County, CIB, CDBG.	Iron County
Earthquake #2	2	Protect water infrastructure from ground shaking events.	Install emergency shut off for water pipes at locations which cross mapped fault lines.	M	5-years	H	Iron County, CIB.	Iron County
Earthquake #3	1	Protect existing county facilities from ground shaking events.	Inventory structures in the County constructed with Unreinforced Masonry.	M	5-years	L	Iron County	Iron County
Earthquake #4	1	Protect existing county facilities from ground shaking events.	Implement structural and nonstructural retrofit County owned URM structures. Inform private property owners of URM vulnerability and	M	10-years	H	State and Local Tax Credit, Preservation Utah, Iron County, CIB.	Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			mitigation options.					
Earthquake #5	1, 5	Plan for continued operations of critical facilities during and after an earthquake event.	Acquire back up generators for critical county facilities.	H	3-years	M	Iron County	Iron County, Fire stations, sheriff's office.
Severe Weather #1	1	Protect existing county facilities from severe weather impacts.	Inventory County owned property for snow load capacity.	M	5-years	L	Iron County	Iron County
Severe Weather #2	1	Protect existing county facilities from severe weather impacts.	Implement necessary improvements on identified County owned structures in need of snow load capacity increase.	M	10-years	H	State and Local Tax Credit, Preservation Utah, CDBG, Iron County.	Iron County
Severe Weather #3	1	Limit damage caused by falling snow.	Adopt an ordinance which sets a Sheering protection requirement for utilities at the entry to the home.	H	2-years	L	Iron County	Iron County
Landslide #1	1, 2	Prevent landslide near critical water infrastructure due to water tank failure/leaks.	Inventory County owned water tanks on or near hillsides for stability and seismic resilience.	L	5-years	L	Iron County	Iron County
Landslide #2	2	Address landslide risk to roadways in and out of Brian Head Town.	Work with UDOT to implement slope stabilization and/or rockfall catch nets along SR-14 and Highway 143 to prevent rockfall	M	Ongoing	M	Iron County, UDOT,	Iron County, UDOT,

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			and landslide on roadways.					
Landslide #3	1, 2	Coordinate with property owners to mitigate landslide and flooding impacts.	Restore County springs and riparian areas which have caused landslides and flooding.	L	Ongoing	H	Iron County, FEMA, NRCS.	Iron County, private property owners.
Problem Soils #1	1	Collect data to inform mitigation actions.	Identify property which has been impacted by problem soils in the community and document impacts.	L	2-years	L	Iron County	Iron County
Problem Soils #2	1	Implement bank stabilization measures in Shurtz Creek	Complete an assessment of erosion and sedimentation on Shurtz Creek. Implement recommended bank stabilization measures.	M	5-years	M	Iron County	Iron County
Problem Soils #3	1, 2	Collect data to inform mitigation actions.	Work with the Utah Geological Survey to update problem soil mapping in Iron County.	M	5-years	L	Iron County, Utah Geological Survey	Iron County, Utah Geological Survey
Radon #1	3	Inform residents of radon risk.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing, annually	L	Iron County	Iron County, Utah Dept. of Environmental Quality
Radon #2	1, 4	Collect data to inform mitigation actions.	Work with UGS to assess radon risk in the county.	M	5-years	L	Iron County, Utah Geological Survey	Iron County, Utah Geological Survey
Multi Hazard #1	3	Inform the public about natural hazards, mitigation, and safety.	Conduct a community engagement campaign for natural hazards and personal	H	Ongoing, annually	L	Iron County	Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			property mitigation at the County Fair and in coordination with Life Safety events hosted for elementary school students.					

Source: Local Planning Team

Brian Head

Brian Head is a mountain resort community in eastern Iron County, which incorporated in March of 1975. The town is a short drive from I-15 via Parowan or Cedar City and is near the National Monument Cedar Breaks and the Dixie National Forest. The base elevation of the community is approximately 9,600 feet and the community has a significantly different climate from the rest of the County. This area sees significant snow annually and during summers typically sees cooler temperatures than communities in the valley.

Brian Head was originally a farming/ranching community, with European settlers using high elevation meadows for grazing and sheep herding. Logging also became an economic staple of the community during the early 1900s. The community now is home to a ski resort which was established in the 1960s, which draws tourism from the southwest for winter and summer recreation.

Demographics

As of the 2018 American Community Survey, Brian Head has a population of 77 people. Comparing to previous documented census', Brian Head's population experienced growth in the 1990s and 2000s and a decline back to pre-1990 population counts. Figure 169 illustrates this trend. The most recent census is not yet available to include in this document.

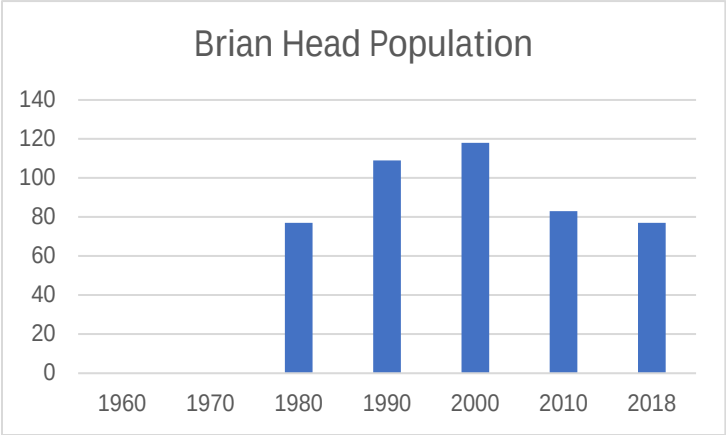


Figure 169: Brian Head Population by Decade

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Cedar City, the community could see around 109 people living in the community in the next 45-years[7].

Economy

The area surrounding Brian Head Town has a history of farming, ranching, and industry. Today, much of this historic industry has transitioned to support trade and accommodations and food services in the community. This points to the presence that the local ski resort has in the community. Figure 170 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool. Real Estate, other services, management, and arts and entertainment occupy comparatively small shares of the economy compared to the footprint occupied by accommodation and food service and trade.

[7] This estimate is created using the 2015 ACS population estimate for Brian Head, which was 60, and adding 81% of this population estimate to the population for that year.

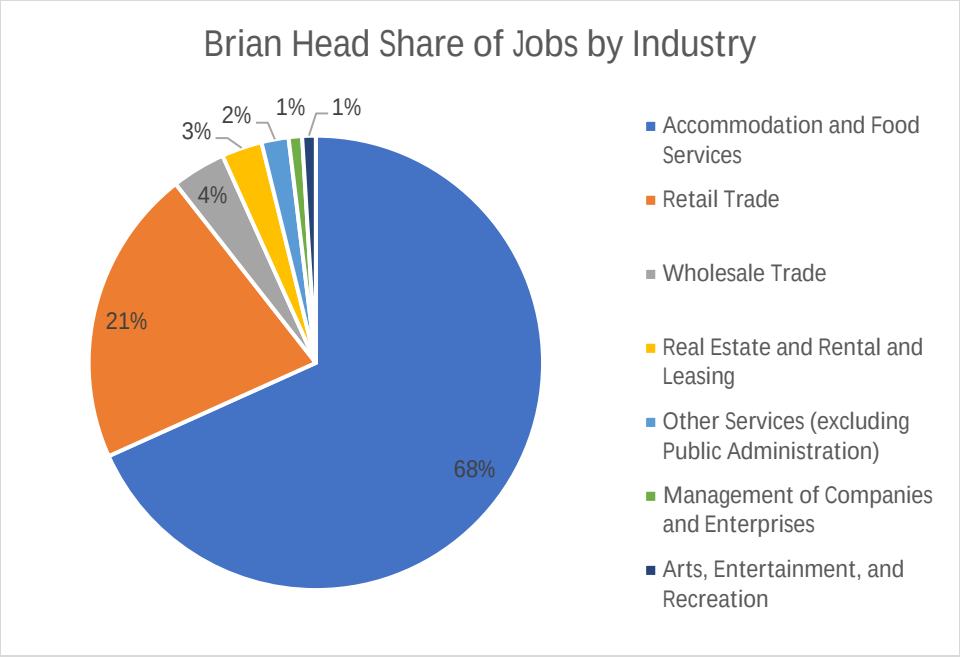


Figure 170: Brian Head Share of Private Primary Jobs by Industry

Development

The Town has had a few subdivisions proposed, but new structures have not been built as of this writing. Some residential homes have been built in currently platted lots within the Town boundaries.

The Town has seen significant increases in transient populations coming to the community for recreation and vacations. This population is likely to affect the development trends in Brian Head over time if visitation continues to increase.

Community Capabilities

Brian Head is governed by an elected council and mayor, who consider community needs and recommendations from town staff in making policy for the town. Staff at Brian Head include a Town Manager, Clerk, and Treasurer, who perform a wide range of roles, including providing information and general conduct of the government. A public works staff support water and sewer service in the community and a planning staff person provides specific information about design standards, zone changes, and development in the community. The Iron County building and zoning provide permit and inspection services in Brian Head. The town website indicates that the services are equivalent to those of a small city, to serve the town when at full capacity in the winter and summer months.

Brian Head Town supports a Public Safety Department which employ police officers who provide law enforcement and first response to emergencies locally. All the public safety officers also serve roles of fire fighter and are certified EMTs.

Brian Head provides water, sewer, and garbage/recycling services locally. Utilities, including electric, and gas are provided by private companies to residents.

Plans and Policies

Brian Head has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. This section provides an overview of Brian Head plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

General Plan

The General Plan (2019) describes the community objectives looking ahead to accommodate growth and community needs. Some policies related to development and growth of the population, economy, and infrastructure are described in the plan, detailing the need to center density in the core of the community, maintain a mountain resort and small-town character, and maintain adequate access for fire and ambulance services throughout the community. The community also describes planning for open space and recreation opportunities and acquiring land for this purpose if needed. Public works services related to water should work to minimize leaks and create a redundancy system to ensure continuous service, fire flow, and water quality. Severe weather considerations are described in this plan for design of new development and landscaping.

The community recognizes the challenges posed by wildland fire in the community in the General plan, calling for fire prevention and education through partnership with the public and the local Community Wildfire Protection Plan (CWPP) Committee. Brian Head emphasizes the need to cultivate relationships with land management and government agencies serving the area at multiple levels, especially as it relates to recent fire event recovery.

Planning and Zoning Code

The planning and zoning code for Brian Head Town indicates development requirements and policy related to natural hazards. Several policies relate to flooding, storm drain, and erosion control, in addition to geologic hazards like landslide, earthquakes, or problem soils. Several policies indicate that there will be requirements for development to study and mitigate natural hazards that exist on a site to protect people and property.

Fiscal Year 2021 Strategic Plan

The Fiscal Year 2021 Strategic Plan (2020) focuses on strategies that the Brian Head Town Staff will implement in the next year to meet the identified community vision. While not directly related to natural hazards, several of the strategies and actions in the plan are related to natural hazard mitigation, preparedness, response, or recovery. The Strategic Plan documents Brian Head's goal to engage in wildfire fuels reduction projects, supply fire responders with appropriate equipment, and acquire a snow cat.

Trails Master Plan

The Brian Head Trails Masterplan (2015) was the product of a collaborative effort to develop a unified trail system in the Brian Head community. The masterplan references the Iron County General plan as a supporting document, which describes the use of flood inundation areas for recreational purposes. Certain trails must meet certain water management and weed barrier requirements as detailed by the plan.

Sustainable Recreation and Tourism Plan

The Sustainable Recreation and Tourism Plan (2018) describes how Brian Head Town, and the surrounding Iron County area can develop recreation while addressing the impact from recreation on the area. The plan documents that recreation and economic assets, including outdoor venues and events, winter sports, and boating can be vulnerable to natural hazards. The plan documents that severe weather and drought are hazards of concern to these activities.

Community Wildfire Preparedness Council Letter

Following the Brian Head Fire of 2017, Brian Head residents developed the Brian Head Community Wildfire Protection Plan in coordination with the Utah State Division of Forestry, Fire, and State Lands and the Brian Head Public Safety Department. The residents involved in the plan became the Community Wildfire Preparedness Council. The CWPC penned a letter to fellow residents with actions that those living near forest areas can take to mitigate fire risk on their property.

Risk Assessment

Brian Head is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Brian Head planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 188 describes the relative risks of hazards in the community.

Table 188: Brian Head Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
EARTHQUAKE	3. Moderate
WILDFIRE	4. Moderate
LANDSLIDE	5. Moderate
FLOOD	6. Moderate
RADON	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Brain Head can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to

reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Brian Head include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Brian Head experienced a large fire near the community since the last iteration of this Natural Hazard Plan, which has highlighted the risk that wildfire poses on the community and the surrounding area. The high elevation community is surrounded by wildlands and water sources for communities downstream. A wildfire near Brian Head will impact the community directly and has the potential to impact other communities far from the fire. The town has adopted Wildland Urban Interface code.

Figure 171 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Iron County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Brian Head experiences moderate to extreme risk to wildfires along major roadways accessing the community, where community assets exist.

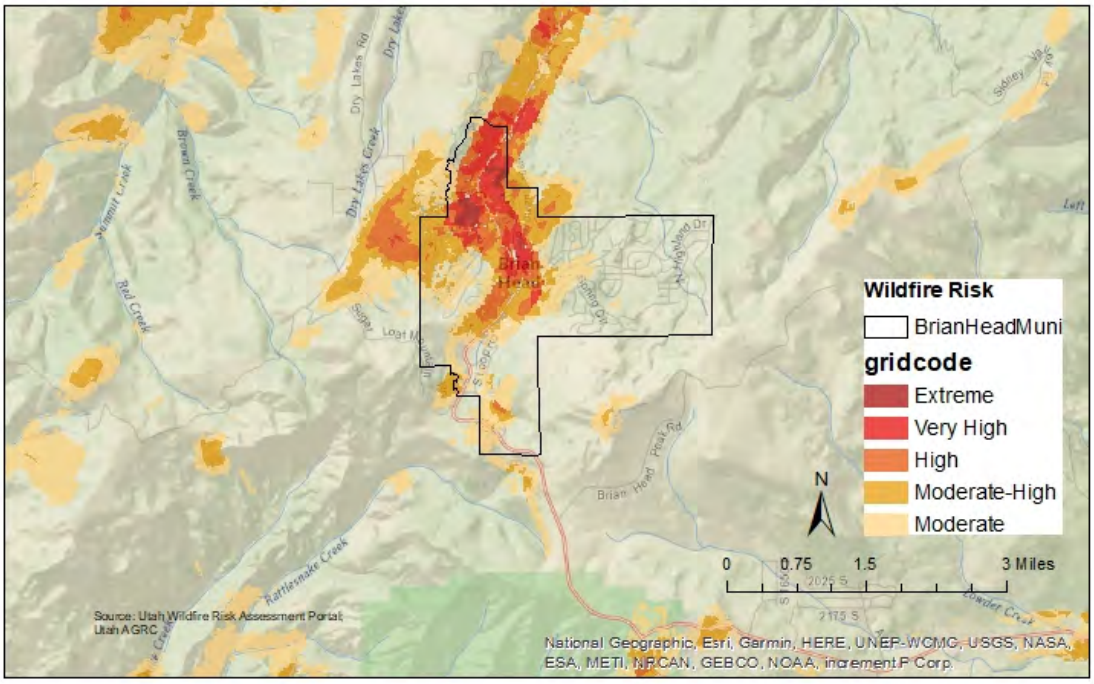


Figure 171: Brian Head Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 189 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels, critical facilities, and miles of roadway in Brian Head. A medical clinic and police department are identified in areas considered moderate to high risk to wildfire. A high percentage of parcels, road miles, and rail

miles are considered at risk to wildfire in Iron County. Wildfire that impacts transportation infrastructure can cause delays in transportation of goods and travel through the region.

Table 189: Brian Head Wildfire Risk

Brian Head Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
66.7%	97.2%	78.4%	78.8%	36.9%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

Brian Head has experienced one recent wildfire which impacted residents and visitors to the community. Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which tracks recent wildfires from 2017 and fires designated under Fire Mitigation Assistance Grant program from FEMA. Table 190details Iron County fire events which are considered FMAG.

Table 190: Iron County FMAG Designated Fires

Fire Name	Year	Acres Burned	Description	Counties Affected
Brian Head Fire (FM-5185-UT)	2017	71,675	26 homes & minor structures destroyed. 1,562 people were evacuated from 11 communities. Impacted sage grouse habitat.	Iron and Garfield Counties.

Source: FEMA

Only the Brian Head Fire has reached the status of a FMAG designation in Iron County as of this writing. The Brian Head fire of 2017 caused widespread damages, and evacuations in Iron and Garfield Counties. Following the blaze, flash flooding on the burn scar caused damages to roadways, structures, and the landscape.

No wildfires impacting Brian Head have been reported to the Utah Wildfire Info database.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-

term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Brian Head, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 172 shows the mapped quaternary faults and recorded earthquake epicenters near Brian Head. The closest earthquake epicenter to Brian Head was recorded approximately 10 miles away, near Cedar City. The Markagunt Plateau Quaternary Fault segments are mapped through and surrounding the community.

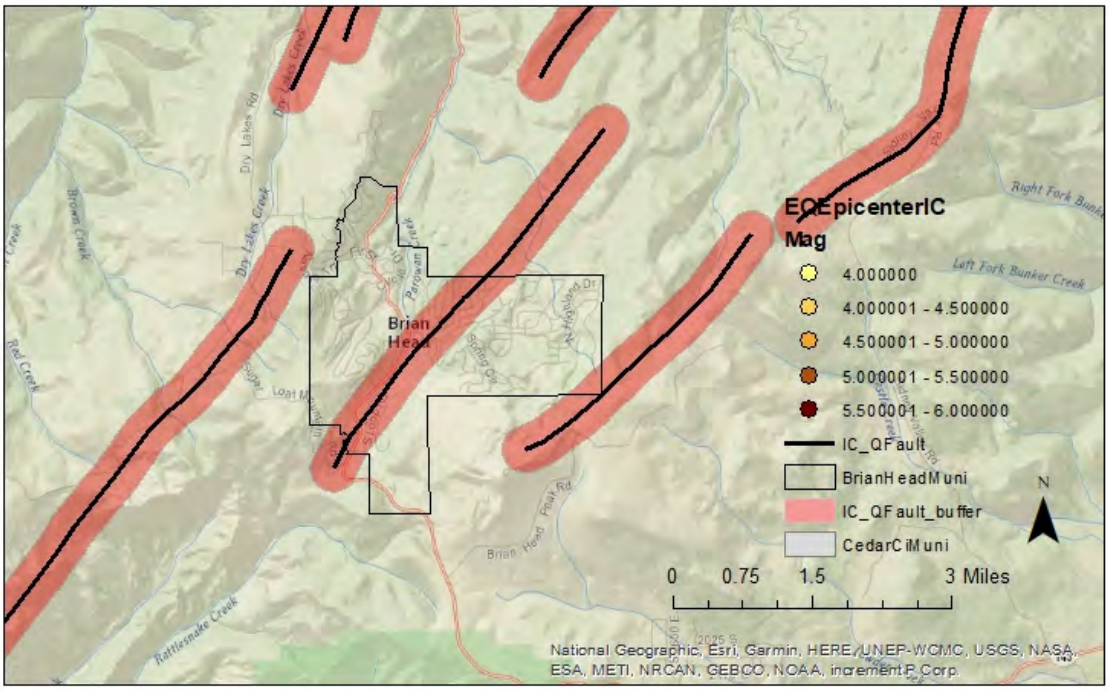


Figure 172: Brian Head Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Two mapped faults interact directly with assets and infrastructure in Brian Head. The summary of the Five County assessment can be found in Table 191. Assets are located within a quarter mile of quaternary faults, however shaking can be felt and cause impacts miles away from the source. Assets more than a quarter mile distance from a fault line are still at risk to earthquakes. Road miles and parcels see the greatest exposure to quaternary faults, which can shift with ground movements, damaging infrastructure.

Table 191: Brian Head Quaternary Fault Exposure

Iron County Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
66.7%	38.9%	56.3%	55.9%	28.1%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Iron County Assessors data does not include dates for construction on a parcel as of the 2019 assessment. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

Brian Head does not have recorded earthquakes in the town boundaries but can experience shaking from events elsewhere in the region. The 1992 earthquake in Washington City produced ground shaking in Cedar City, which is approximately 45 miles away.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Brian Head.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 173 depicts the flood and dam inundation exposure in Iron County. Brian Head does not include mapped flood or dam inundation exposure in the

community as of this writing.

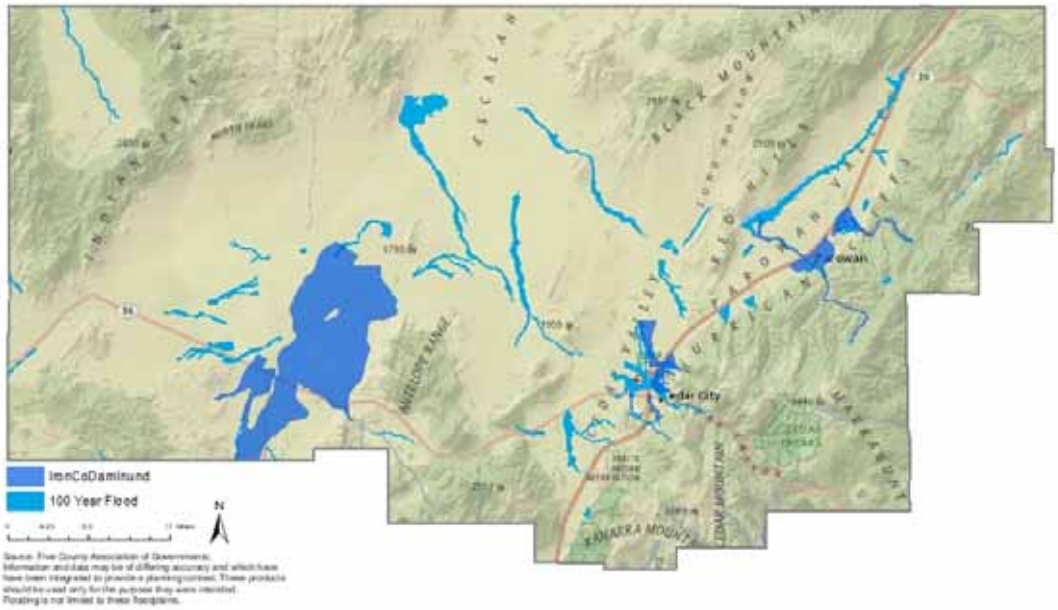


Figure 173: Iron County Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

National Flood Insurance Program

Brian Head property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Brian Head does not participate in the NFIP and has never had flood maps drawn.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 192 describes the flooding events which have impacted Brian Head and the surrounding area.

Table 192: Brian Head Reported Flood Events

Date	Damage/Injury	Description
9/1/1998	$3,000	Heavy rains produced flooding of roads and yards in Cedar City and a washed-out road near Brian Head.
7/9/2001	None reported	Debris flowed over the highway through Parowan Canyon.

7/30/2006	None Reported	Mud and rockslides closed roads in Cedar Breaks.
8/17/2007	None Reported	Heavy rains lead to the closure of Highway 143 between Parowan and Brian Head.
7/31/2012	None Reported	SR-143 closed after flash flooding of Coal Creek near Brian Head.
9/11/2013	$10,000	A rockslide and flash flood closed Sr-143 between Parowan and Brian Head with boulders on the road.
7/11/2017	None Reported	Flash flooding on the Brian Head burn scar led to a debris flow into Paragonah.
7/24/2017	$20,000	Heavy rain on the Brian Head burn scar caused flash flooding and debris flows, washing out roads near Panguitch Lake.
8/3/2017	None Reported	Heavy rain caused debris to flow on to SR 143 and SR 271 from the Brian Head Fire burn scar. Both roads temporarily closed for cleanup.
8/6/2017	$50,000	Rain on the Brian Head Fire burn scar inundated SR 143, Old Highway 91, and Northbound I-15. Both I-15 and SR 143 were closed to clear debris from roadways. Parowan was also flooded during this event, causing damage to homes.
7/9/2018	None Reported	Flash flooding on the Brian Head Fire burn scar closed SR-143.
7/11/2018	None Reported	Heavy rain caused flash flooding and debris flow from the Brian Head Fire burn scar which closed SR-143.
7/13/2018	None Reported	SR 143 was closed after flash flooding caused debris flow from the Brian Head Burn Scar onto the roadway.

Source: NOAA Storm Database

While weather events have historically impacted Brian Head with floods and debris flows, incidents increased in the year following the Brian Head Fire, impacting roadways and communities down the mountain from the fire. Roadways and major connecting highways are regularly impacted by flooding, making roadways impassible with water and debris. Some impacts require reconstruction and repair of the roadway following a flood event. Homes and structures have also been impacted by flooding in the past.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 174 maps the landslide susceptible areas in Brian Head. The Eastern portion of the County, which is high elevation in the mountains is susceptible to landslides.

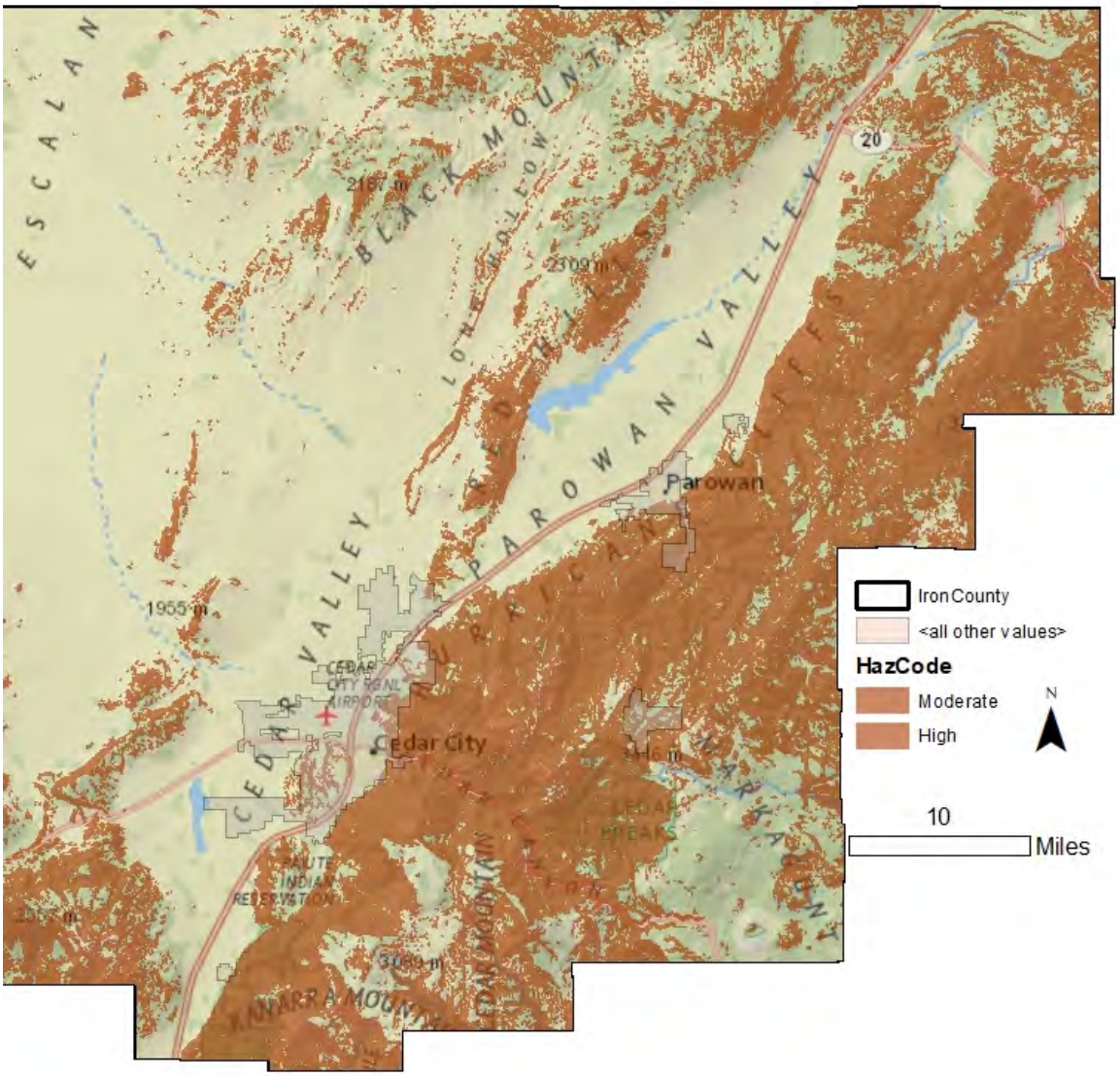


Figure 174: Brian Head Landslide Susceptibility

Source: Utah Geological Survey

Brian Head Town is exposed to landslide susceptible areas, particularly on the west and south sides of the community. Table 193 describes the exposure of certain community assets to landslide susceptible areas. Roadways are the most exposed to landslide susceptible areas. Landslides on the roadway have the potential to separate communities from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. Landslides on

busy routes or connecting routes increase the potential for impacts. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 193: Brian Head Landslide Susceptibility Exposure

Brian Head Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	25.0%	38.2%	49.7%	49.7%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

Brian Head has recorded landslide events near the community which have caused impacts, described in Table 194. The recorded history of landslides provides a picture of potential future events. Landslide events impacting the area around Brian Head occurred following the Brian Head Fire, causing damage to the landscape and roadways.

Table 194: Iron County Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
2017	Iron County	$20,000	None reported	Heavy rain over the Brian Head Fire burn scar caused widespread flash flooding and debris flows.
	Iron County	$50,000	None reported	Heavy rain on the Brian Head Fire burn scar caused flooding and debris flows. Debris along I-15 was 1/8 of a mile long, forcing road closure for several hours.

Source: Shieldus, NOAA Storm Database

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Iron County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 175. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

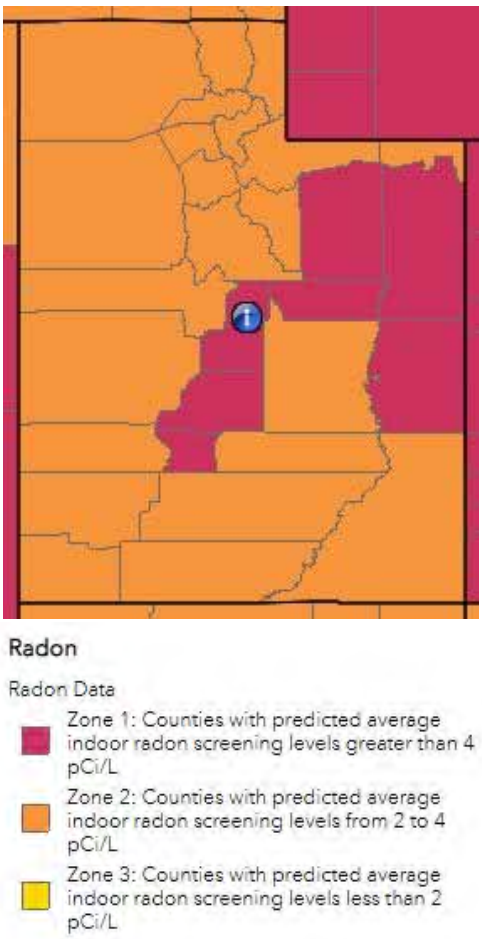


Figure 175: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 195 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 195: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Brian Head, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Brian Head has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Given that Brian Head is at a higher elevation than most Iron County, temperatures tend to be cooler on average. Thunderstorms are the weather hazard that frequently impact Iron County, which can produce hail, high winds, rain, and lightning, which are likely to impact Brian Head.

Hazard History

NOAA reports that there have been 252 severe weather events in Southwestern Utah and Iron County between 1950 and 2020. Three of these events had direct impacts on Brian Head, resulting in damage or injury which is documented in Table 196: Iron County Severe Weather Record. Brian Head experiences several winter storms annually and normally receives several feet of snow from these storm events. While damages or injury are often not reported, it is likely that these events impact travel and access. Severe winds and winter storms are common to this area and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Brian Head, the area likely saw extreme heat during these events which could cause impacts on residents and visitors.

Table 196: Iron County Severe Weather Record

Date	Damage/Injury	Description
11/28/1996	None Reported	Brian Head reported 31 inches of snow during a storm, receiving the most snow in the state from this storm.

4/9/1997	None Reported	Brian Head reported 23 inches of new snow fall during a snowstorm that impacted the state.
4/12/1997	$10,000	Heavy snow caused traffic accidents. Brian Head saw 11 inches and Cedar City saw 8 inches during the event.
12/7/1997	None Reported	Brian Head reported 34 inches of new snowfall following a snowstorm.
1/4/1998	None Reported	Brian Head reported 28 inches of snowfall following a winter storm.
2/14/1998	None Reported	Brian Head reported 34 inches of snow fall during a storm.
3/5/1998	None Reported	Brian Head reported 40 inches of snow following a storm.
4/2/1998	$14,000 1 Injury	A snowstorm dumped 18 inches on Brian Head Ski Resort and 5" fell in several area towns.
10/15/1998	None Reported	Brian Head Ski Resort reported 15 inches of snow following a storm that caused flooding.
12/19/1998	None Reported	Brian Head reported 20 inches of snow following a storm that impacted the State of Utah.
10/30/2000	None Reported	Heavy snowfall across Utah dropped 27 inches at Brian Head.
3/1/2003	None Reported	A winter storm dropped 14 inches of snow at Brian Head.
3/4/2003	None Reported	A winter storm dropped 17 inches of snow at Brian Head.
4/5/2003	None Reported	21 Inches of snow reported at Brian Head after winter storm.
12/25/2003	None Reported	A 3-day winter storm dumped 30 inches of snow at Brian Head.
11/27/2004	None Reported	Brian Head received 24 inches of snow during a storm.
3/28/2005	None Reported	Heavy snow fell across Utah. Brian Head received 28 inches of snow.
4/8/2005	None Reported	Brian Head received 20 inches of snowfall.
12/1/2007	None Reported	UDOT sensors reported 20 inches of snowfall at Brian Head in one day.
1/24/2008	None Reported	Brian Head received 12 inches of snow in 12 hours.
12/18/2008	None Reported	Brian Head reported 24 inches of snow.
10/29/2010	None Reported	40 inches of snow reported near Brian Head.
10/6/2011	None reported	Brian Head Resort received 17 inches of snow.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
11/22/2013	None Reported	22 inches of snow fell at Brian Head.
5/10/2014	None Reported	SR-143 east of Brian Head was closed due to significant snow fall.
2/22/2015	None Reported	Brian Head Resort reported 15 inches of snow during a storm.
2/27/2015	None Reported	Brian Head Resort reported 14 inches of snow during a storm.
2/1/2016	None Reported	Heavy snow closed SR 143 from Brian Head to Mammoth Creek.
2/18/2016	$50,000	High winds with gusts of 87 MPH led to treefall on ski runs at Brian Head Resort.
3/28/2016	None Reported	Brian Head Resort reported 27 inches of snow following a winter storm.
12/26/2016	None Reported	Brian Head Resort reported 43 inches total snow fall during a winter storm.
4/11/2019	None Reported	Brian Head SNOWTEL reported 22 inches of snow following a winter storm.
4/21/2019	None Reported	Brian Head SNOWTEL reported approximately 17 inches of snow.
2/3/2020	None Reported	Brian Head SNOWTEL reported approximately 17 inches of snow following a winter storm.

Source: NOAA Storm Database

Severe weather will continue to impact Brian Head as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Brian Head describes in Codes and Ordinances being aware of soil suitability and stability, requiring in some cases that the use of property show that it is suitable for the soil type and geologic hazards present on the site. There is no specific ordinance detailing problem soil types present in the community. Figure 176 illustrates where the Utah Geological Survey has mapped problem soils for Iron County. Brian Head does not have mapped problem soils in the community.

Figure 176: Iron County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Iron County is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have

been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

Brian Head has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 197: 2016 Brian Head Mitigation Strategy describes progress made on Brian Head's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 197: 2016 Brian Head Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Wildfire #1	Reduce the fuel contribution to potential wildfires. Increase safety from falling trees on streets and trails.	Clearing deadfall from street and trail rights-of-way.	Sept 2016-May 2017	Wildland Fire revenue, general fund, State fire grants, FEMA funding	Ongoing and have identified other projects.
Flood #1	The objective resolves managing storm drains and floodplains by increasing infrastructure.	Construct a comprehensive storm drain master plan.	Sept 2016-May 2017	General Fund, CIB, other State or Federal Grants	Completed.

Source: 2017 Five County Association of Governments NHMP

The Brian Head Town planning team identified actions to include in the community mitigation strategy. Each action in Table 198 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 177.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 177: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Brian Head has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 198: Brian Head 2022 NHMP Mitigation Strategy, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 198: Brian Head 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	1, 3	Involve the public in town mitigation efforts.	Coordinate wildfire preparedness council to engage town in preparedness and public involvement.	M	2-years, ongoing	L	Brian Head Town	Brian Head Town
Wildfire #2	1, 2, 6	Use natural systems to prevent wildfire hazards.	Complete the Quaking Aspen restoration project on the southwest end of town.	H	1-year	M	Brian Head Town, Ski Resort,	Brian Head Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
							Forest Service.	
Wildfire #3	1, 2	Use natural systems to prevent wildfire hazards.	Assess town owned property for fuels management needs and complete fuels removal.	L	Ongoing	M	Brian Head Town	Brian Head Town
Wildfire #4	4	Engage wildland fire hazard mitigation collaboratively	Coordinate with Resort, BLM, Forest Service, and County to complete wildfire mitigation surrounding the Town.	H	Ongoing	M	Brian Head Town	Brian Head Town
Drought #1	6	Inform residents on water conservation practices.	Develop a public education campaign which includes: brochures requesting the use of slow the flow practices for municipal water users, not overwatering lawns, and using natural landscaping.	H	Ongoing, annually.	L	Brian Head Town	Brian Head Town
Earthquake #1	2	Protect town from damaged	Inspection of manholes & sewer utility lines to address damages due to land movement.	H	Ongoing	M	Brian Head Town Public Works	Brian Head Town
Landslide #1	6	Reduce erosion potential following vegetation damage.	Coordinate with private and federal partners in revegetating burn scars to prevent erosion and stabilize soils on burn scars.	M	Ongoing	M	Brian Head Town, FEMA, BLM, Forest Service, Iron County	Brian Head Town, BLM, Forest Service, Iron County
Severe Weather #1	3	Inform visitors and residents of extreme weather conditions as a high mountain area.	Communicate through media, social media, and UDOT automated signage to inform travelers of hazardous road conditions or weather.	M	Ongoing, as needed during storm events.	L	Brian Head Town	Brian Head Town
Flood #1	2	Increase capacity of stormwater	Install new 36” culvert at Highland Drive as described in Storm Drain Master Plan.	H	1-year	M	Brian Head Town	Brian Head Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		drainage infrastructure.					Public Works	
Flood #2	2	Increase capacity of stormwater drainage infrastructure.	Install two new 48" culverts at Loop Road as described in Storm Drain Master Plan.	H	1-year	M	Brian Head Town Public Works	Brian Head Town
Flood #3	2	Increase capacity of stormwater drainage infrastructure.	Install two new 36" culverts at Forest Drive between Mountain View Drive and Deer Trail as described in Storm Drain Master Plan.	H	4-years	M	Brian Head Town Public Works	Brian Head Town
Flood #4	2	Increase capacity of stormwater drainage infrastructure	Install new 36" culvert at Ridgeview St as described in Storm Drain Master Plan.	M	5-years	M	Brian Head Town Public Works	Brian Head Town
Flood #5	2	Increase capacity of stormwater drainage infrastructure	Install new 36" culvert at Vasels Rd as described in Storm Drain Master Plan.	M	6-years	M	Brian Head Town Public Works	Brian Head Town
Flood #6	2	Increase capacity of stormwater drainage infrastructure	Install new 36" culvert at Village Way as described in Storm Drain Master Plan.	M	7-years	M	Brian Head Town Public Works	Brian Head Town
Radon #1	3	Provide public information about Radon risks.	Provide radon risk, testing, and mitigation information to residents. Send information using utility billing, town website, and social media.	H	Annually	L	Brian Head Town	Brian Head Town

Source: Local Planning Team

Cedar City

Cedar City is the largest city in Iron County, located along I-15 and borders Enoch City. Cedar City is the economic hub of the county, although it is not the county seat. The community lies in the Great Basin at the base of the Markaguant Plateau. To the east are high elevation mountain regions, and the south and west are the Great Basin and Mojave Desert. The community has an elevation at 5,800 feet above sea level and receives snow and freezing temperatures in the winter months. The summers are dry with high temperatures often near 90 degrees Fahrenheit.

Cedar City's water resources come from Coal Creek, springs, and wells. Increasing populations pose challenges to the existing water resources.

Population

As of the 2018 American Community Survey, Cedar City has a population of 31,009. Cedar City has experienced rapid and significant growth in the past few decades. As seen in Figure 178, growth peaked in the year 2000 and has slowed since. The most recent census is not yet available to include in this document.

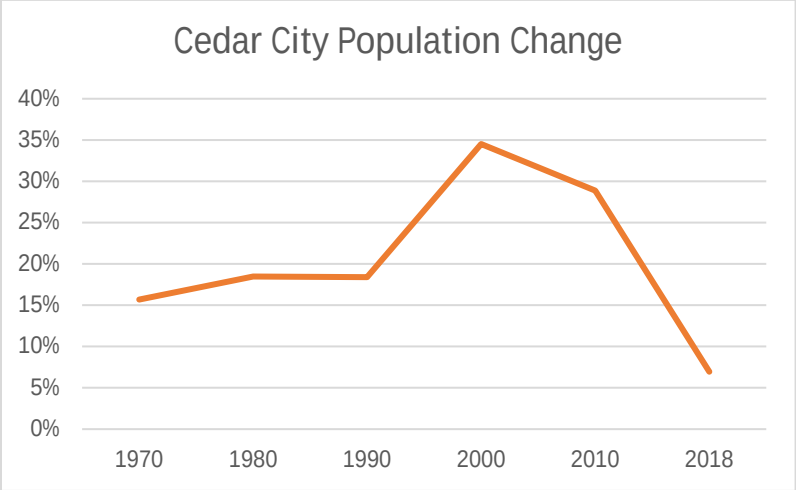


Figure 178: Cedar City Population Change 1970-2018

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Cedar City, the community could see over 76,000 people living in the community in the next 45-years[8]. In this scenario, Iron County is one of the fastest growing counties in the state. Cedar City is likely to see some of this growth as the largest urban area in the county.

Development

Development in Cedar City is occurring throughout the community. The area is seeing both commercial and residential development in the community.

Economy

Cedar City's economy originally centered iron mining to support the ongoing Latter-day Saint colonization in Utah, although the iron industry failed in this area by the mid-1850s. Mining had periodic returns to the region's economy, notably with steel production in the mid-1900s to support war efforts in Europe. The economy turned to agriculture and education with the creation Branch Normal School, which later became Southern Utah University in 1991. Today, the tourism industry is an economic strength, given Cedar City's access to several outdoor recreation areas, including Cedar Breaks Monument, Bryce Canyon National Park and Zion National Park. The community also has a culture and

[8] This estimate is created using the 2015 ACS population estimate for Cedar City, which was 42,290, and adding 81% of this population estimate to the total.

arts sector, which attracts people to the area with the Utah Shakespearean festival and the Utah summer games, to name a few.

Figure 179 further describes the number of jobs by industry in Cedar City, referencing the US Census Bureau tool, On the Map. Cedar City has a diverse economy, but is dominated by retail, accommodation and food services, and manufacturing. Mining and agriculture, which were once significant drivers of the local economy now make up around 1% of jobs in Cedar City. The current economy points to the ongoing development in the region to accommodate growth, and the prominence of tourism and food service in the community.

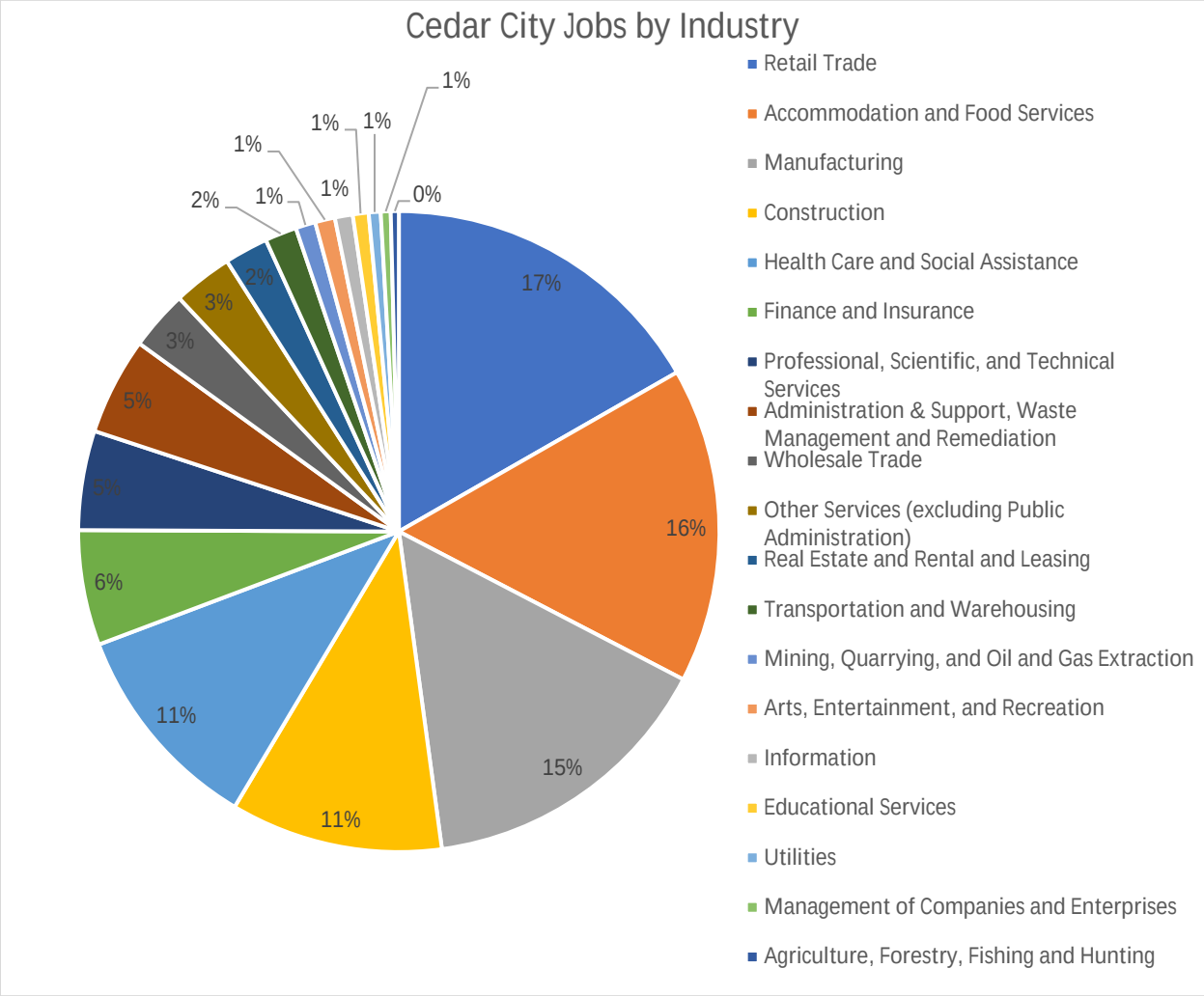


Figure 179: Cedar City Jobs by Industry

According to the Low-and Moderate-Income Area Data on the Housing and Urban Development website, HUD exchange, 54% of Cedar City is considered low and moderate income. This percentage may be increased by the number of students attending Southern Utah University, who are early in careers or pursuits. The American Community Survey estimates that near 20% of the population was between 18 and 24 years of age as of 2018.

Community Capabilities

Cedar City is one of the region's larger communities and has a city government with several staff to provide services and operate city functions. A Mayor and City Council engage in legislative activities, while a city manager ensures that these actions are implemented by the City government. The City has staff provide GIS mapping, emergency response, planning, floodplain management, and other services.

The Cedar City Budget describes several revenue sources that contribute to funding government activities. The largest revenue streams are Sales and Use Taxes and Property Taxes. The budget also indicates that there are several federal and state grants that contribute to the community, indicating that there is staff with capacity and resources to apply for grants in the communities.

Cedar City provides water, sewage, and waste removal for residents in the community, with partnership with the Central Iron County Water Conservancy District for some water users. Other utility providers include:

- Telephone- Century Link
- Electrical- Rocky Mountain Power
- Natural Gas- Dominion Energy

Plans and Policies

The Cedar City General Plan (2012) describes several goals and objectives for the future of Cedar City, including ways the city can prevent impacts from natural hazards. Natural hazards in Cedar City identified in the natural hazard mitigation plan include severe weather, flooding, fire, landslides, earthquakes, and problem soils. Goals and objectives will be described in greater depth for Cedar City in the relevant risk assessment section.

In 2020 Cedar City adopted a Wildland Urban Interface Ordinance, which included collaboration with the Iron County Home Builders association, Cedar City Building department, Cedar City Administration and Council, and the Cedar City Fire Department.

To address wildfire, the community also worked with Enoch City to develop a Cedar City/Enoch Wildfire Preparedness Plan, which identifies a timeline for actions to support response, prevention, public information, and mitigation of wildfires in these two cities. Cedar City actions include decreasing fuels in certain streets or neighborhoods in the area, private property, and Summit Mountain, Ashdown Forest, and Square Top.

Water Conservation Plan (2019) describes water use, anticipated trends, and available supply for the region. Cedar City has a limited supply of water, with approximately 22,446-acre feet available as of 2019. The plan indicates that population growth will further impact the local availability of water. Another challenge described by this plan is the overdrawing of groundwater in the community and action being taken to recharge the resource to limit impacts.

Risk Assessment

Cedar City experiences and is at risk to the natural hazards addressed in this Natural Hazard Mitigation Plan. Severe storms in the winter and summer are common, although other prevalent events include drought and flash flooding because of severe weather events.

Five County has worked with Cedar City to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 199 displays the relative risks of hazards in Enoch.

Table 199: Cedar City Hazard Risks

Hazard	*Risk*
Wildfire	High
Flood	High
Earthquake	High
Severe Weather	Moderate
Drought	Moderate
Landslide	Low
Radon	Low
Problem soils	Low

The following sections provide further description of the exposure, probability, and severity of each natural hazard in Cedar City, concluding with a mitigation strategy to address any vulnerabilities identified in the risk assessment to each natural hazard. The Cedar City local planning team provided input, context, and data to this assessment and developed the mitigation strategy for the community.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories. Figure 180 describes the mapped wildfire risk areas in Cedar City.

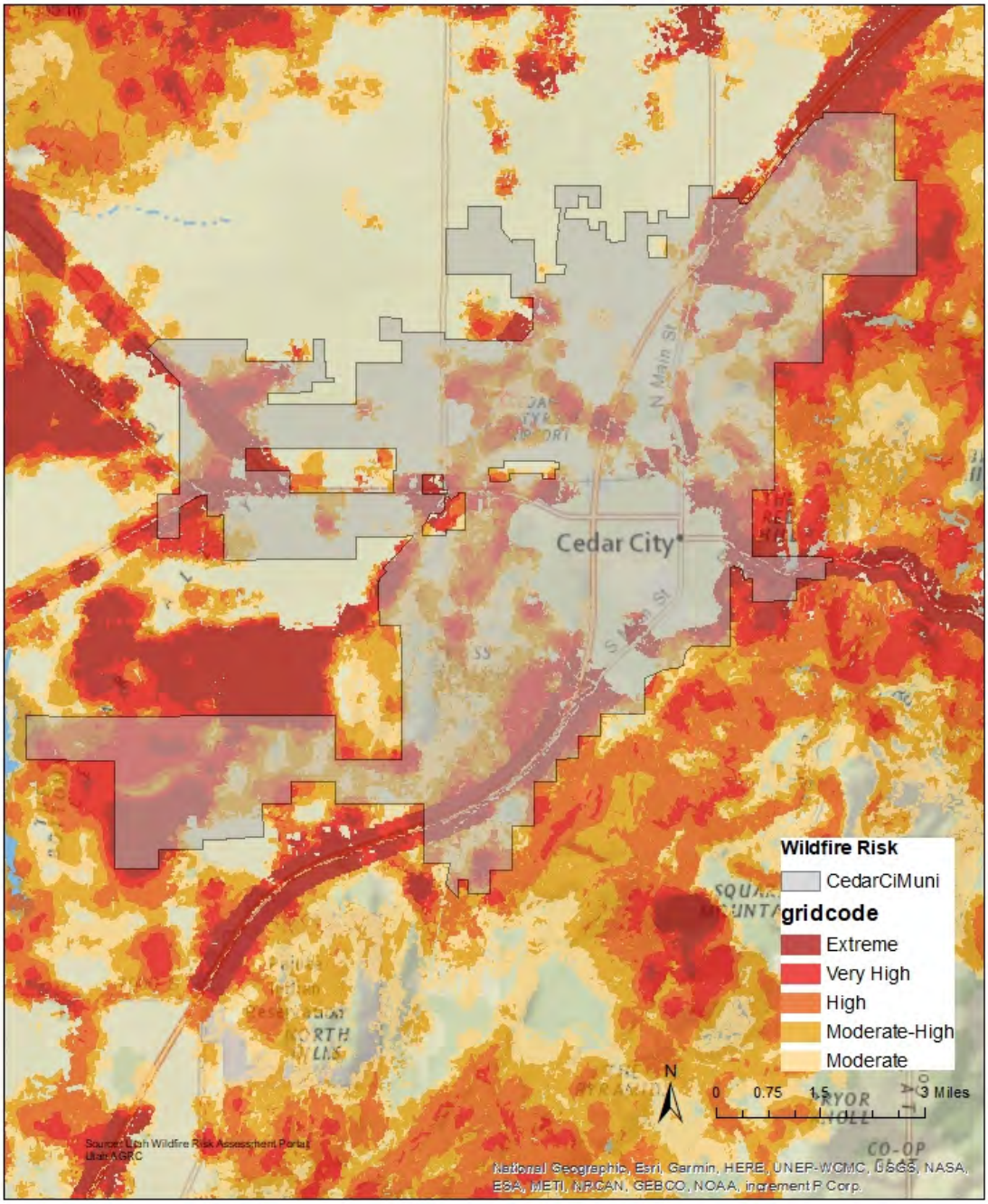


Figure 180: Cedar City Wildfire Risk

Moderate to high wildfire risk tends to focus along the mountain range to the east of the city, the I-15 corridor to the south, and near the lake to the southwest of Cedar City. The Five County Assessment includes an analysis of the people, infrastructure, assets, and critical facilities that may be at risk to a natural hazard. Table 200 reflects the percentage of the community assets that are exposed to wildfire hazards. Several assets are at high risk to wildfire, including road miles, rail miles, and local parks in the community. Commercial and residential parcels are also significantly at risk to wildfire, as more than a quarter of these types of parcels exposed. Critical facilities have limited exposure, however those that

are at risk to wildfire may impact the ability to serve or respond to the community during an emergency. Identified facilities in the risk areas include: an urgent care clinic and three federal agency offices.

Table 200: Cedar City Wildfire Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
38.1%	27.9%	28.8%	53.9%	92.9%	55.6%	9.3%

Source: Iron County Assessor, 2020; UTWRAP, 2020; AGRC, 2020.

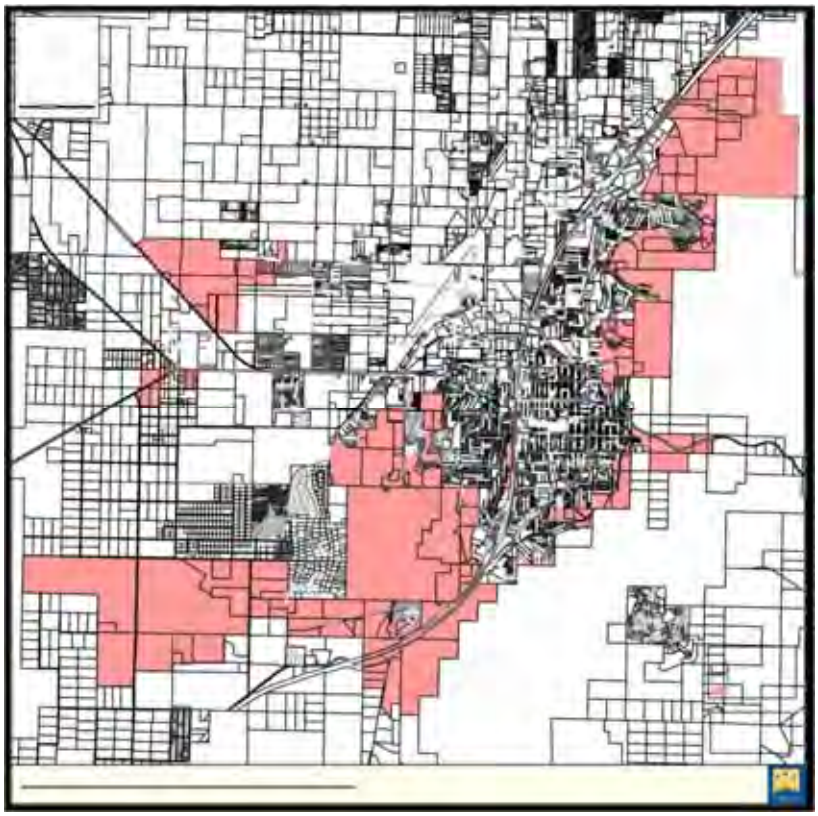


Figure 181: Cedar City Wildland Urban Interface Overlay

Source: Cedar City/Enoch Wildfire Preparedness Plan, 2020

Cedar City has adopted a Wildland Urban Interface (WUI) Code, which set specific design and development guidelines for structures that are near at-risk open space or wildlands. A zoning overlay was created, which presents the parcels that are subject to this code, displayed in Figure 181. The parcels are generally those near the foothills of the nearby mountains, which border Cedar City to the east.

The Cedar City/Enoch Wildfire Preparedness Plan (CWPP) (2020) describes in depth the ability of Cedar City to prepare for and respond to a wildfire, including several actions to improve this capability. Implementation of the actions calls for coordination from the Cedar City Fire Department, Bureau of Land Management, U.S. Forest Service, and other entities who control land locally. Past wildfire mitigation actions include fuels thinning and mitigation since 2015, consistent hiring a summer fuels crew, and vegetation management around the boundaries of municipalities. Planned future mitigation actions include home assessments in the WUI, fuels management in private properties and neighborhoods, Summit Mountain, Ashdown Forest, and Square top public lands.

Hazard History

Cedar City has not experienced wildfire impacting the city boundaries, which endangered people or property in the city limits, according to the Utah Wildfire Info record (2017-2020) and the FEMA Fire Mitigation Assistance Grant designation page. This does not mean that there is no risk to wildfire in the community. Nearby municipalities, like New Harmony in Washington County, which has a somewhat similar elevation, fuels, and climate have experienced several instances of wildfire that have resulted

evacuation orders for some areas. Other nearby wildfires likely had secondary impacts on Cedar City, including air and water quality issues due to ash and smoke, which can travel miles from the site of the fire.

Wildfires in the community can trigger other natural hazards, including landslides and flooding and can be caused or have increased risk due to drought or severe weather events, like lightning. Drought concerns and the prevalence of severe thunderstorms in the region increase concerns for wildfire in the community, especially as drought conditions have been ongoing in recent years. Drier fuels and reduced water availability will impact the community's ability to respond effectively to wildfire events.

Earthquake

Earthquakes are a known risk and challenge of living in Utah. Several active faults in the southwest have caused historic earthquakes, shaking, and other impacts. While earthquake epicenters can occur in areas that do not have mapped quaternary faults, fault lines are likely to be the cause of significant shaking. Other fault hazards include the rising or dropping of land along the fault during an earthquake event. A quarter-mile buffer has been applied to understand what assets may be most at risk in Cedar City to earthquake events, seen in Figure 182.

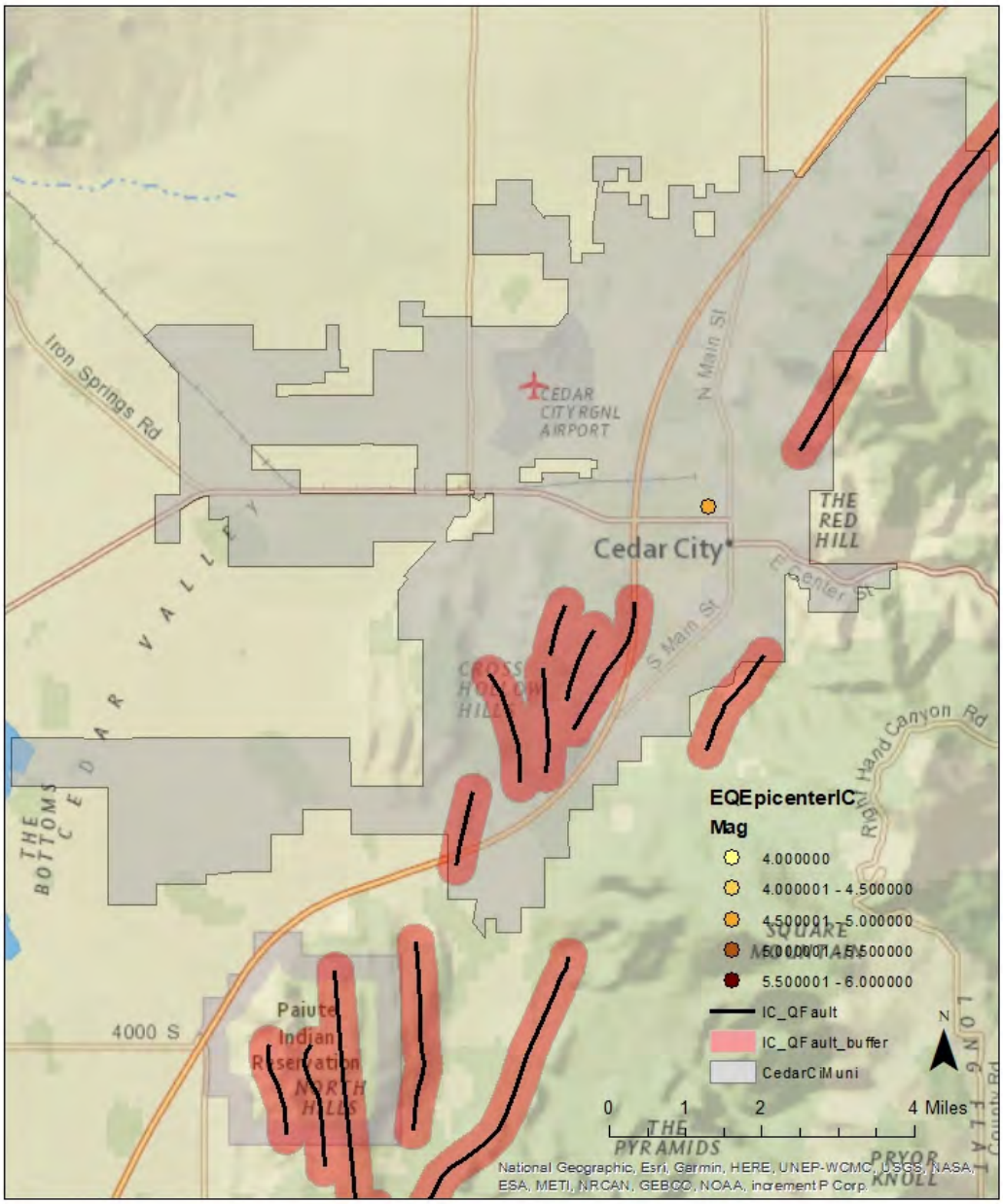


Figure 182: Cedar City Quaternary Faults and Earthquake Epicenters

Quaternary faults have been mapped in the eastern and southern portion of Cedar City. Property, critical facilities, parks, and roadways have been compared to the identified fault lines to better understand what potential impacts from an earthquake may be. Table 201 describes the community assets within a quarter mile boundary to describe what earthquake impacts may be.

Table 201: Cedar City Exposure to Earthquakes

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
6.4%	8.1%	8.0%	15.0%	0.0%	22.2%	11.6%

Several Critical facilities and residential parcels are within a quarter mile of a mapped quaternary fault in Cedar City. Critical facilities within a quarter mile of a faults include: two medical facilities, an assisted living facility, and two schools. I-15 and several local road's cross fault lines, especially in the Cross Hollow Hill area and southern portion of the city.

Other vulnerabilities to consider to earthquake shaking include the age of structures and the construction type. Southwestern Utah has a history of pioneer settlement, and many communities seek to preserve historical buildings and structures. These structures, typically unreinforced masonry, are at greater risk to earthquake hazards. Iron County has limited data describing the construction date of structures on parcels, but knowing the history of the area, Cedar may have historic structures that could be at heightened risk to earthquakes. Further local assessment is necessary to understand the structural challenges that may exist in a seismic event.

Hazard History

A 4.8 magnitude earthquake epicenter has been reported in the city limits, dated to 1942 and is mapped in Figure 182. Since that time, earthquake epicenters have been documented throughout Iron County and the community has experienced ground shaking as a result. Damages during these events have been limited, although there were some impacts reported during the 1992 earthquake which originated in Washington City. Other earthquake events with a magnitude of 4.0 or greater have occurred in or near Cedar City are described in Table 202.

Table 202: Cedar City Earthquake Event History

Year	Location	Magnitude
1981	7.2 miles southwest of Cedar City	4.18
1992	2 miles northwest of Cedar City	4.19
1992	1.8 miles northwest of Cedar City	4.17
2010	3.8 miles southeast of Cedar City.	4.12

Source: University of Utah Department of Geology, 2020.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Cedar City.

Flood

Cedar City has documented exposure to the floodplain, with nearby Coal Creek and several small lakes in the community, some of which appear to be manmade. Nearby Quichapa Lake is outside of the city boundary. Figure 183describes Cedar City's exposure to the mapped floodplain and dam inundation zones.

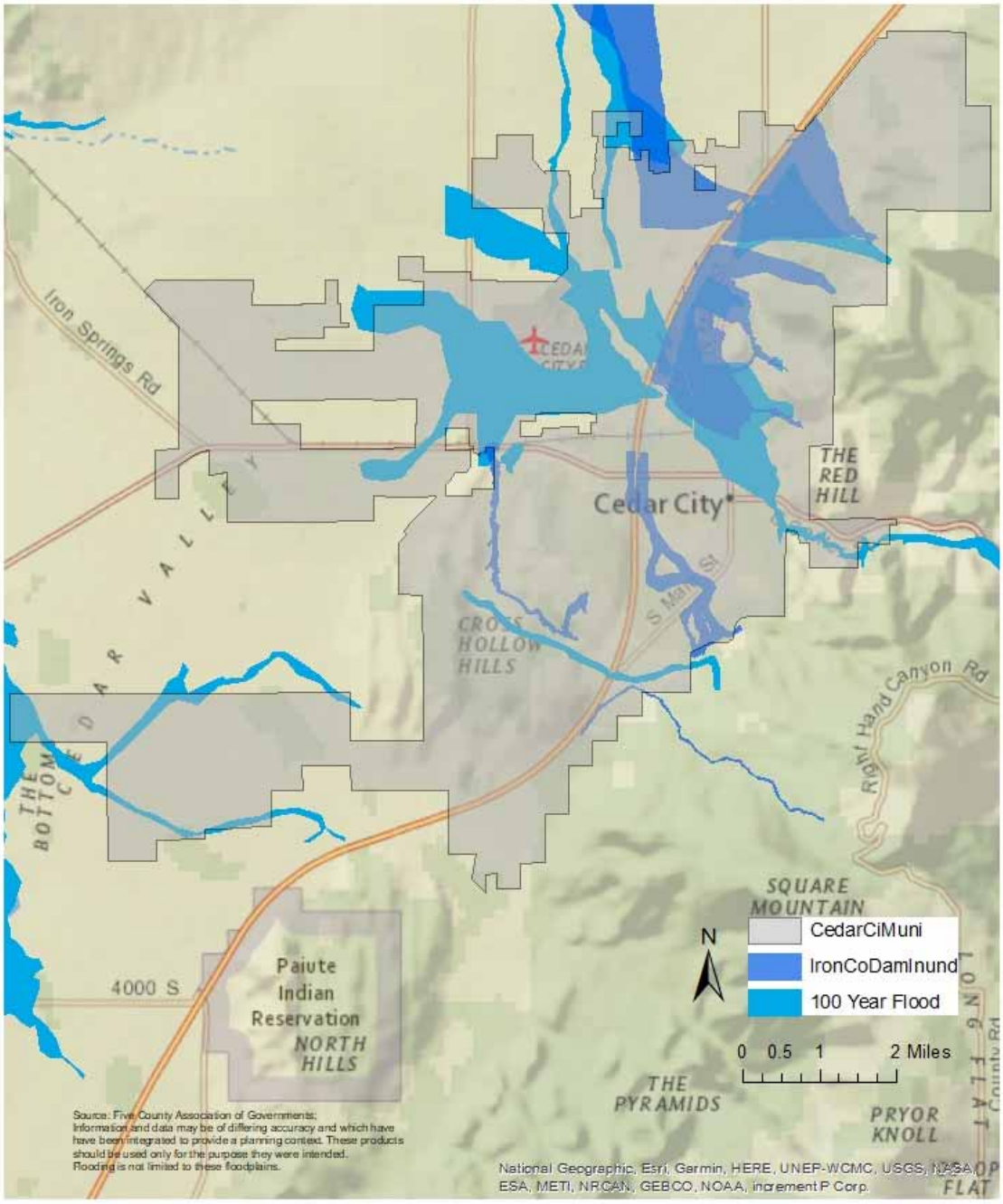


Figure 183: Cedar City Floodplains and Dam Inundation Zone

Source: Floodplain Map, AGRC.

The share of community assets that fall in a mapped floodplain or dam inundation zone is notable in the Cedar City area, as described in Table 203. Thirty-five percent of residential and commercial parcels, 45% of road miles, and 38% of rail miles lie in dam inundation or floodplain zones. Critical facilities in these areas include seven healthcare facilities, one law enforcement building, two federal agency offices, and seven schools.

Table 203: Cedar City Exposure to Flooding and Dam Inundation

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
49.2%	34.2%	35.6%	45.1%	38.9%	55.6%	39.5%

Source: Floodplain Map, Iron County Assessor, UDOT, AGRC.

National Flood Insurance Program

The Cedar City community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding. Table 204 describes the NFIP participation and claims paid in Cedar City. Of the hundreds of residential and commercial properties in Cedar City, there are 34 flood insurance policies in the community.

Table 204: Cedar City NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$17,527	0	7	34	$9,797,600	5	$31,957

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Flood Insurance Rate Maps were developed for Cedar City in 1984 and had CAC in 9/25/2019 and CAV in 8/2/2016. Cedar City participates in the Community Rating System. The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

It is likely that flooding events will continue to impact Cedar City with seasonal severe storms. This area receives monsoon rains in the late summer and fall, which bring a rapid and heavy rainfall. Such rapid rainfall can quickly result in a flooding event, damaging structures, overwhelming existing infrastructure, and moving debris throughout the city. Table 205 describes the documented flooding events in Cedar City that have caused damages or injury. Flooding events frequently cause traffic delays in and near Cedar City, along the Interstate 15 and State Road 14, although damages are not often attributed to these delays.

Table 205: Cedar City Flood Event History

Date	Damages or Injury	Description
6/23/2000	$55,000	A thunderstorm caused flooding in Cedar City which led to 4 feet deep flood waters, inundated drainage systems, basement flooding, subdivision evacuations, and vehicles being swept away among the damages.
8/9/2001	$50,000	Flooding caused accidents on the North freeway interchange as the road was submerged. The Fiddler's Canyon Subdivision also saw flooding of roads and basement.

10/21/2004	$400,000	Heavy rains flooded some homes in the Cedar Meadows Subdivision and some mountain roads east of Cedar City were impassible from heavy snowfall. Water flowing on Coal Creek flooded Cedar City homes as the Creek water was not able to flow under a bridge due to debris.
8/17/2012	$1,500,000 between Enoch and Cedar City	A thunderstorm created flash flood conditions in Cedar City and Enoch. Cedar City saw mostly street flooding.
7/27/2013	$400,000 between Enoch and Cedar City	A thunderstorm inundated Cedar City and Enoch causing flash flooding across both communities. In Cedar City 30-40 homes and a church flooded and a roof collapsed on a commercial building.
8/18/2021	$200,000	A severe thunderstorm caused widespread flooding across Iron County, inundating Coal Creek and resulting in basement flooding and other impacts.

Source: NOAA Storm Event Database, 2021

This history indicates that residential and commercial structures have been impacted by flooding events. There are also infrastructure concerns as roadways, drainage systems, and bridges have not accommodated flood waters during certain events. Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events will become less frequent but may increase in magnitude, which will influence flooding locally.

This assessment indicates that Cedar City has a high risk of flooding. Floods occur frequently and events align with seasonal storms. Flooding impacts often only affecting a portion of the community during an event, although events have been reported across the community since 2000.

Landslide

Landslide hazards include the shifting, falling, or flowing of rocks, soil, and debris along a slope or cliff. Cedar City hillsides and slopes lay to the east of the city, at the base of the mountains, and to the southwest, in an area called Cross Hollow Hills. Few areas in the community have high susceptibility to landslides, and this high susceptibility areas are in the mountainous areas to the east of the city, as seen in Figure 184.

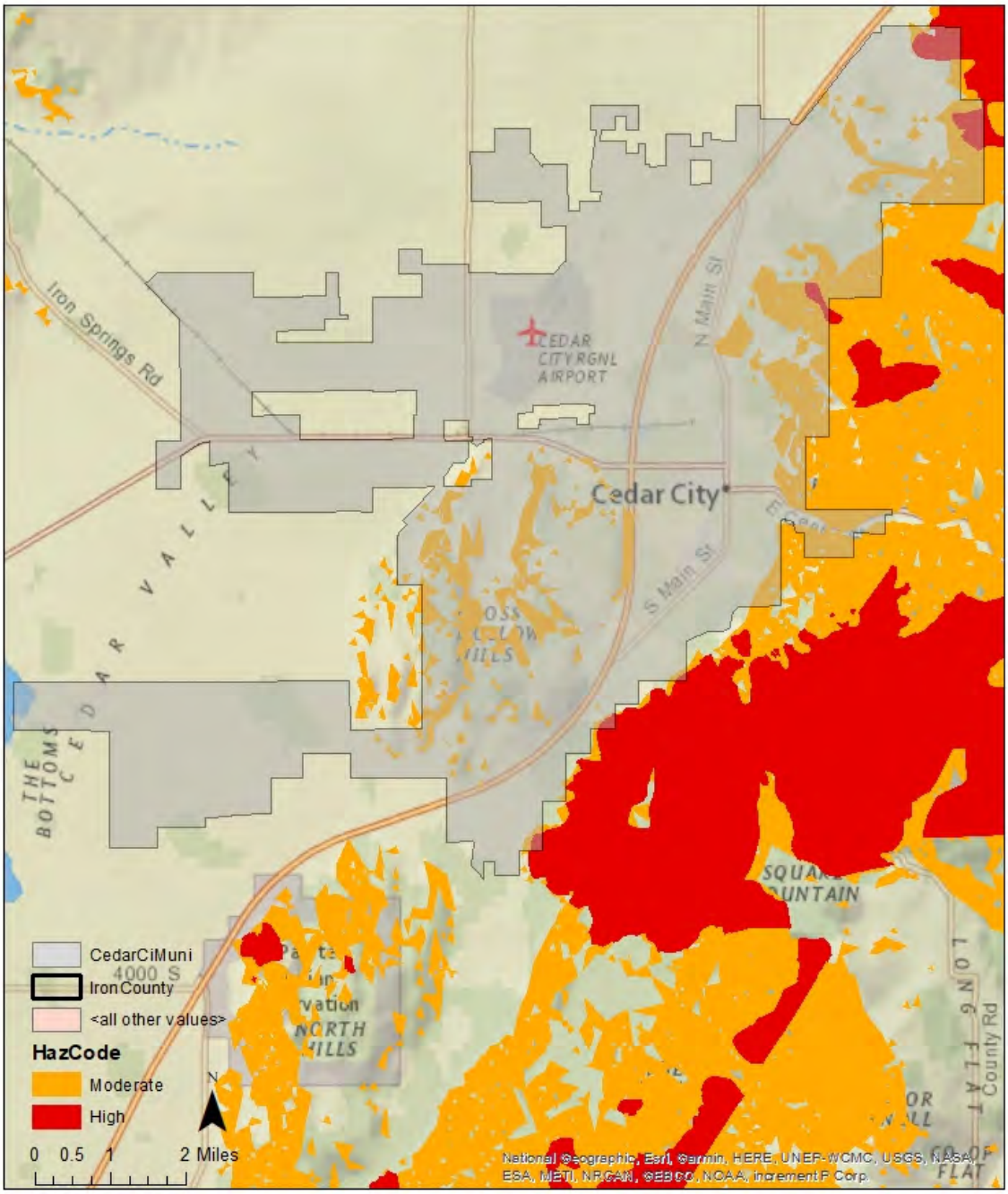


Figure 184: Cedar City Landslide Susceptibility

Presently there is relatively low exposure to landslide hazards that would impact Cedar City, however future growth into the Cross Hollow Hills or up the mountain foothills could increase the exposure to landslide hazards. Table 206describes the current exposure to landslide susceptible areas of several community assets. Local Parks and road miles are most exposed to landslide susceptible areas. Landslides on roads can cause traffic delays and damage to infrastructure. A small portion of the residential parcels in the community are exposed to mapped landslide susceptible areas.

Table 206: Cedar City Landslide Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
0.9%	3.4%	3.2%	10.8%	0.0%	11.1%	0.0%

Source: Utah Geological Survey,

Hazard History

Landslides have not been documented inside the city boundaries in recent years, although several events near Cedar City have impacted the city. Table 207 describes the nearby events and their impacts. Several of the landslide events have occurred in Cedar Canyon and blocked or damaged SR-14, creating traffic delays between communities, recreation resources, and other assets in the canyon from Cedar City.

Table 207: Cedar City Landslide Hazard History

Incident Date	Location	Description
1961	Cedar City	Debris flow at the Red Hill, near Cedar City.
1989	Iron County	Landslide in Cedar Canyon destroyed a portion of SR-14. The landslide also damaged the sealed entrance to a closed mine and an old power line was damaged.
2005	Iron County	A Debris flow on Black Mountain created a log jam, blocking Coal Creek. The flow damaged SR-14 and caused flooding and erosion.
2011	Iron County	SR-14 was buried and damaged by a large landslide in Cedar Canyon. It took months for the road to reopen after the slide.

Source: Utah Geological and Mineral Survey "Technical Reports For 1989-1990 Applied Geology Program" 1990, Utah Geological Survey "Technical Reports for 2002-2009 Geologic Hazards Program" 2010, Utah Geological Survey "Another large landslide closes highway near Cedar City, Utah" 2012, Deseret News "Massive landslide closes road east of Cedar City" 2011.

Cedar City landslide risk is low given the exposure and the recorded frequency of the hazards inside the city boundaries. Landslide events near the City are probable in future, especially as we consider the likelihood for wildfire, drought, earthquake, and severe weather in the area which can contribute to landslide, rockfall, and debris flow events. Growth and development in Cedar City may place new development in areas of greater risk, which could increase the vulnerability to landslide hazards.

Drought

Droughts have impacted the entire Five County region, including Cedar City. The Hazard Identification section describes risks from drought and potential impacts. In Cedar City, there is a risk to groundwater resources, agricultural lands, and increasing risk of other natural hazards from drought events.

Cedar City relies on groundwater as the primary water source. While surface water sees losses due to evaporation, groundwater may see lessened recharge of sources as water at the surface evaporates before it can be absorbed into the ground. Lessened water supply can increase the potential for poor water quality, which will be a concern moving forward.

Cedar City has agricultural resources are in and near the city, which may be impacted during drought conditions. Agricultural sectors can be one of the first to see impacts from drought conditions, as dry conditions damage crops and livestock. These impacts can lead to economic challenges in other sectors of the community and region. According to the water conservation plan, agricultural sectors tend to

Another industry with emerging research about the impacts of drought is outdoor recreation and tourism. Accommodation and food service are one of the larger industries by number of jobs in Cedar City and given the large number of events throughout the year in the community, and access to outdoor recreation including Brian Head, Cedar Breaks, and Zion and Bryce Canyon National Parks.

Drought conditions also can increase the risk from other Natural Hazards, which is something to consider as the community grows. The community has identified wildfire as a risk to the community in the Community Wildfire Protection Plan. Dry conditions can increase risks from wildfire events and landslide risks may also increase as dry, dead vegetation or recently burned areas may not be able to support soil on slopes, especially when precipitation of runoff interacts with the area.

Severe Weather

Severe Weather events experienced in Cedar City includes winter, snow, and rainstorms, hail, wind, lightning, and extreme temperatures. Looking to regional weather reports from NOAA, an estimated $1.1 million in losses and 21 injuries have been reported because of severe weather events. Locally described impacts from severe weather events include damage to roofs, buildings, and trees and street flooding following natural hazard events. These impacts cost money to the city, county, state, and residents, but they also can cause local disruption to utilities, economies, and transportation.

Table 208 describes the severe weather events that have impacted Cedar City. It is likely that events reported for nearby Enoch also impacted Cedar City. Please refer to the Enoch City section of the plan for a description of the hazards that have impacted the Enoch area.

Table 208: Cedar City Severe Weather History

Date	Damages/Injury	Description
7/26/1996	$50,000	Six-tenths of an inch of rain fell in Cedar City in a span of 35 minutes. Flooding from the storm washed mud and rocks on SR-14, which had to be closed for 2 hours.
4/12/1997	$10,000	Cedar City received 8 inches of snow during a storm. Traffic accidents were attributed to the snowfall.
10/16/1998	$100,000	Between 9 and 10 inches of snow fell in Cedar City causing tree damage and power outages
3/21/2011	$5,000	70 MPH winds recorded at the Cedar City ASOS. The winds damaged a building roof.
10/28/2013	$35,000	Strong winds reported with peak gust recorded at 71 MPH. The winds downed 10 trees on the Southern Utah University campus, damaging a building.
5/11/2014	$100,000	Cedar city reported a foot of snow. The storm damaged trees and limbs. The I-15 corridor was heavily impacted and power outages were reported across the region.
4/14/2015	$10,000	High winds reported across south central Utah with a gust recorded at the Cedar City Airport at 61 MPH.
2/17/2016	$15,000	Strong winds blew for hours with a peak gust of 70 MPH. Trees were knocked down on SR-14 and one fell on the Southern Utah University campus onto a building.
3/5/2017	$80,000/ 10 injuries reported across the region.	A cold front brought high winds to the Southwest, impacting several communities, including Enoch, Cedar City, and Filmore with tree and fence damage.

Source: NOAA Storm Event Database, 2021.

Snow and wind events historically cause damages to structures and infrastructure. Two wind events only three years apart caused damages to trees and structures on the Southern Utah University campus. Challenges also are often reported along SR-14, which is not specifically in the Cedar City limits, but causes connectivity challenges to access other communities via Cedar Canyon.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Cedar City from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. Flooding and severe weather events are often related in the area. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Severe weather events are expected to worsen in severity with climate change, increasing risk of damages, injury, and potential for triggering other events.

Severe weather events are considered a moderate risk to Cedar City. The hazard is frequent, although the severity tends to be low to moderate, generally causing minimal damages. While the weather event is often experienced across the City, damages or injury are often limited to a portion of the community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 175. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the

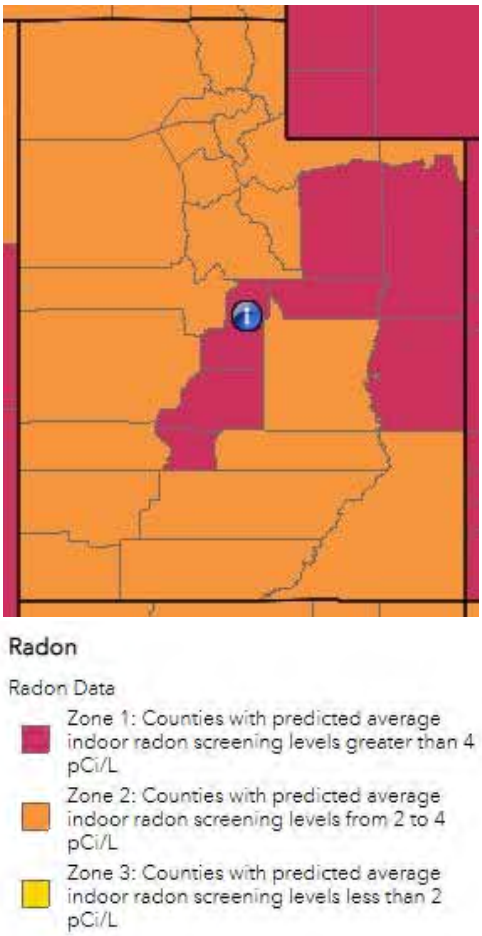


Figure 185: Estimated Indoor Radon Level Zones-Utah

public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 209 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 209: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are often reactive to soil moisture, expanding or collapsing as the soil dries or is wetted. Such actions can cause damage to existing infrastructure and structures on the surface of these problem soils. In Cedar City, collapsible soils and rock are prevalent in the mountains southeast of the community, illustrated by Figure 186. The only problem soils documented by the data is in the city boundaries are along SR-14. Some areas in the Five County region have mapped problem soils in greater detail, but this is not available for Cedar City at this time.

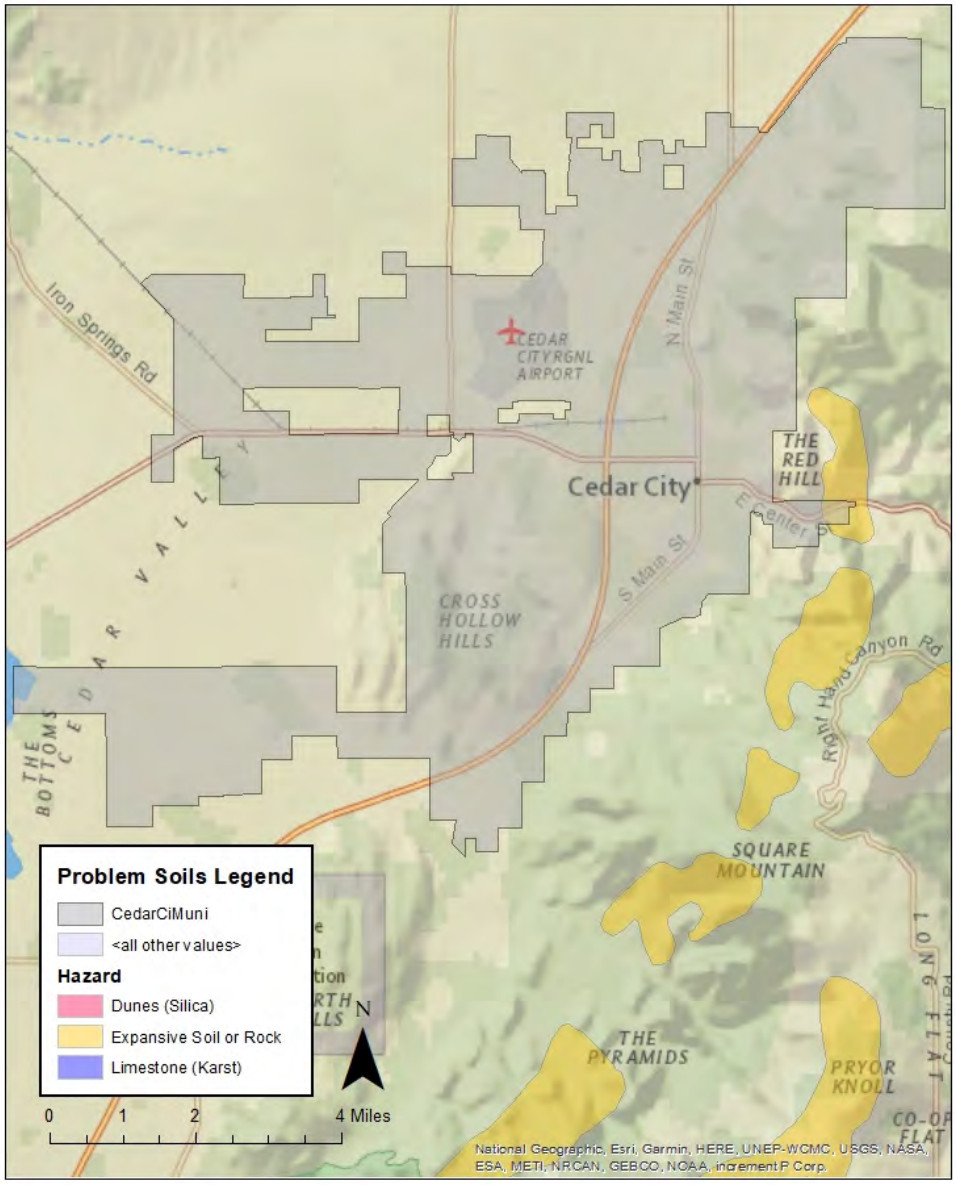


Figure 186: Cedar City Problem Soil Exposure

Source: UGS, 2020.

As observed in Figure 186 and Table 210, very little of Cedar City's assets interact with mapped problem soil areas. Road miles and commercial parcels along SR-14 are exposed to the identified expansive soil or rock, a fraction of a percent of total miles or commercial parcels.

Table 210: Cedar City Problem Soils Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%

Source: UGS, Iron County Assessor, UDOT, AGRC, 2020.

Earth Fissures

Nearby Enoch City has issues with earth fissures due to groundwater use. The Utah Geological survey has demonstrated that there are fissures throughout the Cedar Valley and that the valley has been sinking due to soil composition and groundwater use. While ground fissures have not been recorded in Cedar City, several areas around the City have been impacted, resulting in damages to infrastructure, structures, and causing concern about water quality. (Land Subsidence and Earth Fissures in Cedar Valley, 2011)

Summary

Cedar City is at risk to Wildfire, Earthquake, Flood, landslide, drought, severe weather, radon, and problem soils as demonstrated by this section. Multiple vulnerabilities were identified along SR-14 and Coal Creek to several hazards. Further increasing risk described by ongoing hazard conditions like drought pose challenges to future wildfire, landslide, and flooding events. Addressing these vulnerabilities and risks will be described further in the Mitigation Strategy section.

Mitigation Strategies

To address the risks and vulnerabilities identified in this section, Cedar City has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

The 2016 iteration of the Natural Hazard Plan set two mitigation actions for the Community. A summary of the progress on these items is described in Table 211.

Table 211: Cedar City 2016 Mitigation Strategy Progress

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Prevent Fiddlers Canyon flood waters from damaging homes and agricultural land.	Construct a channel from the west side of I-15 to the north route of the Coal Creek flood channel	5 years	Local government operating budget, state and federal flood programs	Unknown, not needed.
Flood #2	Protect homes, businesses, and city infrastructure that is adjacent to Coal Creek	Construct berms, levees, and other channel improvements that will contain the 100-year flood within the channel. (Phase 3)	3-5 years	Cedar City operating budget, federal grant program	Completed

The Cedar City planning team identified actions to include in the community mitigation strategy. Each action in Table 212 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 187.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 187: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Cedar City has assembled several actions, addressing each of the natural hazards that the community is at risk to.

Table 212: Cedar City 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi Hazard #1	2, 4	Reduce impacts on utility infrastructure.	Develop and harden electrical grid to prevent outages due to natural hazards, solar storms, or manmade disruptions to electrical utility services.	M	Ongoing	M	Cedar City	Cedar City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	1, 2, 4, 6	Reduce wildfire risk from fuels in wildland interface areas.	Implement fuels management actions identified in CWPP 2020. - Fuels reduction at Cody Drive, Thunderbird Gardens, and Private Properties in the WUI. - Summit Mountain, Ashdown Forest, and Square Top	H	Ongoing	L	Cedar City, Fire Departme nt, DNR	Cedar City, Fire Department , DNR
Wildfire #2	2	Reduce wildfire risk to public facilities	Assess city buildings and critical facilities in wildfire risk areas to standards identified in the Wildland Urban Interface Code adopted by the City.	L	Ongoing	L	Cedar City, Fire Departme nt,	Cedar City, Fire Department ,
Severe Weather #1	3	Provide public information about energy efficiency and impacts from extreme temperatures.	Educate residents and property owners about insulating pipes and attics to protect against extreme temperatures.	H	Ongoing, annually.	L	Cedar City	Cedar City
Severe Weather #2	5	Secure critical facilities with generators in the event of electrical disruptions, to ensure that services can be offered to residents.	Assess Cedar City Police Department for back-up power needs.	M	5-years	M	Cedar City	Cedar City, Police department
Flood #1	2	Use planning and data collection to inform mitigation	Update Stormwater Master Plan.	M	5-years	M	Cedar City	Cedar City
Flood #2	3	Inform residents about NFIP.	Encouraging property owners to purchase flood insurance. To be distributed in utility billings.	L	Ongoing, annually	L	Cedar City	Cedar City
Landslide #1	6	Address exposed or	Stabilize soil by planting vegetation	M	Ongoing	M	Cedar City	Cedar City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		vulnerable steep slopes in the city.	on steep, publicly owned slopes					
Earthquake #1	2	Identify and harden structures vulnerable to earthquakes.	Inventory public and commercial buildings constructed pre-1970 or using unreinforced masonry for seismic safety.	L	Ongoing	M	Preservati on Utah, State and Federal Tax Credit, Cedar City	Cedar city
Earthquake #2	2	Identify and harden structures vulnerable to earthquakes.	Strengthening and retrofitting city owned non-reinforced masonry buildings and non-ductile concrete facilities that are vulnerable to ground shaking.	M	Ongoing	M	Preservati on Utah, State and Federal Tax Credit, Cedar City	Cedar city
Earthquake #3	2	Reduce hazards from large furniture and equipment in public facilities.	Implement nonstructural retrofitting techniques in city structures to prevent damage or injury during a shaking event.	H	Ongoing	L	Cedar City	Cedar City
Earthquake #4	2	Identify and harden critical water infrastructure vulnerable to earthquakes	Assess water infrastructure and consider installing shutoff valves and emergency connector hoses where water mains cross fault lines.	M	Ongoing	M	CIB, CDBG	Cedar City
Radon #1	3	Inform residents of radon risks and mitigation	Provide public education to residents and property owners of radon risks in Utah and provide information for testing options.	H	Ongoing	L	Cedar City	Cedar City, Partner Utah DEQ.
Problem Soils #1	1, 2	Reduce earth fissures impact on structures and infrastructure.	Monitor areas at risk to earth fissures by observing changes in groundwater levels.	H	Ongoing	L	Cedar City, CICWD.	Cedar City, CICWD.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Problem Soils #2	1, 2	Assess current development standards and identify potential additional ordinances.	Adopt a Geologic Hazard ordinance.	M	5-years	L	Cedar City	Cedar City
Drought #1	2	Protect the groundwater aquifer	Work with CICWD to study and mitigate issues from overuse of groundwater aquifers, especially in times of drought when recharge of these resources may be lessened.	H	Ongoing	M	Cedar City, CICWD.	Cedar City, CICWD.
Drought #2	2	Conserve water used at public facilities	Incorporate drought tolerant landscaping at Cedar City owned buildings.	H	Ongoing	M	Cedar City	Cedar City
Drought #3	2	Develop and improve water sources and infrastructure.	Build new water storage tank and develop new culinary well.	M	5-10 Years	H	CIB, CDBG, Cedar City	Cedar City, CICWD
Drought #4	2	Improve and collect data to inform mitigation actions.	Update Culinary Water Master Plan.	M	5-years	M	Cedar City, CIB, CDBG	Cedar City

Source: Local Planning Team

Enoch

Located seven miles north of Cedar City, Enoch City is bounded by Interstate-15 on the south and east side of the community. The City is approximately 7.8 square miles within the Cedar Valley of Iron County, with the Hurricane Cliffs on the east side of the valley. Access to nearby outdoor recreation is a short drive to access Brian Head, Cedar Breaks National Monument, and other regional recreation destinations.

The community has a pioneer history, dating to Mexican travel from Los Angeles to Santa Fe on the Spanish Trail. The Old Spanish National Historic Trail runs through Enoch and has a monument noting the historic site in the community. Pioneer settlement in the community began in 1851 with the construction of Johnson's Fort being constructed in 1854. The community incorporated in 1966.

Demographics

As of the 2018 American Community Survey, Enoch has a population of 6,534 people. Comparing to previous documented census', Enoch's population has rapidly grown since 1970. Each decade, the population has grown by 40% or more, peaking with 82% growth from 1970 to 1980. Figure 188 illustrates the change in population in Parowan. The 2020 census was not available to include at the time of this writing.

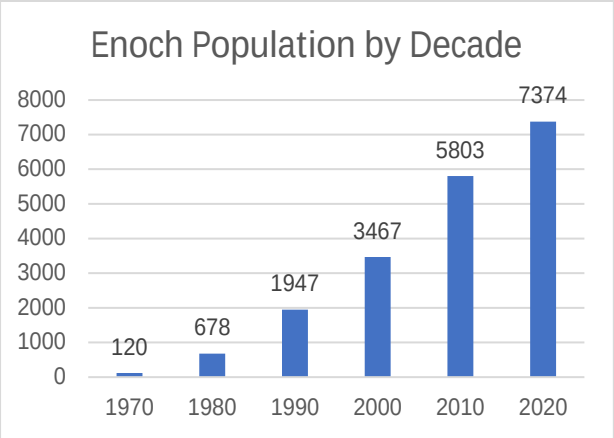


Figure 188: Enoch Population by Decade

Source: US Census Bureau, 2020, Table P1

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Parowan, the community could see around 10,995 people living in the community by 2065[9].

Economy

According to the US Census Bureau on the Map tool, there are 304 private primary jobs in Enoch City[10]. These jobs are described by industry in Figure 189. Construction jobs occupy a large share of jobs in Enoch City, which may relate to the significant growth the community has seen each decade. The remainder of jobs include a mix of trade, accommodation, mining, transportation, and real estate. Based on the number of jobs and population in Enoch, a share of the community's working population likely commutes to neighboring communities for work.

[9] This estimate is created using the 2015 ACS population estimate for Enoch, which was 6,075, and adding 81% of this population estimate to the population for that year.

[10] Private primary jobs are defined as jobs in the private sector which are the highest paying job for an individual.

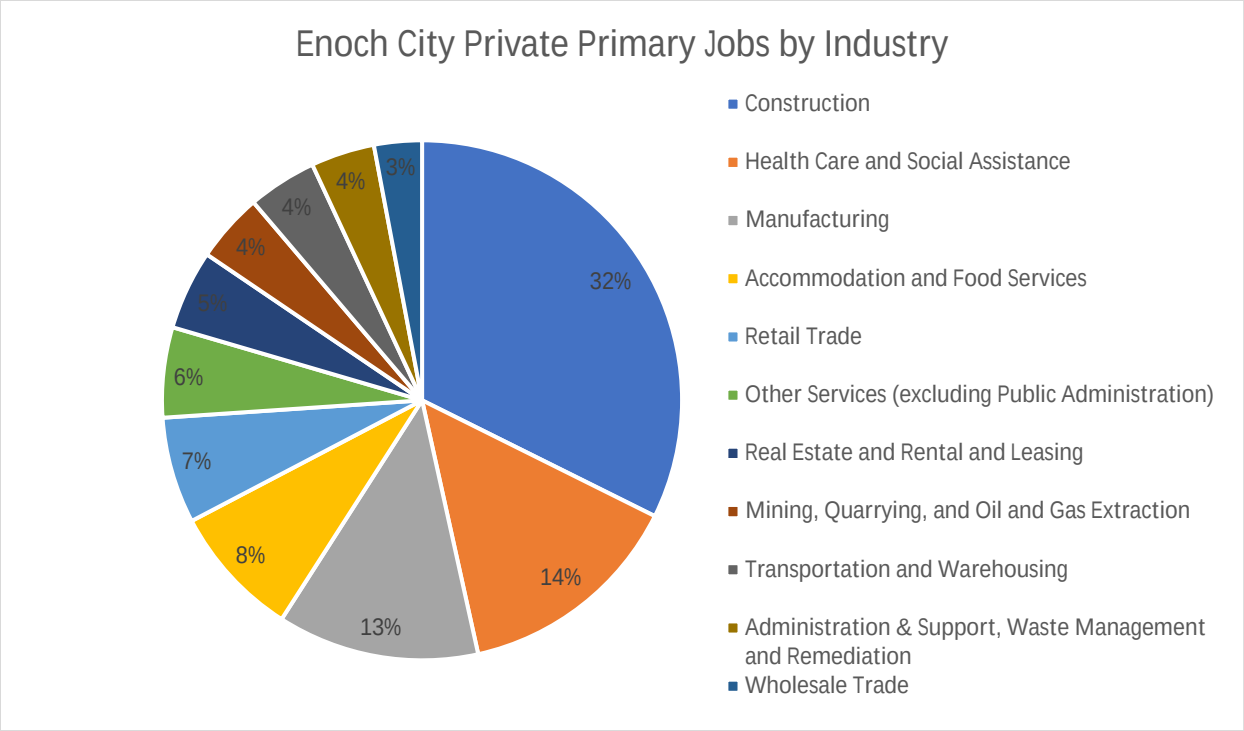


Figure 189: Enoch Jobs by Industry

Source: US Census Bureau, On the Map, 2021.

Development

As described in the demographics section of this chapter, Enoch City experienced a boom in population between the 2000 and 2010 census. The growth in population translated to growth in infrastructure and the built environment locally.

Enoch City adopted an annexation procedure 2007, which sets regulations for annexation and maps an area near the existing municipal boundaries where annexations will be allowed, demonstrated in Figure 190. The annexation map was updated last in September of 2009, according to the city website.

Enoch City has been experiencing growth in three key areas of the community, in the northeast, south central, and the northwest areas of the communities. The Northwest area is north of 5600 North in Figure 190 and is primarily industrial and commercial development. The other two areas are primarily

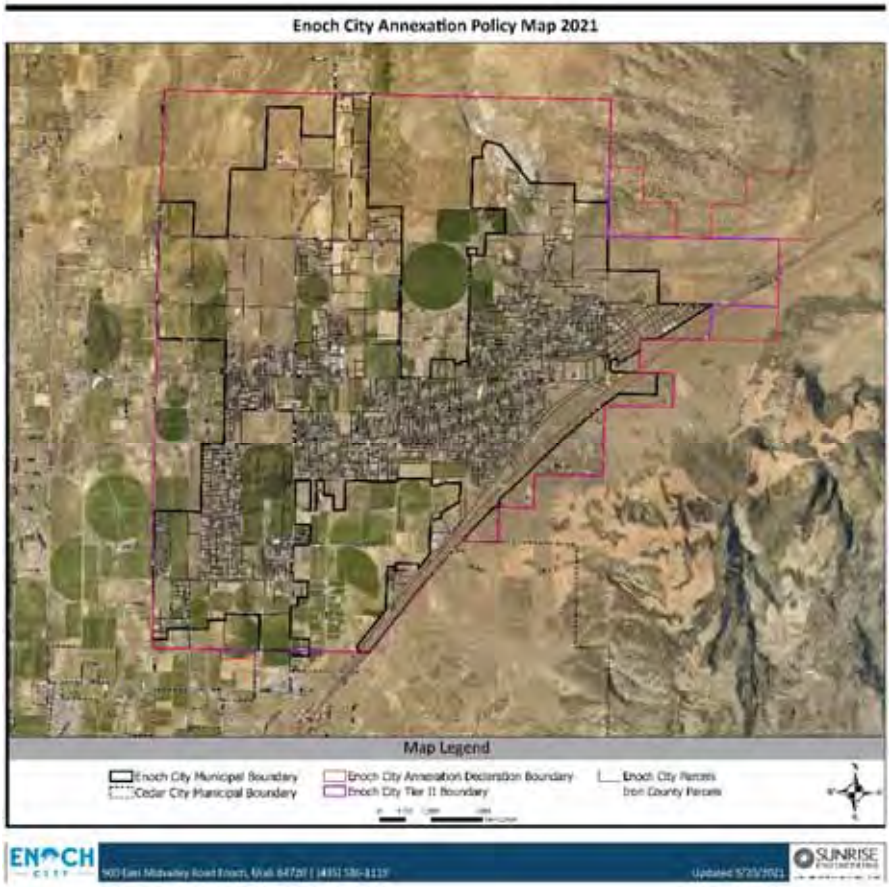


Figure 190:Enoch Annexation Boundary Map

Source: City of Enoch

residential development. Residential development in the southcentral portion of the community is in an area formerly used for agriculture.

Community Capabilities

Enoch City has a City Manager, Council, Planning Commission, Police Department, Building Inspector, planning staff, Emergency Management, Water Board, Recreation Committee, and Economic Development departments, which can plan for, enforce policy, and complete projects to reduce natural hazard impacts. The City has an intergovernmental agreement with Cedar City Fire Department which provide response to fire and other emergency response.

Nine city parks serve residents with outdoor recreation opportunities. The City has a recreation center which serves as a community gathering place for residents.

Enoch City supports water utilities in the community. Wells, utilities, and pumping of these water resources require electrical power to operate. Several of the community's utilities are provided by private companies.

- Telephone - Century Link
- Electrical- Rocky Mountain Power
- Gas- Dominion Energy

Plans and Policies

In 2020 Enoch City adopted a Natural Hazard Ordinance which focuses on appropriate development, need for mitigation in geological hazard areas, including: subsidence, landslide, rockfall, debris flow, flash flooding, and subsidence. To better protect the community from wildfire hazards, Enoch City is adopting a Wildland Urban Interface Ordinance in agreement with their contracted fire department, Cedar City Fire Department.

In addition to this ordinance, the City has added layers to their municipal zoning map that show the relative risk posed by several hazards, based on analysis from the Utah Geological Survey. The mapping tool is publicly accessible and can show residents their relative risk or exposure to the studied natural hazards.

Community Wildfire Protection Plan

The Cedar City Fire Department has worked with Enoch City to develop a Community Wildfire Protection Plan, which was adopted in 2020. This plan identifies a timeline for actions to support response, prevention, public information, and mitigation of wildfires in these two cities. This plan identifies preparedness, mitigation, and response activities that the Cedar City Fire Department, Cedar City, and Enoch will take in the coming years to address wildfire risks. Mitigation actions include fuels reduction in certain areas around the community.

Groundwater Management Plan

The City has developed a groundwater management plan to further protect and support the water supply to residents of Enoch City. While Enoch City does not have significant surface water in the municipal boundaries, ensuring protection and adequate recharge of the groundwater will support the community as it continues to grow and is faced with drought hazards.

Stormwater Impact Fee Facilities Plan and Impact Fee Analysis

In 2017, Enoch City adopted a Stormwater Impact Fee Facilities Plan and Impact Fee Analysis. This plan establishes improvements for both a short- and long-term planning horizon to the stormwater system. Several long-term recommendations include constructing new detention basins and drainage paths to direct stormwater flows to culverts and other stormwater systems.

Risk Assessment

Enoch City experiences and is at risk to the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause impacts. Other significant events include drought and flash flooding because of severe weather events.

Five County has worked with Enoch to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. In assessing exposure in the community, Five County's assessment includes evaluating the percentage of road miles, parcels, parks, and critical facilities that are in mapped risk areas in the community. Critical facilities include schools, hospitals or medical clinics, fire stations, and police and sheriff's departments. Table 213 displays the relative risks of hazards in Enoch.

Table 213: Enoch Hazard Risks

Hazard	*Risk*
Drought	1) High
Earthquake	2) High
Flood	3) High

Severe Weather	4) Moderate
Wildfire	5) Moderate
Landslide	6) Low
Problem Soils	7) Low
Radon	8) Low

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

The Cedar City/Enoch Wildfire Preparedness Plan (CWPP) lists one high priority mitigation item for Enoch City, to conduct fuels work on Enoch owned properties, engage in coordination with various government organizations to address Summit Mountain fuels, and engage in fuels treatment on Enoch Municipal properties. The Wildfire Risk Assessment that accompanies the plan indicates that watersheds are unlikely to be impacted by a fire event.

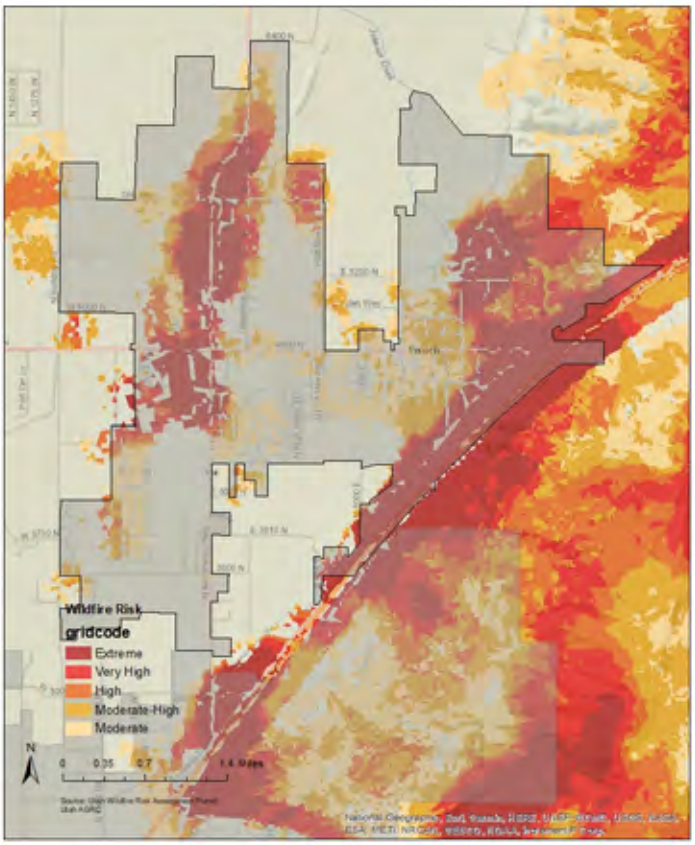


Figure 191: Enoch Wildfire Risk

Source: Oregon Department of Forestry.

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. Figure 191 illustrates the mapped wildfire risk areas in and surrounding Enoch City. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories. This map shows the relative wildfire risk is in the community, along the southeast side, near Interstate-15. As a major thoroughfare that connects Enoch to the rest of the state and provides goods to the area, a losses or delays on I-15 can isolate and create damaging situations in Enoch City. In the municipal boundaries, risks may also be observed in the northwest section of the city.

The Five County Assessment includes an analysis of the people, infrastructure, assets, and critical facilities that may be at risk to a natural hazard. Table 214 reflects the percentage of the community assets that are exposed to wildfire hazards. It can be observed that more than 50% of residential and commercial parcels, and 80% of road miles are in a zone considered to have at least a moderate risk to wildfire. The identified critical facilities that are at risk to wildfire are a police department and an assisted living facility.

Table 214: Enoch Wildfire Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
64.0%	78.8%	78.6%	80.8%	N/A	44.4%	50.0%

Source: Iron County Assessor, 2020; UTWRAP, 2020; AGRC, 2020.

Hazard History

Enoch has not experienced wildfire hazards that have impacted the community, although nearby communities, including Kanarraville and New Harmony have had some documented instances of wildfire that have come near the communities. Wildfire is still a risk for Enoch City, especially as drought and dry conditions impact the area.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Brian Head, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Earthquakes have long been a known risk and challenge of living in Utah. Several active faults in the southwest have caused historic earthquakes, shaking, and other impacts. While earthquake epicenters can occur in areas that do not have mapped quaternary faults, fault lines are likely to be the cause of significant shaking. Other fault hazards include the rising or dropping of land along the fault during an earthquake event. For the purposes of this assessment, a quarter-mile buffer has been applied to understand what assets may be most at risk in Enoch. This can be seen in Figure 192.

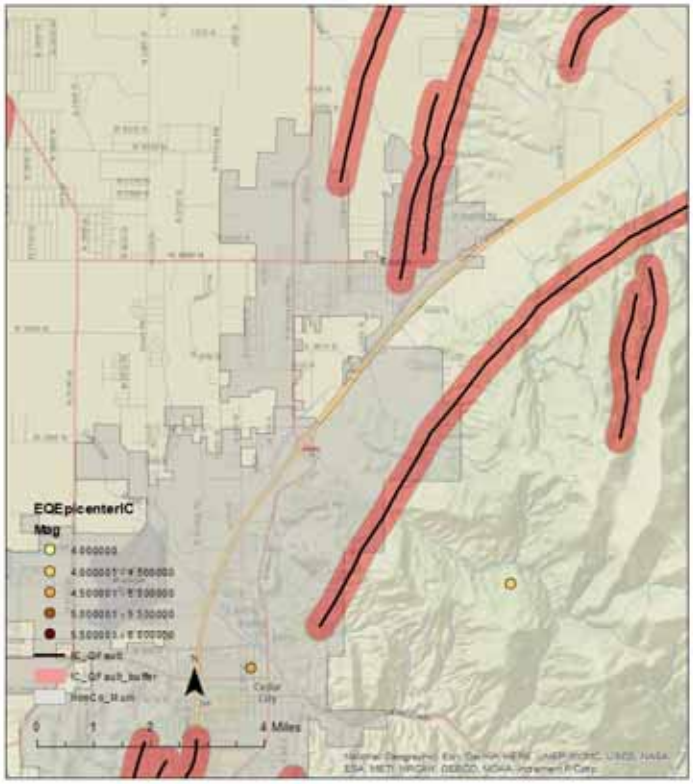


Figure 192: Enoch Earthquake Quaternary Faults and Epicenters

Source: Utah Geological Survey; University of Utah Seismology

Quaternary faults have been mapped in the eastern and northern areas of Enoch. Property, critical facilities, parks, and roadways have been compared to the identified fault lines to better understand what potential impacts from an earthquake may be. Table 215 describes the community assets within a quarter mile boundary to describe what earthquake impacts may be.

Table 215: Enoch Exposure to Earthquakes

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
4.0%	25.5%	25.3%	19.4%	N/A	44.4%	50.0%

Source: Utah Geological Survey, University of Utah Seismology, Iron County Assessor, UDOT, AGRC

Southwestern Utah has a history of pioneer settlement, and many communities seek to preserve historical buildings and structures. These structures, typically unreinforced masonry, are at greater risk to earthquake hazards. Iron County has limited data describing the construction date of structures on parcels, but knowing the history of the area, Enoch may have historic structures that could be at heightened risk to earthquakes. Further local assessment is necessary to understand the structural challenges that may exist in a seismic event.

Liquefaction

Enoch has worked with the Utah Geological Survey to map the areas of the community that are at heightened risk to liquefaction, one of the secondary hazards that can result from ground shaking. The map indicates that Enoch has a low risk of liquefaction throughout most of the community, excluding the northeast and western portion of the city, which range from moderate to very high.

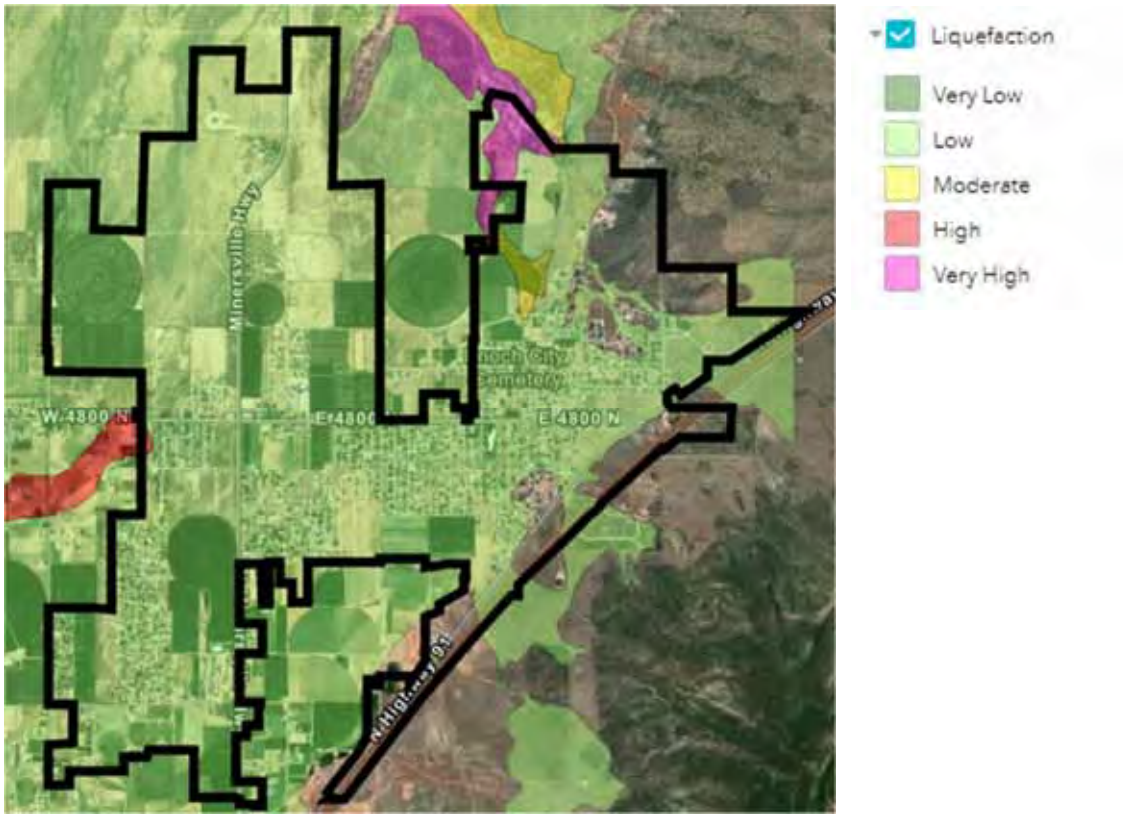


Figure 193: Enoch Liquefaction Risk

Hazard History

There have been no reported epicenters of earthquakes located in Enoch, although epicenters have been reported in neighboring Cedar City and in the unincorporated County. Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Enoch City has no major lakes, streams, or rivers in its boundaries. Figure 194 illustrates the areas where the mapped floodplain and dam inundation zones interact with the community. Enoch does not have Flood Insurance Rate Maps (FIRMS) mapped for the Cite. Mapped exposure to floodplain and dam inundation zones can be observed to the north and south of the city, where Coal Creek crosses into the City. There are no parcels or critical facilities interact with the mapped floodplain or dam inundation zones.

Figure 194: Enoch Floodplains and Dam Inundation Zones

Source: FEMA, AGRC

Table 216 illustrates the community assets that are in the floodplain and dam inundation zone. Less than one percent of residential parcels and road miles in the community are within identified dam inundation and floodplain areas. Travel, transport of goods, property, and Enoch residents are vulnerable to flooding in these areas.

Table 216: Enoch Exposure to Flooding and Dam Inundation

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				

0.0%	0.1%	0.1%	0.8%	N/A	0.0%	0.0%

Source: FEMA, Iron County Assessor, UDOT, AGRC.

Despite the low exposure to mapped flood risk areas, Enoch's hazard history indicates that flooding can be prevalent throughout the community. Enoch has experienced several instances of flash and sheet flooding following severe storms since 2000, including some that caused significant damages in the community. Table 5 summarizes the reported flooding and flash flooding events that have impacted Enoch City.

Table 217: Enoch Flood Event History

Date	Damages or Injury	Description
8/13/2001	$0	Heavy rain produced minor flash flooding in Enoch with no damages or injury reported.
8/17/2012	$1,500,000 between Enoch and Cedar City	A thunderstorm created flash flood conditions in Cedar City and Enoch. There were 110 homes damaged by water entering basements, breaking windows, and damaging homes and vehicles in Enoch. Thirty homes reported damage exceeding $30,000.
7/27/2013	$400,000 between Enoch and Cedar City	A thunderstorm inundated Cedar City and Enoch causing flash flooding across both communities. In Enoch, two homes and a city facility were damaged by flood waters.
8/1/2021	$1.5 million damage	A severe storm caused flash flooding throughout the Cedar Valley. $1.5 million dollars of infrastructure damage was caused and 300 homes were damaged.

Source: NOAA Storm Event Database, 2021

It is likely that flooding events will continue to impact Enoch with seasonal several severe storms. This area receives monsoon rains in the late summer and fall, which bring a rapid and heavy rainfall. Such rapid rainfall can quickly result in a flooding event, damaging structures, overwhelming existing infrastructure, and moving debris throughout the City, which is described further in the Severe Weather hazard section. Enoch has acted to address flash flooding by increasing stormwater drainage infrastructure and using impact fees from new development to contribute to localized stormwater drainage basins near the development, in addition to improving the overall drainage infrastructure community wide.

National Flood Insurance Program

The Enoch community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Enoch developed a floodplain regulation and has participated with the NFIP since November 1, 2021, entering in the Emergency Program. The community has not had Flood Insurance Rate Maps developed as of this writing.

Landslide

Enoch City does not have significant slopes in the community there are few areas that are susceptible to landslides, as described in Figure 195. Areas considered moderate or high susceptibility to landslides are found in the northeast portion of the City boundaries. The bulk of landslide susceptible areas are on the south side of I-15, which separates the City from the Hurricane Cliffs. Future growth or annexation north or across I-15 could place Enoch in susceptible areas.

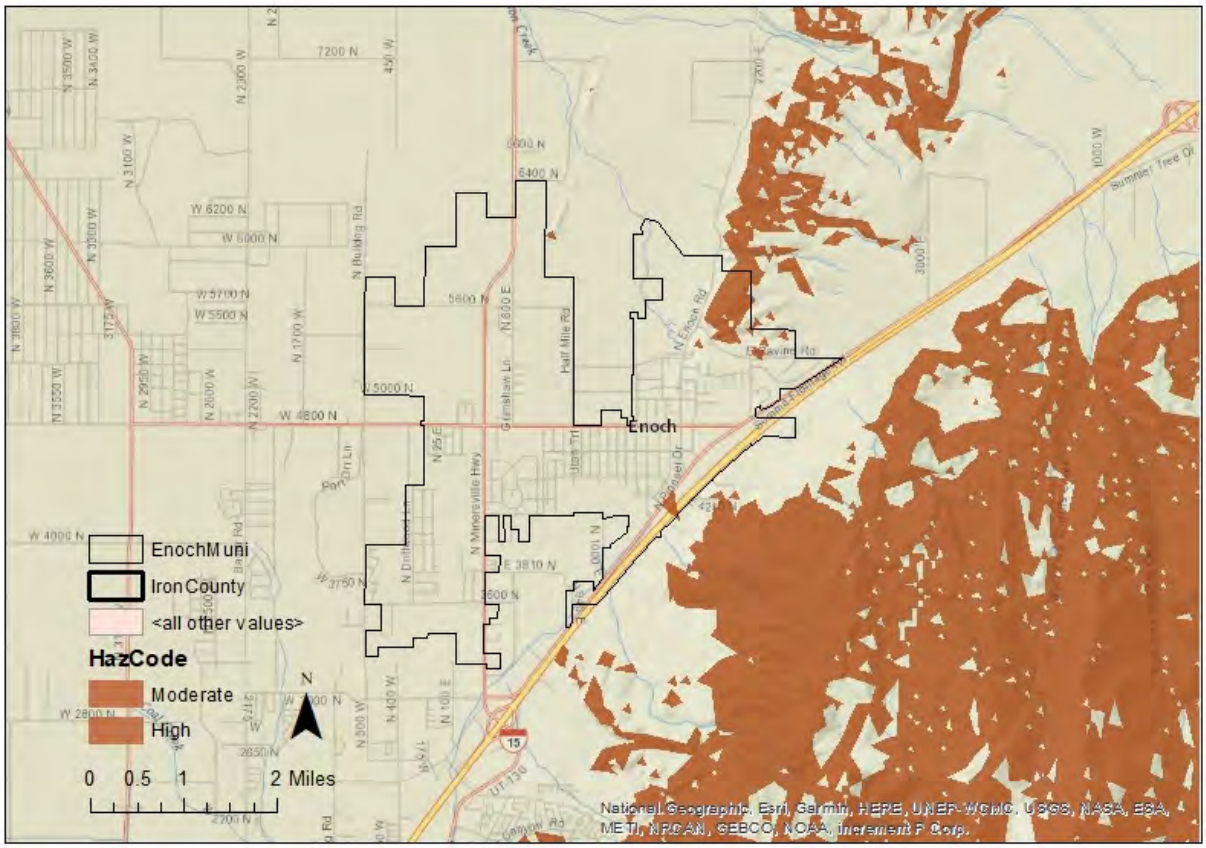


Figure 195: Enoch City Landslide Susceptibility

Source: Utah Geological Survey

Table 218 describes the community assets which fall in mapped moderate to high landslide susceptible areas. Road miles and critical facilities are at greatest exposure to landslide susceptible areas. Roadways can be covered with mud rocks and trees leading to traffic delays, injury, and damage. The cost to remove landslide debris and/or repair the road can be costly and lead to extended delays or closure of the roadway. Critical facilities impacted by a hazard event can impact a community's response and recovery.

Table 218: Enoch Landslide Exposure

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
0.0%	0.3%	0.3%	11.1%	N/A	0.0%	0.0%

Source: Iron County Assessor, Utah Geological Survey, UDOT, Enoch City Planning Team.

Hazard History

The only recorded landslide event in Enoch occurred in 1930. No other landslide events have been documented impacting the city.

Drought

Droughts have impacted the entire Five County region, including Enoch City. The Hazard Identification section describes risks from drought and potential impacts. In Enoch City, there is a risk to groundwater resources, agricultural lands, and increasing risk of other natural hazards from drought events.

Enoch City relies on groundwater as the primary water source. While surface water sees losses due to evaporation, groundwater may see lessened recharge of sources as water at the surface evaporates before it can be absorbed into the ground.

Enoch City's planning team described agricultural resources are in and near the city, which may be impacted during drought conditions. Agricultural sectors can be one of the first to see impacts from drought conditions, as dry conditions damage crops and livestock. These impacts can lead to economic challenges in other sectors of the community and region.

Drought conditions also can increase the risk from other Natural Hazards, which is something to consider as the community grows. The community has identified wildfire as a risk to the community in the Community Wildfire Protection Plan. Dry conditions can increase risks from wildfire events. Landslide risks may also increase as dry, dead vegetation or recently burned areas may not be able to support soil on slopes.

Severe Weather

Severe Weather events experienced in Enoch includes winter, snow, and rainstorms, hail, wind, lightning, and extreme temperatures. Looking to regional weather recordings from NOAA, an estimated $1.1 million in losses and 21 injuries have been reported because of severe weather events.

Locally described impacts from severe weather events include damage to roofs, buildings, and trees and street flooding following natural hazard events. These impacts cost money to the city, county, state, and residents, but they also can cause local disruption to utilities, economies, and transportation.

Solar Storms

An additional concern to Enoch City includes Solar Storms which can cause significant disruptions to the electric grid. Such disruptions can have consequences for critical facilities and infrastructure, impacting communication lines, and resulting in power outages and disruptions. The community utilities, wells, and water pumping apparatus are all electrical based and would be vulnerable during a Solar Storm. Solar Storms can be a naturally occurring phenomenon with energy surges from the Sun, or they can be a result of manmade efforts to disrupt a local electrical grid. For this reason, actions in the mitigation strategy addressing securing the electrical grid from this threat has been included as a severe weather action.

Hazard History

Table 219 describes the severe weather events that have impacted Enoch. It is likely that events reported for Cedar City also affected Enoch, but that there were not reported damages or description for Enoch. Please refer to the Cedar City section of the plan for further description.

Table 219: Enoch Severe Weather History

Date	Damages/Injury	Description
5/3/1999	$0	A severe thunderstorm produced ¾ inch hail in Enoch City.
3/5/2017	$80,000 10 injuries reported across the region.	A cold front brought damaging winds to the Southwest, impacting several communities, including Enoch, Cedar City, and Filmore with tree and fence damage.

Source: NOAA Storm Event Database, 2021.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Enoch City from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. Flooding and severe weather events are often related in the area. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Severe weather events may worsen in severity with changes in climate, increasing risk of damages, injury, and potential for triggering other events.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The EPA estimates that Iron County has an average indoor radon level between 2 and 4 Pic/L of air, as described in Figure 196. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Enoch City has received radon mapping from the Utah Geological Survey, available on their city zoning map, that shows areas of the city which may be subject to greater risk of radon, illustrated by Figure 197. This tool provides an estimate of the area's risk to radon based on subsurface composition. Enoch residents should still conduct short- or long-term tests to determine their individual home's indoor levels and consult with a radon mitigation specialist to understand results and mitigate if needed.

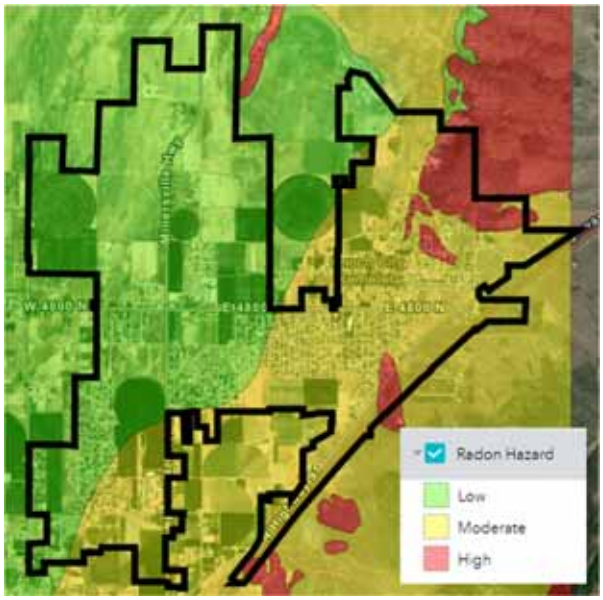


Figure 197: Enoch Radon Hazard Mapping

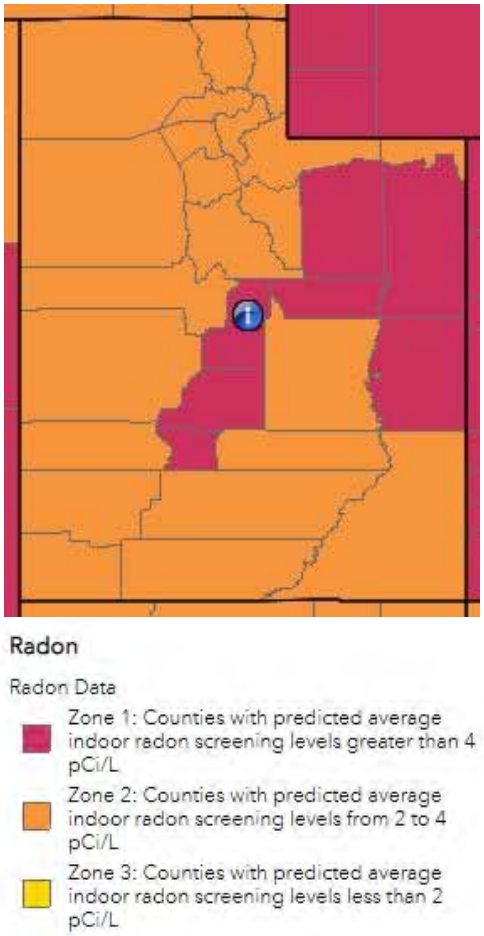


Figure 196: Estimated Indoor Radon Level Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 220 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 220: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

Hazard History

There is not a hazard history for radon beyond the testing record, with even less data being available at the town level. Increased testing and reporting would improve the understanding of the extent of radon risks. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the best way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Enoch City's planning team describes experiences with problem soils locally and have developed ordinances which set requirements for all new construction in the community to assess a site for potential problem soils. Ordinances also require mitigation on sites which are found to have problem soils pre-construction. For specific language and detail about the requirements for soils studies, please refer to the Enoch City Code.

The Utah Geological Survey have provided Enoch City with mapping to describe the relevant problems oils in the area. Most of the city is at risk to some problem soil hazard. Expansive Soils, Corrosive Soils, and Collapsible soils are the most prevalent of the problem soils in Enoch City, with high proportions of the city considered a moderate or greater risk to these soils. Table 221 provides a description of the relative susceptibility of each mapped problem soil in the special mapping area for Enoch. Comparing the mapped risk to these hazards, Corrosive Soils and rock are the most prevalent throughout the community, with Expansive and Collapsible soils having a more moderate risk.

Table 221: Enoch City Problem Soils Risk

Soil and Rock Type	Mapped Risk in Enoch City
Collapsible Soils	Low/Moderate for most of the City, with the Southern edge rated as High to Very High.
Corrosive Soils and Rock	Very High throughout the City.
Expansive Soils and Rock	Moderate High throughout the City.

Source: Enoch City, Utah Geological Survey

Collapsible Soils

Collapsible Soils are strong when dry, but when wet clay bonds between soil bands are destroyed, resulting in collapse or loss of integrity of the soil. Mapping completed by the UGS shows that Enoch is generally at a moderate risk of collapsible soils, with the southern edge of the city at an elevated high or very high risk to this soil type, illustrated by Figure 198.

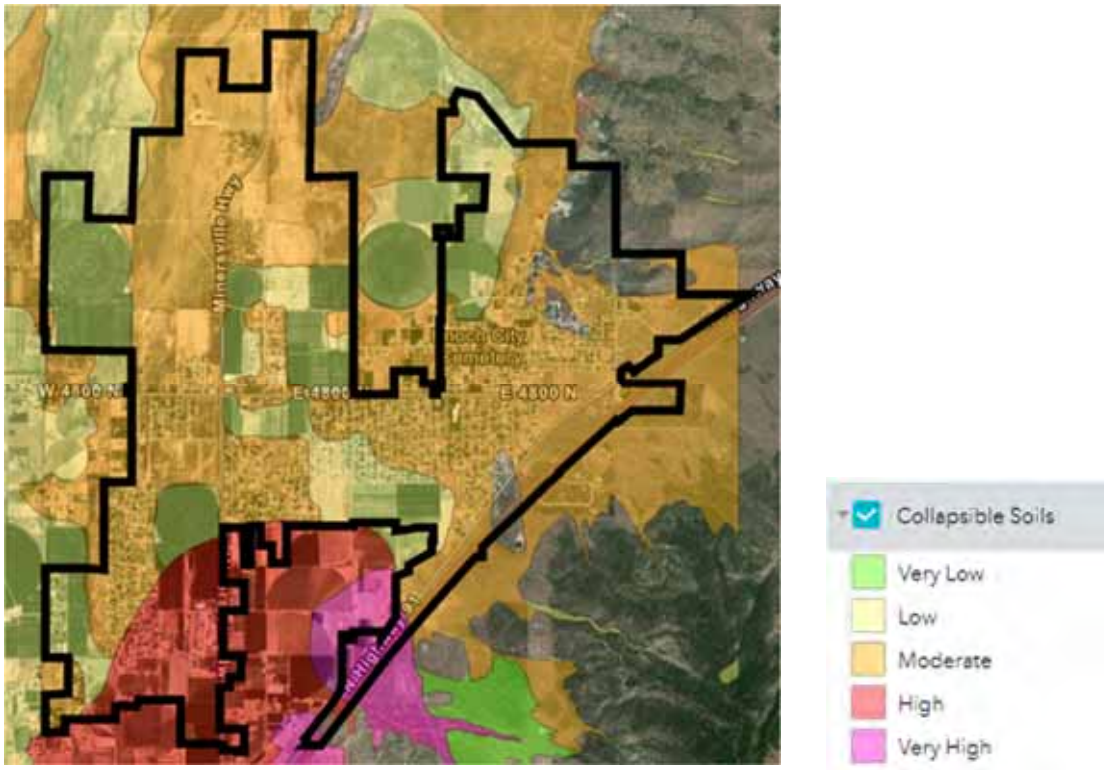


Figure 198: Enoch City Collapsible Soils Map

Corrosive Soil and Rock

Corrosive soils and rocks can damage cement and certain metals that they are exposed to. Figure 199 illustrates that Enoch has a very high susceptibility to Corrosive soils and rocks.

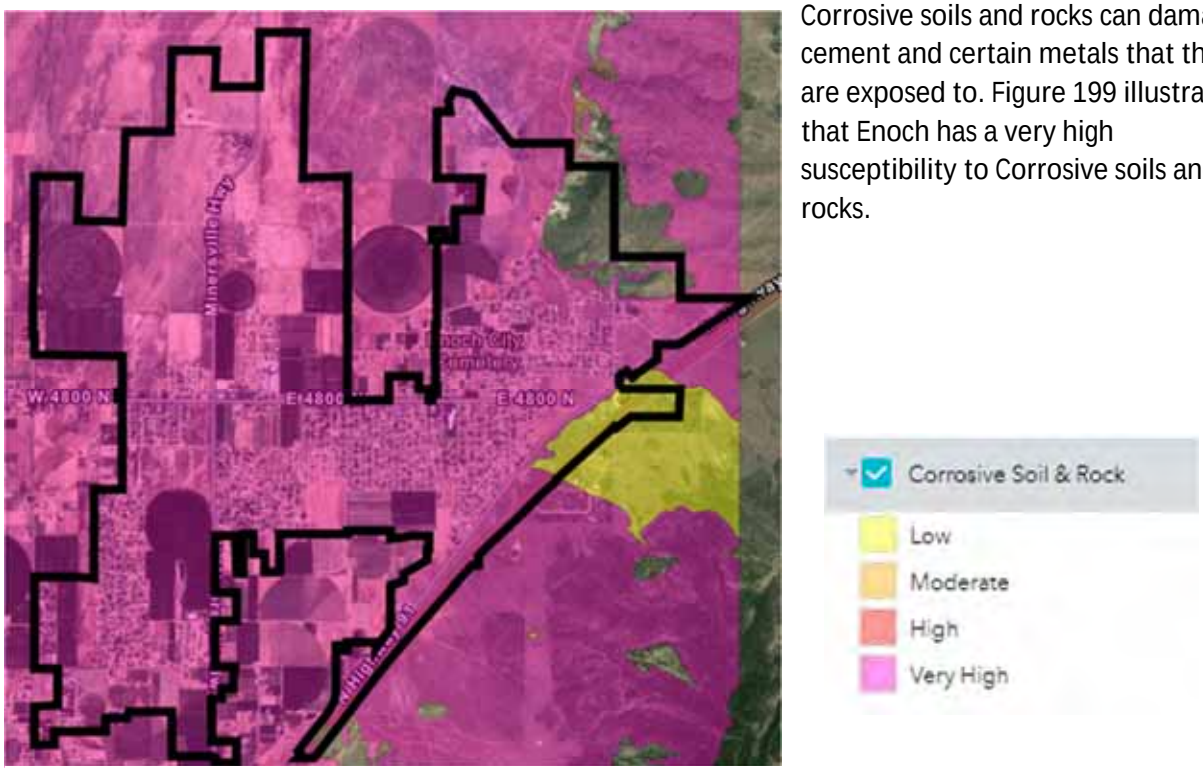
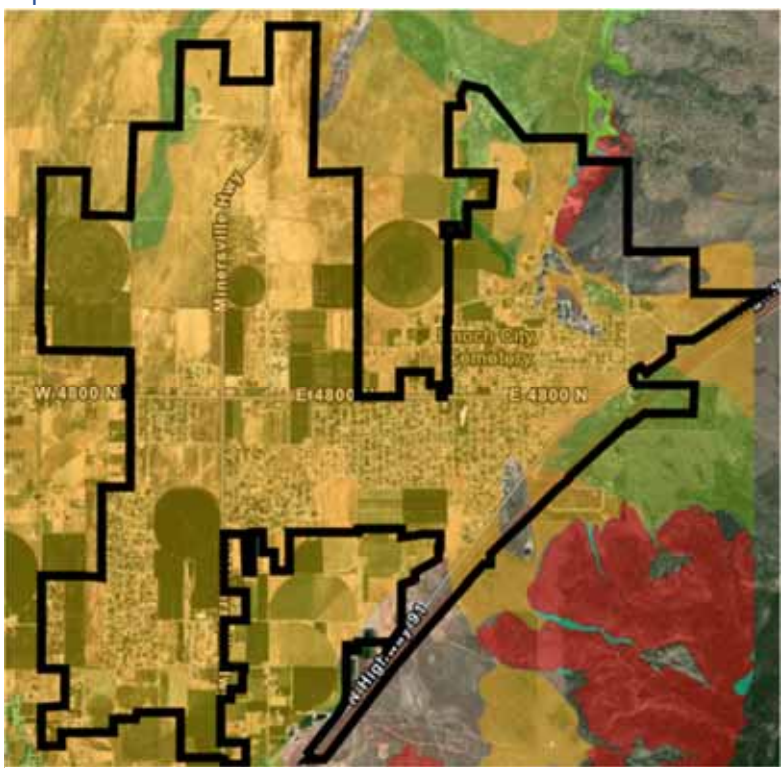


Figure 199: Enoch City Corrosive Soil and Rock Map

Expansive Soil and Rock



Expansive soils are reactive to moisture in the soil, expanding when wet and contracting when dry. The expanding and contraction action can damage development and infrastructure on top of expansive soils. Figure 200 indicates that Enoch has a moderate high risk to expansive soils and rocks.

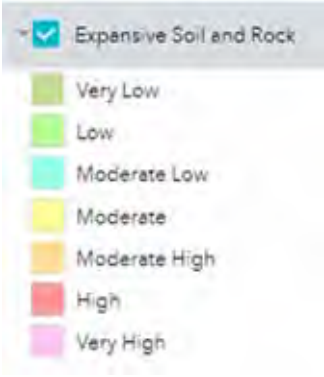
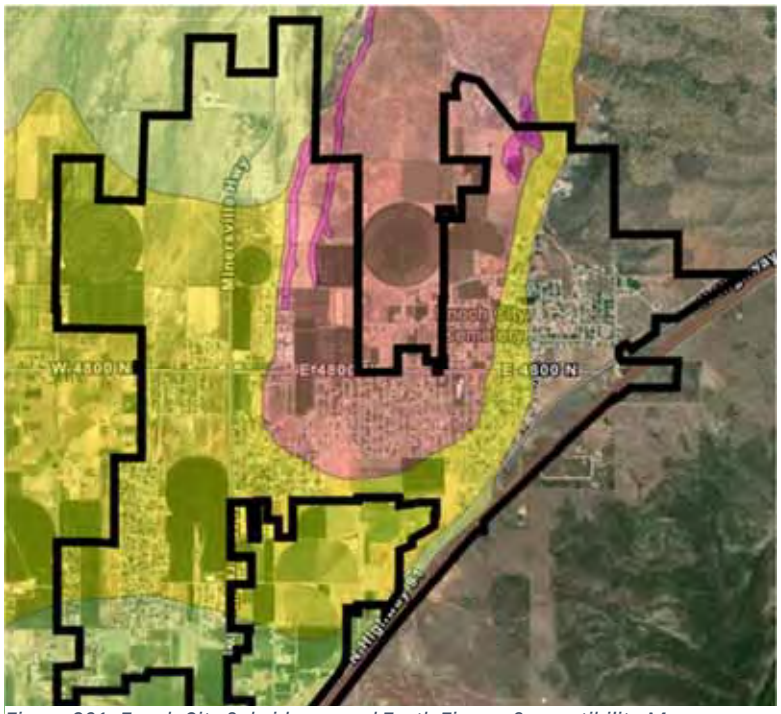


Figure 200: Enoch City Expansive Soil and Rock Map

Earth Fissures



Enoch City has experienced earth fissures and subsidence because of groundwater use, resulting in land settling over the aquifers, which were previously holding up the ground. Effects of earth fissures have recently caused damage to a vacated subdivision. Figure 201 shows that much of the City is at moderate or greater risk to earth fissures.

Figure 201: Enoch City Subsidence and Earth Fissure Susceptibility Map

Earth Fissures have been documented impacting Enoch City from groundwater use. A fissure located in the Parkview Subdivision, in the north of Enoch, is considered Utah's first fissure to impact developing areas, according to the Utah Geological Survey (Lund W. , Knudsen, Inkenbrandt, & Lowe, 2011). Other fissures have been identified throughout the state, impacting agriculture lands. The fissure impacting Enoch resulted in the halting of construction at the subdivision, as the fissure was disturbing sewage utilities and damaging roads and sidewalks in the area (Meiners, 2020).

Earth Fissures and Subsidence are related to the use of groundwater from aquifers in the Cedar Valley. Continued use of groundwater will need to be managed to ensure that water use does not exceed the rate of groundwater recharge. There is no way to repair a fissure, however managing groundwater use and recharge, can stabilize the area (Meiners, 2020).

Hazard History

There is not a full recorded history of problem soil impacts or events for Enoch City, other than the description of impacts from expansive soils, earth fissures, and subsidence. The planning team describes that some structures experienced impacts from expansive soils by previously unmitigated construction. The City has observed that the adoption of ordinances requiring soils study, compaction testing and mitigation planning has successfully addressed problem soils challenges.

Many of the problem soils that impact Enoch are reactive to wet or dry conditions. Changes in weather, climate, and annual precipitation may pose some risk to structures at risk due to problem soils. Severe weather and drought conditions have the potential to affect problem soils, thereby impacting community assets and residents. Severe weather and drought conditions are expected to worsen with climate change, bringing more severe weather events with overall drier conditions.

Mitigation Strategy and Actions

Enoch city has several ongoing and recently completed mitigation actions, including improved local data and information about natural hazard risks, flood controls, and zoning ordinances that address natural hazards. Enoch has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 222 describes progress made on the Enoch mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 222: 2016 Enoch Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Protect property from spring runoff and thundershowers.	Design sediment debris basins east of I-15 to delay and meter flow of severe runoff. Obtain easements from private landowners and the BLM. Construct basins.	10-years	NRCS, Enoch City Storm Drainage Fund	Ongoing, Environmental review for this action is in progress as of December 2020

Source: 2017 Five County Association of Governments NHMP

The Enoch City planning team identified actions to include in the community mitigation strategy. Each action in Table 223 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 202
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 202: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Enoch has assembled several actions, addressing each of the natural hazards that the community is at risk to. The City did not include actions

for Problem Soils in their mitigation strategy as the community currently engages in soils and compaction testing pre-construction and sets requirements for development to mitigate. These efforts have been effective at limiting negative impacts from problem soils on new construction.

Table 223: Enoch 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #1	2	Reduce impacts from severe weather events on power grid.	Develop and harden electrical grid to prevent outages due to natural hazards, solar storms, or manmade disruption to electrical utilities.	M	5-years	M	Enoch City	Enoch City
Severe Weather #2	2	Reduce impacts from severe weather events on power grid.	Secure City owned, critical facilities with generators in the event of electrical disruptions, to ensure that services can be offered to residents.	M	5-years	M	Enoch City	Enoch City
Wildfire #1	2, 4, 6	Coordinate with other entities to engage in fuels management.	Implement fuels management actions identified in CWPP 2020: Private properties in the WUI, Enoch City owned properties, Summit Mountain	H	5-years	M	Enoch City, Cedar City Fire Dept	Enoch City, Cedar City Fire Department
Wildfire #2	1, 4, 6	Work with residents to create defensible space.	Conduct home assessments at residences in the WUI.	M	1-year	L	Enoch City, Cedar City Fire Dept	Enoch City, Cedar City Fire Department
Drought #1	4, 6	Protect water storage through the groundwater aquifer.	Work with CICWCD to recharge aquifer through piping of winter runoff and storm water to reduce loss to evaporation.	M	5-years	M	Enoch City, CICWCD	Enoch City, CICWCD

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #2	3	Inform residents about drought risks.	Public education about water conservation and drought related actions.	H	1-year	L	Enoch City, CICWCD	Enoch City
Flood #1	2	Reduce severe flooding on I-15.	Design and construct sediment debris basins east of I-15 to delay and meter flow of severe runoff.	H	Ongoing/ 10-years	H	NRCS, Enoch City Storm Drainag e Fund	Enoch City
Flood #2	1	Protect natural channels and drainages in the community.	Purchase property from homeowners to channel flood waters through Enoch City to the north drainage area. Efforts will contribute to water infiltration into the aquifer.	M	Ongoing/ 10-years	H	FEMA BRIC Grant, Enoch City, NRCS	Enoch City
Flood #3	2	Reduce flooding on Half Mile Road residences.	Complete stormwater drainage on the north portion of Half Mile Road.	M	5-years	H	Enoch City	Enoch City
Landslide #1	1, 2, 6	Protect hillsides and vulnerable slopes in the community from landslide and damage.	Assess vegetation in wildfire prone areas to encourage plants with strong root systems and plan for planting following wildfire events to prevent landslides on bare soil. Use the risk assessment included in the CWPP to help identify these areas.		5-years	L	Enoch City, Cedar City Fire Depart ment	Enoch City, Cedar City Fire Department

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #1	1, 3	Identify URM in the community.	Inventory historically significant structures throughout the community. Provide property owners with information about seismic safety and preservation.	M	5-years	L	Enoch City	Enoch City
Radon #1	3	Inform residents of radon risks and vulnerabilities.	Provide public education to Enoch residents and property owners about radon risks, testing, and mitigation. Publish education in City newsletter or in utility bills.	H	1-year	L	Enoch City	Enoch City

Source: Local Planning Team

Kanarraville

Kanarraville is a rural community which incorporated in 1934. Pioneers first settled in the area following a flood that washed away Fort Harmony following heavy rains in 1862. According to Kanarraville Town, the community has maintained a steady population between 200-400 people.

The community is bordered by Kararra Mountain to the east of the community, with I-15 to the west. Old Highway 91 runs through the community, and before I-15 became a thoroughfare, this road used to connect communities throughout the southwest. Nearby cities include Cedar City and New Harmony in Washington County.

Demographics

As of the 2020 Census, Kanarraville has a population of 442 people, and the average family size is 2.77 people. Figure 203 shows the population as reported by each Census since 1960. The Kanarraville population has grown an average of 11.4% each decade between 1960 to 2020. In the last 10-years, the population has increased by 36.7%.

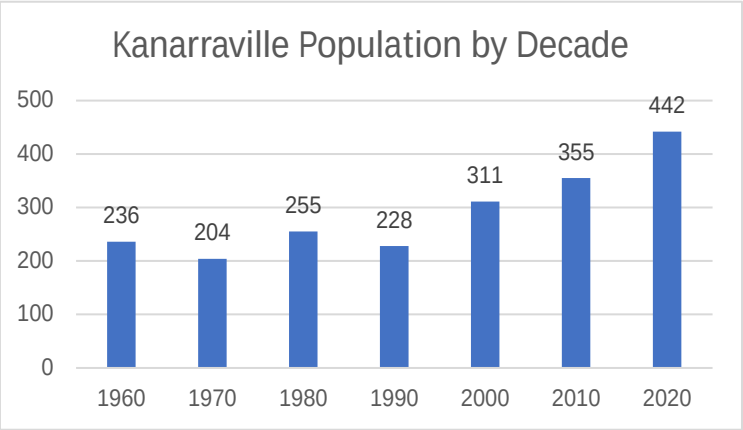


Figure 203: Kanarraville Population by Decade

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Kanarraville, the community could see approximately 524 people living in the community by 2065[11].

Income and Poverty

The median household income in Kanarraville is approximately $57,679 (US Census Bureau, 2021). Poverty in Kanarraville is below the state average, at 5% of the total population. Most of this set of residents who are considered in poverty are those 65 years and over, which may be attributed to an aging or retirement population.

Housing

The US Census describes that there are 183 total housing units in Kanarraville, of which 15 are vacant. (US Census Bureau) Kanarraville residents are dominantly homeowners, as 82% of occupied units are owner occupied housing units. (US Census Bureau) Few rental options are available in the community.

Prominent real estate websites document the average estimated home values in an area. Referencing data through September 30, 2021, Zillow estimates that home values in Kanarraville are around $350,378 for seasonally adjusted, mid-tier homes and represents an increase of 17.8% in the last year

[11] This estimate is created using the 2015 ACS population estimate for Kanarraville, which was 290, and adding 81% of this population estimate to the population for that year.

(Zillow.com, 2021). Rapid increase in costs can be prohibitive for new residents and changes in living situations among current residents hoping to remain in the community.

Economy

Kanarraville was originally settled with mining, ranching, and agriculture as the staples in the community. While agriculture is no longer a primary economic force for the community inside the city boundaries, many local businesses have started in the community. These businesses range from arts, restaurants, hospitality to boutique shops. The US Census Bureau OnTheMap Tool describes in greater detail the private primary[12] share of jobs by industry in Kanarraville. Figure 204 shows that retail trade makes up approximately two-thirds of the area's jobs, pointing to the importance of local businesses to the community. Resources, goods, and other jobs can be found in neighboring Cedar City.

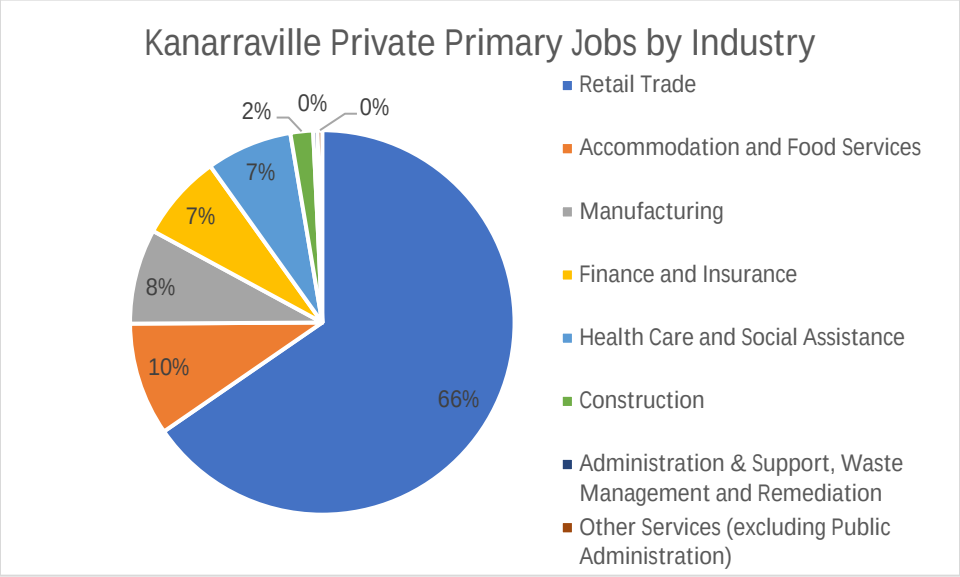


Figure 204: Kanarraville Share of Private Primary Jobs by Industry

Source: OnTheMap, 2021.

Kanarraville has had a recent boom in tourism due to the once local secret, Kanarraville falls, where Kanarra Creek flows through narrow, red rock slot canyons. The falls and the Kanarra Canyon see tens of thousands of visitors annually, and visitors likely contribute to the local economy. Kanarraville has implemented a permitting process for recreation at the falls to better control the use and maintain the area, limiting use to 150-users per day.

Development

Growth in Kanarraville since 2016 has included the purchase of 14-acres south of the town for a new fire station, with the goal to have the fire station complete in the next ten-years. No other significant development has been recorded in the community.

[12] Private primary jobs are the highest paying private jobs that a person has.

Community Capabilities

Kanarraville has an elected Mayor and Town Board who are elected to a four-year term and serve the community through local legislation. Town staff include a Clerk, Treasurer, Fire Chief, Maintenance, Kanarra Falls, Transfer Station Attendants, and Cleaning.

The town administers several services to the residents and community. Kanarraville water services are managed by the Kanarraville Water department. The source is a well and there are plans to drill a secondary well. Community facilities include a school, government building, water system, community parks, fire department and cemetery. These areas act as gathering spaces and known community spaces where people can get local information during an emergency.

Kanarraville has interlocal agreements with Iron County the following services:

- Building Code Enforcement
- Search and Rescue
- Law Enforcement

An interlocal agreement with Cedar City Fire Department is how the community addresses fire risk and hazards in the city boundaries. This partnership has led to the development of a fire break in the southern end of the community, following concerns that the sage fields were ignitable fuels near a park and residences.

There are several capabilities that the community can use in the event of a natural hazard or other emergency. Reverse 911 and outdoor warning signals have been effective tools to mitigate the impacts of natural hazards in the past.

The community has expressed an interest in creating a position of Floodplain Administrator. This role can increase capacity locally for mitigation activities as this role ensures that development activities comply with floodplain management codes and ordinances locally.

Plans and Policies

Kanarraville uses a general plan and capital improvements plan to inform changes in community zoning and large purchases or projects to improve the community. The general plan does not identify natural hazards, but a capital improvements plan for the community identifies the need for a new fire house.

Risk Assessment

Kanarraville experiences and is at risk to the natural hazards addressed in this Natural Hazard Mitigation Plan. The area regularly experiences storms in the winter and summer that cause impacts. Other significant events include drought and flash flooding because of severe weather events.

Five County has worked with Kanarraville to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. In assessing exposure in the community, Five County's assessment includes evaluating the percentage of road miles, parcels, parks, and critical facilities that are in mapped risk areas in the community. Critical facilities include schools, hospitals or medical clinics, fire stations, and police and sheriff's departments. Table 224 displays the relative risks of hazards in Kanarraville.

Table 224: Kanarraville Hazard Risks

Hazard	*Risk*
Severe Weather	1) High
Drought	2) High
Wildfire	3) High
Earthquake	4) Moderate
Flood	5) Moderate
Landslide	6) Low
Radon	7) Low
Problem Soils	8) Low

The following sections provide detailed description of the exposure, probability, and severity of each natural hazard in Kanarraville, concluding with a mitigation strategy to address any vulnerabilities identified in the risk assessment to each natural hazard. The Kanarraville local planning team provided input, context, and data to this assessment and developed the mitigation strategy for the community.

Wildfire

Wildfire is a common challenge in Southwestern Utah due to the generally arid climate and hot temperatures. While wildfire is a natural event which controls dead material and encourages new growth in the wilderness, interactions with the built environment, communities, and popular recreation areas make wildfire a potential danger in communities in the West.

Kanarraville has a concern about fire danger due to the nearby mountains and fields to the south. Recent fires have not endangered the town; however, they did cause diversion of traffic into the community. A wildfire that posed the most direct threat to the community occurred nearly 18-years ago in the mountains on the east side of the community. Damages or impacts were not reported.

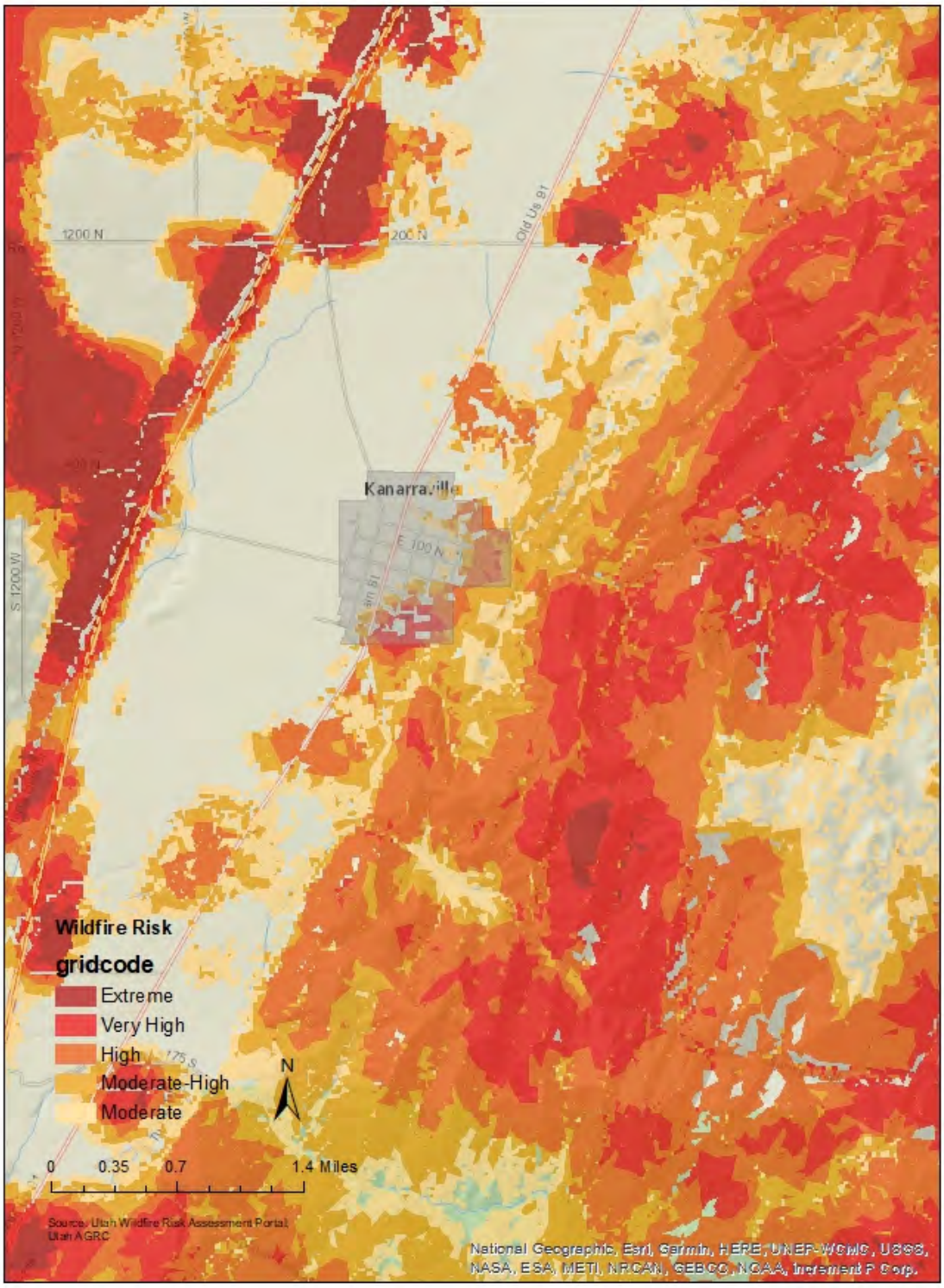


Figure 205: Kanarraville Wildfire Risk

Source: Oregon Department of Forestry

Utah Risk Assessment Portal from the Department of Natural Resources details the potential risk of wildfire to a community based on previous fires. For the purposes of this assessment, the risks have been limited to those in the moderate to extreme categories to show where in Kanarraville is the highest risk to wildfire hazards. The map shows where the relative wildfire risk is in the community, along the east side of the community, in the mountains, and to the south. There are wildlands and sage fields on the east and south sides of the community, providing ample fuels near the homes and facilities in these parts of the town. Table 225 reflects the percentage of the commercial and residential parcels that are exposed to wildfire hazards.

Table 225: Kanarraville Exposure to Wildfire Risk

Kanarraville Exposure to Wildfire						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	62.5%	44.7%	45.5%	34.7%	N/A	N/A

Source: Iron County Assessor, 2020; UTWRAP, 2020; AGRC, 2020.

Hazard History

Kanarraville has not experienced wildfire impacting the city boundaries, which endangered people or property in the city limits, according to the Utah Wildfire Info record (2017-2020) and the FEMA Fire Mitigation Assistance Grant designation. Nearby towns, like New Harmony in Washington County, which has a somewhat similar elevation, fuels, and climate have experienced several instances of wildfire that resulted in evacuation orders. Other nearby wildfires likely had secondary impacts on Kanarraville, including air and water quality issues due to ash and smoke, which can travel miles from the site of the fire.

Wildfires in the community can trigger other natural hazards, including landslides and flooding and can be caused or have increased risk due to drought or severe weather events, like lightning. Drought concerns and the prevalence of severe thunderstorms in the region increase concerns for wildfire in the community, especially as drought conditions have been ongoing in recent years. Drier fuels and reduced water availability will impact the community's ability to respond effectively to wildfire events.

Earthquake

Earthquakes are a known risk and challenge of living in Utah. Several active faults in the southwest have caused historic earthquakes, shaking, and other impacts. While earthquake epicenters can occur in areas that do not have mapped quaternary faults, fault lines are likely to be the cause of significant shaking. Other fault hazards include the rising or dropping of land along the fault during an earthquake event. A quarter-mile buffer has been applied to understand what assets may be most at risk in Kanarraville to earthquake events, seen in Figure 206.

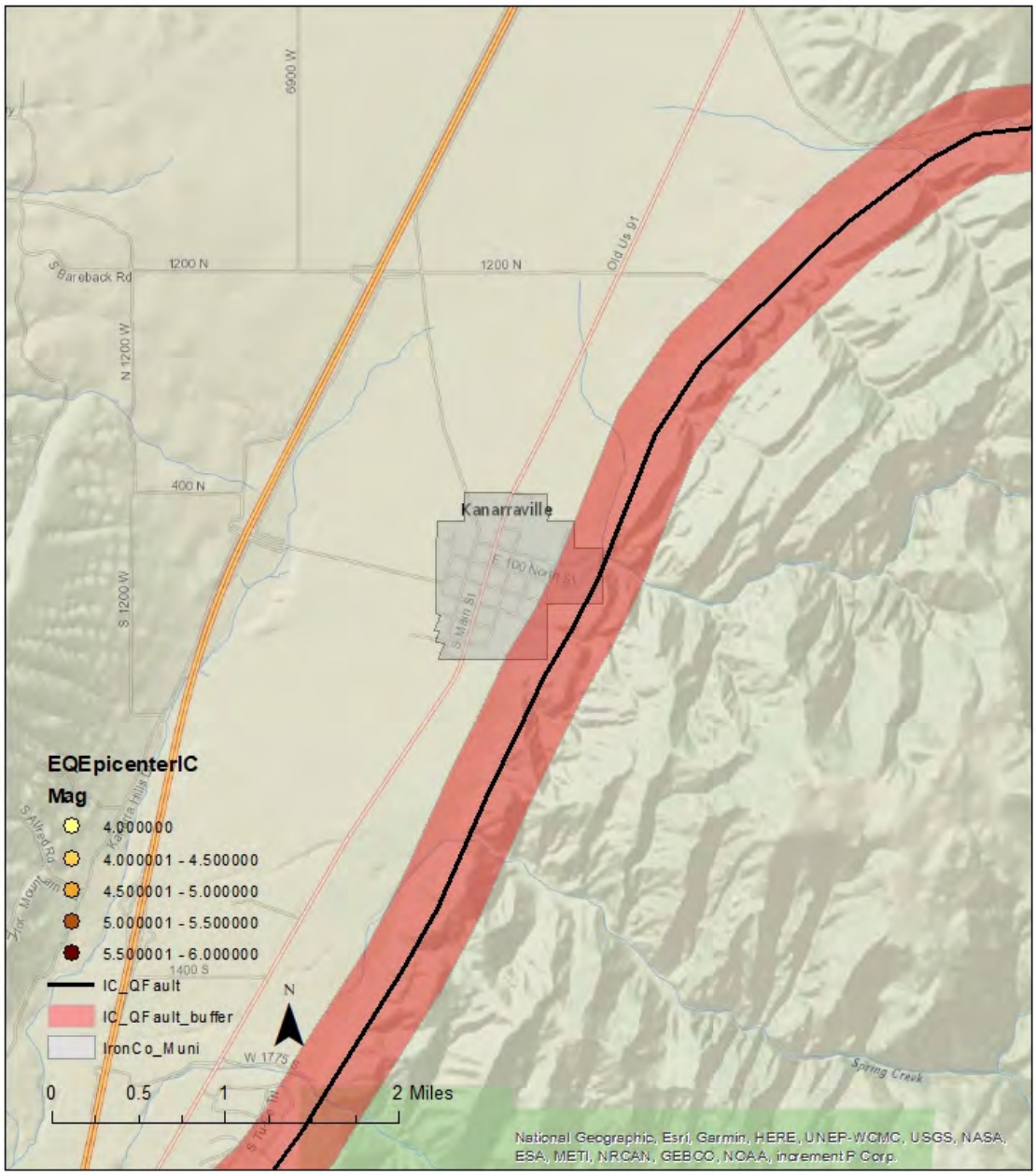


Figure 206: Kanarraville Quaternary Fault Exposure and Earthquake Epicenter

Kanarraville has the Cedar City segment of the Hurricane Fault line running to the East of the City. An assessment of the City's potential Earthquake risk relies on the proximity of the community assets to a Faultline. This is reflected on the map by a quarter-mile buffer surrounding the fault. Table 226 describes the assets and parcels that lie within the buffer and may be at greater risk to earthquake impacts. Road miles and commercial parcels see the most exposure to this quaternary fault, which can impact local economies, access to areas of the community, and cause traffic delays.

Table 226: Kanarraville exposure of assets within a quarter mile of a quaternary fault

Kanarraville Exposure within a Quarter Mile of a Quaternary Fault

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	12.5%	11.3%	11.4%	17.9%	N/A	N/A

Source: Iron County Assessor, UDOT, AGRC, Utah Geological Survey, University of Utah Seismology

Other vulnerabilities to consider to earthquake shaking include the age of structures and the construction type. Southwestern Utah has a history of pioneer settlement, and many communities seek to preserve historical buildings and structures. These structures, typically unreinforced masonry, are at greater risk to earthquake hazards. Iron County has limited data describing the construction date of structures, but knowing the history of the area, it is likely that Kanarraville has some historic structures that could be at heightened risk to earthquakes.

Hazard History

There have been no reported earthquake epicenters at 4.0 magnitude or greater recorded in Kanarraville.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Cedar City.

Flood

The town of Kanarraville was settled following a flood that displaced residents from Fort Harmony in the late 1800s. Utah, although dry and arid, experiences disastrous flooding throughout the southwest region. Events in the area are often the result of precipitation which cause flash floods. The falls and Kanarra Creek are a source of water for Kanarraville that draw hikers and visitors to the area. Since the site gained popularity, hikers regularly need to be rescued from the canyon during high river flow or from falling on slippery, wet, slickrock surfaces.

Data gathered and mapped from the Utah Division of Water Rights illustrates the risk of dam inundation and flooding in the 100-year floodplain for communities in the Five County Region. Kanarraville has no mapped risk of dam inundation, but the community is exposed to the 100-year floodplain. The current floodplain is mapped in the northeast of the community, at the mouth of Kanarra Canyon along Kanarraville Creek, as described in Figure 207.

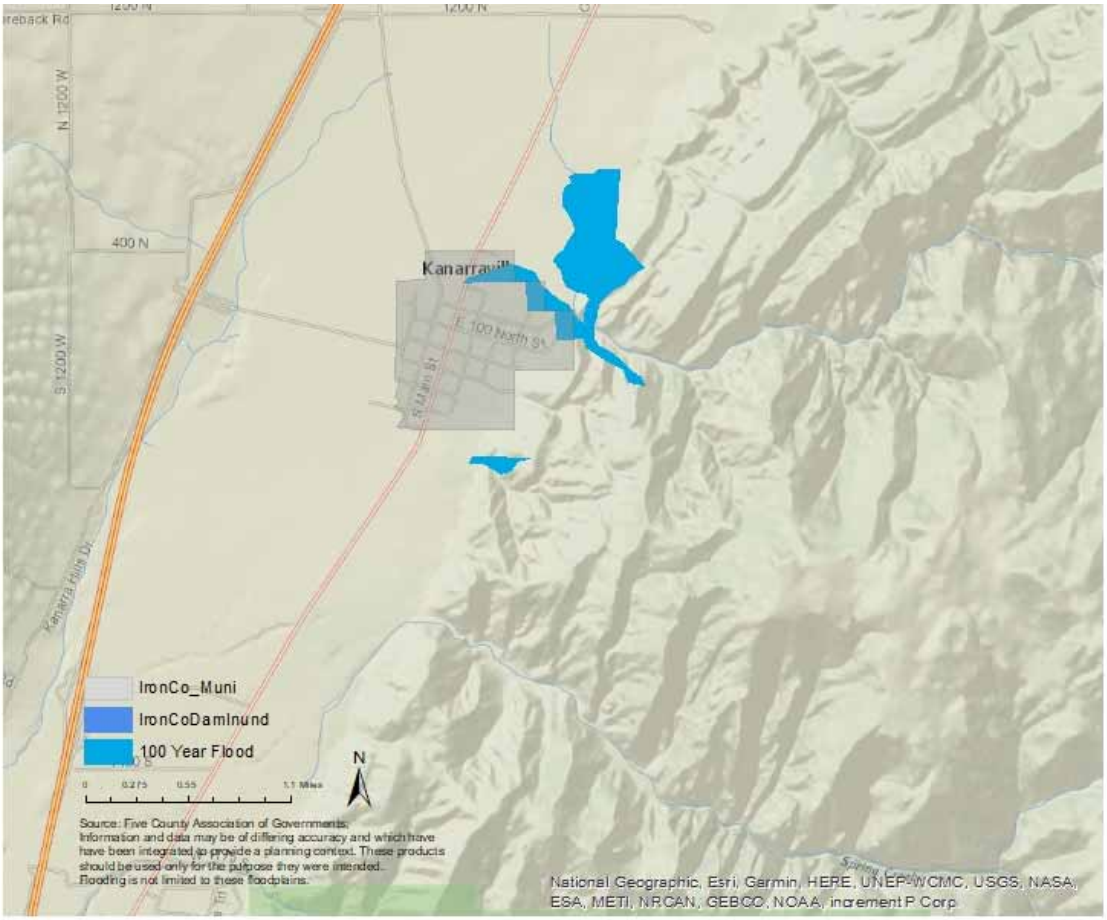


Figure 207: Kanarraville Flooding and Dam Inundation Map

Flooding is likely to impact not only facilities, homes, and infrastructure near Kanarra Canyon, but also the recreation seen along the Kanarra Falls Trail that climbs a slot canyon to waterfalls. Such terrain is at high risk to flash flooding with even slight precipitation and can injure or temporarily leave hikers stranded. Recreational use can significantly impact local, county, and state resources to respond during a natural event, and is reflected in news reporting of recent rescues from the canyon.

Table 227 describes the community assets that are in the floodplain and dam inundation zone. Road miles see the greatest exposure, with nearly 12% exposed to the 100-year floodplain. Roadways can be blocked by water and debris during a flooding event, causing damages to vehicles and roadways, delaying traffic, impacting emergency response, and blocking sections of the community. Residential property in the flood area exposes residents and visitors to injury and property to damages.

Table 227: Kanarraville Exposure to mapped Flood and Dam Inundation zones

Kanarraville Exposure to Flood					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
0.0%	6.9%	6.6%	11.9%	N/A	N/A

Source: FEMA, Utah Division of Water Rights, Iron County Assessor, UDOT, AGRC.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Kanarraville structures and assets outside of the mapped floodplain are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has occurred outside identified flood hazard areas (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021). Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Kanarraville does not participate in the NFIP.

Hazard History

Prior to 2021 there were no documented flooding events which caused damages or impacts to Kanarraville on the NOAA storm database, news, or other sources. In August 2021, Kanarraville experienced damages to homes and yards due to flooding associated with a severe storm event. Iron County Emergency Management reported that several log jam blockages on Coal Creek caused breaches which may have contributed to the flood waters. The iconic log ladder on the Kanarra Falls trail was washed away during the event.

Flooding can cause or contribute to other natural hazard events, predominantly landslide, rockfall, and debris flow, as waters flowing over bare soil or rock can wash away or loosen the ground, contributing to movement. Severe weather, landslides, earthquake, and wildfires can cause or contribute to flooding events, as increased precipitation, or changes in landscape change flows in channels and drainages.

Landslide

Landslides, debris flows, and rockfall are common natural hazards in Utah, often observed in areas with steep slopes or cliffsides. In Southern Utah, the meeting of the Colorado Plateau and the Great Basin marks an area with a risk to landslides. Despite the relative frequency of landslides in the Southwest, Kanarraville has not recorded landslides impacting the community. Kanarraville is at the base of a mountain range, with slopes bordering the east side of the community. It is from these slopes that landslide risk is greatest for the community, as described in Figure 208.

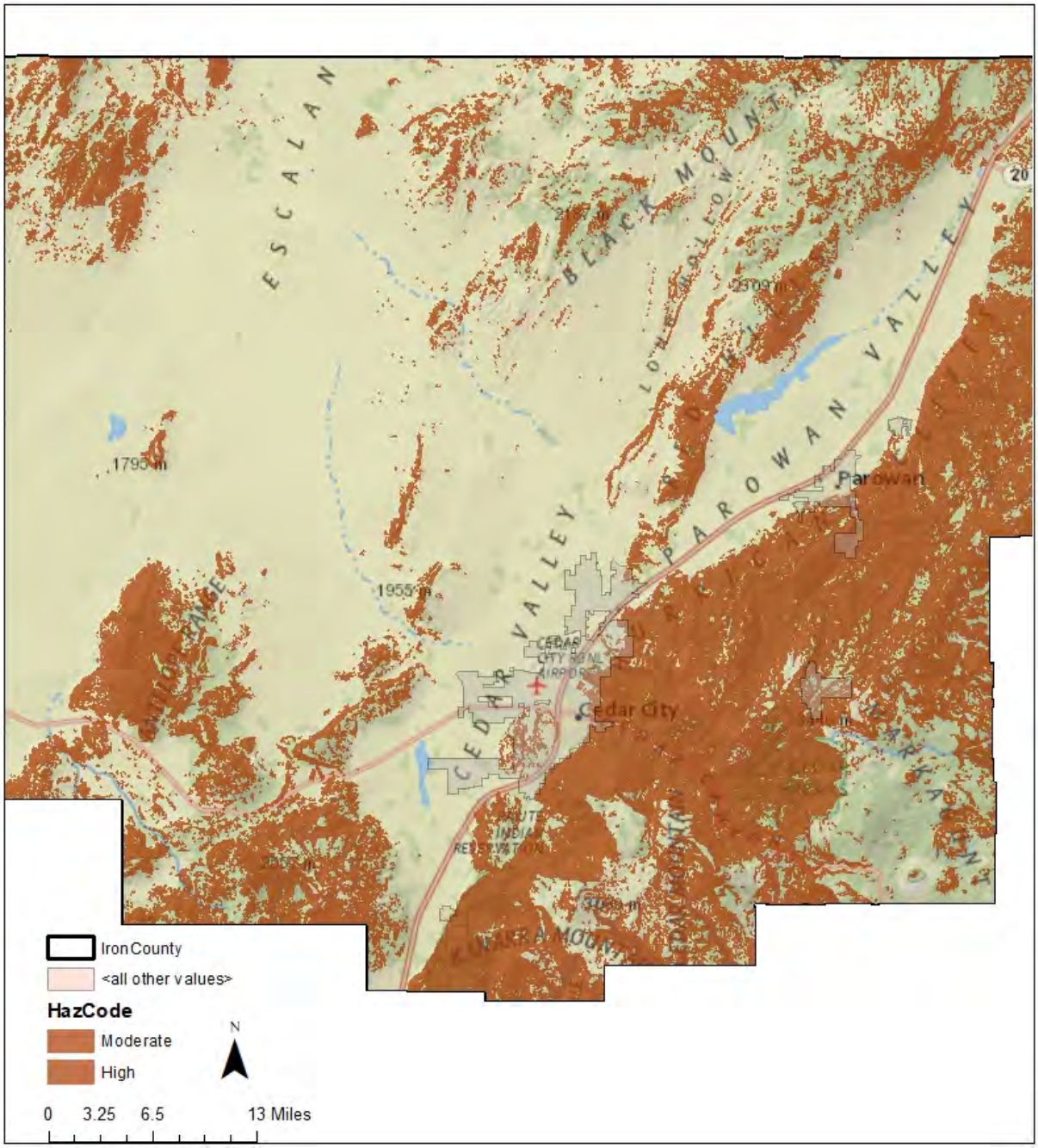


Figure 208: Eastern Iron County Landslide Susceptibility

Source: Utah Geological Survey

Data from the Utah Geological Survey describes the susceptibility of an area to landslides by assessing past landslides, slope, and other factors. While there is a moderate risk on the eastern border of Kanarraville, no mapped parcels fall in the identified susceptible areas, as described by Table 228. Nearly 10% of roadways in Kanarraville would be impacted by a landslide in the susceptible areas. Impacts on roadways can cause to traffic delays and impact emergency response access to the area.

Table 228: Kanarraville Exposure to Landslide Susceptible Areas

Kanarraville Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	0.0%	0.0%	0.0%	9.6%	N/A	N/A

Source: Iron County Assessor, UDOT, AGRC, Utah Geological Survey.

Hazard History

One landslide event has been recorded for Kanarraville, described in Table 229. This event was a debris flows and it is unclear whether the event had direct impacts on the community.

Table 229: Kanarraville Landslide Hazard History

Incident Date	Location	Description
1955	Kanarraville, Iron County	Debris flow near Kanarraville.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Drought

The Five County Region has experienced seven periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite.

Monitoring drought generally occurs across several climate division. Kanarraville lies in the Southcentral division, which includes much of southern Utah. Drought, given its regional scope will impact the whole of Kanarraville residents, facilities, infrastructure, businesses, and property.

Drought can compound preexisting water supply or delivery concerns. Kanarraville has previously experienced problems with the local water supply, which has resulted in water tanks being filled to supply the community. To further mitigate future potential water challenges, the community has plans to drill a second well.

Severe Weather

Severe Weather events experienced in Kanarraville includes winter, snow, and rainstorms, hail, wind, lightning, and extreme temperatures. Looking to regional weather recordings from NOAA, an estimated $1.1 million in losses and 21 injuries have been reported because of severe weather events.

Severe weather tends to affect a region or county at large and can be difficult to track for communities like Kanarraville, as reporting often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Kanarraville,

however our analysis assumes that severe weather events will impact the whole of Kanarraville residents, facilities, infrastructure, businesses, and property.

Hazard History

Table 230 describes the severe weather events that have impacted Kanarraville. It is likely that events reported for nearby communities also impacted Kanarraville. Please refer to the Iron County, New Harmony, or Cedar City sections of this plan for further description.

Table 230: Kanarraville Severe Weather History

Date	Damages/Injury	Description
6/29/2013	$0	A thunderstorm produced high winds. A sensor near black Ridge recorded a gust of 58 MPH.

Source: NOAA Storm Event Database, 2021.

Kanarraville is a community that is a short distance from Interstate-15, a major north/south thoroughfare through Utah. Severe storms that cause road closures and accidents near Kanarraville often result in traffic detours of highway traffic through town. In-town impacts of severe weather include down trees, power outages, and traffic delays. These impacts have been noted to have lessened over time, as residents have connected generators to homes, creating redundancy in electric power.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Kanarraville from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. Flooding and severe weather events are often related in the area. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Severe weather events may worsen in severity with changes in climate, increasing risk of damages, injury, and potential for triggering other events.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 209. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

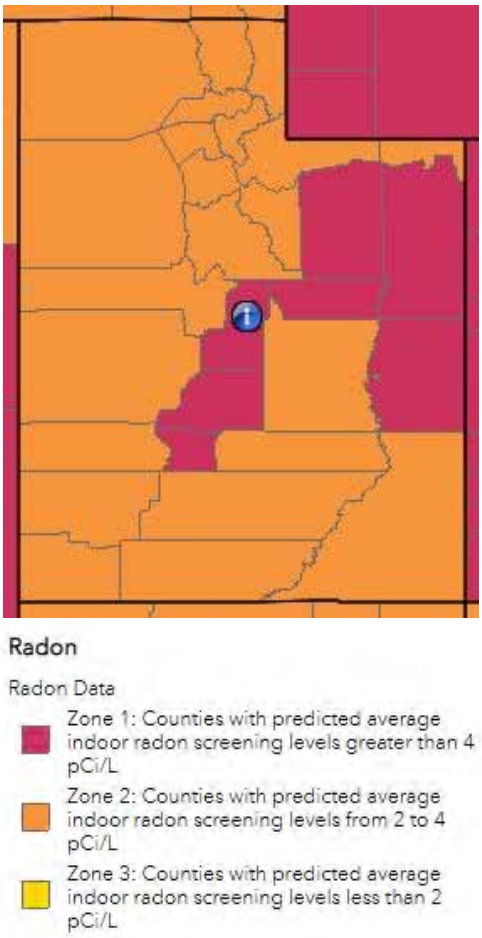


Figure 209: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 231 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 231: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

The Utah Geological Survey has mapped soils which may pose a threat to construction in a community. These soils include Expansive Soils and Rock, Limestone Karst formations, and Dunes. Further description of the problem soils prevalent to the Southwest can be found in the Hazard Identification Problem Soils section of this plan. Figure 88 illustrates where the Utah Geological Survey has mapped problem soils for Iron County. Kanarraville does not have mapped problem soils in the community.

Figure 210: Iron County Problem Soils Map

Source: UGS, AGRC

The Utah Geological Survey has developed updated mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of prevalent soil types to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Kanarraville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

To address the risks and vulnerabilities identified in this section, Kanarraville has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in the table below, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

The 2016 iteration of the Natural Hazard Plan set two mitigation actions for the Community. A summary of the progress on these items is described in Table 232.

Table 232: Kanarraville 2016 Mitigation Strategy Progress

Hazard	Objective	Action	Timeline	Funding Source	Progress
Wildfire #1	Fuels reduction and defensible space tactics	Continue to place strategic fuel breaks throughout the focus area.	Ongoing	Local government operating budget, Special Service District	New property south of town was purchased and fuel breaks were developed
Wildfire #2	Fuels reduction and defensible space tactics	Encourage landowner mitigation and defensible space work.	Ongoing	Local government operating budget, Special Service District	Fire prevention info is printed quarterly in the water newsletter

Source: 2016 Five County Multi-Jurisdictional Natural Hazard Mitigation Plan

The Kanarraville planning team identified actions to include in the community mitigation strategy. Each action in Table 233 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 211.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 211: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Kanarraville has assembled several actions, addressing each of the natural hazards that the community is at risk to. Table 233 describes the mitigation strategy for Kanarraville developed for the 2022 iteration of the plan. This section describes projects for the community to implement in the coming years to address the risks and vulnerabilities that they have to natural hazards.

Table 233: Kanarraville 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi Hazard #1	2, 5	Reduce impacts resulting from power outage.	Purchase well generator and assess additional emergency generators needed for essential town structures during an emergency	M	10-years	M	Enterprise and General Funds	Town Clerk and Maintenance Department

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #1	2, 4	Protect community electrical infrastructure.	Coordinate with Rocky Mountain Power to assess aging power poles in the community.	L	5-years	L	Rocky Mountain Power and Kanarraville Town	Town Clerk
Wildfire #1	1, 2	Update local policy to protect residences and infrastructure vulnerable to wildfire.	Adopt the Wildland Urban Interface Code.	M	1-year	L	N/A	Town Clerk
Wildfire #2	1, 2, 6	Reduce fuels in and around the community.	Continue to place fuel breaks around the community.	H	Ongoing	M	Kanarraville General Fund	Fire and Maintenance Departments.
Drought #1	2	Diversify Kanarraville Water Sources.	Drill a new well as additional source of water for the community.	H	Current/1-year	H	USDA Grant	Kanarraville Town, KP Ventures, Ensign Engineering
Drought #2	3	Inform residents of drought hazard locally.	Provide public education about waterwise usage during drought in the Town Water Newsletter.	H	Ongoing, annually	L	N/A	Town Clerk and Treasurer
Flood #1	2	Increase infrastructure flood capacity.	Assess storm drains and drainage ditches that surround the town for water capacity. Address stormwater flow and capacity of drainage ditches per the results of the assessment.	M	3-years	M	General Fund	Maintenance Manager and Team

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	2	Repair drainage ditch which regularly experiences debris flows.	Clear and repair the drainage ditches off old-highway 91 in coordination with Iron County. One drainage is located in the North of town, and one is in the South.	M	Ongoing	M	General Fund, Iron County	Town Clerk and Maintenance Team, Iron County
Earthquake #1	2	Inventory community buildings for URM and other seismic vulnerability.	Assess public buildings and water structures that may be vulnerable to ground shaking or structural damage.	M	8-years	H	General Fund	Town Clerk and Maintenance Manager
Problem Soils #1	1, 2, 4	Identify sensitive soils near the community.	Work with Dixie State University to update the geological survey of Kanarra Falls hiking area.	M	Ongoing	L	N/A	Town Clerk
Radon #1	3	Inform residents of radon risks and mitigation.	Provide information about radon and radon testing to the community through Town Newsletters.	H	Ongoing	L	Enterprise Fund	Town Clerk and Treasurer

Source: Local Planning Team

Paragonah

Paragonah is located northeast of Parowan in Iron County, making it the incorporated city that is furthest north in the County. The community is connected to the rest of the county by I-15 and SR 271. The town is approximately 661 square acres with a population of 444.

Paragonah has a similar climate and geography to Parowan and Cedar City, being in the valley at the base of the Hurricane Cliffs. The community was originally named Red Creek, after the creek and reservoir in the area, which runs into the community from the nearby mountain range.

The local culture is largely focused on pioneer settlement in the southwest.

Demographics

As of the 2018 American Community Survey, Paragonah has a population of 444 people. Comparing to previous documented census', Paragonah's population experienced significant growth in 2000 and has remained somewhat steady since this count. Figure 212: Paragonah Population by Decade illustrates this trend. The most recent census is not yet available to include in this document.

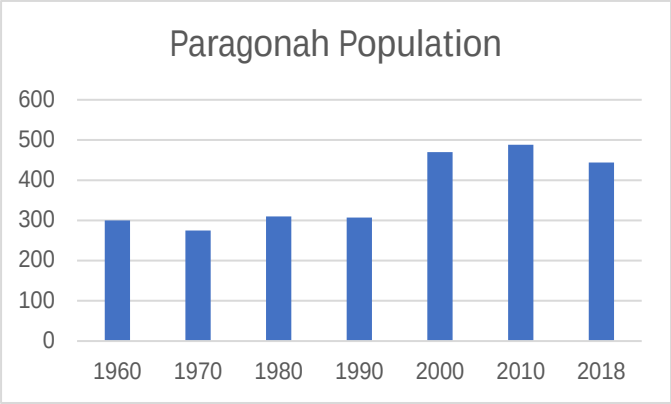


Figure 212: Paragonah Population by Decade

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Paragonah, the community could see around 982 people living in the community in the next 45-years[13].

Economy

Figure 213 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool. Wholesale trade is a large portion of the local jobs in Paragonah, followed by construction jobs. Given the population, it is likely that some residents commute out of Paragonah for work, evidenced by the OnTheMap Tool, which estimates that 96 people live in the community and are employed outside the community.

[13] This estimate is created using the 2015 ACS population estimate for Paragonah, which was 543, and adding 81% of this population to the estimate for that year.

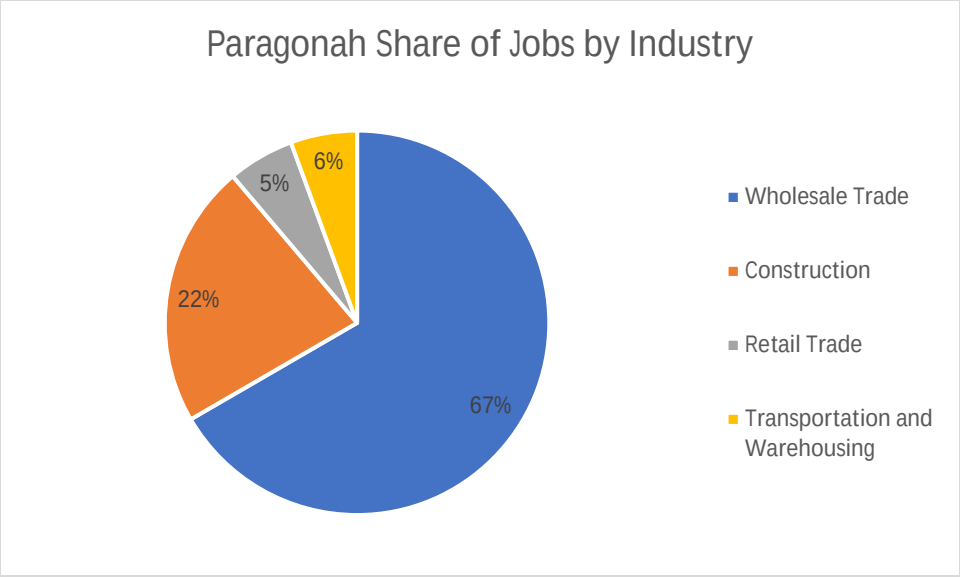


Figure 213: Paragonah Share of Private Primary Jobs by Industry

Source: US Census Bureau, OnTheMap, 2021.

Development

The community has experienced minimal significant development. A development moratorium was in place until 2019 which only permitted two building permits annually. Since 2019, some new homes have been built within the town limits and there have been two small annexations of lots which overlapped the town-county boundary.

Several new roads have been created or are planned for to address local concerns with access and isolation of certain neighborhoods. A grass fire prompted the creation of a dirt road through a private landowner's field for evacuation purposes. This road is cleared annually by the town. Other considerations include the deeded right of way from the recently annexed lots, where property owners agreed to the creation of a new road to create a secondary entrance/exit to the neighborhood.

Community Capabilities

Paragonah is governed by an elected council and mayor, who consider community needs and recommendations from town staff in making policy for the town. Town staff include a clerk, treasurer, town electrician, and public works.

The Town provides power & water utilities to residents. The town does not have sewer systems. Natural gas is provided by Dominion Energy and communication services are provided by major cellular and internet providers. Fiberoptic lines are in the community, running along Highway-91. This is a challenge as a natural gas line is located on one side of the line and a flood channel is on the other.

Parowan City Police are contracted to provide law enforcement services in Paragonah. The Intermountain Health Care based Gold Cross Ambulance provides emergency medical services to the area. The town supports a volunteer fire department who also act as first responders, and several maintain a wildland forestry certification.

Plans and Policies

Town's transportation masterplan in process of being updated and is considering need for additional roadways and access points for community safety.

Flood plan -

Annexation plan - form requires that they consider flood utilities habitat protected wildlife, slope prior to their review with planning and zoning.

Subdivision ordinance – 1985 with updates 2007 updating

General plan -

Zoning ordinance -

Risk Assessment

Paragonah is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Paragonah planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 234 describes the relative risks of hazards in the community.

Table 234: Paragonah Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. High
WILDFIRE	4. High
EARTHQUAKE	5. Moderate
RADON	6. Moderate
PROBLEM SOIL	7. Low
LANDSLIDE	8. Low

A detailed description and mapping of each of the natural hazards that impact Paragonah can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Paragonah include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Paragonah has not experienced a large fire near the community, however they were impacted by flooding and landslides following the Brian Head Fire in 2017. The community is located near wildlands and open space at the base of the Hurricane Cliffs.

Figure 214 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Iron County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Paragonah experiences moderate to extreme risk to wildfires along major roadways accessing the community, where community assets exist.

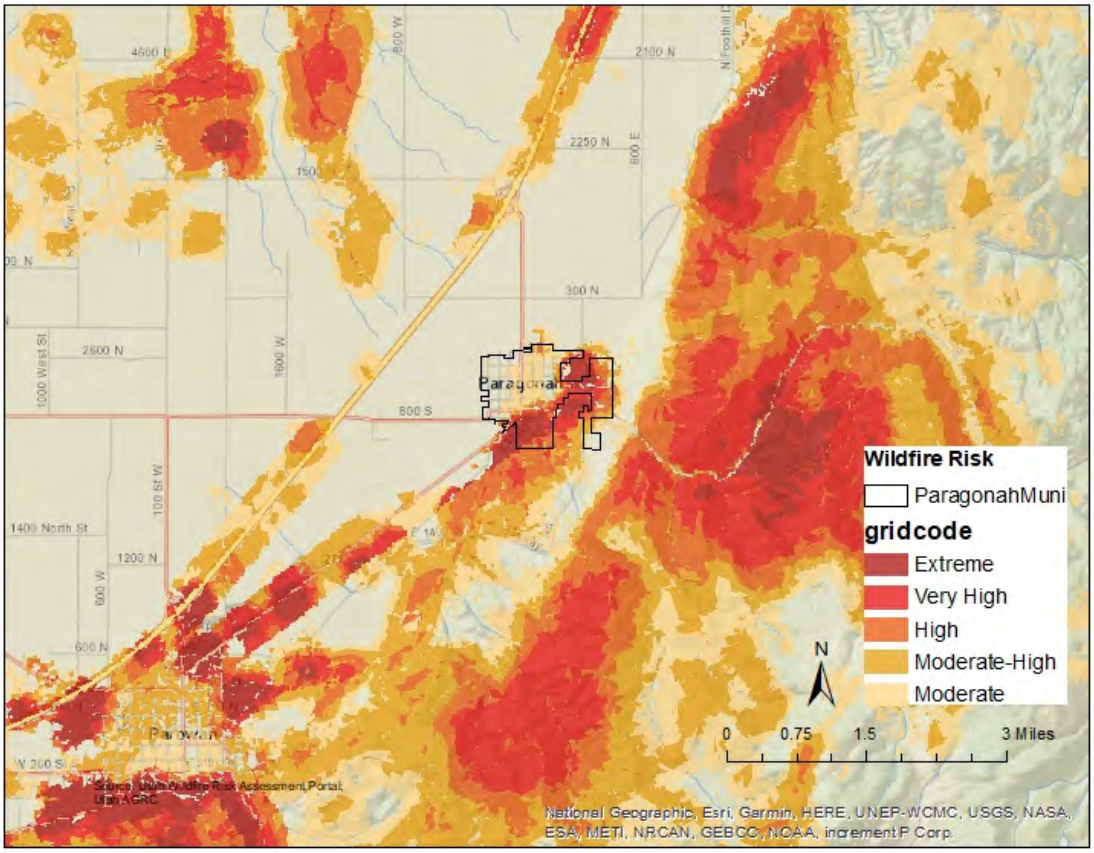


Figure 214: Paragonah Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 235 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels and miles of roads in Paragonah. Wildfire that impacts transportation infrastructure can cause delays in transportation of goods, emergency response, and travel through the region. The large number of

commercial and residential parcels exposed can lead to property damage, economic losses, and personal injury or death if impacted by a wildfire event.

Table 235: Paragonah Wildfire Risk

Paragonah Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	100.0%	73.2%	73.3%	29.1%%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

Paragonah has not experienced wildfire events that have impacted the community directly. The recent Brian Head Fire was designated as a FMAG fire in 2017. The Brian Head fire of 2017 caused widespread damages, and evacuations in Iron and Garfield Counties. Following the blaze, flash flooding and debris on the burn scar caused damages to roadways, structures, and the landscape, which also impacted Paragonah.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Paragonah, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 215 shows the mapped quaternary faults and recorded earthquake epicenters near Paragonah. The closest earthquake epicenter greater than 4.0 magnitude was recorded approximately 16 miles from Paragonah, near the Iron County border. The Paragonah Faults lie to the east and the south of the community.

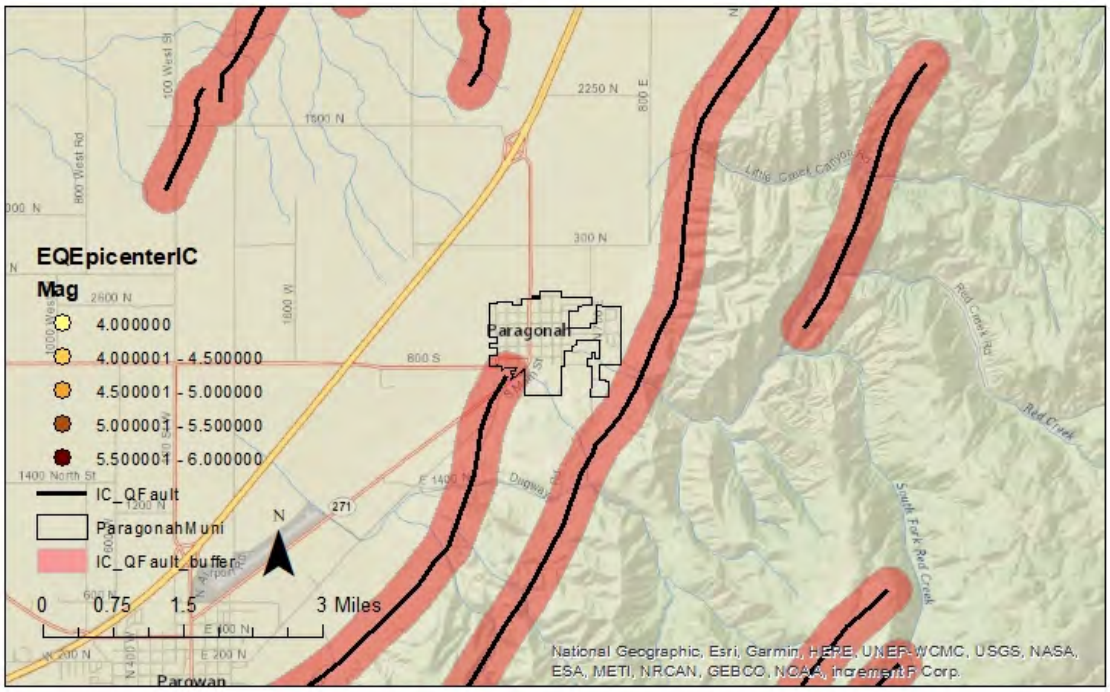


Figure 215: Paragonah Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Two faults are located within a quarter mile of Paragonah and may infrastructure and assets. The summary of the Five County assessment can be found in Table 236**Error! Reference source not found.**. Shaking during an earthquake event can be felt and cause impacts miles away from the source, not just a quarter mile of a fault. Assets more than a quarter mile distance from a fault line are still at risk to earthquakes. Road miles and parcels see the greatest exposure to quaternary faults, which can shift with ground movements, damaging infrastructure.

Table 236: Paragonah Exposure within a Quarter Mile of Quaternary Faults

Paragonah Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	9.2%	9.2%	9.3%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Iron County Assessors data does not include dates for construction on a parcel as of the 2019 assessment. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. It is likely that Paragonah has structures which were constructed before 1975 in their community. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. Paragonah does not have recorded earthquakes greater than 4.0 magnitude in the town boundaries. It is likely that the community has experienced shaking from smaller events, or event outside of the town boundary. The 1992 earthquake in Washington City produced ground shaking in Cedar City, which is approximately 45 miles away.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Brian Head.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 216 depicts the flood and dam inundation exposure in Paragonah. Dam inundation is a possible flood risk in Paragonah, with waters flowing down Red Creek, as described in the map.

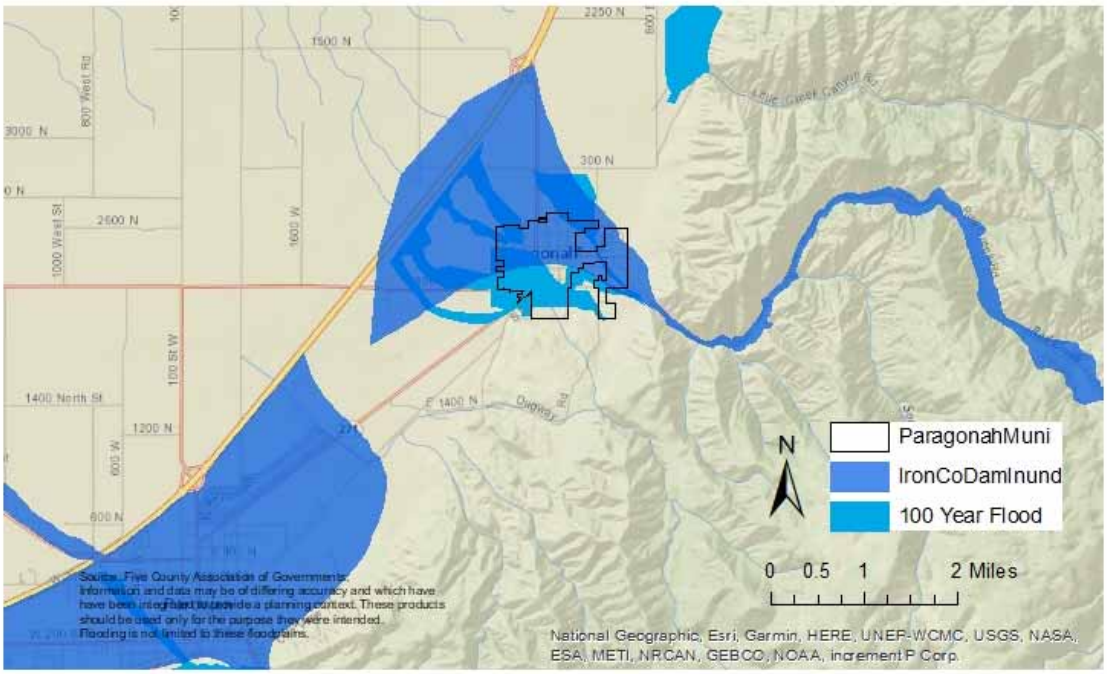


Figure 216: Paragonah Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

The share of community assets that fall in a mapped floodplain or dam inundation zone is notable in Paragonah, as described in Table 237. Over 90% of residential and commercial parcels, road miles, and critical facilities lie in dam inundation or floodplain zones. Significant community assets, property, and

infrastructure are in mapped flood risk areas and pose vulnerabilities to residents, the local economy, transportation, and the ability for emergency response in the community.

Table 237: Paragonah Exposure to Flooding and Dam Inundation

Paragonah Exposure to Flooding and Dam Inundation						
Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
100.0%	96.4%	96.4%	91.5%	N/A	N/A	100.0%

Source: Floodplain Map, Iron County Assessor, UDOT, AGRC.

National Flood Insurance Program

Paragonah property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding. Table 238 describes the NFIP participation and claims paid in Paragonah.

Table 238: Paragonah NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$376	0	0	1	$350,000	0	$0

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Flood Insurance Rate Maps were developed for Paragonah in 2005. There is only one NFIP policy in Paragonah and no claims have been paid. The town does not have a town floodplain manager and the County engineer provides floodplain management. The planning and zoning commission reviews applications for development to consider flooding concerns.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 239 describes the flooding events which have impacted Paragonah and the surrounding area.

Paragonah has received regular flooding since the 2017 Brian Head Fire as severe rain and winter run off floods the town with water, mud, and debris which has impacted town and county subdivisions and infrastructure near the mouth of the canyon. This event prompted the community to apply for flood prevention and mitigation and emergency funds to address the flood prone areas of Paragonah and Parowan canyons. Activities include digging retention basins and addressing low lying bridges.

Table 239: Paragonah Reported Flood Events

Date	Damage/Injury	Description
9/8/1997	$40,000	A five-foot wall of water washed down Red Creek into Paragonah, flooding streets, yards, and homes.
7/11/2017	None Reported	Flash flooding on the Brian Head burn scar led to a debris flow into Paragonah.
7/25/2021	Unknown	High winds, hail, and significant rain fall produced flooding across much of Iron County. In Paragonah, debris and water blocked a channel, producing flooding in a subdivision and on i-15. A power plant at the mouth of the canyon saw damage during the event.

Source: NOAA Storm Database, Local Planning Team

Only two flooding event is described in the NOAA Storm Database, one of which occurred following the Brian Head fire. It is possible that other flooding events have occurred, which have not been documented in hazard event histories.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 217 maps landslide susceptible areas in eastern Iron County.

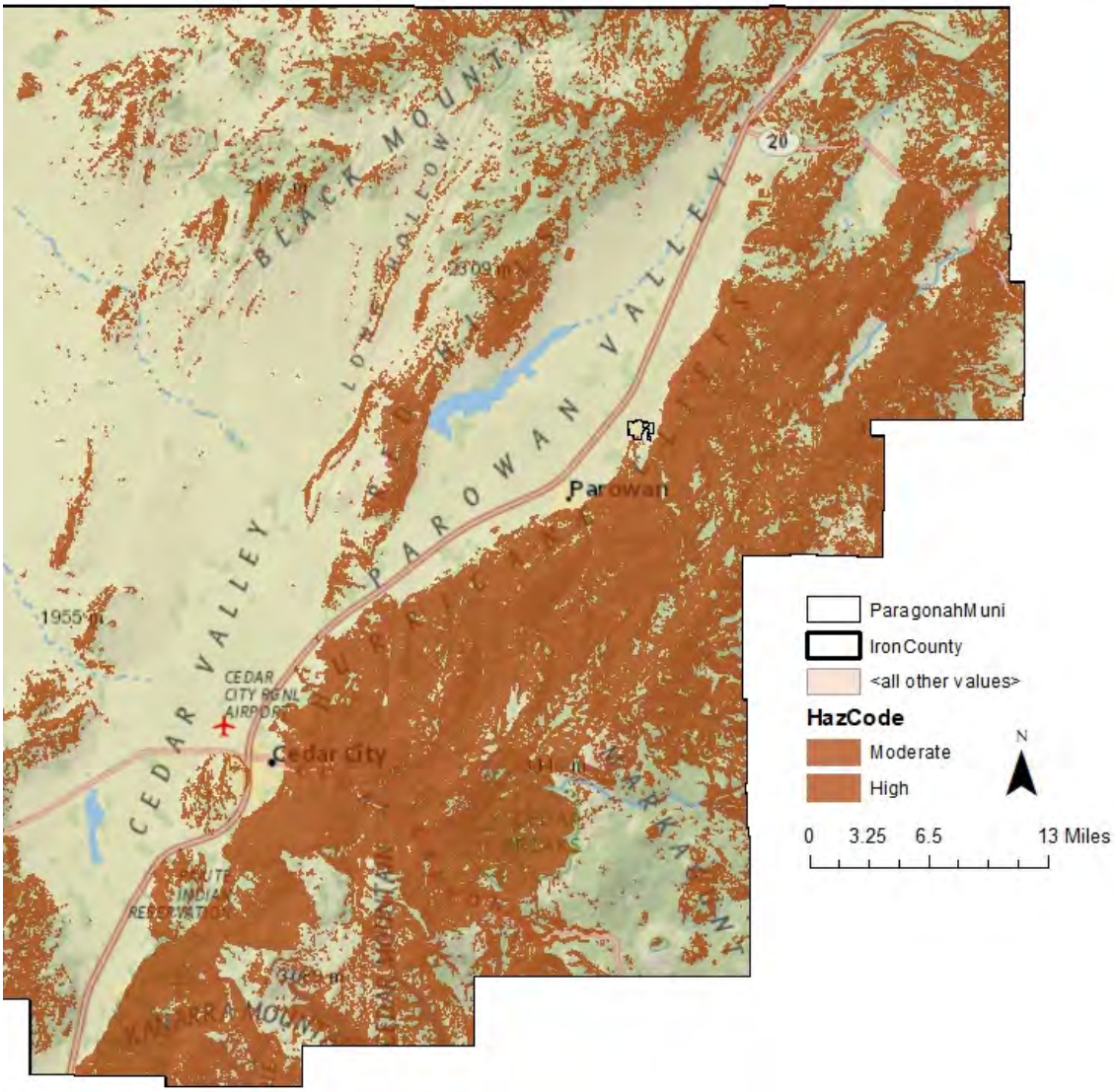


Figure 217: Paragonah Landslide Susceptibility

Source: Utah Geological Survey

While landslide susceptible areas are not mapped in Paragonah, susceptible areas are mapped to the east and south of the community, along the Hurricane Cliffs. Table 240 describes the low exposure of community assets to landslide susceptible areas. While the community does not have any mapped landslide susceptible areas in the town boundary, severe weather or flooding events could increase landslide risk or place existing structures at greater landslide risks. Future growth in the community could place new construction in susceptible areas.

Table 240: Paragonah Landslide Susceptibility Exposure

Paragonah Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

Paragonah has not experienced landslide events within the town boundary. Debris flows experienced from flash flooding are documented in the flooding section of this chapter.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Iron County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 218. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

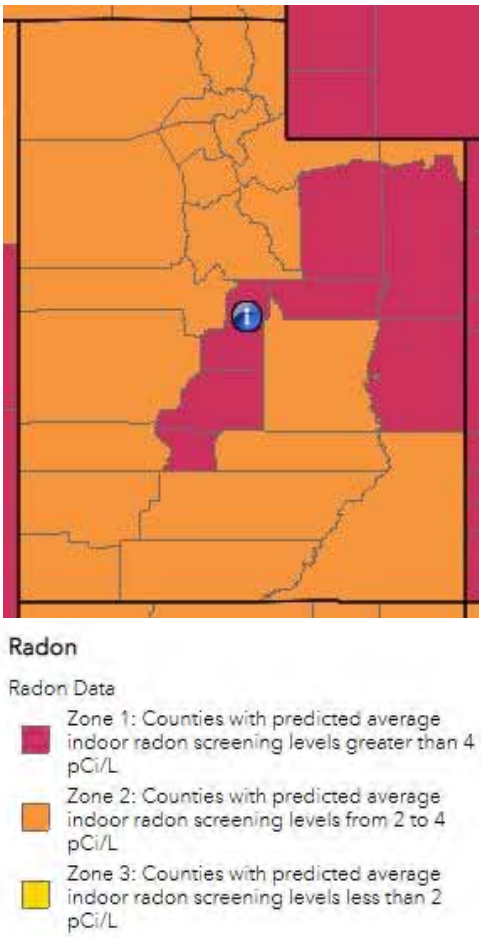


Figure 218: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 241 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 241: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Paragonah, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Paragonah has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms are the weather hazard that frequently impact Paragonah, which can produce hail, high winds, rain, and lightning. Impacts from these events can include damaged windows, roofs, downed trees, and powerlines, traffic accidents, impacts to outdoor recreators, and other local impacts.

Hazard History

NOAA reports that there have been 252 severe weather events in Southwestern Utah and Iron County between 1950 and 2020. Five of these events had direct impacts on Paragonah, resulting in damage or injury which is documented in Table 242. Paragonah experiences winter and thunderstorms seasonally. While damages or injury are often not reported, it is likely that these events impact travel and access. Severe winds and winter storms are common to this area and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Paragonah, the area likely saw extreme heat during these events which could cause impacts on residents and visitors.

Table 242: Paragonah Severe Weather Record

Date	Damage/Injury	Description
10/15/1998	$100,000	Paragonah received 9-10 inches of snow during a severe winter storm.
4/15/2002	None Reported	A windstorm caused Statewide impacts, including multiple car accidents caused by windblown dust obstructing vision on I-15 near Paragonah.
3/9/2006	None Reported	13 inches of snow was reported in Paragonah following a severe storm.
1/6/2008	None Reported	A winter storm dropped 8 inches of snow in 12 hours in Paragonah.

7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/8/2013	None Reported	A winter storm left 17 inches of snowfall in Paragonah.

Source: NOAA Storm Database

Severe weather will continue to impact Paragonah as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Paragonah does not have mapped problem soils in the community, as described in Figure 219, which illustrates where the Utah Geological Survey has mapped problem soils for Iron County. Several communities in the region describe challenges with clays and other problem soils. It will be important to recognize the extent of local experience with problem soils and challenges they have caused to development to adequately understand the potential risk to Paragonah. As of this writing, Paragonah has not described local experiences with problem soils.

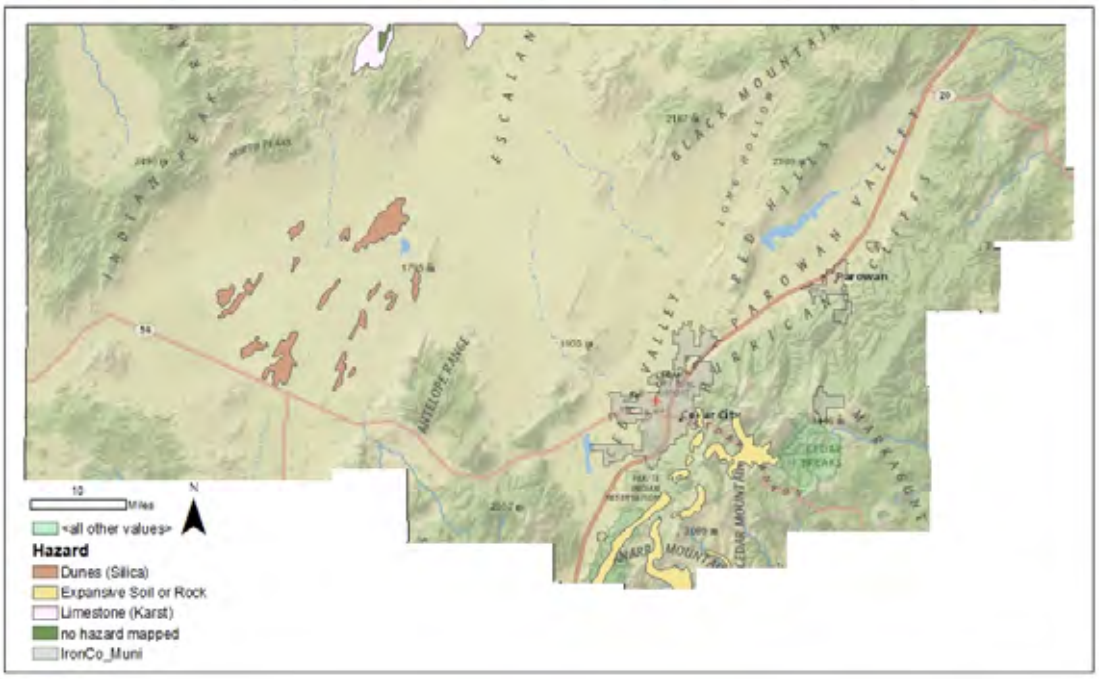


Figure 219: Iron County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Paragonah is at risk to wildfire, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities include potential economic impacts from supply chain delays, access, or traffic impacts, impacts on the tourism industry, residents, and property in the area following a natural hazard event. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, severe weather, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

Paragonah has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 243 describes progress made on the Paragonah mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 243: 2016 Paragonah Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Protect homes from Red Creek Flood Waters.	Expand the existing Red Creek floodway from the mouth of the canyon to west of I-15. Iron County is responsible from the mouth of the canyon to the town boundary and again after it leaves the town boundary to west of I-15. Paragonah is responsible within the town boundary.	5-years	Utah Army National Guard 115th Engineer Battalion, 348 East Main street, Lehi, UT will contribute equipment and personnel but no ash outlay, Iron County and Paragonah town will purchase materials. Federal loans and grants as available.	In progress, still needed.

Source: 2017 Five County Association of Governments NHMP

The Paragonah planning team identified actions to include in the community mitigation strategy. Each action in Table 244 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 220: Regional Plan Goals.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 220: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Paragonah has assembled several actions, addressing each of the natural hazards that they are at risk to. The town has only identified actions for flood which have been significant in the past several years.

Table 244: Paragonah 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2, 4	Protect homes from Red Creek Flood Waters.	Expand the existing Red Creek floodway from the mouth of the canyon to west of I-15. Iron County is responsible from the mouth of the canyon to the town boundary and again after it leaves the town boundary to west of I-15. Paragonah is	H	5-years	H	Utah Army National Guard 115th Engineer Battalion, 348 East Main street, Lehi, UT will contribute equipment and personnel	Paragonah Town, Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			responsible within the town boundary.				but no ash outlay, Iron County and Paragonah town will purchase materials. Federal loans and grants as available.	
Flood #2	1, 2, 6	Identify flooding vulnerabilities in Paragonah Canyon	Complete planning and assessment for flood mitigation needs in Paragonah Canyon.	M	5-years	L	Paragonah Town, Iron County	Paragonah Town, Iron County
Flood #3	1, 2	Identify and address underperforming stormwater infrastructure.	Increase capacity of retention basins, culverts, and stormwater drainage systems	M	Ongoing	M	USDA, CDBG, CIB, Paragonah Town, Iron County	Paragonah Town, Iron County

Source: Local Planning Team

Parowan

Parowan is the Iron County seat. The community is located on I-15 in the northeastern County between Paragonah and Cedar City, with Brian Head Town to the east. The community is considered the first settlement of southern Utah by Mormon Pioneers in 1851. The area is also the traditional lands of native peoples before pioneer settlement, evidenced by the artifacts and petroglyphs found near the community.

Parowan has access to outdoor recreation and tourism, with the only year-round route to Brian Head through the community. Other area amenities include the Dixie National Forest, Bryce Canyon National Park, and Cedar Breaks National Monument.

Demographics

As of the 2018 American Community Survey, Parowan has a population of 2,965 people. Comparing to previous documented census', Parowan's population experienced steady growth since 1960, with growth over 20% from 1970 to 1980 and 1990 to 2000 Figure 221: Parowan Population by Decade illustrates the change in population in Parowan. The 2020 census was not available to include at the time of this writing.

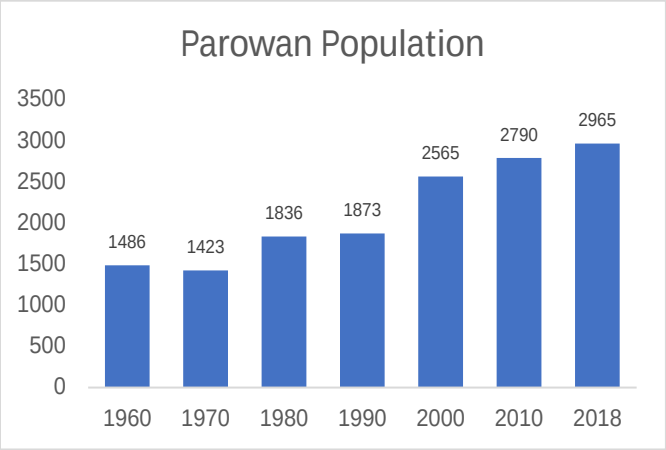


Figure 221: Parowan Population by Decade

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Iron County is expected to see an 81% increase in population between 2015 and 2065. If applied to Parowan, the community could see around 2,172 people living in the community by 2065[14].

Economy

At the time of settlement by pioneers it was noted that the area was rich with resources, including water, timber, and Iron. Mining, milling, and agriculture were likely industries prominent to the community at the turn of the century. Figure 222 describes an analysis of the current share of jobs by industry from the US Census Bureau OnTheMap tool. Retail trade, construction, and manufacturing are significant portions of the local economy. In contrast, mining, occupies a small share of the economy comparatively. Agriculture, forestry, fishing, and hunting are still approximately 10% of the jobs locally, which points to this industry being retained locally.

[14] This estimate is created using the 2015 ACS population estimate for Parowan, which was 2,858, and adding 81% of this population estimate to the population for that year.

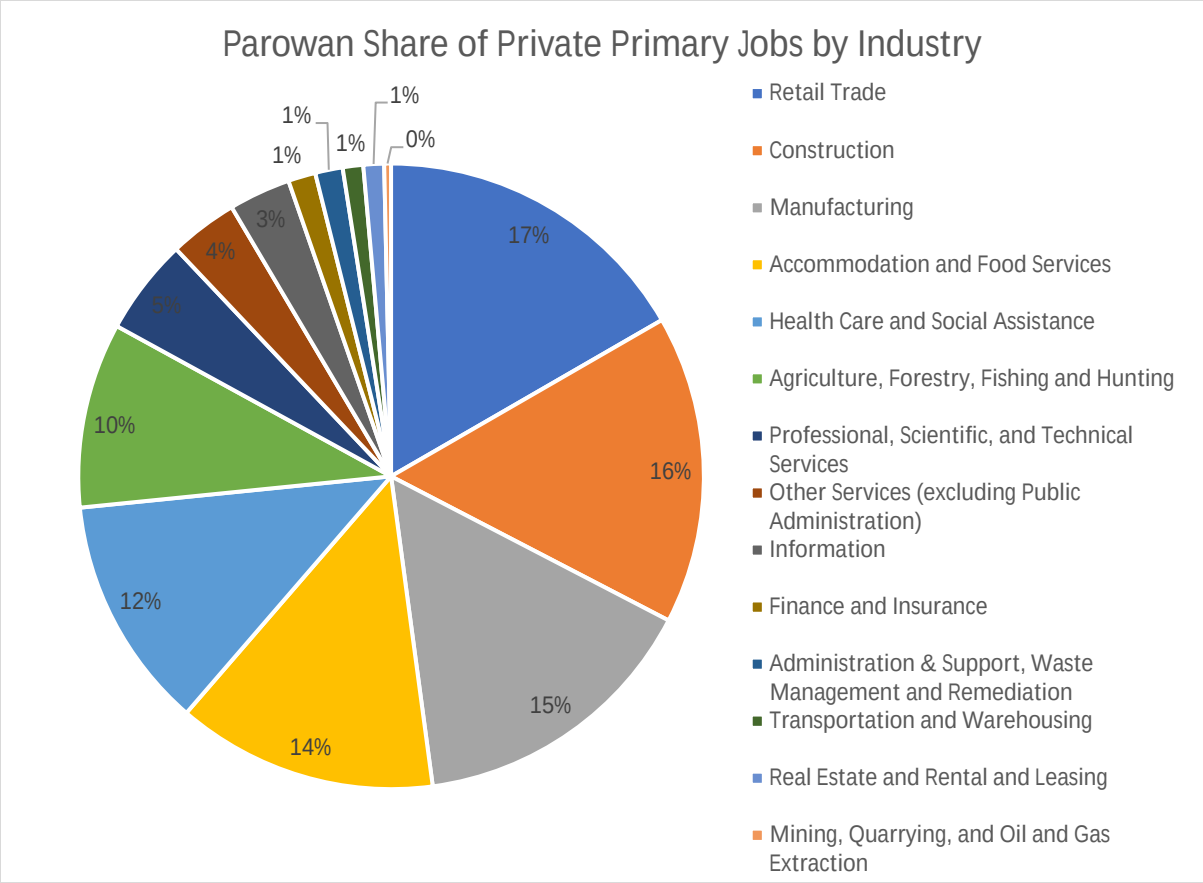


Figure 222: Parowan Share of Private Primary Jobs by Industry

Source: US Census Bureau, OnTheMap, 2021.

Development

In Parowan there have been no new subdivisions in the past 3-5 years with minimal development of homes. The City did recently annex 29-acres which is planned as an RV park near 200 South.

Community Capabilities

Parowan is governed by an elected council and mayor, who consider community needs and create policy for the town. Several boards and comities provide recommendations to the council on decisions and make decisions for the community. Boards include:

- The Airport Board
- Board of Adjustments Committee
- Library Board
- The Economic Development Committee
- Parowan Theater Board
- Planning and Zoning Committee
- Power Board
- Shade Tree Committee
- Water Board

The Parowan Chamber of Commerce connects the needs of businesses with the larger community. Members receive advertising on Chamber websites and printed materials, and receives business trainings, and access to other chamber resources. The chamber also provides advocacy to local and state leaders on issues which may impact business.

Parowan City staff provide administrative and community services which implement decisions made by Council. In addition to the administrative roles in the government, Parowan supports several public safety departments, including police and fire response.

Parowan provides water, electric, sewer, and garbage/recycling services locally. Gas utilities are provided by private companies to residents.

Plans and Policies

Parowan has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. This section provides an overview of Parowan plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

General Plan

The General Plan for Parowan City was completed in 2015 but was not made available for review for this plan update.

Planning and Zoning Code

The planning and zoning code for Parowan City indicates development requirements and policy related to natural hazards. Policies address landslide, flood, wildfire, problem soils, and drought hazards. Policies addressing natural hazard risks seek to protect the health safety or general welfare of the community. Parowan code describes building standards, uses of land, reporting, mitigation, and other requirements which may be required of new development if a natural hazard has been identified on a site. Discussion with a planning official from the City to identify requirements for a given site.

Risk Assessment

Parowan is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Parowan planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 245 describes the relative risks of hazards in the community.

Table 245: Parowan Hazard Risk

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. High

SEVERE WEATHER	3. Moderate
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Moderate
RADON	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Parowan can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Parowan include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Parowan has not experienced a large fire near the community since the last iteration of this Natural Hazard Plan, but the community is still at risk to wildfire. The area is located near the Hurricane cliffs, which have forested areas which can ignite, especially as the area has been in a nearly 20-years of extended drought conditions.

Figure 223 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Iron County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Parowan experiences moderate to extreme risk to wildfires throughout the community and in the area surrounding the City, as described in Figure 223.

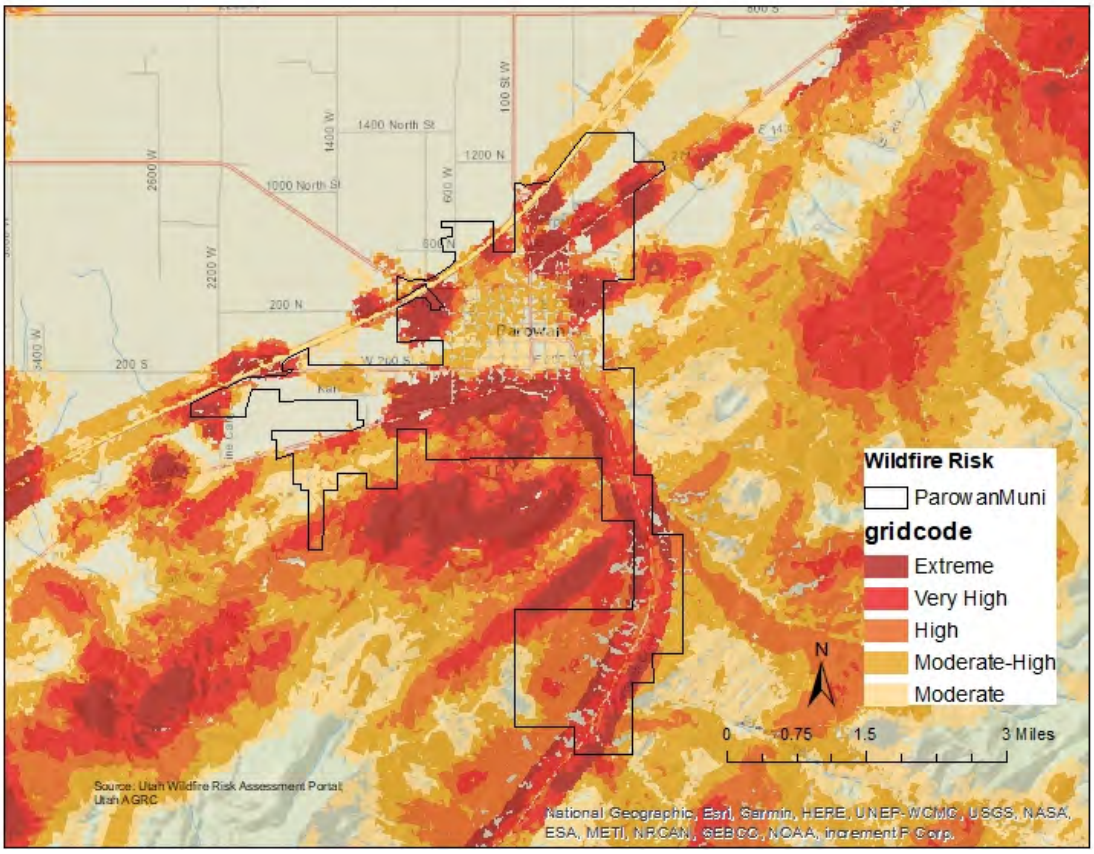


Figure 223: Parowan Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 246 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels, critical facilities, and miles of roadway in Parowan. A medical clinic is an identified critical facility in areas considered moderate to extreme risk to wildfire inside the city boundary. A high percentage of residential parcels are in areas of wildfire risk. Wildfire that impacts transportation infrastructure can cause delays in transportation of goods and travel through the region.

Table 246: Parowan Wildfire Risk

Parowan Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
12.5%	69.1%	92.5%	90.8%	33.3%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

Hazard History

This plan references the Utah Wildfire Info database, which tracks recent wildfires from 2017 and fires designated under Fire Mitigation Assistance Grant program from FEMA. While there are no wildfire events which directly impacted Parowan with a fire threat, the Brian Head fire from 2017, detailed in Table 247, had long term impacts on Parowan. Following the fire suppression efforts, Parowan

experienced debris flows, landslides, and flash flooding from the burn scar which flowed into the community and blocked roadways.

Table 247: Iron County FMAG Designated Fires

Fire Name	Year	Acres Burned	Description	Counties Affected
Brian Head Fire (FM-5185-UT)	2017	71,675	26 homes & minor structures destroyed. 1,562 people were evacuated from 11 communities. Impacted sage grouse habitat.	Iron and Garfield Counties.

Source: FEMA

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Parowan, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 224 shows the mapped quaternary faults and recorded earthquake epicenters near Parowan. The closest earthquake epicenter to Parowan was recorded approximately 14 miles away, near Cedar City

and had a magnitude of 4.05 and occurred in 1943. Several faults are mapped in and around Parowan, including the Markagunt Plateau and Paragonah faults.

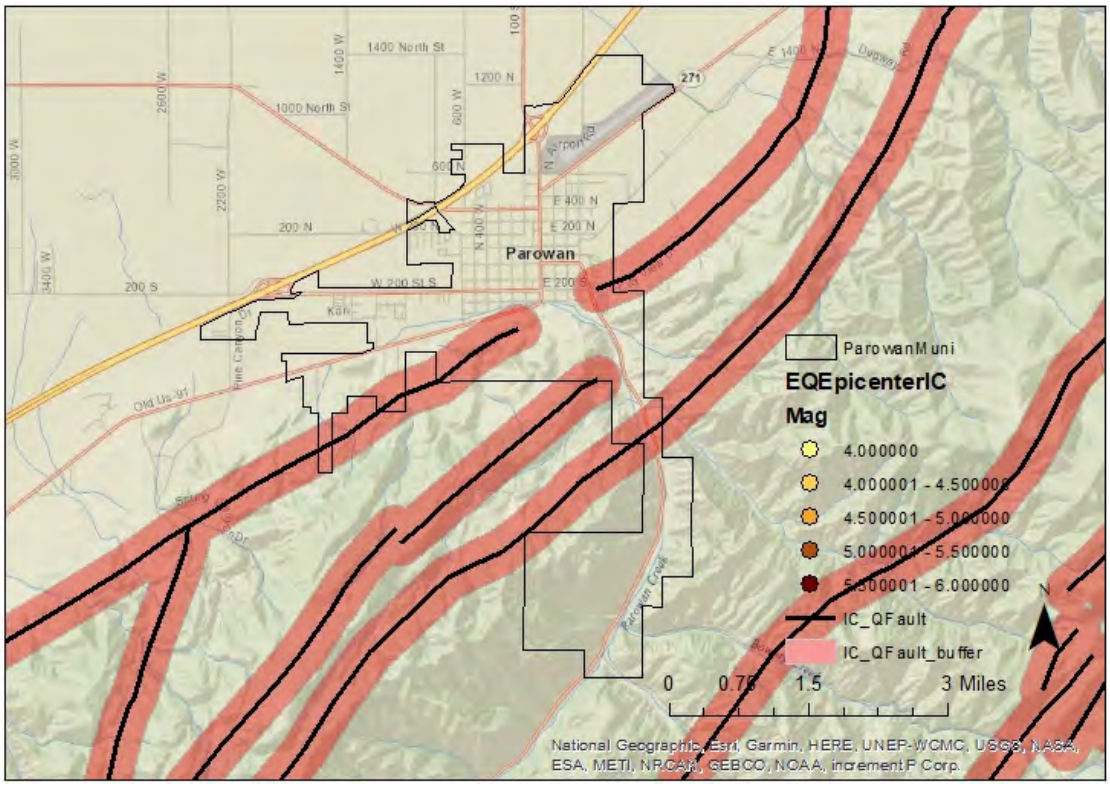


Figure 224: Parowan Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Mapped faults run through Parowan City, as observed in Table 248, and likely interact with assets and infrastructure. Assets are located within a quarter mile of quaternary faults, however shaking can be felt and cause impacts miles away from the source. Assets more than a quarter mile distance from a fault line are still at risk to earthquakes. Road miles and parcels see the greatest exposure to quaternary faults, which can shift with ground movements, damaging infrastructure.

Table 248: Parowan Quaternary Fault Exposure

Parowan Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	1.8%	10.8%	10.2%	8.5%	N/A	N/A

Source: Oregon Department of Forestry, Garfield County Assessor, Utah AGRC.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Iron County Assessors data does not include dates for construction on a parcel as of the 2019 assessment. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater

Parowan does not have recorded earthquakes in the municipal boundaries but can experience shaking from events elsewhere in the region. Severe earthquakes are less frequently occurring, but when can cause shaking, damages, and other impacts over a large area from the epicenter. An example being the 1992 earthquake from Washington City, which caused shaking and damages in Cedar City.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Parowan, but more information about liquefaction can be found in the Hazard Identification chapter.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain or winter snow melts off with warming summer temperatures. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. As Illustrated in Figure 225, Parowan has inundation concerns from dam failure and exposure to the mapped, 100-year floodplain in the community.

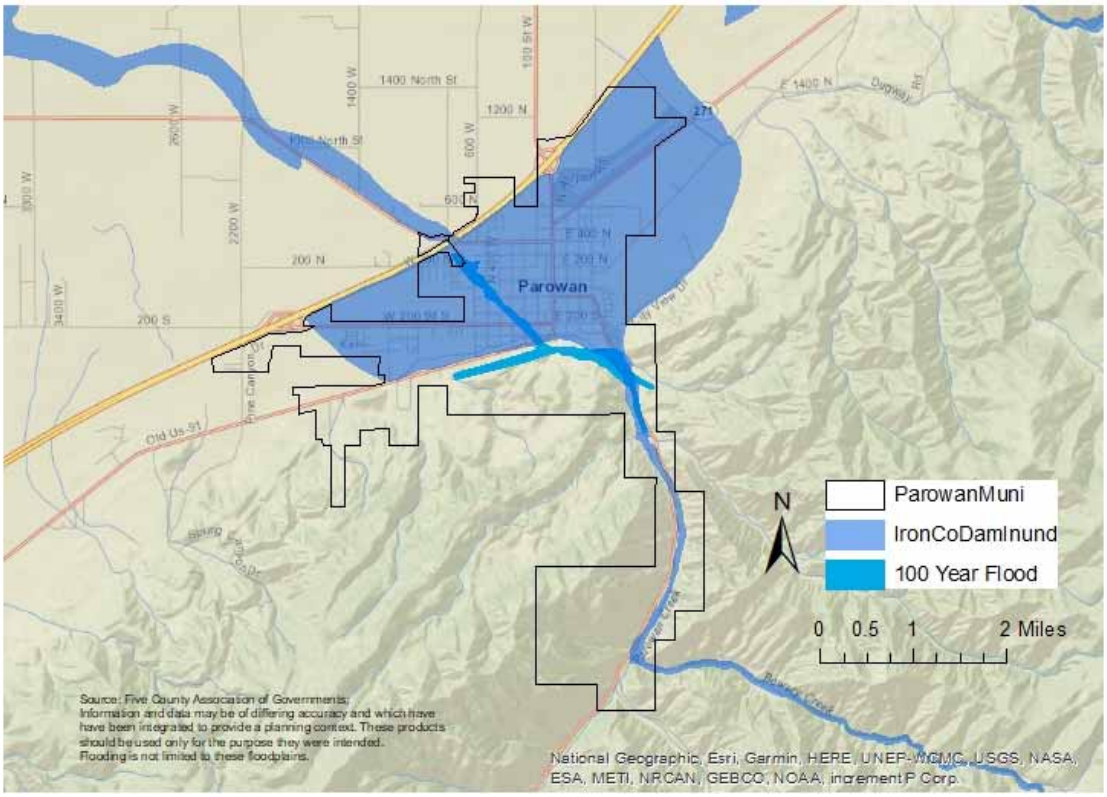


Figure 225: Parowan Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 249 summarizes the community assets and infrastructure exposure to floodplain and dam inundation areas. As evidenced by the map and this summary, Parowan has significant exposure to areas at greatest risk to inundation from a flood event. Critical facilities in inundation areas may see their facility and ability to respond impacted by a flood or inundation event, which can impact the rest of the community with delayed responses in an emergency event. Parowan's critical facilities exposed to mapped flood and inundation areas include schools, police station, fire station, and medical clinics. Parcels and miles of roadway are also identified in flood and inundation areas, which present potential impacts to the local economy and transportation throughout the community.

Table 249: Parowan Exposure to Flooding and Dam Inundation

Parowan Exposure to Flooding and Dam Inundation						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
100%	96.4%	93.4%	93.7%	70.2%	N/A	N/A

Source: FEMA, Iron County Assessor, UDOT, AGRC.

National Flood Insurance Program

Parowan property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Parowan's Flood Insurance Rate Map effective date is March of 1986, and the community has participated in the NFIP since that date. Table 250 summarizes the community participation in NFIP. There are only six policies in the community, with one claim paid. No repetitive losses have been reported to the NFIP. The community received a Community Assistance Contact (CAC) from FEMA in October of 2019.

Table 250: Parowan NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$3,898	0	1	6	$1,565,000	1	$31,957

Source: FEMA NFIP Insurance Report, 2020; Repetitive Losses/BCX Claims, 2020.

Iron County and the State of Utah is working through the RiskMAP program to update flood maps throughout the County. The completion date for this updated mapping has not been determined.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms,

which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 251 describes the flooding events which have impacted Parowan and the surrounding area.

Table 251: Parowan Reported Flood Events

Date	Damage/Injury	Description
7/9/2001	None reported	Debris flowed over the highway through Parowan Canyon, sandbags were used to protect homes.
8/23/2003	$30,000	Highway 143, southeast of Parowan saw flash flooding and rockslides. Later that day, flash flooding was experienced in Parowan. 26 homes were flooded and recreators were stranded at the Yankee Meadow.
8/17/2007	None Reported	Heavy rains closed Highway 143 between Parowan and Brian Head.
8/18/2010	None Reported	1.5 to 2.0 inches of rainfall near Parowan caused flash flooding on SR-143. Two feet of water and debris was reported on the road.
9/11/2013	$10,000	A rockslide and flash flood closed Sr-143 between Parowan and Brian Head with boulders on the road.
8/6/2017	$50,000	Rain on the Brian Head Fire burn scar inundated SR 143, Old Highway 91, and Northbound I-15. Both I-15 and SR 143 were closed to clear debris from roadways. Parowan was also flooded during this event, causing damage to homes.
8/20/2017	None Reported	Flooding on Parowan Creek spilled over I-15, closing the right-hand northbound lane.

Source: NOAA Storm Database

While weather events have historically impacted Parowan with floods and debris flows, incidents increased in the year following the Brian Head Fire, impacting roadways and structures down the mountain from the fire. Roadways and major connecting highways are regularly impacted by flooding, making roadways impassible with water and debris. Some impacts may have required reconstruction and repair of the roadway following a flood event. Homes and structures have also been impacted by flooding in the past.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which may influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 226 maps the landslide susceptible areas in Parowan. The Eastern portion of the County, which includes Parowan, is susceptible to landslides.

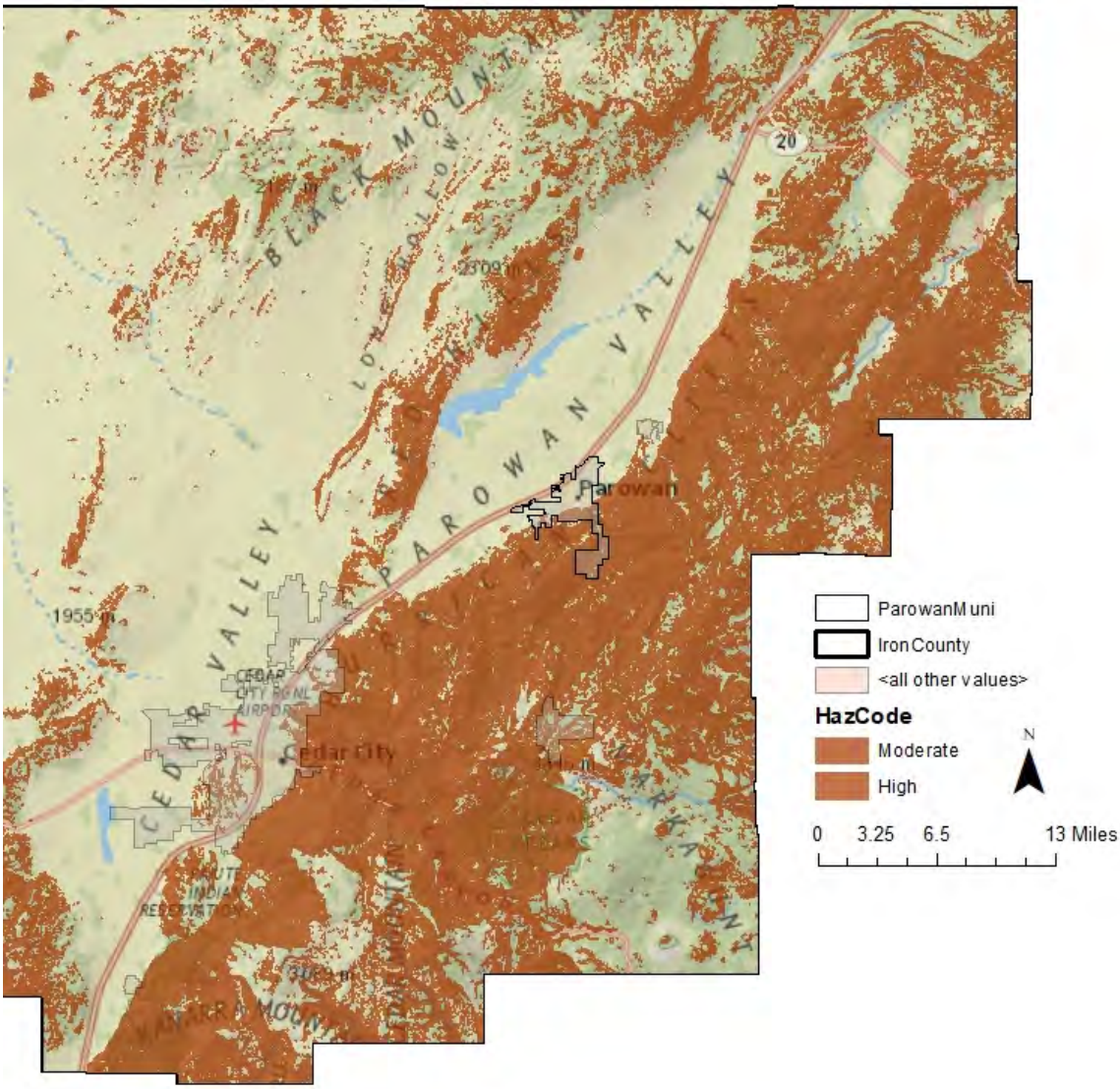


Figure 226: Parowan Landslide Susceptibility

Source: Utah Geological Survey

Parowan is exposed to landslide susceptible areas, particularly on the southern portion of the community. Table 252 describes the exposure of certain community assets to landslide susceptible areas. Roadways are the most exposed to landslide susceptible areas, with 7.4% of road miles exposed. Landslides on the roadway have the potential to separate communities from resources, goods, and access to the rest of the County and would affect residents, especially if the roadway is inaccessible for an extended period. Landslides on busy routes or connecting routes increase the potential for impacts.

Future growth in the community could place new construction in susceptible areas without proper planning.

Table 252: Parowan Landslide Susceptibility Exposure

Parowan Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	1.4%	1.3%	7.4%	N/A	N/A

Source: Utah Geological Survey, Garfield County Assessor, AGRC.

Hazard History

Landslide events have been reported in and near Parowan as debris flows and rockfall which primarily impacted the SR 143 between Parowan and Brian Head, especially following the Brian Head Fire. These events are associated with heavy rainfall and flash flooding and are reported in the Flood section of this chapter.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation are destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Iron County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 227. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

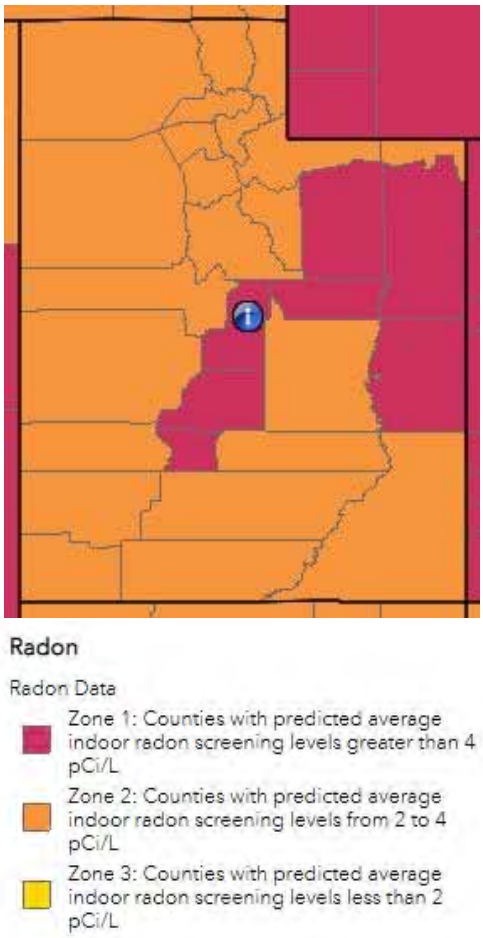


Figure 227: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 253 describes the reported findings. Across Iron County, the average test result is 2.4 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 253: Iron County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Parowan, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Parowan has a semi-arid climate, which sees annual snowfall in winter months, and summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Temperatures in the community are like Cedar City, due to the higher elevation and northernly orientation than nearby St. George. Thunderstorms are the weather hazard that frequently impact Iron County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 252 severe weather events in Southwestern Utah and Iron County between 1950 and 2020. Eight of these events had direct impacts on Parowan, resulting in damage or injury which is documented in Table 254. Severe winds and winter storms are common to this area and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Parowan, the area likely saw extreme heat associated with these events which could cause impacts on residents and visitors.

Table 254: Parowan Severe Weather Record

Date	Damage/Injury	Description
4/10/1997	None Reported	Parowan saw eight inches of snow during a storm that impacted the State of Utah.
1/10/1998	None Reported	A snowstorm dropped 3 inches of snow in Parowan.
10/15/1998	$100,000	A heavy snowstorm impacted the State of Utah, with Parowan receiving nine to ten inches of snow. Tree damage and power outages were reported associated with this event.
4/15/2002	None Reported	Heavy wind caused damage across the state of Utah, including escalating a wildfire in Parowan which forced the evacuation of residents.
6/2/2005	None Reported	High winds associated with a thunderstorm downed a tree, which damaged powerlines leading to power outage.

7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
4/25/2014	10 Injuries	High winds caused dust to blow which led to vehicle accidents on I-15 between Parowan and Beaver.
7/18/2015	None Reported	Nickel size hail was reported near Parowan during a severe thunderstorm.
12/15/2015	None Reported	A winter storm produced 16.5 inches of snow in Parowan.

Source: NOAA Storm Database

Severe weather will continue to impact Brian Head as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Parowan describes in Codes and Ordinances being aware of soil suitability and stability challenges in the community, requiring in some cases that, to use the property, a developer show that it is suitable for the soil type and geologic hazards present on the site. There is no specific ordinance detailing problem soil types present in the community. Figure 228 illustrates where the Utah Geological Survey has mapped problem soils for Iron County. Parowan does not have mapped problem soils in the community, but problem soils may still exist in the community, which could cause damages or challenges to construction.

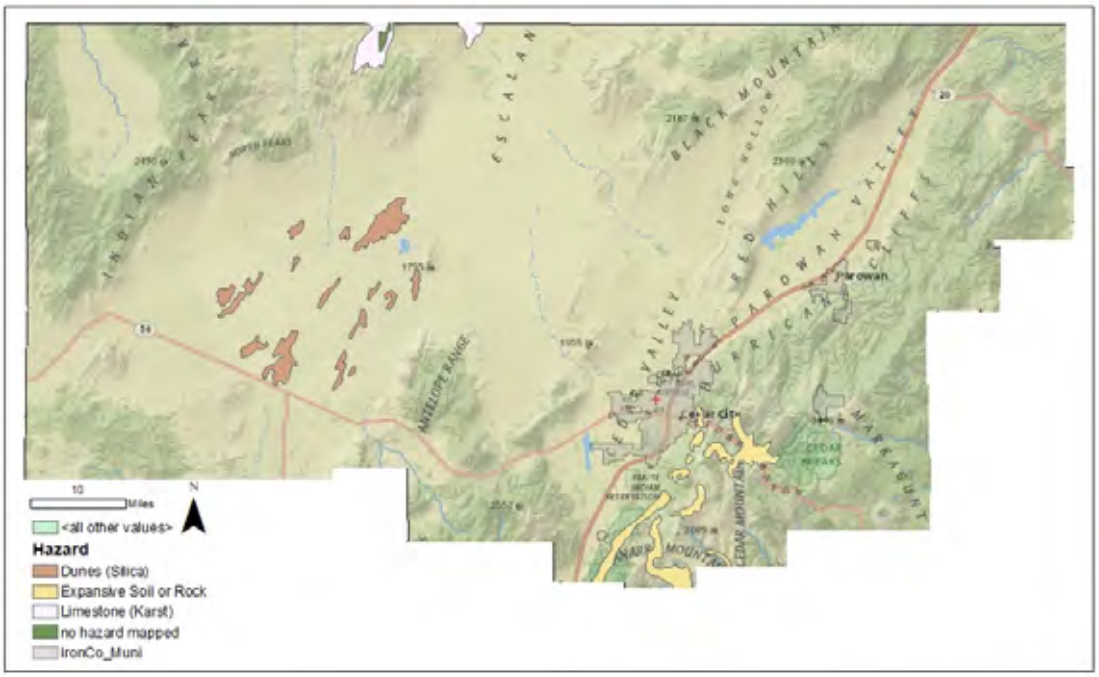


Figure 228: Iron County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region.

The community and the county do not have a record of problem soil impacts, although building permits will include a study indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Parowan is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires in the future based on the risk assessment.

Mitigation Strategy and Actions

Parowan has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 255 describes progress made on Parowan's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 255: 2016 Parowan Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Wildfire #1	Fuel's reduction and defensible space tactics.	Continue to place strategic fuel breaks throughout the focus area.	Ongoing	Local government operating budget, special service district	Removed trees and fuels.
Wildfire #2	The objective resolves managing storm drains and floodplains by increasing infrastructure.	Encourage landowner mitigation and defensible space work.	Ongoing	Local government operating budget, special service district	Unknown, but still needed.

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Parowan has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in Table 256, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

The Parowan planning team identified actions to include in the community mitigation strategy. Each action in Table 256 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

To address the risks and vulnerabilities identified in this chapter, Parowan City has assembled several actions, addressing each of the natural hazards that the community is at risk to.

Table 256: Parowan 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2, 6	Manage storm drains and floodplains by increasing infrastructure.	Replace current bridge over Parowan Creek with a new bridge to convey the 100-year floodplain.	H	5-years	H	Joint Highways Funding, FEMA BRIC.	Parowan City
Flood #2	2	Manage storm drains and floodplains by increasing infrastructure.	Sediment cleans out at City detention basin and clearing of streams	M	1-year, ongoing	M	Parowan City, Iron County	Parowan City, Iron County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	1, 2, 4, 5, 6	Fuel's reduction and defensible space tactics with focus on interior lots, including the exterior city boundaries.	Coordinate with the local volunteer fire department for fuels mitigation in the community and maintain a current fire mitigation plan with the Utah Forestry, Fire, and State Lands Division.	M	1-year, ongoing	M	Parowan City, Utah State Forestry and Fire Agency (funds provided for in-kind mitigation activities)	Parowan City, Fire Department
Wildfire #2	3	Fuel's reduction and defensible space tactics with focus on interior lots, including the exterior city boundaries.	Distribute information about fuels mitigation on personal property in Chamber of commerce welcome packets for new utility users.	M	1-year, ongoing	L	Parowan City, Chamber of Commerce	Parowan City, Chamber of Commerce
Landslide #1	6	Mitigation through natural processes.	Develop a revegetation and reseeding strategy for burned slopes in the community to prevent increased risk of flood and debris flows.	L	3-years	L	Parowan City, BLM, USFS.	Parowan City, BLM, USFS.
Drought #1	2, 6	Conserve local resources.	Replace all grass at City office with xeriscaping.	H	2-years	M	Parowan City, State of Utah	Parowan City
Earthquake #1	3	Reduce damages and impacts from earthquakes.	Inform the public of nonstructural retrofits to secure furniture and equipment.	H	1-year, ongoing annually	L	Parowan City, Iron County Emergency management	Parowan City, Iron County Emergency management

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #2	2, 4	Upgrade critical facilities and infrastructure to prevent losses.	Coordinate with the Iron County School District to assess and address seismic safety at Parowan schools, as identified in the Utah k-12 public schools URM inventory report.	M	5-years	M	State of Utah, FEMA, Parowan	Parowan, Iron County School District.
Radon #1	3	Reduce public health impacts from hazards.	Inform residents of radon testing and mitigation options.	H	1-year, ongoing	L	Parowan City	Parowan City
Problem Soils #1	1, 2	Follow local ordinances and requirements.	Continue to require soils testing prior to development in the community.	M	Ongoing	L	Parowan City	Parowan City

Source: Local Planning Team

Kane County

Kane County is located at the Utah-Arizona Border, with the Colorado River located to the east and Washington County to the west. The county has approximately 3,988 square miles of land according to the US Census Bureau. The area exists in the geographic formation known as the Colorado Plateau, marked by a series of mesas and plateaus surrounded by highlands. Streams and rivers have carved deep canyons in this region, which is seen in Kane County in spaces like the Glen Canyon Recreation Area.

Like many other southern Utah counties, Kane County includes large areas of public lands and recreation lands. State and national parks include: Grand Staircase- Escalante National Monument, Lake Powell and Glen Canyon Recreation Area, Kodachrome Basin State Park, Coral Pink Sand Dunes State Park, and Bryce Canyon and Zion National Parks. The county is remote and dominated by rural areas. There are few major access roads to the community, with the major state highways including 89, 89A, 9, and 14. Millions of visitors enter the county annually to see natural features and outdoor recreation.

Community Characteristics

Kane County has five incorporated cities and towns: Alton, Big Water, Glendale, Orderville, and Kanab, where most of the county's population lives. These cities and towns are documented in their own section of the hazard plan. The large county includes several unincorporated communities which will be addressed in the Kane County section of the plan. Unincorporated communities addressed in this section include Bullfrog and Duck Creek Village.

Economic pursuits in the community are diverse, from film and tv in Kanab, recreation, and natural resources throughout the County. Kane County has experienced changes, from population to development, which will be described in this section.

Demographics

Kane County has experienced growth countywide, described in Figure 230, with an average growth rate of 21.3%. unincorporated county has observed growth of 41.3%, showing that rural areas are experiencing growth in the county. Rapid growth was observed between 1970 and 1980 in the County, with population slowing since that time.

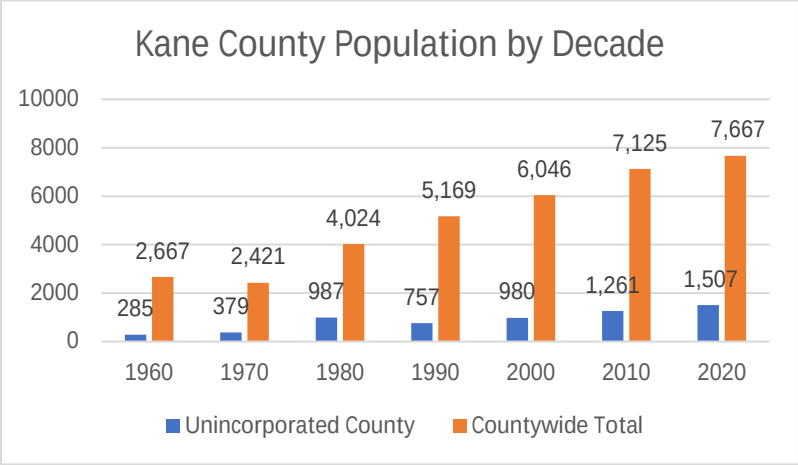
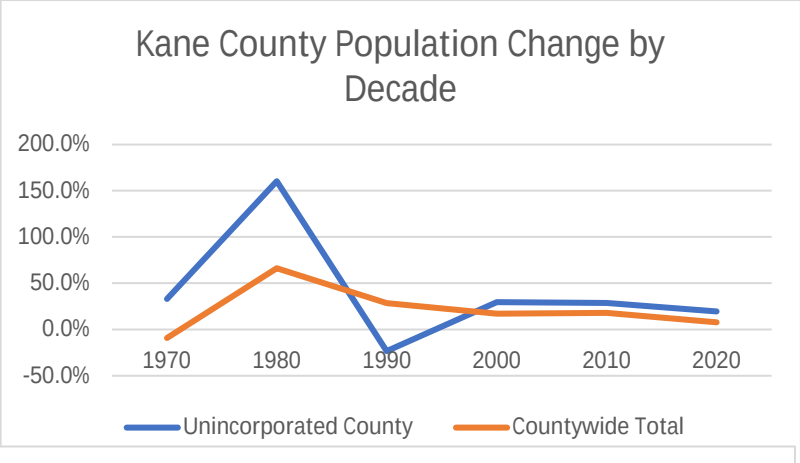


Figure 229: Kane County Population by Decade

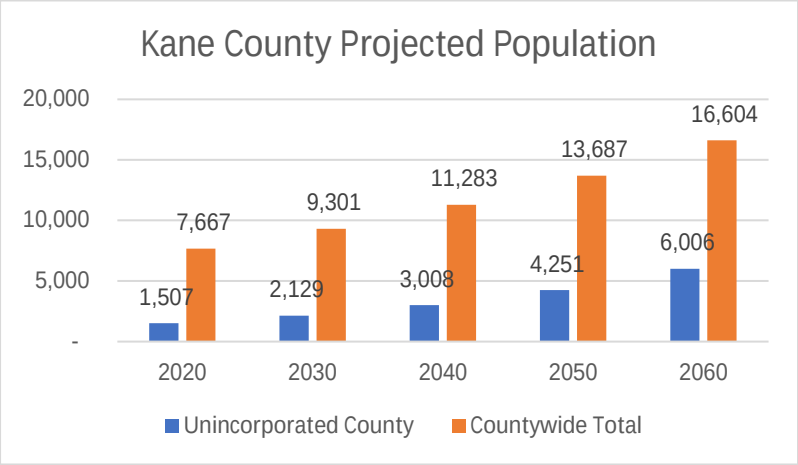
Source: US Census Bureau

The County population saw rapid change in the 1970s to 1990s, with a peak recorded in 1980. The population growth has stabilized since the 2000 census.

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population, bringing the population to an estimated 11,433 persons. (Hollingshaus, et al., 2022)



Using the average change in population for the county, the future population by 2060 was also projected. The projection is solely based on historic patterns in the County since 1970 and does not account for land availability or other metrics in the county. Figure 231 illustrates the projected population for both the unincorporated and full county total.



Geography and Climate

Kane County, located on the western side of the Colorado Plateau, encompasses approximately 3 million acres of some of the most remote and rugged lands in the United States. The county is a land of extremes in elevation, vegetation, precipitation, and landscapes. The county is divided into four broad landscapes known from northwest to southeast as the High Southern Plateaus, the Grand Staircase, the Kaiparowits Plateau, and the Colorado River Canyons. Kane County lies across four broad watersheds, all part of the Colorado River system. Less than ten percent of the waterways found within the county are perennial streams.

Steep canyons, limited water, unique and isolated geologic substrates, and large fluctuations in climatic conditions have all influenced the composition, structure, and diversity within the county. Elevations in Kane County range from less than 5,000 feet to over 9,000 feet. This wide range of elevation has marked influence on the climate of the County. Precipitation within the county varies from 7 to 18 inches annually. Winter-time precipitation varies from 4 to 12 inches and is the primary source of recharge of ground water systems. Winter precipitation is the greatest along the northwest border of the county in the higher elevations of the Paunsaugunt Plateau.

Climate, elevation, and the presence of adequate water have determined the present-day land ownership and land use patterns of Kane County. Almost 90 percent of the county land base remains in federal ownership. The land base which is privately owned is located along perennial water courses and at the base of high elevation forests. While agriculture has been an important base of economic activity

in Kane County, the total amount of land devoted to agricultural pursuits is relatively minor. However, the majority of BLM and National Forest public lands have been included in livestock grazing allotments.

Kane County is a land of contrasts. Its 4,100 square miles of territory extend from the sandstone deserts of Glen Canyon and Lake Powell to the 10,000-foot-high alpine meadows of the Paunsaugunt Plateau. Less than one percent of the county land base is located inside incorporated communities. The lack of precipitation and difficulty of access has resulted in a land use pattern which is dominated by public lands surrounding a small base of private lands. Some land in the higher elevations forest lands have been developed for recreation homes and cabins. Extensive deposits of coal and other natural resources have been the subject of numerous explorations and feasibility studies. Each of these land uses presents different challenges and opportunities.

Economy

The economy of Kane County has historically been based upon livestock grazing. The canyon country of eastern Kane County remained a sparsely settled area until the construction of Glen Canyon Dam on the Colorado River in the late 1950's. The resulting reservoir, Lake Powell, created the momentum for the establishment of several communities surrounding the lake as tourism increased in the area. Lake Powell is a world class attraction which draws millions of visitors each year and most of these visitors travel through the county to reach the lake. With Lake Powell and the Grand Staircase-Escalante National Monument partially within its border, Kane County relies heavily on tourism. The county is experiencing moderate growth by attracting additional trade and service sector activity to support growing tourist activity.

The US Census Bureau publishes data about jobs and industries in an area like Kane County. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code, illustrated by Figure 232. The data provided allows us to see which industries support the greatest share of jobs in the County. Accommodation and Food Services, Other Services, and Retail trade industries provide the largest share of jobs[15] in the County. Other services, excluding public administration, captures businesses which are involved in equipment and machinery repair, nonprofit or advocacy, personal care, pet care, and laundry service among other services. Agriculture is not represented in this data, but according to County Natural Resource documents, agricultural industry remains a portion of the county economy.

[15] The jobs are private primary jobs, or the highest paying of the jobs an individual might have, to prevent double counting of jobs.

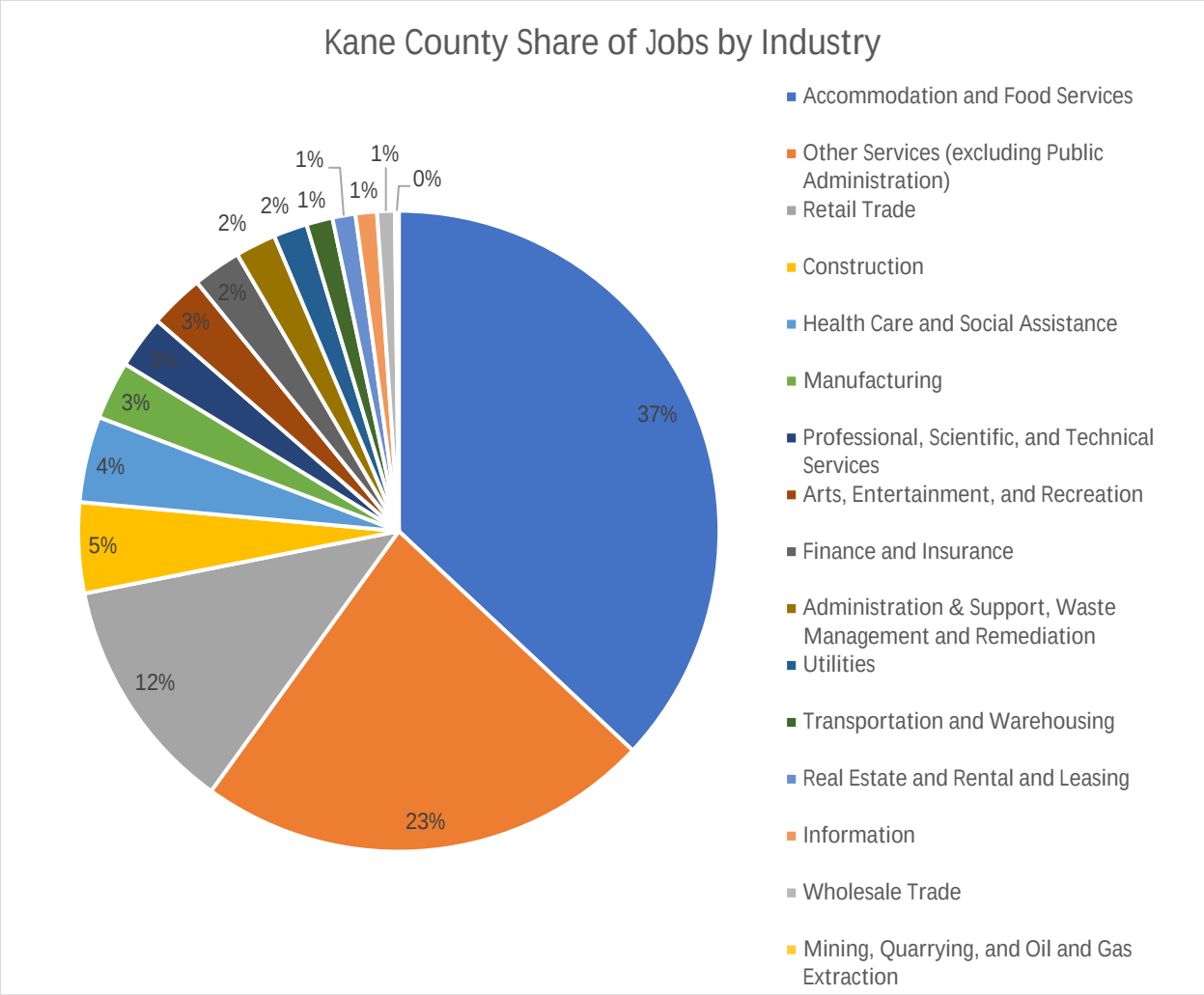


Figure 232: Kane County Share of Jobs by Industry

Source: US Census Bureau

Development

Development has been occurring largely in incorporated communities in Kane County. Applecross Station Visitors Center is a planned community near the east entrance of Zion National Park. This development will support a visitors' center, commercial center, and new trails. It will also be a location for shuttles into the park and through Kane County.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward. This plan also includes a description of the unincorporated communities in the county, to better identify challenges or problems which may exist within these communities.

Plans and Policies

Kane County sets local policies and drafts plans to guide local actions and meet state requirements. The plans and policies which were available for this plan include the County Ordinances, the General Plan, and the County Resource Management Plan. Other plans and policies may exist which were not made available for review in this plan. To better understand each of the

County Ordinances

County ordinances set regulations and policy for the county to preserve the public health, safety, and welfare of those living in and visiting Kane County. Several ordinances reference and set requirements for local activities to prevent natural hazard impacts. Some of which include, setting requirements for a geologic and soils survey in certain circumstances, setting requirements for lands with steep slopes or grades, requiring development permits for areas in the special flood hazard area, requiring that structures meet snow load requirements, preserving natural terrain and drainages in development, and controlling brush and reseeding in grazing management locally.

General Plan

The General Plan "outlines goals and policies for unincorporated land use, transportation and access management, conservation of natural resources, protection against natural and human-caused hazards, provision of public services, preservation of historic resources, development of the economic base, accommodation of affordable housing, and partnering with federal and state land management agencies." Natural hazards are not a standalone element of the general plan, but through describing other elements, like natural resources, environment, and public safety, Kane County describes goals and policies which would reduce hazard risks, including: recognizing the constraints to development in the natural environment, assessing for geologic, flood, or other natural hazards in development proposals, cross jurisdictional coordination regarding natural resources, development of wildland fire protection systems and a wildland fire plan, and the adoption of the Wildland Urban Interface. Goals and policies, like requiring assessment of hazards for development, are reflected in County ordinances.

Resource Management Plan

The Kane County Resource Management Plan describes how the use of natural resources, including minerals, water, agriculture, public lands, and other resources have played a historic role in the county's development. These uses continue today and the Resource Management Plan describes how these resources will be managed to ensure longevity and a good environment in which to live in the county. Items described that relate to natural hazards in this plan include, maintaining and restoring natural hydrologic function, improving watershed conditions on eroding sites and sensitive areas, participation in updated floodplain mapping, and removal of pinyon and juniper to prevent wildfire and damage to the watershed.

Community Assets

Kane County is a governmental entity in southwestern Utah, which engages the public and private business in organizing resources and skills in the county. The County has several assets under its jurisdiction and others which require coordination with private, state, and federal entities to manage. Many of these skills and assets are essential to mitigate, prepare, respond, and recover from natural hazards.

Government.

The governing body is an elected county commission with three commissioners, who pass ordinances and make decisions as a body on behalf of the County residents. This body is informed by other boards, like the planning commission, county staff, and the public about issues in the community.

County Staff Capabilities

The county employs several staff who work directly or indirectly with natural hazards, mitigation, preparedness, or response and recovery. Several of the staff people serve both the unincorporated and incorporated areas of the county, including law enforcement and public works. The County Land Use and Zoning Administrators advises the planning commission and the county commission on code requirements and planning needs for the health and safety of residents and visitors. The County employs an Emergency Manager who leverages agencies, contacts, and needs for preparedness, response, and recovery for many events, including natural hazards. The Roads department mitigates risks though maintenance and repair of County assets and infrastructure.

County capabilities include GIS mapping, develop mutual aid agreements with other agencies and communities, grant writing, and emergency response and operations. Funding for Capital improvement and infrastructure projects in the County are typically funded through Capital Improvement Project funding, debt through General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

County supported emergency response includes a Fire warden, who enforces wildland fire regulations and restrictions in the County. The Kane County Sheriff's Office coordinates law enforcement and other emergency response throughout the County, including in communities without their own police department. The Sheriff’s Office also support search and rescue operations. Fire Departments in Cedar Mountain, Kanab, and Bullfrog operate emergency medical technician services.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. In Kane County, highway 89 runs north to south in the western portion of the community and then turns to the east in Kanab, and runs to the east until Lake Powell, when it turns south into Page, Arizona. Highway 89 connects all the incorporated cities and towns in Kane County. Other major roadways in the County include SR-9 and SR-14.

The Kane County Hospital is the only hospital servicing Kane County. There are community clinics, but only located in the City of Kanab. Communities in unincorporated County or in other incorporated cities and towns must travel to Kanab or other counties to receive medical care.

Lake Powell is a man-made lake in the Glenn Canyon Recreation Area which dams the Colorado river. The lake acts as a source of water storage, outdoor recreation, and energy production through generators at the dam. Recent droughts have demonstrated the local importance of this water and energy source to communities like Kane County.

Schools

There are seven public schools in Kane County, located in communities along Highway 89 which are under the purview of the Kane County School District.

Unincorporated Communities

Unincorporated communities addressed in this section include Bullfrog and Duck Creek Village. The unincorporated areas of the county are diverse and dispersed throughout the County, although they are all located near the county borders.

Bullfrog is a community located in the northeastern portion of Kane County, bordering the Glen Canyon Recreation area and Lake Powell. The community attracts tourism to the area annually and has a ferry which crosses the lake into neighboring San Juan County.

Duck Creek Village is in the northwestern area of Kane County, bordering Garfield County. Duck Creek Village is a high elevation, mountain community, which has access to national parks and monuments, a ski area, several lakes, and other outdoor attractions. The area is also largely tourism dependent, with visitors from three counties having access to the community.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for Kane County, Utah. This assessment describes the natural hazards considered in this plan which pose risks to Kane County. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 257 below, summarizes the natural hazards in a list from High to low hazard risk as it pertains to unincorporated Kane County.

Table 257: Kane County Natural Hazard Risk

HAZARD	RISK
DROUGHT	High
LANDSLIDE	High
WILDFIRE	High
SEVERE WEATHER	High
EARTHQUAKE	Moderate
FLOOD	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Kane County's risk assessment.

Drought

The Five County Region has experienced seven periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe weather. Kane County lies in the southeastern portion of the region, along the Colorado River. The Colorado River has notably shown impacts from drought in the Lake Powell water storage.

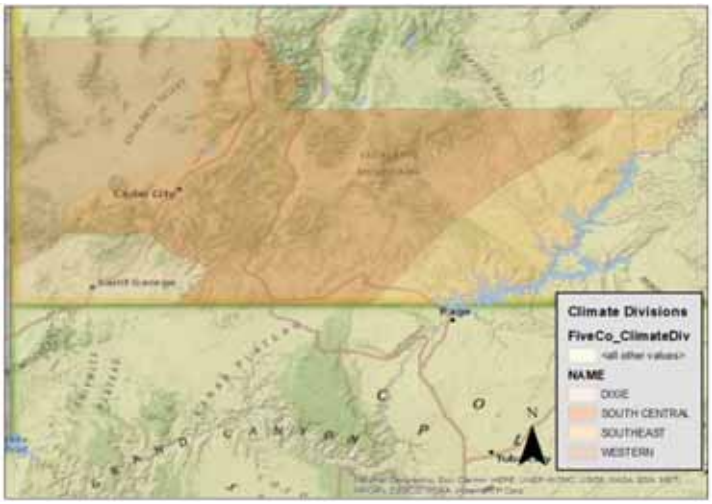


Figure 233: Five County Climate Divisions

Monitoring drought generally occurs across several climate division. Kane County lies in the South Central and Southeast divisions. These division include much of central and eastern portions of the region, as described by Figure 233. Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community. Figure 234 and Figure 235 describe the average annual precipitation by year in each of the Kane County climate divisions. Years in the positive are experiencing above average precipitation, where those in the negative are recorded as below average precipitation years. As can be observed by the trendline, both climate divisions are experiencing more frequent below average precipitation years, which has long term repercussions on the growing population, natural resource availability, and popular attractions to the region.

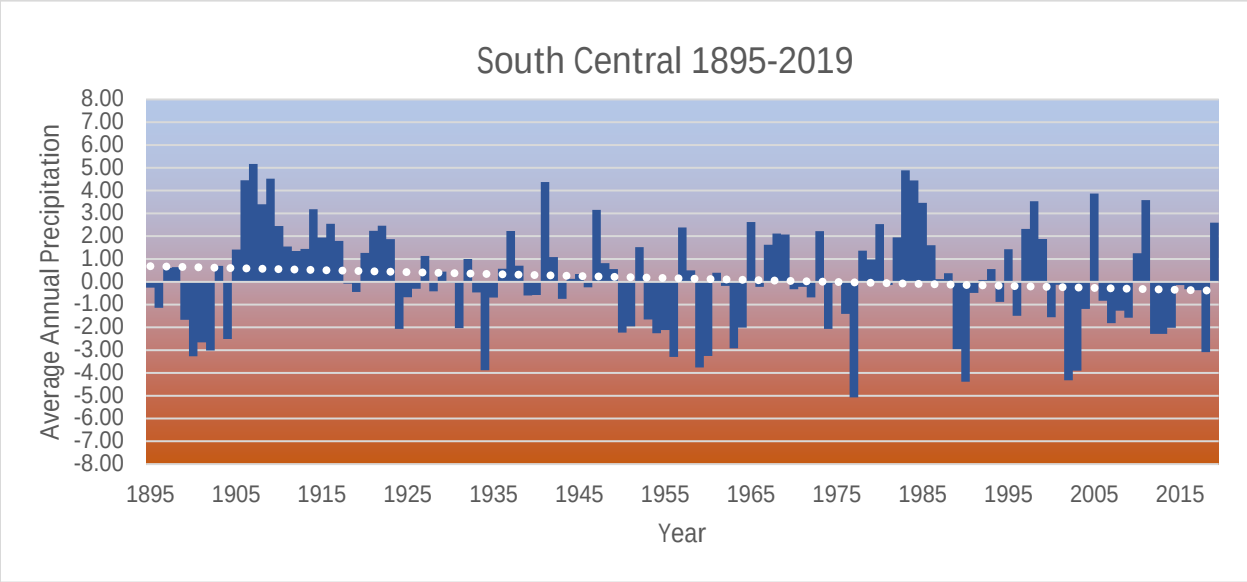


Figure 234: South Central Climate Division Annual Precipitation

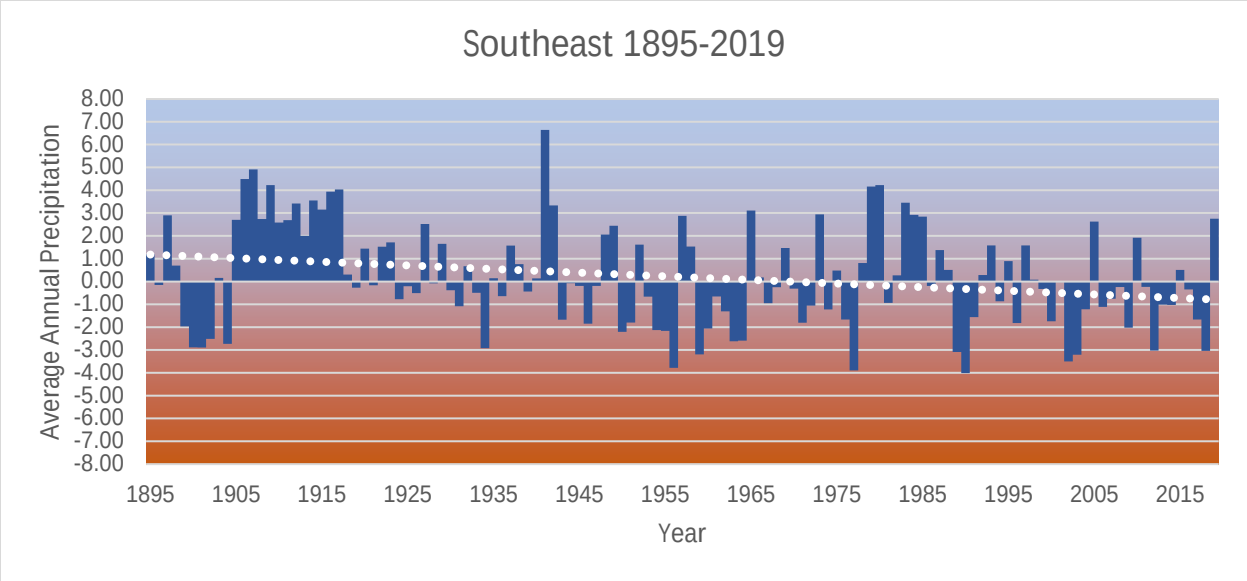


Figure 235: Southeast Climate Division Annual Precipitation

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Figure 236 illustrates the areas exposed to landslide hazard, which includes much of the County and the incorporated communities.

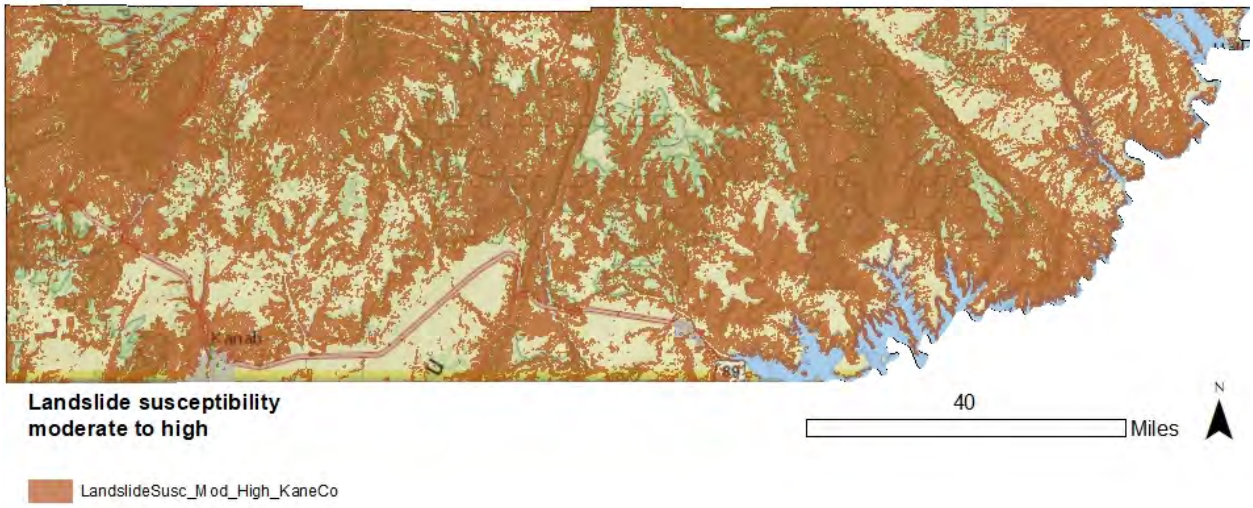


Figure 236: Kane County Landslide Susceptibilty

In Kane County, critical facilities and commercial parcels see exposure to landslide and rockfall risk areas, described in Table 258. Half of all critical facilities in the unincorporated county are exposed to landslide risk areas. Over 40% of commercial parcels and residential parcels are exposed to landslide risk areas, which can result in damage to structures, deaths, and injury among the users or residents of these spaces. Nearly one quarter of roads in the unincorporated county are in a moderate to high landslide susceptible area. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace.

Table 258: Kane County Exposure to Landslide Susceptible Areas

Kane County Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
50.0%	46.4%	45.3%	45.3%	24.8%	N/A	N/A

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Some of the geology in Kane County is notably formed by landslide events. Zion National Park, for example has features where landslides have been formative to the current landscape. Several landslides have occurred countywide since pioneer settlement in the area. Table 259 describes the record of landslide events in unincorporated Kane County.

Table 259: Kane County landslide record

Incident Date	Location	Description
1932	Kane County	Landslide at Big Meadow Wash on the Zion-Mount Carmel Highway.
1942	Glendale, Kane County	Landslide four miles north of Glendale.
1947	Kane & Iron County	Rockslide at Zion National Park
1952	Kane & Iron County	Debris flow at Zion National Park
1983	Kane County	Landslide in Kane County at Coal Hill, near Mt. Carmel Junction.
1984	Kane County	Landslide in Kane County.
2005	Kane County	Kanab Creek rockfall resulted in one fatality
2011	Kane County	NCDC Landslides from Sheldus.
2016	Kane County	Flash flooding caused a rockfall near Pine Creek Bridge, blocking both sides of the road, closing the road between Canyon Junction and the East Entrance of Zion National Park for Several hours.

Source: USGS, Utah Geological Survey, Sheldus,

Much of the County and its residents are exposed to landslide risk. Recreation areas in Kane County appear to be vulnerable to landslide events, especially in the Zion National Park and Mount Caramel Junction area of the County, based on historic reference. While damage was not recorded in many past events, a 2005 event killed a child as they were playing by a creek, highlighting the exposure that exists in outdoor recreation environments.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Kane County is marked by a diverse landscape with urban, rural, agricultural, and public lands assets, which can be vulnerable to fire. Figure 237 describes the relative risk of wildfire in the county, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Kane County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

Based on this assessment, municipalities and the area directly surrounding larger or more dense cities and towns have a heightened risk to wildfire as population centers could be impacted. A significant portion of the moderate to extreme fire risk in Kane County is found in the northwest portion of the County, although fire risk is identified near Kanab.

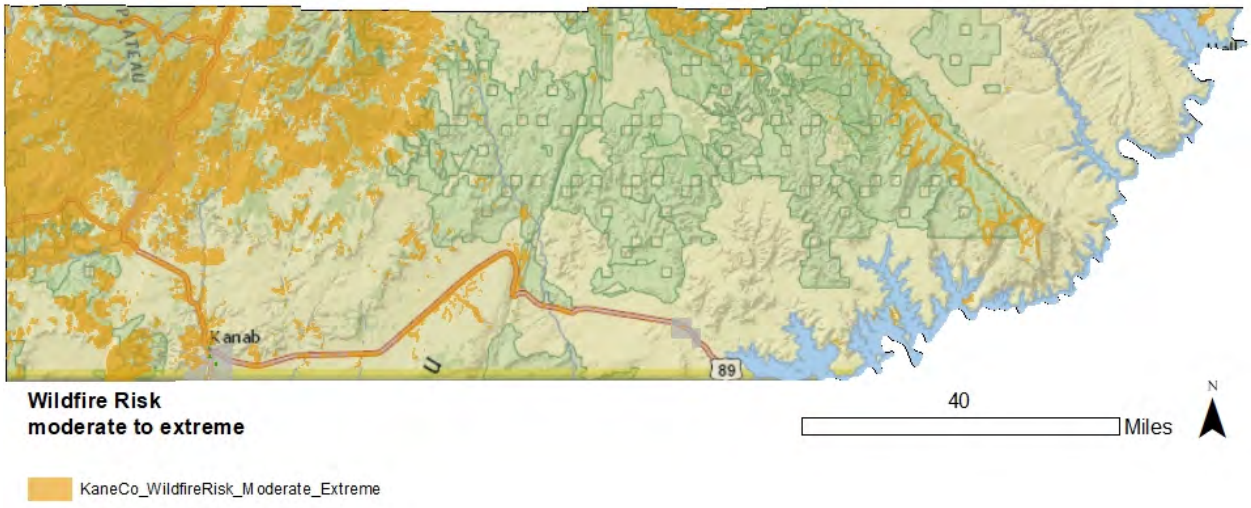


Figure 237: Kane County Wildfire Risk

Source: Oregon Department of Forestry

Table 260 includes an assessment of the unincorporated county exposure of assets to the wildfire risk areas identified in the figure above. Looking to this table, we understand the assets in the county are at risk to wildfire. Over half of commercial parcels in the County are at risk to wildfire and 37.5% of critical facilities are exposed. The exposure of populations and assets in the unincorporated County is likely to increase as the county population grows and more people locate in wildland urban interface areas.

Table 260: Kane County Wildfire Risk Exposure

Kane County Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
37.5%	53.6%	48.2%	48.2%	13.6%	N/A	N/A

Source: Oregon department of Forestry

Hazard History

Kane County has experienced many fires, both human and naturally caused. The county is marked by low elevation, dry desert, and alpine desert geographies, presenting some risk. Several organizations

respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area. Table 261 describes the wildfires in Kane County that have received FEMA Fire Management Assistance Declarations. These assistance grants provide matching funds to assist in fire control and suppression.

Table 261: Kane County FEMA Fire Mitigation Assistance Grant Designations

Fire Name	Year	Acres Burned	Other Impacts
Shingle Fire	2012	8,000	A Human Caused fire that threatened communities, powerlines, SR-14, and Highway-89 and caused evacuations from communities in Kane County. Garkane cut power to the area because of the fire.

Source: FEMA Region 8 Fire Management Assistance Grant (FMAG), (USDA Forest Service , 2012), (Utah Public Radio, 2012)

Most fires in Kane County have been addressed by BLM, forest service or other entities. These fires are documented on the Utah Wildfire Info website going back to 2017. News sources also document impactful fires for the County, which have been included in this hazard history, listed in Table 262.

Table 262: Kane County Wildfire History

Fire Name	Year	Acres Burned	Description
Pine Hollow Fire	2020	2,771	A lightning caused fire led to evacuations and risks to livestock, rangeland, and California Condor habitat.
Strawberry Fire	2020	43	Lightning caused fire required the closure of a trail near Mammoth Creek Road.
Wire Pass	2020	1,580	A lightning caused fire impacted trails, trailheads and powerlines. The event caused the closure of trails near the Wave.

Source: Utah Wildfire Info.

In 2020, three significant fires were reported causing damage to open space and recreation areas. Infrastructure and livestock were also threatened, in addition to wildlife. There were no fires reported in Kane County in 2018 or 2019. Smaller wildfires may have occurred which were not reported on the Wildfire Info site. The county likely saw secondary impacts from fires in other nearby communities, like smoke and ash.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region. Much of the higher elevations of Kane County, outside of urban areas, contribute to the Forest, Riparian, and Drinking Water assets for the area, increasing the relative risk to these areas.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in

communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that Kane County is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Kane County, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Kane County sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months in high elevation areas. Thunderstorms frequently impact the County, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which is documented in the flood section of this plan. High winds have also been reported to cause damage in the region.

Hazard History

Severe storm events which resulted in injury, loss of life, or property and crop damages have been reported across Kane County. Table 263 summarizes the impacts and losses experienced from severe weather events that impacted the region and county. While this list seeks to narrow to a Kane County representation of impacts, given the widespread and often regional impact of weather, some natural events may have had injuries, deaths, or damage in other counties.

Table 263: Kane County Summary of Severe Weather Impacts

Severe Weather Hazard	Deaths	Injuries	Property Damage	Crop Damage
Blizzard	0	0	0	0
Funnel Cloud	0	0	0	0
Hail	0	0	20,000	0
Heat	5	0	0	0
Heavy Rain	0	0	2,500	0
Heavy Snow	0	0	0	0
High Wind	0	0	50,500	200
Thunderstorm Wind	0	3	501,000	200
Winter Storm	0	0	0	0
Grand Total	**5**	**3**	**574,000**	**400**

Source: NOAA, accessed July 30, 2020.

Wind events have caused the most injuries and property damages in the County. Heat events are responsible for several deaths in the county, and tend to occur in the summer months, leaving those outdoors vulnerable to heat exposure. Table 264 describes the damage and injury which occurred during severe weather events in Kane County. Roadways are vulnerable to events like snow and rain, which cause traffic delays and accidents. Lake Powell and the Bullfrog Marina are regularly exposed to high winds, which cause damages to boats and injury to occupants.

Table 264: Kane County Severe Weather Record

Date	Damage/Injury	Description

7/22/1997	None Reported	A funnel cloud was reported over Lake Powell.
9/11/1997	None Reported	Severe weather produced hail and rainfall of 2.5" in one hour near Kanab. Several homes flooded and Highway 89 was closed due to flooding.
10/2/1997	None Reported	A thunderstorm produced flash flooding and high winds across the State. Hail 0.75" in diameter were reported in Kanab and the city measured 1.41" of rain.
4/12/1998	None Reported	A snowstorm produced 9" of snow in Kanab
12/19/1998	None Reported	Duck Creek Village reported 22" of snow during a storm.
10/21/2000	None Reported	Orderville reported .75" hail during a severe thunderstorm.
9/7/2002	None Reported	A severe thunderstorm near Lake Powell caused 69 MPH winds and 0.75" hail at the Bullfrog Marina.
6/2/2003	None Reported	Bullfrog Marina experienced 80 MPH wind gusts during a severe thunderstorm.
9/29/2004	$20,000	A severe storm produced heavy rainfall causing flash flooding near Big Water and 0.75" hail which was reported to fall two-inches deep in Kanab.
4/23/2005	None Reported	Rain and hail were reported statewide, including Bullfrog, which saw 0.37" of precipitation.
7/12/2005	1 death	Temperatures near 110 degrees led to the death of a hiker in Glen Canyon.
1/24/2008	None Reported	Brian Head and other mountainous areas of Southern Utah saw 12 inches of snow fall during a winter storm.
2/3/2008	None Reported	A snowstorm produced heavy snow fall, including 11 inches produced in Orderville.
4/15/2008	None Reported	The Bullfrog marina reported 61 MPH wind gusts.
12/15/2008	None Reported	Mount Carmel Junction reported 12 inches of snow during a snow event.
12/17/2008	None Reported	A snowstorm produced 8 inches of snow in Orderville.
12/24/2008	None Reported	Kanab received 6 inches of snow during a storm.
3/22/2009	None Reported	Wind gusts of 65 MPH were reported at the Bullfrog Marina.
6/26/2009	None Reported	Wind gusts of 68 MPH were reported at the Bullfrog Marina.
12/7/2009	None Reported	A severe winter storm produced 19 inches of snow in Orderville.
4/5/2010	None Reported	High winds reported at Bullfrog Marina. The strongest gust was 71 MPH.
4/12/2010	None Reported	The Bullfrog Marina reported high winds above 60 MPH for a half hour.
8/16/2010	None Reported	The Bullfrog Marina recorded wind gusts of 59 MPH.
10/6/2010	None Reported	65 MPH wind gusts were reported at Bullfrog Marina.
12/29/2010	None Reported	Ten inches of snow were reported in Kanab during a snow storm.
2/26/2011	None Reported	Eight inches of snow fell in Kanab.
10/6/2011	None Reported	The Bullfrog Marina reported wind gusts of 62 MPH.
1/21/2012	None Reported	The Bullfrog Marina reported a maximum wind gust of 58 MPH.
2/13/2012	None Reported	Eight inches of snow fell in Orderville.
3/8/2013	None Reported	Kanab reported 7 inches of snow during a storm.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/5/2013	None Reported	A wind gust of 64 MPH was reported at Bullfrog Marina.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Kanab reported 8.5 inches and Duck Creek Village reported 16 inches of snow during a storm.

2/27/2014	None Reported	The Bullfrog Marina experienced strong wind gusts, with a peak gust of 65 MPH.
3/30/2014	None Reported	A peak gust of 70 MPH was reported during several hours of high winds at Bullfrog Marina. .
5/23/2014	$1,000 property damage	Thunderstorm winds blew a houseboat into a cliff on Lake Powell and wind gusts were reported to peak at 39 MPH at Bullfrog Marina.
12/31/2014	None Reported	A snow event produced 8.7 inches of snow in Bullfrog basin, doubling the average snow fall of 4 inches from this area over the past 45 years.
2/22/2015	None Reported	Nine inches of snow fell in Kanab.
5/14/2015	None Reported	A severe thunderstorm produced “penny sized” hail near the community of Big Water.
6/5/2015	None Reported	Nickel sized hail fell near the town of Duck Creek Village during a severe thunderstorm.
6/10/2015	None Reported	A wind gust of 60 MPH was reported at the Bullfrog Marina.
1/30/2016	None Reported	Heavy snow caused road closures on several roads, including SR-14.
3/6/2016	None Reported	Bullfrog marina reported a wind gust of 60 MPH.
3/22/2016	None Reported	Several hours of heavy winds produced a peak gust of 68 MPH at the Bullfrog Marina.
8/10/2016	None Reported	During a thunderstorm, large hail fell at Mt. Carmel and Orderville, while high winds were reported at the Bullfrog Marina.
11/17/2016	None Reported	A wind gust of 61 MPH was reported at the Bullfrog Marina.
12/23/2016	None Reported	Kanab saw six inches of snow during a storm.
8/3/2017	None Reported	The Bullfrog Marina reported a wind gust of 62 MPH.
9/14/2017	3 injuries $500,000 property damage	A thunderstorm over the Glen Canyon National Recreation Area overturned several boats injuring occupants. Wind gusts at the Bullfrog Marina peaked at 73 MPH.
4/12/2018	None Reported	A peak wind gust of 63 MPH was reported in Bullfrog.
2/20/2019	None Reported	A winter storm produced eight inches of snow in Kanab, three inches of snow in Big Water, and two inches in Bullfrog Basin.

Source: NOAA Storm Database

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Kane County from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

In addition to the resident population, Kane County has significant outdoor and recreation assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Flood maps are completed by FEMA and used for local regulations of construction in observed flood risk areas. These maps provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 238 describes the 100-year floodplain and dam inundation for the County.

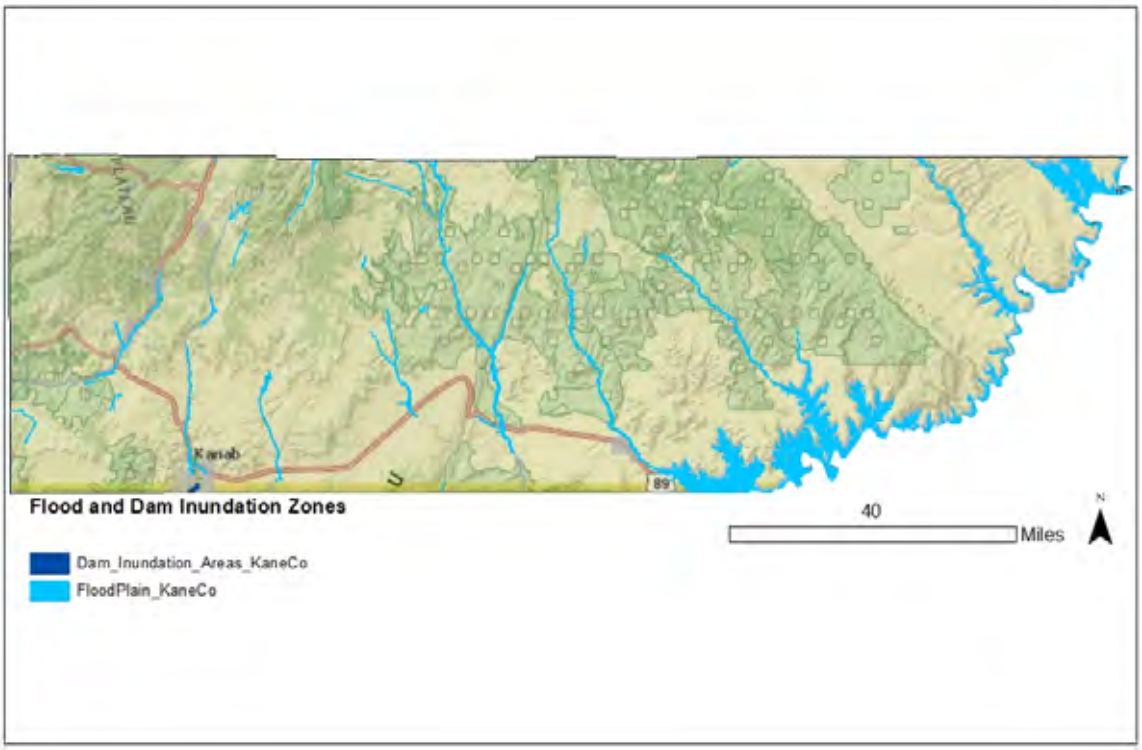


Figure 238:Kane County Flood and Dam Inundation Risk

Source: FEMA, UGRC, Utah Geological Survey

For this analysis, the Five County Association of Governments merged Dam Inundation areas with floodplains to understand the total assets that could be at risk within a mapped flood area.. Table 265

shows the combined exposure to the floodplain and dam inundation zones in the unincorporated county. Floodplains in Kane County appear to impact little of the residential areas of the unincorporated county. Road miles impacted by flood may be at risk to damage or inundation. Only one area of dam inundation has been identified in the County—within the Kanab City limits.

Table 265: Kane County Exposure to Floodplains and Dam Inundation Zones

Kane County Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	9.1%	0.4%	0.5%	2.5%	N/A	N/A

Source: FEMA, UGRC, Utah Geological Survey, Kane County Assessor, UDOT

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Kane County structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year?, 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Kane County participates in the NFIP and had the most recent Flood Insurance Rate Maps were developed for the community in 1986 and a flood control ordinance has been effective in the community since 1989. The flood control ordinance designates the building inspector as the administrator of the flood control ordinance to review permits for flood data, use base flood data, interpret FIRM boundaries, and maintain records of compliance with flood ordinance.

Table 266 describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. A CAC and CAV took place on 10/29/2019 and 5/8/2008 respectively.

Table 266: Kane County NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$9,776	0	1	27	$8,028,100	4	$57,217

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Kane County does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county. There have been approximately 25 flooding events that have caused damages or losses to the County since 1996, with a total of over 150 events reported countywide by NOAA during that timeframe. Most deaths, property damage, and crop damage due to flooding events are reported for the unincorporated county. Table 267 describes the flood events in Kane County which have reported damages or injury.

Table 267: Kane County Flood Hazard Record

Kane County Flood Hazard Record		
Date	Damage/Injury	Description
9/11/1997	$30,000 property damage	A severe storm caused flash flooding in the Kanab area, producing two and a half inches of rain in an hour. Highway 89 was closed due to flooding and four homes were flooded.
9/14/1997	$5,000 property damage	Rain fell at a rapid rate of one inch in 30 minutes near Kanab, resulting in flooding on SR-11 with water reported to be six inches deep in some places.
9/1/1998	$30,000 property damage $2,000 crop damage	Over one inch of rain fell in Kanab during a 30-minute period, flooding homes and roads.
9/5/1998	1 death $3,000 crop damage	A storm which brought thunderstorms and monsoon rains in Southern Utah killed a young girl who was recreating in the Glen Canyon National Recreation Area during a flash flood.
7/14/2001	$,1000 property damage	Flash flooding was reported in canyons throughout Kane County. Several roads were washed out during the event.
9/12/2002	$10,000 property damage	Flash flooding near Bullfrog and Lake Powell resulted in damage to a sewer line, sending water and mud into nearby campgrounds.
8/22/2003	$50,000 property damage	A bridge was washed out and road damaged during a flash flood east of Kanab in Johnson Canyon.
9/29/2004	$3,000 property damage	Flash flooding reported outside of Big Water during a severe thunderstorm.
10/5/2006	$15,000 property damage	Wahweap Creek flooded and washed-out roads.
7/21/2010	$10,000 property damage	A flash flood caused damage to a dirt road that crosses Bullfrog Creek.
7/28-29/2010	$30,000 property damage	Thunderstorms caused flash flooding across several washes, drainages, and canyons near the Glen Canyon National Recreation Area, causing damages to roads throughout the area. In one instance, the damage prevented park rangers from accessing the area.
8/2/2010	$10,000 property damage	Park rangers could not access Grand Staircase Escalante National Monument after flash flooding damaged the Skutumpah Road.
8/16/2010	$10,000 property damage	Several roads were damaged or impassable after slot canyons were flooded near the Glen Canyon National Recreation Area.

10/5/2010	$20,000 property damage	A thunderstorm produced flooding throughout Kane County, damaging and blocking several roads and trails. Johnson Canyon reported basement flooding during the event.
12/19/2010	$800,000 property damage	A large storm caused flooding throughout Kane County caused the closure or blocked several roads. Significant impacts were reported on Highway 89, with water reported at one foot deep at one segment and a landslide documented which deposited a four-foot deep and 50-foot-wide debris field onto the roadway. Orderville and Glendale reported local street flooding.
9/11/2012	$2,000 property damage	Stout creek flooded, impacting a commercial fly-fishing business and some of their facilities along the creek.
8/31/2013-9/1/2013	$10,000 property damage	Flash flooding was reported in Croton Canyon and the lower Escalante Drainage, which washed out roads near the two areas.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.
8/26/2014	$5,000 property damage	Road damage was reported near Johnson Canyon and Buckskin Wash following flash flooding.
8/27/2014	$5,000 property damage	Smoky Mountain Road was impassable following flooding on Wahweap creek.
6/5/2015	$20,000 property damage	Big Water was impacted by flash flooding on Wahweap Creek, as roads were damaged.
6/6/2015	$50,000 property damage	Flash flooding near Lake Powell stranded visitors waiting for floodwaters to subside. Three boats were damaged by floodwaters, one of which was considered a total loss.
7/9/2017	$200,000 property damage	Flash flooding in Kanab impacted 20 homes and damaged roads and a drainage canal.
7/21/2017	$10,000 property damage	Several people were stranded after flash flooding damaged House Rock Road and Cottonwood Road.

Source: NOAA Storm Database

Vulnerabilities identified in past events include visitors for outdoor recreation in the canyons, creeks, and lakes of the area. Flash flooding can have a rapid onset, and surprise even the most prepared. Other impacts reported in this record include blockage or closure of roadways due to flooding. In some areas of the County, blocked roadways can be especially dangerous, as residents or visitors may have increased delays to emergency services access, like medical, fire, and law enforcement.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89 near Alton, Glendale, and Orderville. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 239 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County.

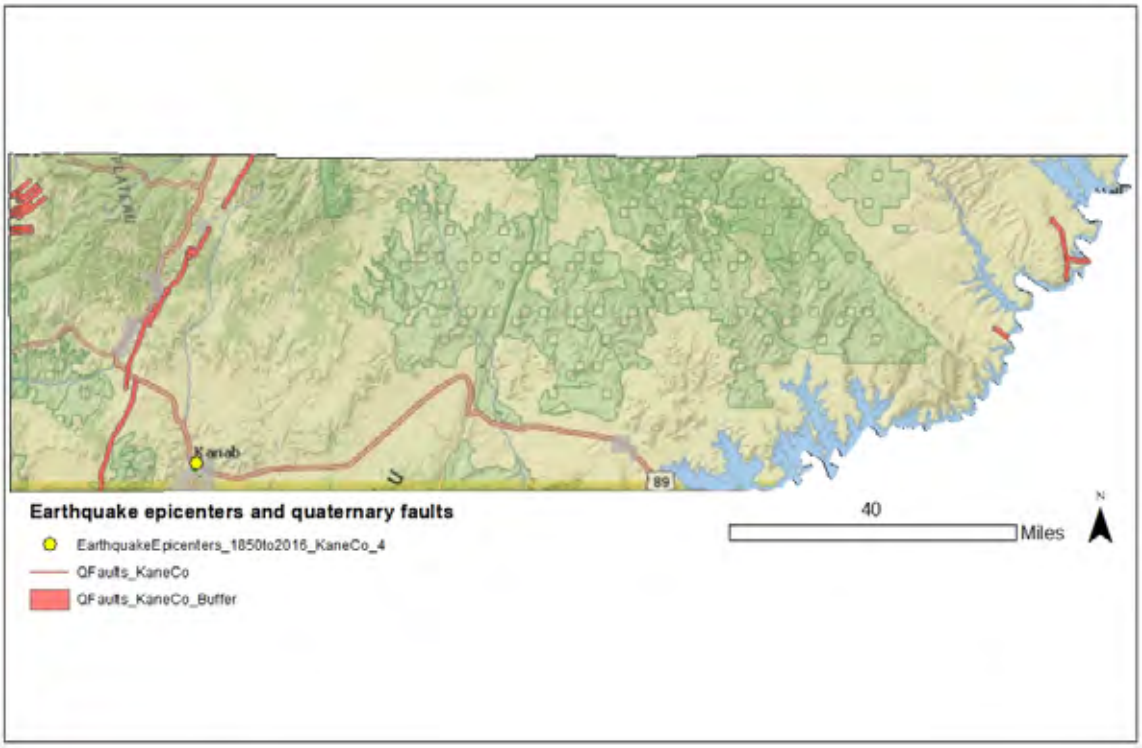


Figure 239: Kane County Earthquake Epicenters and Quaternary Faults

Source: Source: Utah Geological Survey, UGRC

The Five County Association of Governments completed an assessment of the number of community assets that are within a quarter mile of a quaternary faulty, illustrated in Table 268. The unincorporated county has very little overlap with infrastructure or parcels and the quaternary faults. Despite the limited exposure to quaternary faults, the county is still at risk to earthquake events, as ground shaking can be experienced and cause damages miles from the epicenter. Ground shaking can cause damage and trigger other hazards throughout the impacted area.

Table 268: Kane County Exposure within a Quarter Mile of a Quaternary Fault

Kane County Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	0.0%	1.6%	1.5%	1.2%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, UDOT, UGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County assessor's data does not describe the date that structures were built. Local inventory of structures built with unreinforced masonry or prior to the adoption of seismic code requirements can provide a better picture to the extent of structures which may be vulnerable. Southern Utah has a pride in the pioneer history of the region, which often includes

preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with impact potential increasing as the magnitude continues to increase. In the region, the Hurricane fault has the potential to cause up to a 7.0 magnitude earthquake. High magnitude earthquakes are less frequent and an average of 18 are recorded globally each year.

Table 269: Kane County Earthquake Record

Incident Date	Location	Description
1887	Kanab, Kane County	A 4.8 magnitude earthquake is recorded near Kanab.

Source: University of Utah Seismology

Kane County has only reported one earthquake epicenter within the county that was 4.0 magnitude or greater, described in Table 269. While few individual earthquakes in Kane County have been recorded with a magnitude of 4.0 or greater, the community is seismically active, with clusters of earthquakes shaking reported, like a series of events in 2016, where 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016) This demonstrates that the area is seismically active.

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed for Kane County to fully assess the potential and risks of liquefaction.

Summary

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 240. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

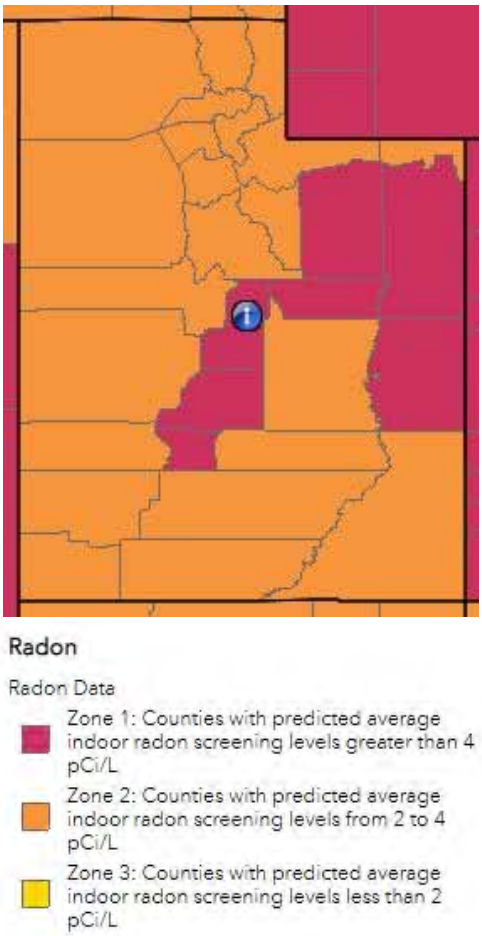


Figure 240: Utah Indoor Radon Level Estimate Zones

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 270 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 270: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development in Kane County. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas. The County land use administrator, engineer, or buildings official may require a soils survey report for an area to be developed. An engineer or geologist should prepare the document, describing the suitability of soils on the property and potential mitigations of the hazard if identified on the site.

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County.

Five County used Problem Soil Susceptibility data from 2011 that describes the extent of problem soils for some additional portions of the county, primarily the southwest and northeastern areas of the county. Figure 241 maps the data available and Table 271 shows the exposure of Kane County assets, infrastructure, and parcels to problem soils. Problem soils can create some challenges for structural integrity as changes in weather and soil moisture change, which in some cases can lead to soil expansion or collapse.

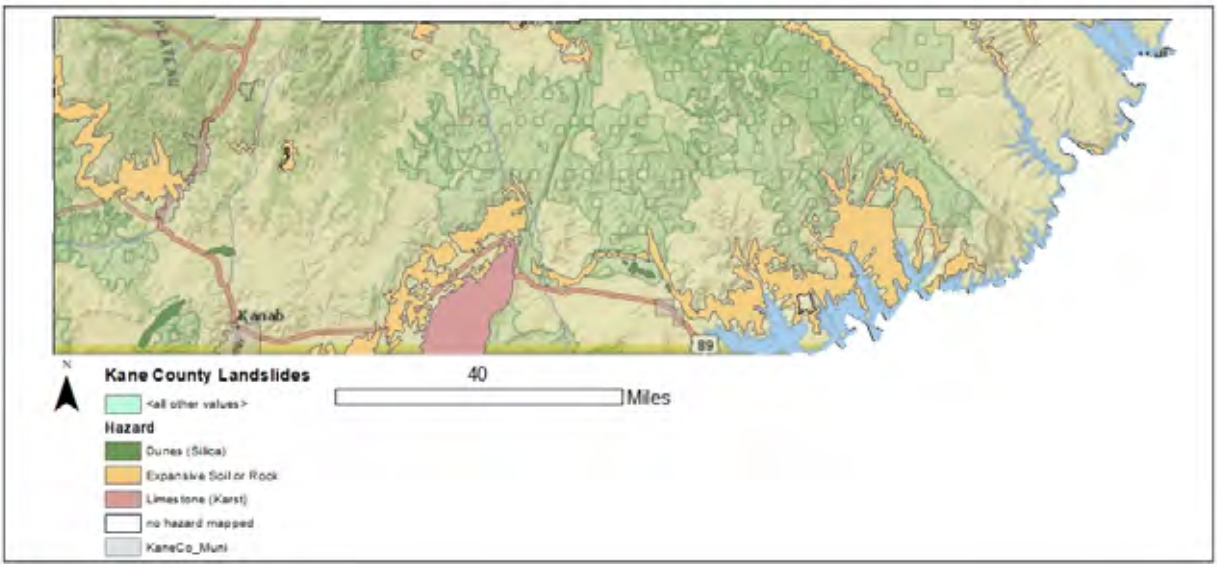


Figure 241: Kane County Problem Soils Exposure

Table 271: Kane County Exposure to Problem Soils

Kane County Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	0.9%	1.0%	1.0%	10.3%	N/A	N/A

Source: UGS

Kane County could benefit from problem soil mapping susceptibility mapping to better identify and describe problem soils prevalence in the County. The county may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Kane County does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. County records will describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site. Problem soils tend to be

Summary

Drought, landslide, severe weather, and flood are all considered high risks in Kane County based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have human impacts, problem soils are often considered to be more of a construction problem, causing damage when unmitigated.

This risk assessment identified vulnerabilities within the unincorporated County. Much of the reported severe weather hazards, floods, and landslides impacted roadways and/or outdoor recreation ventures.

Historic records of flooding and landslides demonstrate that low-lying bridges and roads near drainages and canyons are vulnerable during hazard events.

Several economic endeavors are identified vulnerabilities to natural hazards, including grazing and outdoor recreation. Natural resource economies like grazing are reliant on adequate vegetation and moisture and reasonable temperatures in which to have their livestock outdoors. Drought, wildfire, and severe weather conditions can place additional stress on this industry. Likewise, outdoor recreation has recently been impacted by drought at Lake Powell, where low water levels have made certain docks and boating areas inaccessible and threatened hydropower equipment operation.

Emergency response, park rangers, and other officials have been stranded or cut off from certain areas during events like landslide, flood, and severe storms, creating vulnerability during emergency situations. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations.

Utilities have been impacted by natural hazard events, including Wildfire, requiring shut off of the utility or damage to the utility during events like flooding which have damaged sewage lines. These can cause delays and impact the public health as contamination or lack of access to heating or cooling during extreme temperatures affect the residents.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

Kane County participated in the 2016 iteration of the Five County Association of Governments Natural Hazard Mitigation Plan process. In this plan they identified several actions to address the hazard risks in the community. This mitigation strategy has been summarized in Table 272, with a column identifying progress on action.

Table 272: Kane County 2016 Mitigation Strategy

Strategy	Objective	Action	Timeline	Funding Source	Progress
Drought #1	To provide education to the general public with regard to drought and water conservation.	County-level distribution of water conservation via newsletter and/or website to affiliated constituents.	Ongoing	State and Federal grants, Local government operating budget, water purveyors	Not started
Drought #2	To provide education to the general public with regard to drought and water conservation.	Water purveyors distribute water conservation information to affiliated constituents.	Ongoing	State and Federal grants, Local government operating budget, water purveyors	Not Started
Drought #3	To conserve water within the agricultural sector.	Develop/demonstrate water conservation practices for agricultural use.	Ongoing	State and Federal grants, water purveyors	Ongoing
Drought #4	Establish specific county-level water conservation measures.	County-level implementation of mitigation strategies identified in "Drought in Utah- Learning from the Past-Preparing for the Future" www.water.utah.gov	3-5 years	State and Federal grants, Local government operating budget, water purveyors	Not Started
Radon Gas #1	Promote radon gas reduction measures through non-structural improvements .	Increase public education related to radon gas hazards by distributing Utah Department of Environmental Quality informational brochures to County and City planning and engineering departments.	Ongoing	County and City operating budget, Utah Department of Environmental Quality operating budget.	Needs to be done

Strategy	Objective	Action	Timeline	Funding Source	Progress
Radon Gas #2	To reduce radon gas risk as it relates to the built environment.	Utilize the Radon Risk Map provided in this plan as a tool to assess radon gas risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific radon hazard identification study and implement applicable control techniques.	Ongoing	Private funds/developer, County or City government operating budget.	Not implemented yet
Radon Gas #3	Promote Radon awareness	Provide Radon brochures in every new home, promote and observe National Radon Action Month, address radon kits during the foundation permitting.	Ongoing	Local, State, and Federal funds	Not started
Severe Weather #1	To reduce severe weather risk as it relates to the built environment.	Continued dedication/vigilance in enforcing the standards established in the International Building Code (IBC) as it relates to wind-loading, electrical grounding, snow loading, and other weather related hazards.	Ongoing	County or City government operating budget	IBC standards are followed by county and city building enforcement officials. This items is ongoing.
Severe Weather #2	Ensure that the general public is warned of severe weather occurrences vial broadcast media	Enhance the Emergency Alert System (television and radio).	Ongoing	Federal and State government operating budget	In progress.
Severe Weather #3	Ensure that the general public is warned of severe weather occurrences vial broadcast media	Enhance NOAA Weather Radio All Hazard coverage.	Ongoing	Federal and State government operating budget	I don't think we have NOAA weather radio coverage in Kane County

Strategy	Objective	Action	Timeline	Funding Source	Progress
Severe Weather #4	Guard against the negative effects of severe weather by becoming a StormReady community.	At the County Local Emergency Planning Committee (LEPC) level, meet the program guidelines then apply to the National Weather Service StormReady program.	3-5 years	County and City operating budget	Kane County has met with NWS and has completed storm ready program
Problem soils #1	Lessen the risk to buildings from problem soils.	Address problem soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/developer; Local government operating budget; Utah Geologic Survey operating budget	Subdivisions require a soils and maps report which we think is probably the same thing
Problem soils #2	Lessen the risk to buildings from problem soils.	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/developer; Local government operating budget; Utah Geologic Survey operating budget	The report is reviewed by the health department and our county engineer.
Problem soils #3	Lessen the risk to buildings from collapsible and expansive soils.	Through mapping, identify areas which contain collapsible and expansive soils. Require soils testing at the building/construction level and ensure that engineer's recommendations are followed.	Ongoing	Private funds/ developer; Local government operating budget	Soil testing is required per standard building codes. Contractors required to mitigate soil problems.
Landslide #1	Increase the level of knowledge related to landslides.	Increase public education related to landslide hazards by distributing Utah Geological Survey (UGS) landslide informational brochures to local municipality level emergency management, engineering and planning departments.	Ongoing	Local, jurisdictional level.	Not started

Strategy	Objective	Action	Timeline	Funding Source	Progress
Landslide #2	To reduce landslide risk as it relates to the built environment.	Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	See answer in problem soils
Landslide #3	To reduce landslide risk as it relates to the built environment.	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	See answer in problem soils
Landslide #4	To reduce landslide risk as it relates to the built environment.	Drafting/updating zoning and/or landslide ordinances to prevent development of structures near debris flows, landslides, and rock fall areas.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	No landslide specific ordinances but this should be addressed by the soils & maps report
Wildfire #1	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas. Work along with Home Owners associations.	Mailings; Printed Information; Public Service Announcements; Comply with the Wildland-Urban Interface Code (WUI)	Ongoing	State and Federal wildfire grant programs,	Wildfire education is ongoing through all the methods mentioned . Kane County complies with WUI code. This item will always be ongoing
Wildfire #2	Fuels reduction and defensible space tactics.	Continue interagency fuels projects, education, and mitigation throughout the focus area.	Ongoing	Local government operating budget; Special Service District operating budget, forestry Fire, and State Lands.	This is a continual process. Various projects are in progress at all times

Strategy	Objective	Action	Timeline	Funding Source	Progress
Wildfire #3	Ameliorate access concerns.	Increase ingress/egress into private property/subdivisions.	Unknown	Local government operating budget; Special Service District operating budget; private property owner; Federal Government	Continually ongoing
Wildfire #4	Ameliorate access concerns.	Coordinate the roadwork being done by private land owners with the work being done by the National Park Service and the Bureau of Land Management.	Unknown	Local government operating budget; Special Service District operating budget; private property owner; Federal Government	We coordinate with land owners and federal partners on roadwork to ensure it complies with required codes.
Flood #1	Minimize future flood damage in the unincorporate d County.	Nonstructural measures appear to be the most prudent option for the county to implement. Zoning to prevent development of structures near all rivers, creeks, and lakes (100' min. setback).	Ongoing	Local government operating budget; State and Federal flood and planning grant programs	Health department requires setbacks from waterways
Flood #2	To reduce flooding risk as it relates to the built environment.	Address flood control at the building/construction level by requiring all subdivision proposals to have a storm water drainage system.	Ongoing	Private funds/ developer.	Required of all subdivisions and reviewed by county engineer.
Flood #3	To reduce flooding risk at the community level.	Clear debris and other material from all waterways.	Ongoing	Related public/private property owners.	Continually Ongoing
Flood #4	Promote participation in the National Flood Insurance Program (NFIP) throughout the county.	Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.	1 year	Local government operating budget; State and Federal flood grant programs	Need to start

Strategy	Objective	Action	Timeline	Funding Source	Progress
Flood #5	Improve flood plain management activities by exceeding the minimum Nation Flood Insurance Program standards. Decrease flood insurance Rates.	Each community will voluntarily participate in the FEMA Community Rating system which will help to keep communities safer, reduce flood insurance rates, and improve flood plain management activities.	Ongoing	Local, State, and Federal Funding Sources	Ongoing
Earthquake #1	Promote building safety through non-structural improvements .	Increase public education related to earthquake hazards by distributing Utah Seismic Safety Commission informational brochures to County and City emergency management agencies.	Ongoing	County and City operating budget; Utah Seismic Safety Commission operating budget.	Not started
Earthquake #2	To reduce earthquake risk as it relates to the built environment.	Continued dedication/vigilance in enforcing the seismic standards established in the International Building Code (IBC).	Ongoing	County or City government operating budget (where applicable).	Building officials follow IBC standards
Earthquake #3	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #1: Utilize the Earthquake Risk Map provided in this plan as a tool to assess earthquake risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study.	Ongoing	Private funds/developer	Not started
Earthquake #4	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #2: At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	3-5 Years	Local government operating budget; Utah Geologic Survey operating budget.	Not started

The Kane County planning team identified actions to include in the community mitigation strategy. Each action in Table 273 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 242.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 242: Regional Plan Goals

Table 273: Kane County 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2	Reduce impacts of sand and debris on stormwater drainage systems.	Increase the size of culverts along 3-miles of the highway near Mountain View Drive off Chinle drive of Kanab.	M	5-years	M	Kane County, CDBG, CIB, UDOT	Kane County
Flood #2	1, 2	Reduce impacts of sand and debris on stormwater drainage systems.	Increase the size of culvert at Sand dunes road west of the Sand Dunes State Park.	M	5-years	M	Kane County, CIB, UDOT	Kane County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #3	1, 2	Reduce impacts of sand and debris on stormwater drainage systems.	Install low water crossings in Vermillion Cliffs Subdivision.	M	5-years	M	Kane County, CDBG, CIB, UDOT	Kane County
Flood #4	1, 2, 5	Reduce impacts flash flood and severe weather on county infrastructure.	Install a box culvert at the crossing of House Rock Valley Road at Buckskin Wash.	M	5-years	M	Kane County, CIB, UDOT	Kane County
Flood #5	2	Plan for County improvements which integrate mitigation.	Develop a roadway infrastructure capital improvement plan.	H	5-years	M	Kane County, CIB, UDOT	Kane County
Flood #6	4	Improve data to inform mitigation decisions.	Participate in flood mapping and the national flood insurance program.	H	5-years	M	Kane County, FEMA	Kane County, State, cities/towns.
Flood #7	1, 2, 5	Improve infrastructure to reduce flood risk to residential areas.	Assess County owned bridges, culverts, and drainage infrastructure for capacity and implement needed improvements.	M	Ongoing	M	Kane County, CIB, UDOT	Kane County
Flood #8	1, 2, 4, 5	Improve infrastructure to reduce flood risk to residential areas.	Coordinate with UDOT to assess bridges, culverts, and stormwater drainage infrastructure for capacity along Highway 89.	M	Ongoing	M	Kane County, UDOT	Kane County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	3, 4	Protect agriculture industry from drought impacts.	Preserve economic stability during a drought by encouraging agricultural interests to obtain crop insurance to cover potential losses due to drought.	H	Ongoing	L	Kane County	Kane County
Drought #2	6	Conserve water resources.	Replace unused grass areas with native vegetation on County owned property.	H	5-years	M	Kane County	Kane County
Drought #3	2, 3, 4	Conserve water resources.	Establish drought policies with tiered actions to implement at different severities of drought conditions.	H	5-years	L	Kane County	Kane County
Drought #4	6	Conserve water resources.	Set standards for development to use drought tolerant and native vegetation.	M	5-years	L	Kane County	Kane County
Severe Weather #1	3, 5	Inform residents of extreme temperatures risk.	Educate residents and visitors of the dangers of extreme temperatures (hot and cold) and severe weather events and the steps they can take to protect themselves during an event.	H	Ongoing, annually	L	Kane County	Kane County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #2	3, 5	Inform residents of extreme temperatures risk.	Partner with local cities and towns to identify community structures which could be used as daytime cooling centers during extreme heat days in areas of high vulnerability.	M	5-years	L	Kane County	Kane County
Severe Weather #3	3, 4, 5	Inform residents of extreme temperatures risk.	Distribution of severe weather information like heat, lightning, and severe thunderstorms to recreation equipment retailers or outfitters to share with their clientele.	H	Ongoing	L	Kane County, local businesses, hotels	Kane County, local businesses, hotels
Wildfire #1	1, 2, 5	Reduce fuel loads.	Coordinate with fire warden to identify mitigation actions.	H	Ongoing	M	DNR, Kane County	Kane County
Wildfire #2	2, 5	Protect County facilities from wildfire risk.	Assess critical facilities & County owned property to ensure that materials are flame resistant and landscaping is Firewise.	M	Ongoing	M	Kane County	Kane County
Earthquake #1	1, 2, 3, 4	Collect data to inform mitigation. Inform residents of potential hazards.	Develop an inventory of structures built before seismic code & URM for the county. Educate property owners on seismic safety and retrofits.	L	Ongoing	L	Kane County, State and Federal Historic Tax Credit, Preservation Utah	Kane County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #2	2	Protect and secure critical equipment.	Partner with hospitals, clinics, and other critical facilities to brace generators, elevators, and other vital equipment.	M	5-years	L	Kane County, Hospital, Fire Stations, Sheriff's office	Kane County, Hospital, Fire Stations, Sheriff's office
Earthquake #3	1, 2	Use codes and ordinances to protect structures from earthquake.	Require the anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc).	H	2-years	L	Kane County	Kane County
Earthquake #4	2	Use codes and ordinances to protect structures from earthquake.	Using flexible piping when extending water, sewer, or natural gas service.	M	Ongoing	M	Kane County, utility providers	Kane County
Earthquake #5	2	Protect and secure critical facilities and their users.	Installing window film on county owned property to prevent injuries from shattered glass.	L	2-years	L	Kane County	Kane County
Earthquake #6	3, 4	Inform residents and organizations of earthquake hazards.	Developing an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.	H	Ongoing, annually	L	Kane County	Kane County
Earthquake #7	2	Protect and secure critical equipment.	Requiring new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	H	2-years	L	Kane County	Kane County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	1, 2	Identify and reduce landslide hazards.	Applying soil stabilization measures, such as planting soil stabilizing vegetation on steep, County owned slopes.	M	Ongoing	M	Kane County, FEMA, BLM, DNR	Kane County
Landslide #2	1, 2	Identify and reduce landslide hazards.	Installing catch-fall nets for rocks at steep slopes near roadways at Cedar Mountain over highway 14.	M	5-years	M	Kane County, UDOT, Washington County	Kane County
Landslide #3	1, 2	Identify and reduce landslide hazards.	Inventory and identify catch-fall nets for rocks at steep slopes near roadways on highway 89.	M	5-years	M	Kane County, UDOT, Washington County	Kane County
Landslide #4	1, 2, 5, 6	Address flooding and landslide risk following wildfire events.	Develop a plan for revegetation of steep slopes following a natural hazard like a debris flow, landslide, flood, or wildfire which has damaged the existing vegetation.	L	5-years	M	Kane County, UDOT, and towns.	Kane County, UDOT, and towns.
Problem Soil #1	4	Use data and information to inform mitigation activities.	Work with the Utah Geological Survey to update problem soil mapping.	L	5-years	L	Kane County, UGS, Cities and Towns.	Kane County, UGS, Cities and Towns.
Problem Soil #2	4	Use data and information to inform mitigation activities.	Inventory locations where problem soils have caused damages to properties in the County.	L	Ongoing	L	Kane County, UGS, Cities and Towns.	Kane County, UGS, Cities and Towns.
Radon #1	3	Inform residents of radon hazard.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing, annually	L	Kane County, Cities and Towns.	Kane County, Cities and Towns.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #2	1, 2, 4	Reduce risk of radon in public facilities.	Partner with the County School District to complete tests in Kane County Schools.	M	5-years	L	Kane County, Kane County School District	Kane County, Kane County School District, Cities and Towns.

Source: Local Planning Team

Alton

Alton, Utah is in the northwestern corner of Kane County and is among the higher elevation communities in the County, enjoying cooler temperatures annually. The town is at the base of Sunset Cliffs, part of the Paunsaugunt Plateau formation of the Colorado Plateau. The area is known for outdoor recreation and geologic formations. The town was settled in 1865.

Community Characteristics

Alton is a rural community of Southern Utah which has historically been an agrarian community. The town has seen changes in population over the years, with decline and growth over the decades.

Demographics

The Alton population as of the 2020 Census is 118 people, as described in Figure 243. the relative change in population is described in Figure 244 and shows that the community experienced growth through the 1980s, 1990s, and 2000s, then shortly thereafter saw declining population recorded in 2010. The population has remained in the same range since the 2010 census. The towns average population change since 1970 is 5.1%.

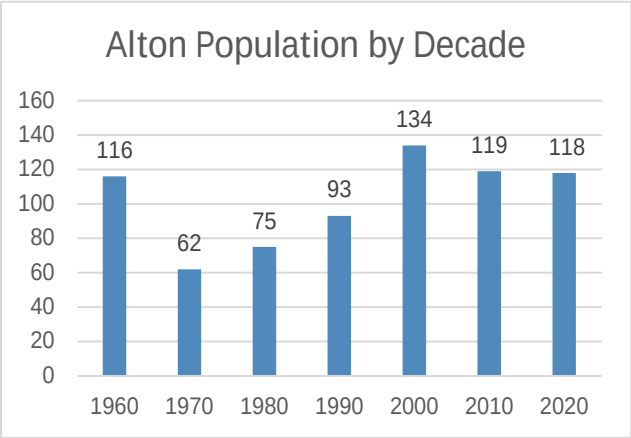


Figure 243: Alton Population by Decade

Source: US Census Bureau

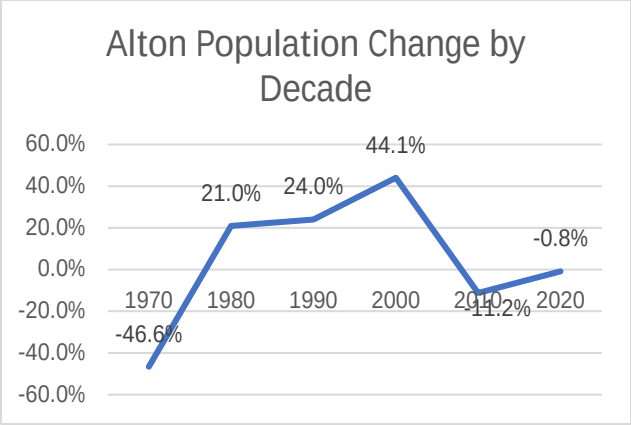
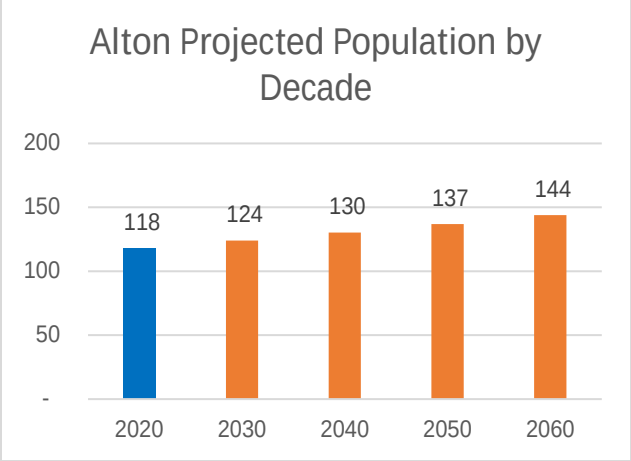


Figure 244: Alton Population Change

Source: US Census Bureau

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population. If applied to the Town of Alton through a step-down analysis, the town may see an additional 57 residents in the next 40-years, bringing the population to 175. (Hollingshaus, et al., 2022)



Source: US Census Bureau

Using the average change in population of 5.1% for the town, the future population by 2060 was also projected. The projection is solely based on historic patterns in the town since 1970, and does not account for land availability, local policy, or other metrics relevant to population growth in the community. Figure 245 illustrates the

projected population based on average change. Based on this average, the community could see growth near 144 people in the community.

Economy

The Alton Town economy is dominantly natural resource based, with farming and agriculture being a staple of the local economy historically. Today the town includes a post office and several hotels which cater to visitors to the area.

The US Census Bureau publishes data about jobs and industries in an area like Alton Town. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code. The data provided allows us to see which industries support the greatest share of jobs in the Town. Only two industries are represented in the date from the US Census Bureau in their 2019 estimates: transportation and warehousing and arts, entertainment, and recreation, described in Figure 246. Other industries in the area which may provide jobs to people in Alton include a nearby mine, agriculture, and other industries.

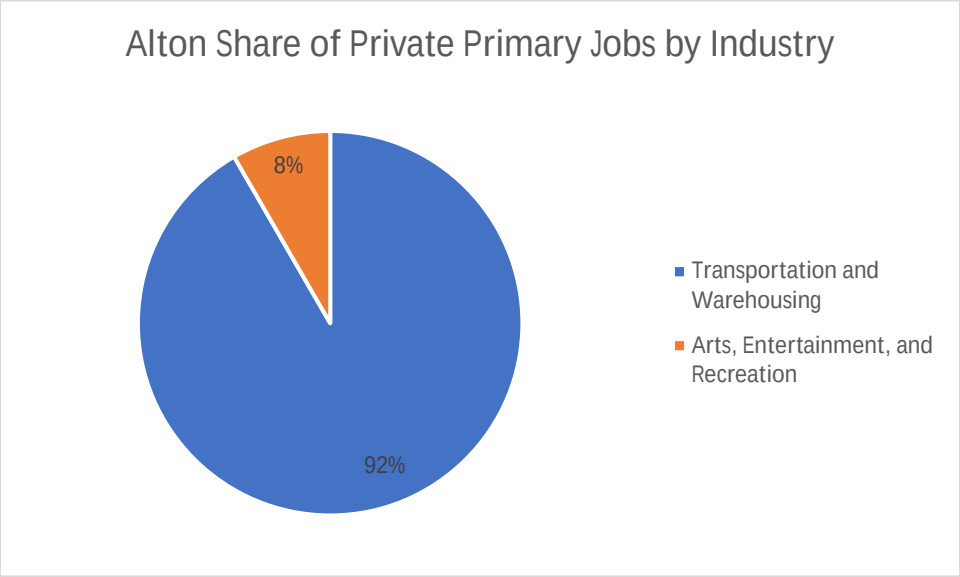


Figure 246: Alton Share of Private Primary Jobs by Industry

Source: US Census Bureau

Development

The community describes that one small subdivision application has been applied for, but no other development has been completed in the past 3-5 years.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward.

Plans and Policies

No plans or policies were made available for this planning process.

Community Assets

The Town of Alton is a mayor-council form of government which elects a mayor and several council members to make legislative decisions for the community. A town clerk provides administrative assistance for the town.

Funding for capital improvement and infrastructure projects in the town may be funded through agreements with the County, General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

Alton Town has its own fire station, and the Kane County Hospital supports a team of EMTs in the town. The town relies on Kane County for law enforcement activities. Please reference the County section of this plan for an overview of emergency response capabilities.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. Alton is near Highway 89, with access to the highway via either County Road 3996 or W Alton Rd. The only identified critical facilities are the Alton Town Hall and Alton Fire Station. There are no schools located in Alton.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Town of Alton, Utah. This assessment describes the natural hazards considered in this plan which pose risks to the town. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 274 below, summarizes the natural hazards in a list from high to low hazard risk as it pertains to the town.

Table 274: Alton Town Natural Hazard Risk Assessment

HAZARD	RISK
DROUGHT	High
WILDFIRE	High
SEVERE WEATHER	High
EARTHQUAKE	Moderate
LANDSLIDE	Moderate
FLOOD	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Alton Town's risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County sections of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Alton in the Northwest of the county has nearby cliff and hillside features, making it susceptible to landslide events. Figure 247 illustrates the areas exposed to landslide hazard near Alton Town, according to Utah Geological Survey data for rural Utah.

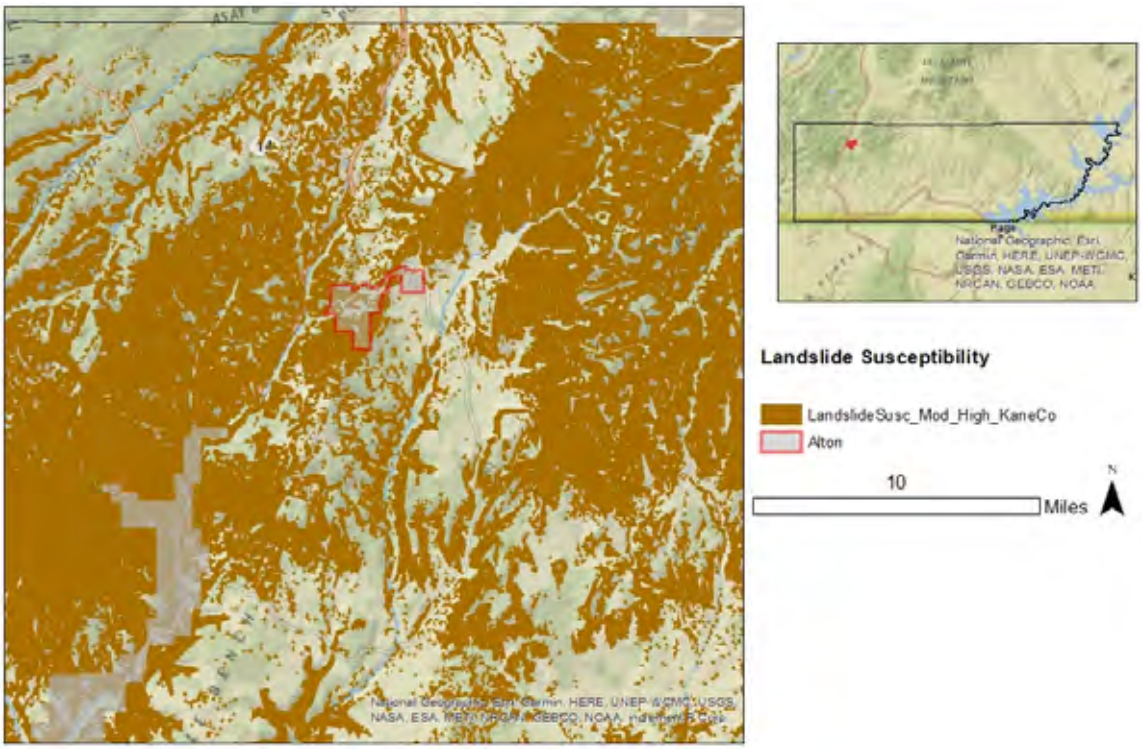


Figure 247: Alton Landslide Susceptibility

Table 275 describes the assets in the community which are exposed to landslide susceptible areas. No Critical facilities have been identified in susceptible areas. In Alton, all commercial parcels see exposure to landslide and rockfall risk areas. Parcels exposed to landslide risk areas can result in damage to structures, deaths, and injury among the users or residents of these spaces. Over 20% of roads in the unincorporated county are in a moderate to high landslide susceptible area. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace.

Table 275: Alton Exposure to Landslide Susceptible Areas

Alton Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	100.0%	9.4%	11.5%	21.1%	N/A	N/A

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Hills, slopes, and cliffs are described near the community of Alton, which have the potential for landslide or rockfall. There have not been recent landslides in Alton which have caused damages, although the Utah Geological Survey has compiled historic landslides for the area, illustrated in Figure 248.

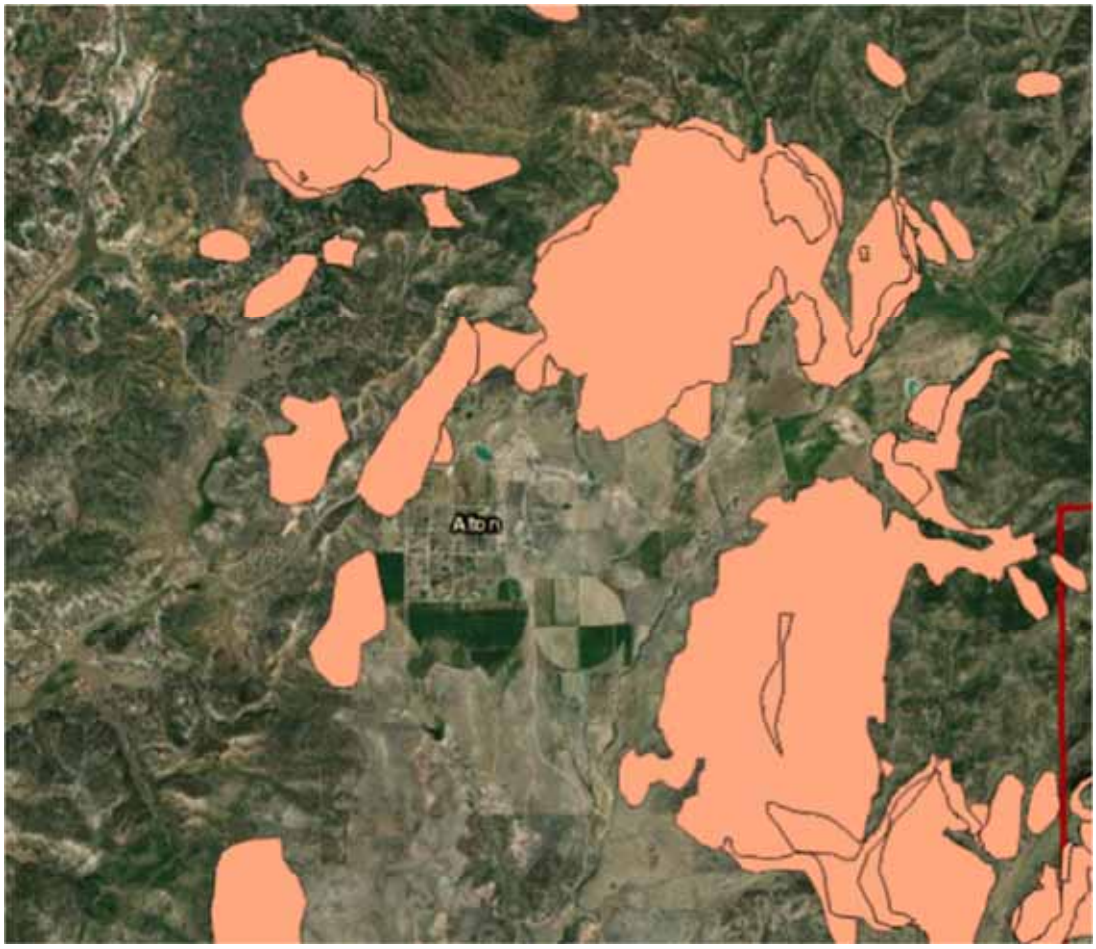


Figure 248: Alton Historic Landslides

Alton has not experienced recent landslides, but the exposure to risk remains in the community. Future growth may place more commercial and residential parcels, roads, or other infrastructure in landslide exposed areas.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Alton Town is a rural community located in higher elevations of the County. The area is largely surrounded by agriculture and public lands. Figure 249 describes the relative risk of wildfire in the town, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Alton has moderate to extreme wildfire risk identified throughout the community, but especially to the south and west of the town boundary.

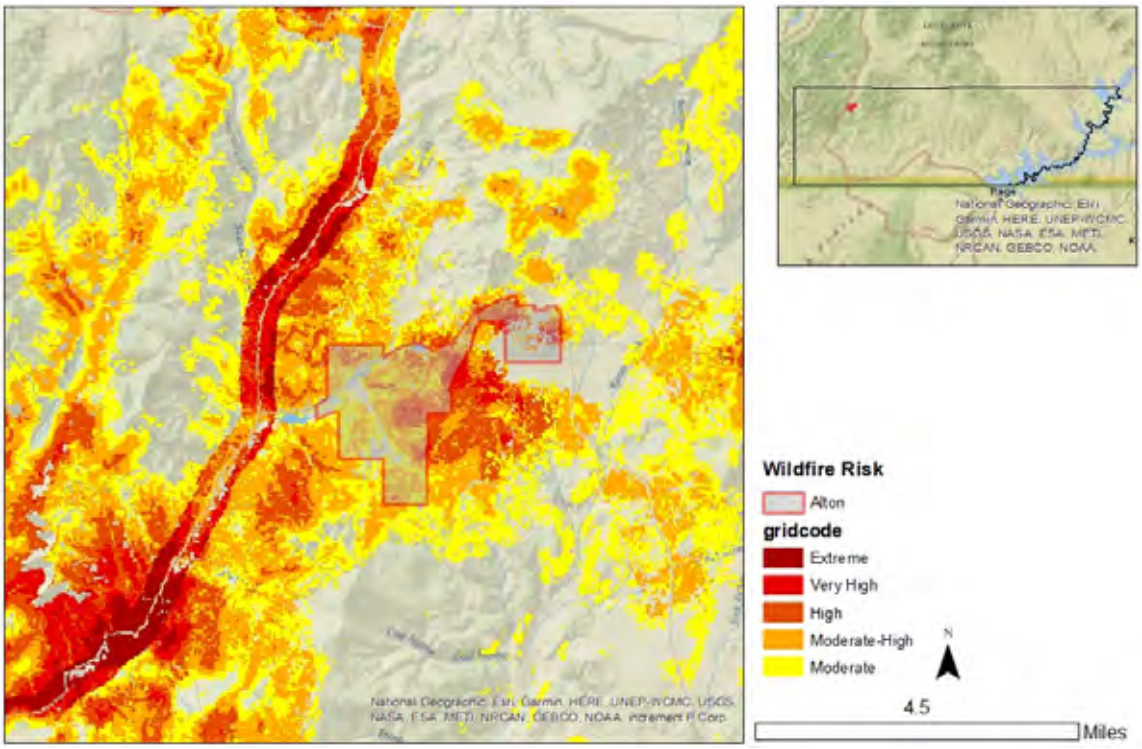


Figure 249: Alton Wildfire Risk Exposure

Source: Oregon Department of Forestry

Table 276 includes an assessment of the unincorporated county exposure of assets to the wildfire risk areas identified in the figure above. Looking to this table, we understand the assets in the county are at risk to wildfire. Over half of commercial parcels in the County are at risk to wildfire and 37.5% of critical facilities are exposed. The exposure of populations and assets in the unincorporated County is likely to increase as the county population grows and more people locate in wildland urban interface areas.

Table 276: Alton Exposure to Wildfire Risk

Alton Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	100.0%	91.8%	92.0%	42.4%	N/A	N/A

Source: Oregon department of Forestry

Hazard History

Alton has not experienced recent significant wildfire. Nearby fires which impacted unincorporated Kane County had the potential to impact the town. The area is marked by low elevation, dry desert, and alpine desert geographies, presenting some fire risk. Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area.

Most fires in Kane County have been addressed by BLM, forest service or other entities. These fires are documented on the Utah Wildfire Info website going back to 2017. News sources, federal sources, and local records also document impactful fires near Alton, which have been included in this hazard history, listed in Table 277.

Table 277: Alton Wildfire History

Fire Name	Year	Acres Burned	Description
Shingle Fire	2012	8,000	A Human Caused fire that threatened communities, powerlines, SR-14, and Highway-89 and caused evacuations from communities in Kane County. Garkane cut power to the area because of the fire. This fire received FEMA Fire management Assistance Declaration.

Source: Utah Wildfire Info, (Utah Public Radio, 2012), (USDA Forest Service , 2012)

Shingle fire near McDonald Lake, which is near the western boundary of town. Fire did not cross highway 89 or cause direct impacts to Alton. A map of the closure and fire boundary is illustrated in Figure 250.

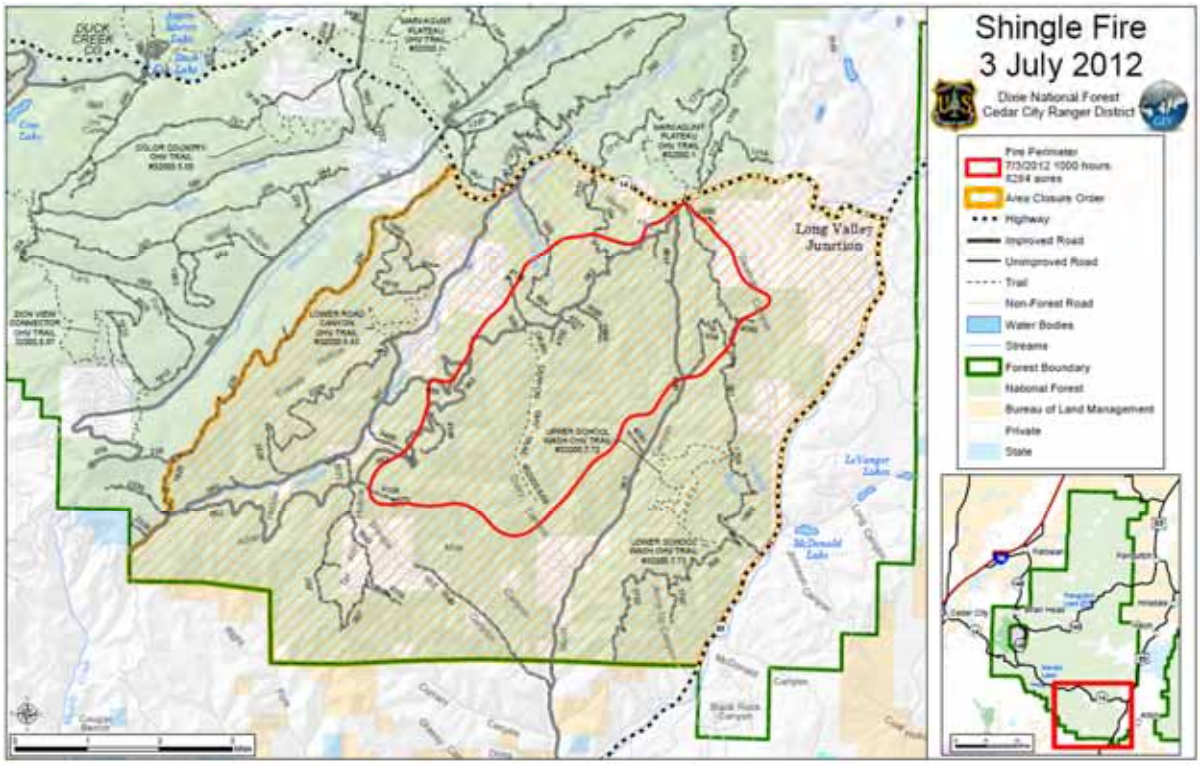


Figure 250: Shingle Fire Boundary

Smaller wildfires may have occurred in the town or surrounding area which were not reported on the Wildfire Info site. The town likely saw secondary impacts from fires in the unincorporated County, like the Shingle or Strawberry fires, including smoke or ash.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that the town is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Alton Town, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

The town sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months and thunderstorms throughout the year, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which is documented in the flood section of this plan. High winds have also been reported to cause damage in the area.

Hazard History

Table 278 describes the damage and injury which occurred during severe weather events in and near Alton Town. As some events which were in nearby towns or communities likely also had impacts on Alton, some reports from outside the community have been reported here. Further, it is likely that the entire County experienced extreme heat during the three heat events which contributed to deaths. Snow and hail events are described near Alton, which likely impact roadway access and can cause local property damage or vehicle accidents. Some events produce significant amounts of snow, with nearly two feet reported in a 2019 snowstorm.

Table 278: Alton Severe Weather Record

Date	Damage/Injury	Description
12/19/1998	None Reported	Duck Creek Village reported 22” of snow during a storm.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Kanab reported 8.5 inches and Duck Creek Village reported 16 inches of snow during a storm.
6/5/2015	None Reported	Nickel sized hail fell near the town of Duck Creek Village during a severe thunderstorm.
1/30/2016	None Reported	Heavy snow caused road closures on several roads, including SR-14.
11/27/2019	None Reported	A snowstorm produced 21 inches of Snow at Alton Town.

Source: NOAA Storm Database

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Alton from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Flash flooding is further described in the next section of this plan.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

Kane County and Alton town have outdoor and recreation assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Alton does not have Flood Insurance Rate Maps completed for the community. Flood maps are completed by FEMA and used for local regulations of construction in observed flood risk areas. These maps provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 251 illustrates that there are not identified floodplain or dam inundation zones in Alton Town, however further mapping may provide additional insight to the community's risks.

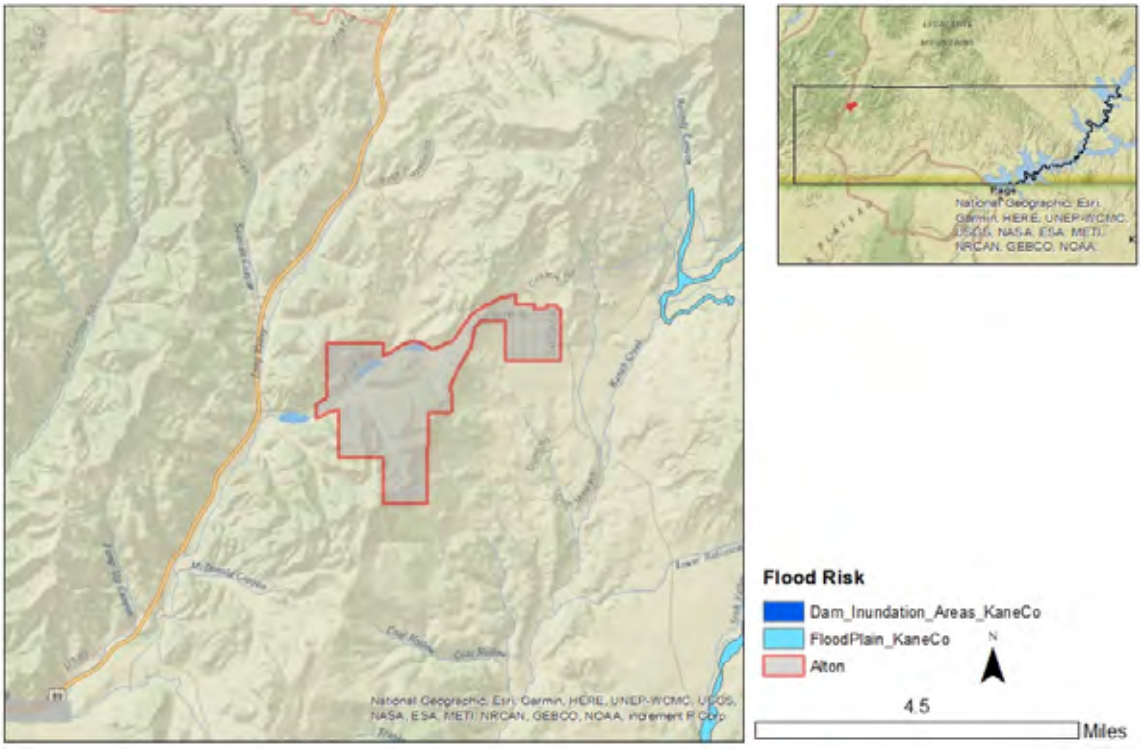


Figure 251: Alton Flood and Dam Inundation Zone Exposure

Source: FEMA, UGRC, Utah Geological Survey

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase flood insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Alton Town does not participate in the NFIP and has not had Flood Insurance Rate Maps developed. A CAC and CAV took place on 1/29/2019 and 3/4/2005 respectively.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county, including in Alton Town. The NOAA storm database describes no direct damages to Alton Town. Table 279 describes flood events which documented Countywide impacts which likely also impacted Alton Town.

Table 279: Alton Town Flood Hazard Record

Alton Town Flood Hazard Record		
Date	Damage/Injury	Description
12/19/2010	$800,000 property damage	A large storm caused flooding throughout Kane County caused the closure or blocked several roads. Significant impacts were reported on Highway 89, with water reported at one foot deep at one segment and a landslide documented which deposited a four-foot deep and 50-foot-wide debris field onto the roadway. Orderville and Glendale reported local street flooding.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.

Source: NOAA Storm Database

Highway-89 is vulnerable to flood impacts in the County and is a major connector road from Alton town to other areas of Kane County. In some areas of the County, blocked roadways can be especially dangerous, as residents or visitors may have increased delays to emergency services access, like

medical, fire, and law enforcement. Flooding is noted to cause other events in the county, including landslides which the area is vulnerable to.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89 near Alton, Glendale, and Orderville. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 252 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County. Only one earthquake epicenter with a magnitude of 4.0 or greater is reported in the county, in the City of Kanab.

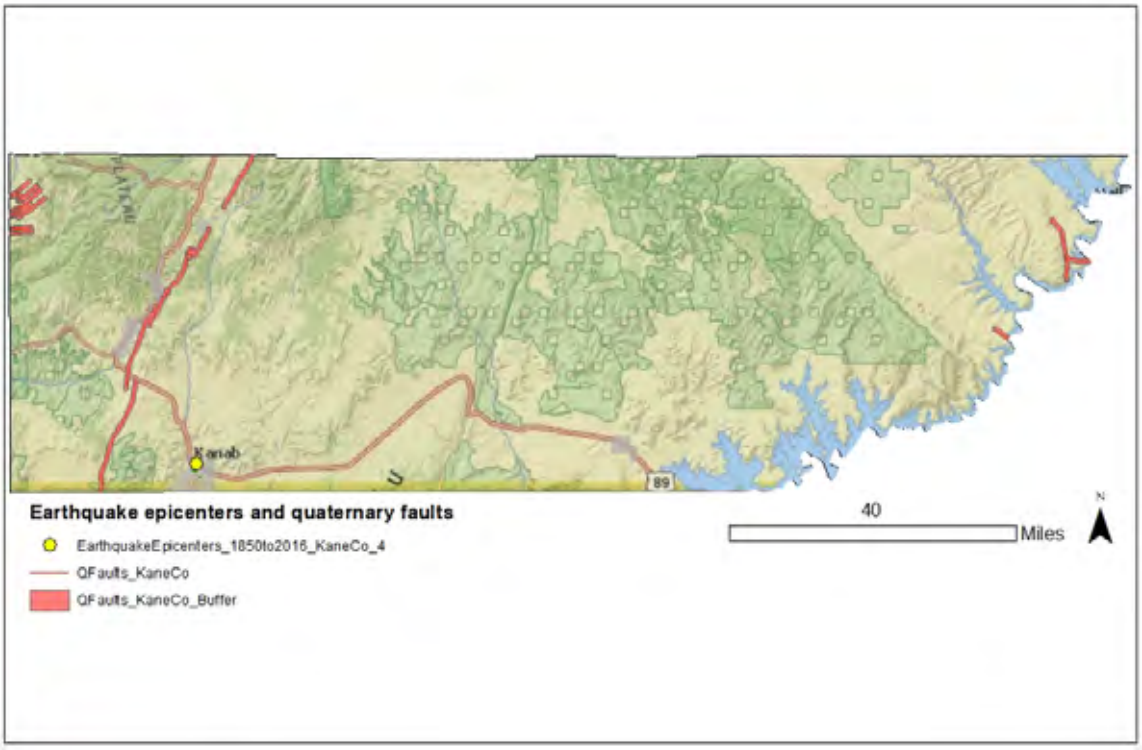


Figure 252: Alton Earthquake Epicenter and Quaternary Faults Exposure

Source: Utah Geological Survey, UGRC

The Sevier Fault does not interact with the Town boundaries, thus reducing the risk of surface faulting in the community. Ground shaking from an earthquake event is still a risk to the community.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County did not have data to describe the year that structures were built to determine which and how many structures are more vulnerable to ground shaking. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of

historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with observed impacts increasing as the magnitude continues to increase.

While few individual earthquakes in Kane County have been recorded with a magnitude of 4.0 or greater, the community is seismically active. In 2016 clusters of earthquakes were reported near Orderville. During this event, 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016)

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed for Kane County to fully assess the potential and risks of liquefaction.

Summary

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 253. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

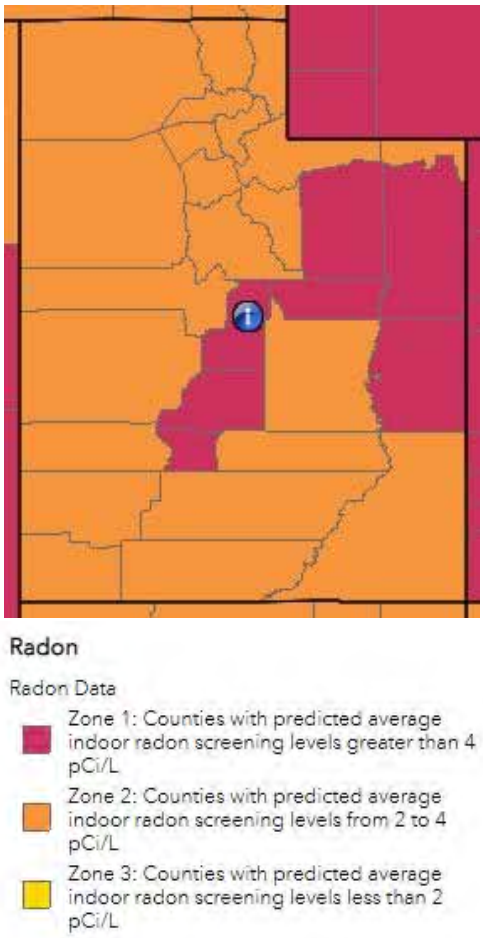


Figure 253: Indoor Radon Estimate Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 280 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 280: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development in Kane County. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas. The County land use administrator, engineer, or buildings official may require a soils survey report for an area to be developed. An engineer or geologist should prepare the document, describing the suitability of soils on the property and potential mitigations of the hazard if identified on the site.

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County.

Five County used Problem Soil Susceptibility data from 2011 that describes the extent of problem soils for some additional portions of the county, primarily the southwest and northeastern areas of the county. Figure 254 maps the data available in Kane County. Problem soils can create some challenges for structural integrity as changes in weather and soil moisture change, which in some cases can lead to soil expansion or collapse.

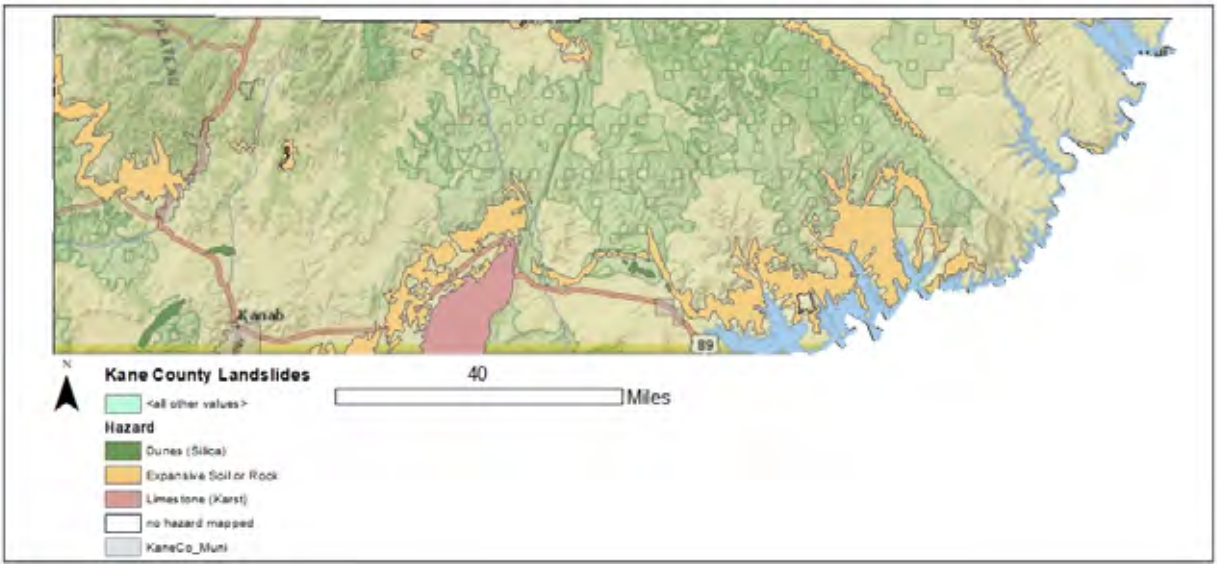


Figure 254: Kane County Problem Soils Exposure

As observed in the map, Alton Town does not include mapped problem soils within or near the town boundaries. Kane County could benefit from problem soil mapping susceptibility mapping to better identify and describe problem soils prevalence in the County. The county may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Alton Town does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. County records will describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site.

Summary

Wildfire, drought, and severe weather are considered high risks in Alton Town based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have direct health impacts on those exposed, problem soils are often considered to be more of a construction problem, causing damage when unmitigated.

This risk assessment identified vulnerabilities in Alton Town. Much of the reported severe weather hazards, floods, and wildfires impacted roadways and/or outdoor recreation ventures near the community. Highway-89 is particularly susceptible based on the historic record for the area. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations.

Several economic endeavors are identified vulnerabilities to natural hazards, including grazing and outdoor recreation. Natural resource economies like agriculture are reliant on adequate vegetation and moisture and reasonable temperatures in which to have their livestock outdoors. Drought, wildfire, and severe weather conditions can place additional stress on this industry.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

Alton Town did not participate in the 2016 iteration of the Natural Hazard Mitigation plan and has no actions to report on. The Five County Association of Governments worked with the local planning team to develop a mitigation strategy, using the identified risks and vulnerabilities in this plan as a starting point.

The Alton Town local mitigation planning team identified several items that could be included as mitigation actions in the community strategy, described in Table 281. These actions have been identified and discussed during planning meetings based on the risk assessment. Problem soils testing is required by the public health department prior to all new construction to get a building permit. The town does not consider problem soils a significant threat to the health and safety of the town and have not included mitigation actions for this hazard.

Each action in Table 281 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 255.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 255: Regional Plan Goals

Table 281: Alton Town Mitigation Strategy 2022

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	1, 5	Encourage Firewise landscaping for town residents.	Coordinate yard clean ups and education about Firewise landscaping, to align with the annual spring town clean up.	H	Ongoing annually	L	Alton Town, Fire Department, Kane County	Alton Town, Fire Department, Firewise program partnership.
Wildfire #2	2, 5	Encourage Firewise landscaping at town owned facilities.	Assess critical facilities to ensure that materials are flame resistant and landscaping is Firewise	H	Ongoing	L	Alton Town, Fire Department, Kane County	Alton Town, Fire Department, Firewise program partnership.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	1, 2, 6	Limit impacts of landslide and debris flows on burn scars.	Develop a plan for revegetation of steep slopes following a natural hazard like a debris flow, landslide, flood, or wildfire which has damaged the existing vegetation.	L	Ongoing	L	Alton Town, Fire Department, Kane County	Alton Town, Fire Department, Kane County
Severe Weather #1	2	Ensure town hall facilities can serve residents during power outage.	Acquire a generator for town office.	H	5-years	M	Alton Town	Alton Town
Earthquake #1	2	Protect the town's facilities and users during a ground shaking event.	Assess the town hall for structural stability and implement identified nonstructural and structural retrofits.	M	5-years	M	State and Federal Historic Tax Credits, Preservation Utah.	Alton Town
Earthquake #2	3	Inform residents of earthquake hazards	Distribute information on earthquake hazards and vulnerabilities in the town. To include postings to social media pages and town group text communications.	H	Ongoing annually	L	Alton Town	Alton Town, Earthquake Utah partnership.
Drought #1	3	Inform residents of drought events and conservation practices.	Inform residents of waterwise watering practices. During drought events, include communication about conservation and limiting water use. To include posting to town social media and group texts.	H	Ongoing annually and as needed.	L	Alton Town	Alton Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2, 4, 6	Coordinate with local, state, and federal partners to comply with flood programs.	Participate in flood mapping efforts and the national flood insurance program.	M	Ongoing	L	Alton Town	Alton Town
Radon #1	1, 3	Inform residents of radon risk and testing.	Provide radon risk, testing, and mitigation information to residents through postings to town social media and the town group text. .	H	Ongoing, annually	L	Alton Town	Alton Town

Source: Local Planning Team

Big Water

Big Water town is in southern Utah, near Lake Powell. The community is connected to the rest of the County and nearby Page, Arizona by Highway-89. The town incorporated in 1984 and had previously been a construction camp for workers on the Glen Canyon Dam. Big Water is a small community of southern Utah surrounded by outdoor recreation opportunities, from Lake Powell to nearby hikes, viewpoints, and canyons.

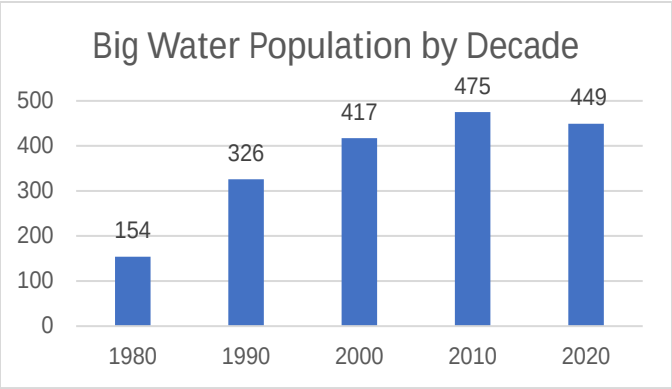


Figure 256: Big Water Population by Decade

Source: US Census Bureau

Community Characteristics

Big Water is one of Southern Utah's newer communities, which grew because of the development of the Glen Canyon Dam and Lake Powell in the 1950s. Since the initial focus on construction in the community, the area has grown to be a local access point to Lake Powell and other recreation in the eastern portion of Kane County.

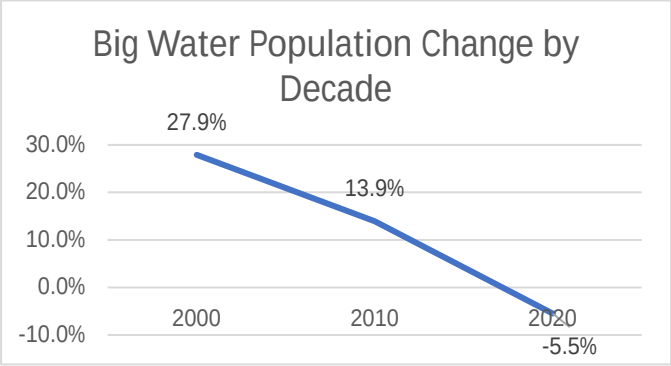


Figure 257: Big Water Population Change

Source: US Census Bureau

Demographics

The Big Water population as of the 2020 Census is 449 people, as described in Figure 256. The relative change in population is described in Figure 257 and shows that the community experienced growth through the 2010 and saw some population decline in 2020. The towns average population change since 1970 is 12.1%.

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population. If applied to the Town of Big Water through a step-down analysis, the town may see an additional 218 residents in the next 40-years, bringing the population to 667. (Hollingshaus, et al., 2022)

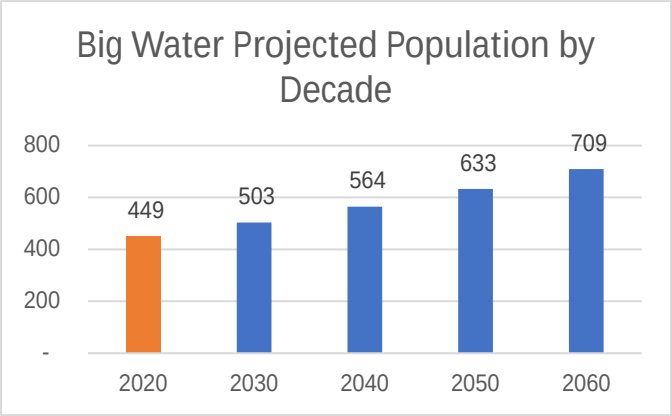


Figure 258: Big Water Projected Population by Average Percent Change

Source: US Census Bureau

Using the average change in population of 12.1% for the town, the future population by 2060 was also projected. The projection is solely based on historic patterns in the town since 1970, and does not account for land availability, local

policy, or other metrics relevant to population growth in the community. Figure 258 illustrates the projected population based on average change. Based on this average, the community could see growth near 709 people in the community.

Economy

The Big Water Town economy is dominantly small business and hospitality based. The town website provides a list of local businesses, which include several recreation, accommodation, and other service businesses. The US Census Bureau publishes data about jobs and industries in an area like Big Water Town. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code, illustrated in Figure 259. The data provided allows us to see which industries support the greatest share of jobs in the Town. This data demonstrates that the transportation and warehousing, accommodation and food service, and construction provide a significant share of jobs locally in the community.

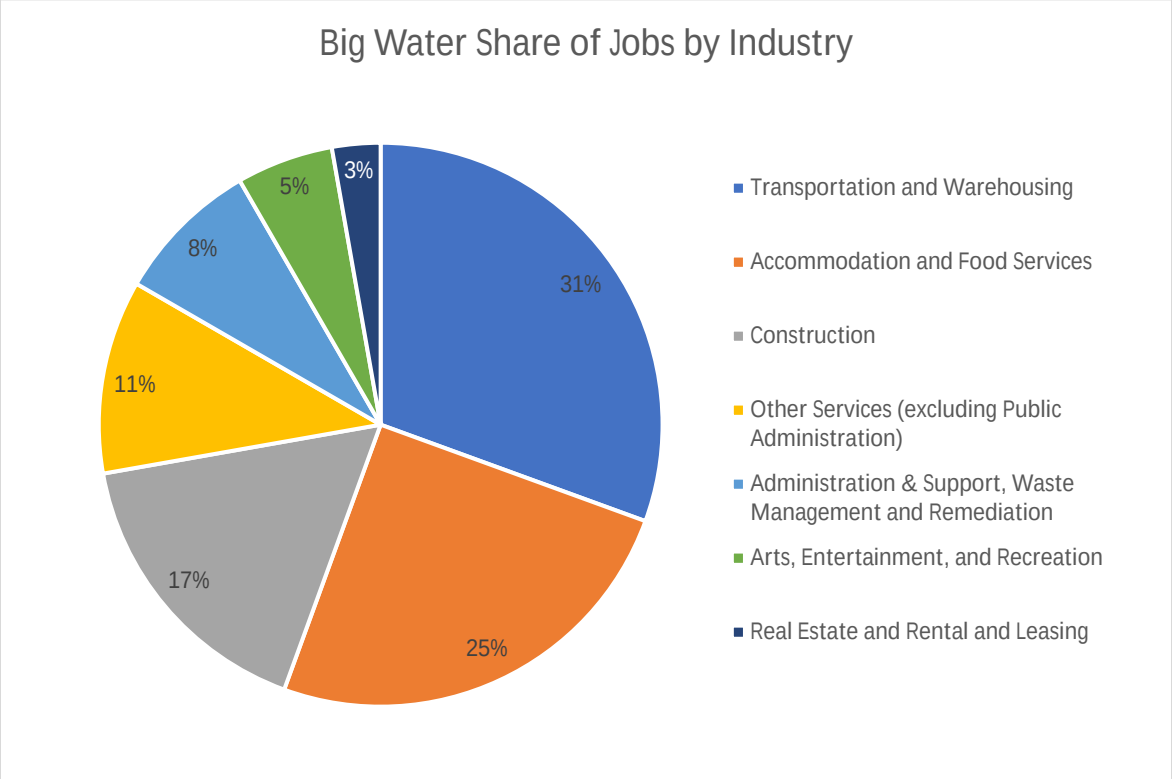


Figure 259: Big Water Share of Jobs by Industry

Source: US Census Bureau

Development

The Town of Big Water has experienced new commercial and residential growth in recent years. Commercial growth is dominantly in the leisure and accommodation services, as new development includes a 'glamping' business. In addition, a new RV park is expected in the coming years.

Residential growth includes the construction of town homes, which has begun in phases and several new homes being built in the community.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward.

Plans and Policies

Big Water develops plans and policies to guide the community development and set rules and regulations to provide for the health, safety, and public welfare of the town. These regulations and visions are described in the Municipal Code, Planning and Zoning Code, and the General Plan for the town.

Municipal Code

The Town's municipal code sets requirements for subdivisions, building codes, and other requirements for the community to develop and grow. Several ordinances discuss sensitive lands and natural hazard risks to address identified hazards during preconstruction phases of development. Relevant codes and ordinances include:

- 11.04.020
    - Adoption of the International Building Code which sets standards for structure safety.
- 14.06.020
    - Section 3a describes requirements for identification of natural features like wetlands, slopes of 30% grade or more, flood channels, bodies of water, drainages, or other natural features.
    - Section 3h requires applications to provide proposed storm drainage system.
    - section 7e. provides requirements for additional reports, letters of feasibility, studies, or evidence indicating proposed subdivisions address geologic or flood hazard, erosion control, groundwater protection, or other environmental matter at the request of council.
- 14.8.020
    - Requires final subdivision applicants to provide drawings for the design and construction of storm drainage and flood control facilities elevations, and location of fire hydrants, among other required improvements.
- 14.16.030
    - Section 4b. requires an engineer representing the town to inspect drainage and flood control facilities.
    - Town engineer must approve the installation of public improvements, including drainage facilities and fire hydrants.

Planning and Zoning Code

The planning and zoning code is intended to establish areas with suitable uses for the long-term goals of the community. The zoning code includes requirements for site planning, conditional uses, and enforcement of other codes and ordinances locally.

- 15.02.040
    - Zoning implements the goals from the general plan to manage growth and development and ensure orderly use of lands.

- 15.14.030
    - Site plan requirements.
    - 7. All existing and proposed water, sewer and storm drainage lines and facilities, streets and roads with design plans for any new water, sewer and storm drainage lines and facilities, if applicable, streets and roads, meeting the design and construction requirements of the Town, and other agencies, if applicable, prepared by a licensed engineer, at a scale acceptable to the Zoning Administrator. Access to all utilities and points of utilities hookups shall be shown.
- 15.14.050 the planning commission may grant a conditional use permit in compliance with this ordinance if from the application and the facts presented, the Commission finds:
    - 3. The provision of public facilities and amenities, including roads and streets, water, sewer, storm drainage, public safety and fire protection and other utilities.
    - 11. Measures designed to protect the natural features of the site including wetlands and floodway and drainage protection, groundwater protection, cut and fill limitations, wildlife habitat and historic and archeological site protection, and other natural site features.
- 15.22.020
    - Section 8a. restricts construction on sensitive areas, like lands with a slope equal to or greater than 30% grade, a minimum distance of 100 horizontal feet.
    - 8b. no building or structure should be constructed in flood channels as identified by a federal or state agency.
- 15.22.060
    - No road or street shall be constructed upon or cross an area identified as an area of slope with an average 30% grade, or greater, a minimum distance of 100 horizontal feet.
- 15.26.120
    - Non residential uses and buildings 2a. no building or structure, except fo ra required public utility, shall be constructed on areas determined to be sensitive. For the purpose of this ordinance, sensitive areas are areas of slope with a n average 30% grade or greater, a minimum distance of 100 horizontal feet.
    - 2b. flood channels as identified by a federal or state agency.
- 15.28.040
    - Allows the reconstruction of nonconforming structures if damaged or destroyed by a natural hazard, act of god, or public enemy within one year of damages.

General Plan

The town general plan, adopted 2018, sets goals for the future growth of the community, addressing elements including housing, transportation, and community development. An element described in the plan, Natural Resources and Hazards, illustrates the potential natural hazard exposure and mitigation measures the community will take. This section sets goals for water conservation, reducing risk in new developments, and protecting the air, water, and soil resources surrounding the town.

Community Assets

The Town of Big Water is a mayor-council form of government which elects a mayor and several council members to make legislative decisions for the community. A town clerk provides administrative assistance for the town.

Funding for capital improvement and infrastructure projects in the town may be funded through agreements with the County, General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

Big Water has its own fire station, and the Kane County Hospital supports a team of EMTs in the town. The town supports a marshal locally for law enforcement. Please reference the County section of this plan for an overview of emergency response capabilities.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. Big Water is along Highway 89, with access north of the County along Fish Hatchery Rd and south along Jacobs Tanks Rd. The identified critical facilities are the town hall, an elementary school, and the fire department.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Town of Big Water, Utah. This assessment describes the natural hazards considered in this plan which pose risks to the town. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 282 below, summarizes the natural hazards in a list from high to low hazard risk as it pertains to the town.

Table 282: Big Water Town Natural Hazard Risk Assessment

HAZARD	RISK
DROUGHT	High
FLOOD	High
SEVERE WEATHER	High
EARTHQUAKE	Moderate
LANDSLIDE	Moderate
WILDFIRE	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Big Water's risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County sections of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Big Water is seeing the impacts of drought firsthand, with direct impacts at the water level of lake Powell. Notable popular boat launch sites near the community, including the Wahweap launch site have needed to extend their boat ramps to remain open. The water level has reached historic lows.

Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Big Water in the southeast of the county has cliffs, slickrock, and canyon features, making it susceptible to landslide and rockfall events. Figure 260 illustrates the areas exposed to landslide hazard near Big Water Town, according to Utah Geological Survey data for rural Utah.

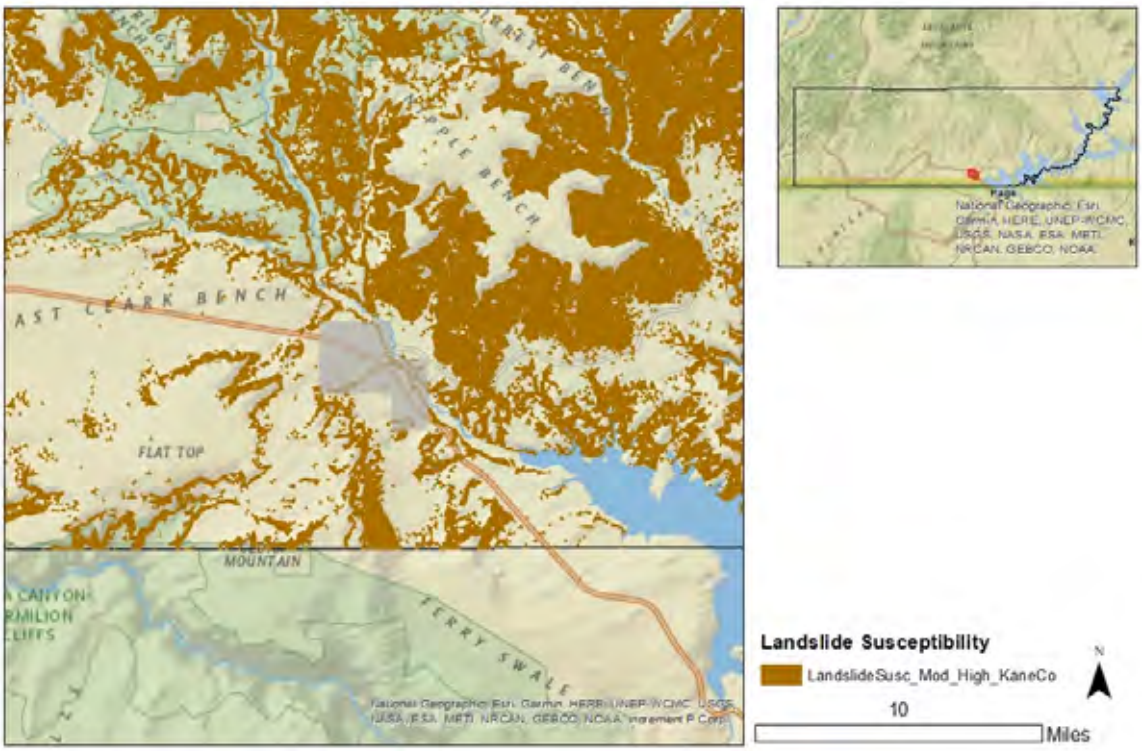


Figure 260: Big Water Landslide Susceptibility

Table 251 describes the assets in the community which are exposed to landslide susceptible areas. No critical facilities or commercial parcels have been identified in susceptible areas. In Big Water, 5.2% of residential parcels are exposed to landslide or rockfall areas. Parcels exposed to landslide risk areas can result in damage to structures, deaths, and injury among the users or residents of these spaces. One percent of roads are in a moderate to high landslide susceptible area. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace.

Table 283: Big Water Exposure to Landslide Susceptible Areas

Big Water Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	5.2%	4.7%	1.0%	N/A	N/A

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Hills, slopes, and cliffs are described near the community of Big Water, which have the potential for landslide or rockfall. There have not been recent landslides in the town which have caused damages, although the Utah Geological Survey has compiled historic landslides for the area, illustrated in Figure 261. Landslides have not been recorded in the town, but are documented in the cliffs northeast of the town.

Figure 261: Big Water Historic Landslide Records

Big Water has not experienced recent landslides, but the exposure to risk remains in the community. Future growth may place more commercial and residential parcels, roads, or other infrastructure in landslide exposed areas.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Big Water Town is a rural community located in higher elevations of the County. The area is largely surrounded by agriculture and public lands, with the national monument to the north and east of the community. Figure 262 describes the relative risk of wildfire in the town, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Big Water has some areas of moderate wildfire risk identified in the town boundaries.

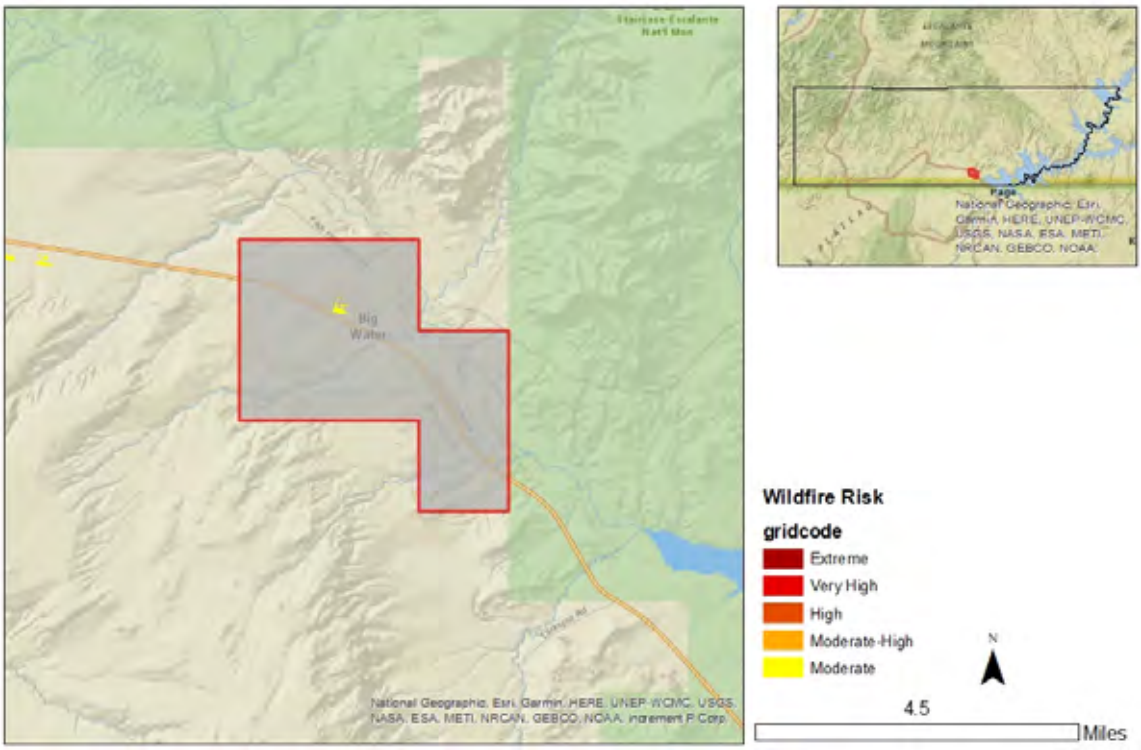


Figure 262: Big Water Wildfire Risk

Source: Oregon Department of Forestry

Table 284 includes an assessment of the town's exposure of assets to the wildfire risk areas identified in the figure above. Looking to this table, we understand that some assets in the county are at risk to wildfire. Residential Parcels and Road Miles appear to be exposed to moderate or greater wildfire risk areas. Residential areas exposed to wildfire place people and property at risk and wildfires which impact roadways can affect the access of emergency services.

Table 284: Big Water Exposure to Wildfire Risk

Big Water Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	4.7%	4.2%	0.3%	N/A	N/A

Source: Oregon department of Forestry

Hazard History

Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area. Big Water has not experienced recent significant wildfires in the town boundaries. The 2020 fires, Pine Hollow and Wire Pass were both approximately 25 miles west of the town and are described in Table 285. The town likely saw secondary impacts from fires in the unincorporated County, including smoke or ash.

Table 285: Big Water Wildfire Record

Fire Name	Year	Acres Burned	Description
Pine Hollow Fire	2020	2,771	A lightning caused fire led to evacuations and risks to livestock, rangeland, and California Condor habitat.
Wire Pass	2020	1,580	A lightning caused fire impacted trails, trailheads and powerlines. The event caused the closure of trails near the Wave.

Source: Utah Fire Info

The area is marked by low elevation, dry, desert, presenting some fire risk, especially given the number of visitors which come to the area annually. Smaller wildfires may have occurred in the town or surrounding area which were not reported on the Wildfire Info site.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that the town is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact the Town of Big Water, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

The town sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months and thunderstorms throughout the year, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which is documented in the flood section of this plan. High winds have also been reported to cause damage in the area.

Hazard History

Table 286 describes the damage and injury which occurred during severe weather events in and near Big Water Town. As some events which were in nearby towns or communities likely also had impacts on Big Water, some reports from outside the community have been reported here. Further, it is likely that the entire County experienced extreme heat during the three heat events which contributed to deaths. Severe thunderstorms are reported to produce precipitation, hail, and high winds near Big Water, which have the potential to cause property damage or injury. One event in the Glen Canyon Recreation Area resulted in injuries and damages to boats on the lake during a wind event. All the deaths reported here are the result of hot temperatures which impacted outdoor recreators.

Table 286: Big Water Severe Weather Record

Date	Damage/Injury	Description
7/22/1997	None Reported	A funnel cloud was reported over Lake Powell.
9/29/2004	$20,000	A severe storm produced heavy rainfall causing flash flooding near Big Water and 0.75" hail which was reported to fall two-inches deep in Kanab.
7/12/2005	1 death	Temperatures near 110 degrees led to the death of a hiker in Glen Canyon.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
5/14/2015	None Reported	A severe thunderstorm produced "penny sized" hail near the community of Big Water.
2/20/2019	None Reported	A winter storm produced eight inches of snow in Kanab, three inches of snow in Big Water, and two inches in Bullfrog Basin.

Source: NOAA Storm Database

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Big Water from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Flash flooding is further described in the next section of this plan.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

Kane County and Big Water town have outdoor and recreation assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that annually draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Big Water does not participate in the NFIP and has not had Flood Insurance Rate Maps developed. These maps provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 263 illustrates that Wahweap Creek is a potential source for flooding in the town, however further mapping may provide additional insight to the community's risks.

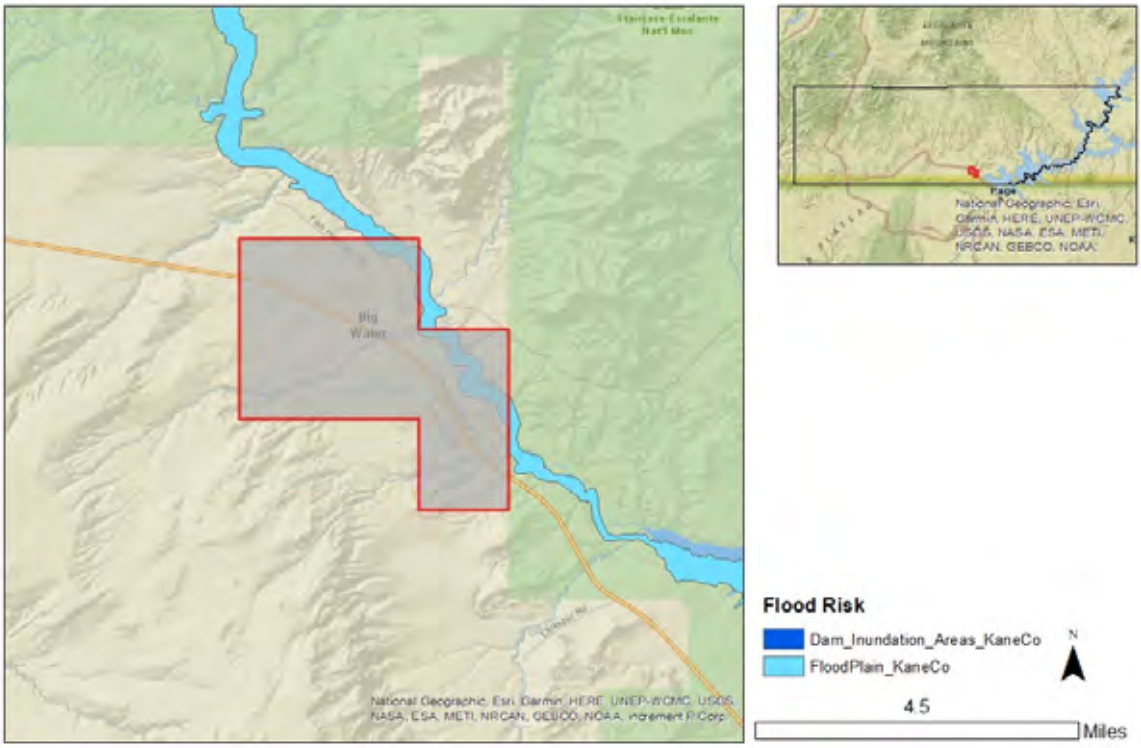


Figure 263: Big Water Flood and Dam Inundation Zones

Source: FEMA, UGRC, Utah Geological Survey

Table 287 includes an assessment of the town's exposure of assets to the flood risk areas identified in the figure above. Looking to this table, we understand that only residential and commercial parcels are identified as exposed to the floodplain and dam inundation zone locally.

Table 287: Big Water Exposure to Flood and Dam Inundation Risk

Big Water Exposure to Flood and Dam Inundation Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	1.6%	1.4%	1.4%	0.0%	N/A	N/A

Source: Oregon department of Forestry

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land. Flash floods have been documented in Big Water and their history is described in the flood history section of this plan.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase flood insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Big Water does not participate in the NFIP and has not had Flood Insurance Rate Maps developed.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county, including in the Town of Big Water. The NOAA storm database describes no direct damages to the town. Table 288 describes flood events which documented Countywide impacts which likely also impacted Big Water Town.

Table 288: Big Water Flood Hazard Record

Big Water Flood Hazard Record		
Date	Damage/Injury	Description
9/5/1998	1 death $3,000 crop damage	A storm which brought thunderstorms and monsoon rains in Southern Utah killed a young girl who was recreating in the Glen Canyon National Recreation Area during a flash flood.

7/14/2001	$,1000 property damage	Flash flooding was reported in canyons throughout Kane County. Several roads were washed out during the event.
9/29/2004	$3,000 property damage	Flash flooding reported outside of Big Water during a severe thunderstorm.
10/5/2006	$15,000 property damage	Wahweap Creek flooded and washed-out roads.
7/28-29/2010	$30,000 property damage	Thunderstorms caused flash flooding across several washes, drainages, and canyons near the Glen Canyon National Recreation Area, causing damages to roads throughout the area. In one instance, the damage prevented park rangers from accessing the area.
8/16/2010	$10,000 property damage	Several roads were damaged or impassable after slot canyons were flooded near the Glen Canyon National Recreation Area.
8/31/2013-9/1/2013	$10,000 property damage	Flash flooding was reported in Croton Canyon and the lower Escalante Drainage, which washed out roads near the two areas.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.
8/27/2014	$5,000 property damage	Smoky Mountain Road was impassable following flooding on Wahweap creek.
6/5/2015	$20,000 property damage	Big Water was impacted by flash flooding on Wahweap Creek, as roads were damaged.
6/6/2015	$50,000 property damage	Flash flooding near Lake Powell stranded visitors waiting for floodwaters to subside. Three boats were damaged by floodwaters, one of which was considered a total loss.

Source: NOAA Storm Database

Highway 89 and canyons near the community are vulnerable to flooding and flash floods. In some areas of the County, blocked roadways can be especially dangerous, as residents or visitors may have increased delays to emergency services access, like medical, fire, and law enforcement. Flooding is noted to cause other events in the county, including landslides which Big Water is at risk to. Visitors to the area for hiking, camping, and other outdoor recreation are vulnerable to flooding, especially flash flooding which can have rapid onset and occur frequently in the canyons and drainages of Kane County.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89 near Alton, Glendale, and Orderville. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 264 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County. There are no faults or earthquake epicenters identified in or near Big Water. Only one earthquake epicenter with a magnitude of 4.0 or greater is reported in the county, in the City of Kanab. Faults in San Juan County appear to cross the Glen Canyon Recreation area highlighting additional potential for risk from these areas.

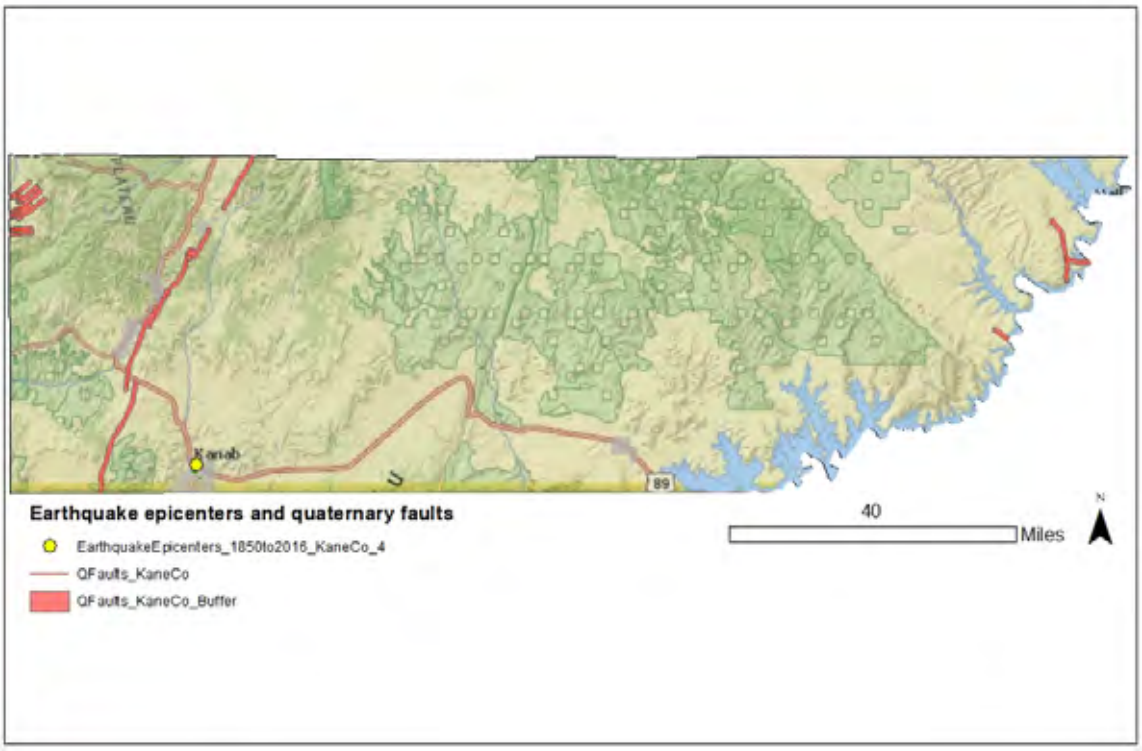


Figure 264: Kane County Earthquake Epicenters and Quaternary Faults

Source: Utah Geological Survey, UGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County's assessor roles did not have data to describe the year that structures were built to determine which and how many structures are more vulnerable to ground shaking. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking

event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with observed impacts increasing as the magnitude continues to increase.

While few individual earthquakes in Kane County have been recorded with a magnitude of 4.0 or greater, the community is seismically active. In 2016 clusters of earthquakes were reported near Orderville. During this event, 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016)

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed for Kane County to fully assess the potential and risks of liquefaction.

Summary

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 265. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

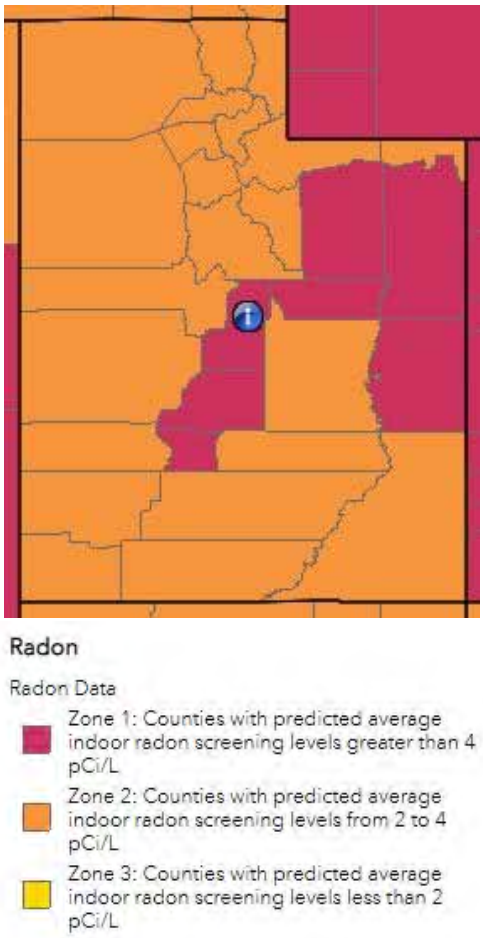


Figure 265: Estimated Indoor Radon Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 289 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 289: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas of the county, although near Big Water, the Utah Geological Survey has only identified Expansive Soil or Rock and Dunes in mapping completed in 2011. Figure 266 maps the data available near Big Water. Note that identified problem soil hazard areas have not been identified within the town boundaries.

Expansive Soils composition includes clays which interact with moisture, expanding when whetted and contracting when dry. Utilities, structures, and infrastructure can be damaged from the soil movement associated with expansion. Dunes have also been identified near the community, which can blow sand and dust during wind events.

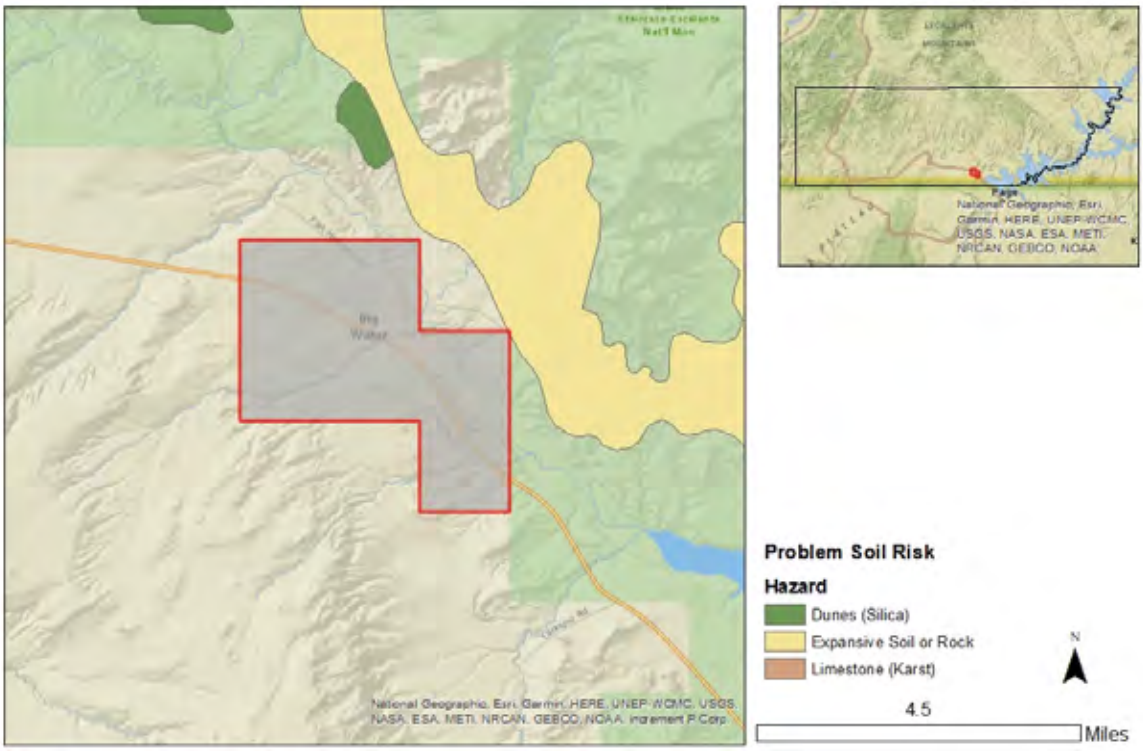


Figure 266: Big Water Problem Soils Exposure

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County. Further mapping of the area will provide greater detail to the problem soils prevalence in the community. The Town may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Big Water Town does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. County records may describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site.

Summary

Drought, severe weather, and flood are all considered high risks in Big Water based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have direct health impacts on those exposed, problem soils are often considered to be more of a construction problem, causing damage when unmitigated.

This risk assessment identified vulnerabilities in Big Water Town. Much of the reported severe weather hazards, floods, and landslides impacted roadways and/or outdoor recreation ventures near the community. Highway-89 is particularly susceptible based on the historic record for the area. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations. Floods impact the full-time residents through property

Several economic endeavors are identified vulnerabilities to natural hazards, including outdoor recreation. Visitors may select alternate destinations if they feel conditions will not be good for their intended activity. Drought, wildfire, and severe weather conditions can place additional stress on this industry. Related industries like accommodations, food service, and retail may see secondary impacts if visitation is impacted.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

The Town of Big Water participated in the 2016 iteration of the Five County Association of Governments Natural Hazard Mitigation Plan process. In this plan they identified an action to address the problem hazard risks in the community. This mitigation strategy has been summarized in Table 290, with a column identifying progress on action.

Table 290: Big Water 2016 Mitigation Strategy

Strategy	Objective	Action	Timeline	Funding Source	Progress
Problem soils	Minimize ground water contamination .	Site specific geological soil studies to prevent sewer leech field failures.	Ongoing	Home owners/ developers	Sampling is completed by the Health Department, on request by the town.

Five County Association of Governments worked with the local planning team for Big Water to develop a mitigation strategy, using the identified risks and vulnerabilities in this plan as a starting point. Strategy

development also referred to previous strategies to ensure that new actions continue progress already made toward risk reduction. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 267.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 267: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Big Water has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 291, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 291: 2022 Big Water Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	1, 2	Use findings from community studies to improve mitigation.	Complete the ongoing Water Table Study and use findings to improve local conservation and drought mitigation efforts.	M	2-years	L	Division of Drinking Water, CIB, CDBG	Big Water Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2, 4	Work collaboratively with partners to address natural hazard risks.	Coordinate with UDOT and Kane County to assess Culverts under Highway-89 for capacity and debris clearing to prevent roadway flooding on critical infrastructure.	M	Ongoing	L	Big Water Town, UDOT	UDOT
Severe Weather #1	1, 2	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Require in Town Code that developers engage in stormwater infrastructure development, like curb and gutter, swales, retention basins, etc.	H	1-year, ongoing	L	Develop ers	Big Water Town, local developers.
Landslide #1	1, 2	Assess active landslides for future mitigation needs.	Coordinate with BLM and National Parks Service to assess slopes which may cause flooding in drainages or on the Creek near town.	M	Ongoing	L	Big Water Town	Big Water Town
Wildfire #1	1, 2, 3, 4, 6	Reduce invasive species and fuel loads	Annually, during town yard clean ups, provide residents public information about fire mitigation on personal property. Include notice in utility billings and on site from fire department/Kane County emergency management.	H	Ongoing	L	Big Water Town	Big Water Town, Kane County, Fire Department

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #1	3	Inform residents of natural hazard risks and earthquake preparedness.	Annually, in utility billings, send residents information about earthquake safety and preparedness needs locally.	H	Annually	L	Big Water Town	Big Water Town, Earthquake Utah
Radon #1	3	Inform residents of natural hazard risks and mitigation options available.	Inform the public of radon gas risks, testing, and mitigation techniques using City website and social media.	H	Annually	L	Big Water Town	Big Water Town, Utah DEQ
Multi-Hazard #1	1	Use best practices and standards for development in areas exposed to geologic hazards.	Adopt a geologic hazard ordinance which addresses radon, problem soils, landslides, and other natural hazards.	H	Ongoing	L	Big Water Town	Big Water Town, Utah Geologic Survey.

Source: Local Planning Team

Glendale

Glendale Town is a rural town in Kane County which is situated between Zion and Bryce Canyon National Parks, Cedar Breaks and Grand Staircase-Escalante National Monuments, and the Coral Pink Sand Dunes State Park. Nearby outdoor recreation opportunities include hiking, hunting, off roading, and fishing.

The town is in the western portion of the county, near the towns of Alton and Orderville along Highway-89. This area of the county is called Long Valley, which was formed by the east fork of the Virgin River.

Community Characteristics

Glendale was settled in the late 1800s by Mormon pioneers. The area was dominantly used for agriculture and livestock grazing. The town is in a valley, near the east fork of the Virgin River and is part of the Paunsaugunt plateau region, marked by high elevation, desert, and canyons in southwestern Utah.

Demographics

The Glendale population as of the 2020 Census is 312 people, as described in Figure 268. the relative change in population is described in Figure 269 and shows that the community experienced growth through the 2010 and saw some population decline in 2020. The towns average population change since 1970 is 7.0%.

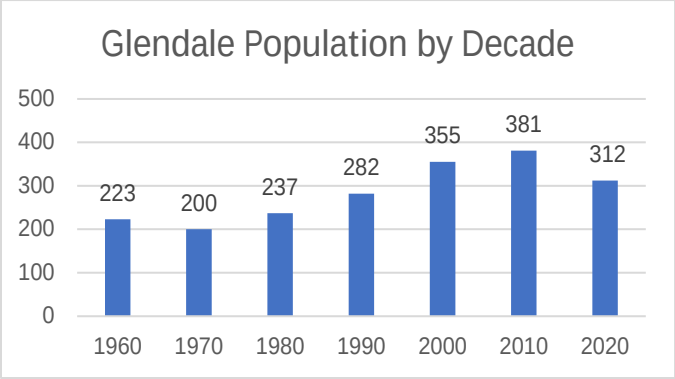


Figure 268: Glendale Population by Decade

Source: US Census Bureau

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population. If applied to the Town of Glendale through a step-down analysis, the town may see an additional 151 residents in the next 40-years, bringing the population to 463. (Hollingshaus, et al., 2022)

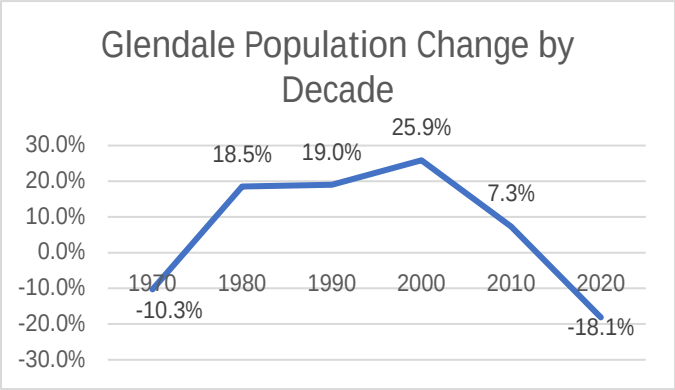


Figure 269: Glendale Population Change

Source: US Census Bureau

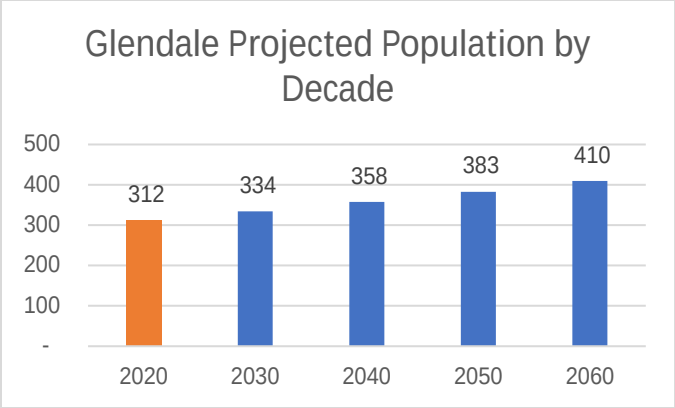
Using the average change in population of 7.0% for the town, the future population by 2060 was also projected. The projection is solely based on historic patterns in the town since 1970, and does not account for land availability, local policy, or other metrics relevant to population growth in the community. Figure 270 illustrates the projected population based on average change. Based on this average, the community could see growth near 410 people in the community.

Figure 270: Glendale Projected Population by Average Population Change

Source: US Census Bureau

Economy

The Glendale Town economy is dominantly small business and hospitality based. The US Census Bureau publishes data about jobs and industries in an area like Glendale Town. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code. The data provided allows us to see which industries support the greatest share of jobs in the Town. Figure 271 demonstrates that the construction, retail trade and accommodation and food service industries are the primary industries present in the community.



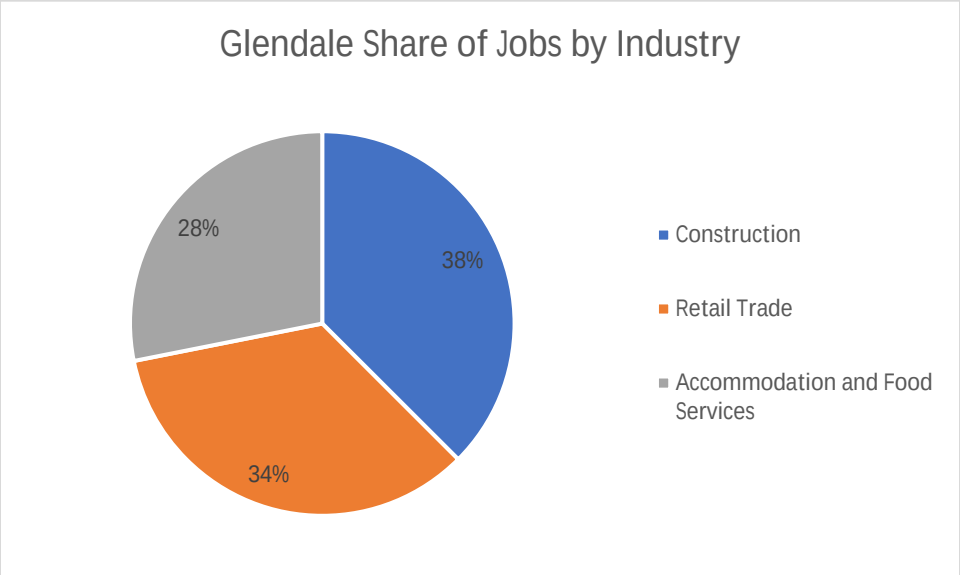


Figure 271: Glendale Share of Jobs by Industry

Source: US Census Bureau

Development

No new development.

Community Capabilities

An understanding of the planning mechanisms, policies, staff capabilities, and tools that exist in the community which inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward.

Plans and Ordinances

No plans, ordinances, or policies were made available by the town for review.

Community Assets

The Town of Glendale is a mayor-council form of government which elects a mayor and several council members to make legislative decisions for the community. A town clerk provides administrative

assistance for the town and a buildings official to enforce the building code. The town relies on the County for many services including law enforcement, waste removal, etc. see the County section of this plan for a description of County capabilities.

Funding for capital improvement and infrastructure projects in the town may be funded through agreements with the County, General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

Glendale supports a fire department for fire response and suppression. The Kane County Hospital supports EMTs in nearby Kanab and Alton which provide service to the area. Kane County Sheriff's Office supports law enforcement in the town. Please reference the County section of this plan for an overview of emergency response capabilities.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. Glendale Town is located on Highway 89, with other access roads connecting the community to other areas of the county including: Stout Canyon Road and East Johnson Road. The identified critical facilities are the town hall and the fire department.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Town of Glendale, Utah. This assessment describes the natural hazards considered in this plan which pose risks to the town. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 292 below, summarizes the natural hazards in a list from high to low hazard risk as it pertains to the town.

Table 292: Glendale Town Natural Hazard Risk Assessment

HAZARD	RISK
DROUGHT	High
FLOOD	High
SEVERE WEATHER	High
WILDFIRE	Moderate
EARTHQUAKE	Moderate
LANDSLIDE	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Glendale's risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County sections of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Glendale Town has experienced recent drought impacts like the rest of the area. In 2020 and 2021 several reservoirs throughout the state of Utah were at record low levels due to severe drought conditions across the state. This area still includes some agricultural uses and outdoor recreation uses which are vulnerable during drought events.

Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Glendale is in a river valley with many nearby canyons and hillsides. Figure 272 illustrates the areas exposed to landslide hazard near Glendale Town, according to Utah Geological Survey data for rural Utah. Much of the town boundary includes susceptible areas.

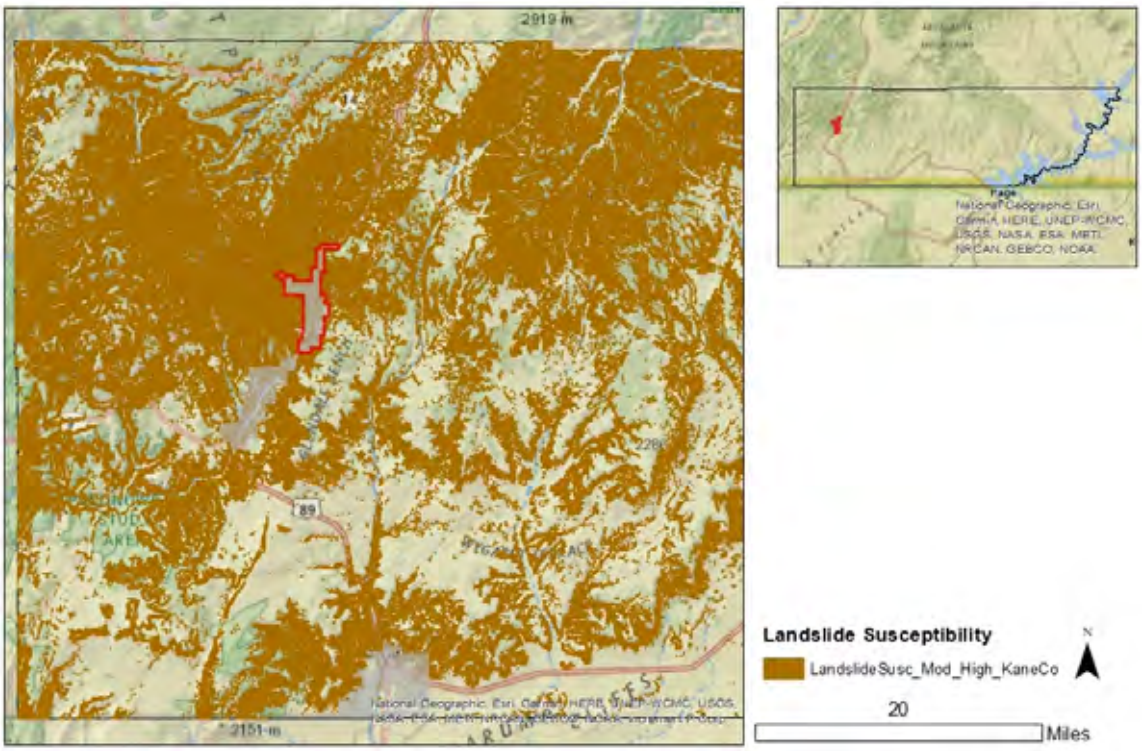


Figure 272: Glendale Landslide Susceptibility

Table 293 describes the assets in the community which are exposed to landslide susceptible areas. No critical facilities or commercial parcels have been identified in susceptible areas. In Glendale over one third of all commercial and residential parcels are exposed to landslide susceptible areas. Parcels exposed to landslide risk areas can result in damage to structures, deaths, and injury among the users or residents of these spaces. More than half of all miles of roadway in the town are exposed to landslide susceptible areas. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace. The town's only park is also in an identified landslide susceptible area.

Table 293: Glendale Exposure to Landslide Susceptible Areas

Glendale Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	35.3%	36.9%	39.3%	52.9%	N/A	100.0%

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Hills, slopes, and canyons are described near the community of Glendale, which have the potential for landslide or rockfall. There are two landslides reported near the town described in Table 294.

Table 294: Glendale Landslide Record

Incident Date	Location	Description
1942	Glendale, Kane County	Landslide four miles north of Glendale.
2017	Glendale, Kane County	A landslide south of the town impacted Highway 89 and covered the road with debris.

Source: (Ari Menitove, 2017)

Figure 273: Glendale Historic Landslide Record

The Utah Geological Survey has compiled historic landslides for the town, illustrated in Figure 273. Evidence of several landslides have been recorded in Glendale but are documented in the hills to the east and southwest of the town. Future growth may place more commercial and residential parcels, roads, or other infrastructure in landslide exposed areas.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Glendale Town is a rural community located in higher elevations of the County. The area is largely surrounded by forested hillsides and agricultural land. Figure 274 describes the relative risk of wildfire in the town, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

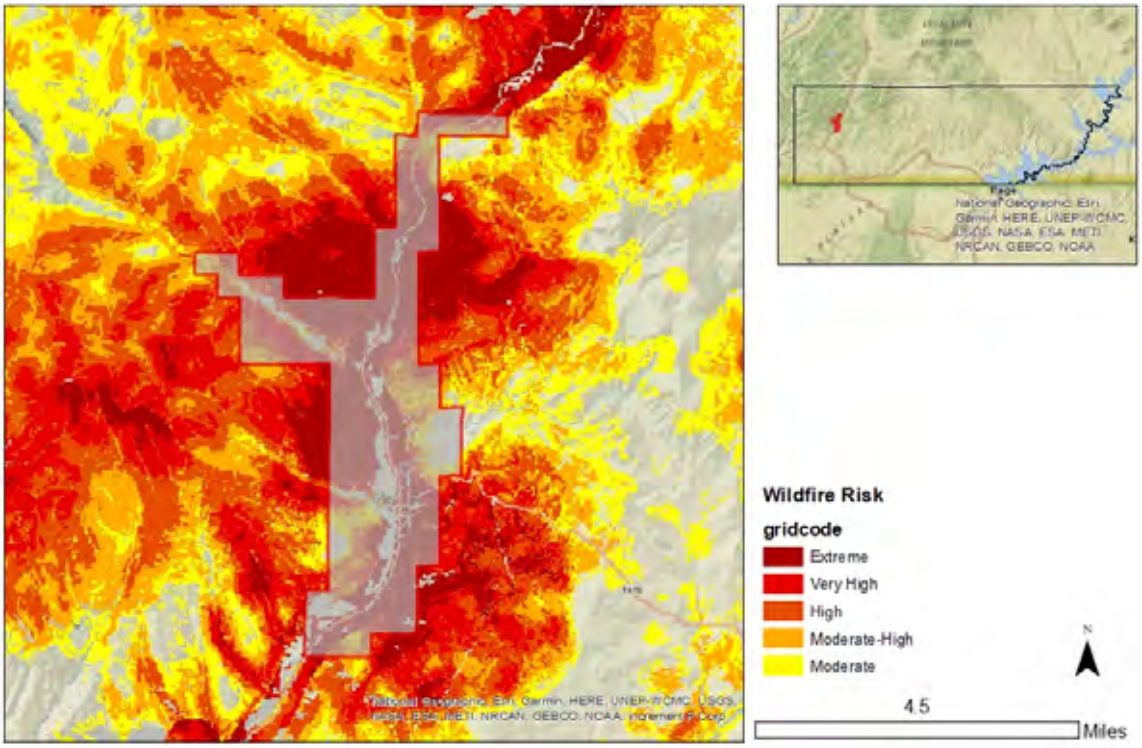


Figure 274: Glendale Wildfire Risk

Source: Oregon Department of Forestry

Exposure to wildfire risk is identified throughout the community of Glendale. Table 295 includes an assessment of the town's exposure of assets to the wildfire risk areas identified in the figure above. Assets of Glendale have a high exposure to mapped wildfire risk areas. Nearly all residential parcels are exposed and all commercial parcels are exposed, placing people and property at risk. Critical facilities like the town hall and the fire department in wildfire areas may impact access to community information, response, and recovery during an event. Impacted roads may affect travel and emergency responses to the area.

Table 295: Glendale Exposure to Wildfire Risk

Glendale Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	100.0%	97.2%	97.4%	54.5%	N/A	100.0%

Source: Oregon department of Forestry

Hazard History

Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area. Glendale has not experienced recent significant wildfires in the town boundaries. Fires elsewhere in the County may have impacted the community with secondary impacts like smoke or ash.

The area is marked by high elevation, desert, presenting some fire risk, especially given the number of visitors which come to the area annually. Smaller wildfires may have occurred in the town or surrounding area which were not reported on the Wildfire Info site.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that the town is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Glendale Town, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

The town sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months and thunderstorms throughout the year, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which is documented in the flood section of this plan. High winds have also been reported to cause damage in the area.

Hazard History

The National Oceanic and Atmospheric Association records weather related hazard events and their reported impacts. Table 296 summarizes the damage and injury during severe events which occurred near Glendale. None of the reports directly reference Glendale, although it is likely that events in nearby communities or those that impacted the entire county also affected Glendale. Severe thunderstorms are reported to produce precipitation, hail, and high winds near Glendale, which have the potential to cause property damage or injury. All the deaths from severe weather are attributed to extremely hot temperatures which were likely felt across the county.

Table 296: Glendale Severe Weather Record

Date	Damage/Injury	Description
10/21/2000	None Reported	Orderville reported .75” hail during a severe thunderstorm.
7/12/2005	1 death	Temperatures near 110 degrees led to the death of a hiker in Glen Canyon.
1/24/2008	None Reported	Brian Head and other mountainous areas of Southern Utah saw 12 inches of snow fall during a winter storm.
2/3/2008	None Reported	A snowstorm produced heavy snow fall, including 11 inches produced in Orderville.
12/17/2008	None Reported	A snowstorm produced 8 inches of snow in Orderville.
12/7/2009	None Reported	A severe winter storm produced 19 inches of snow in Orderville.
2/13/2012	None Reported	Eight inches of snow fell in Orderville.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Kanab reported 8.5 inches and Duck Creek Village reported 16 inches of snow during a storm.
1/30/2016	None Reported	Heavy snow caused road closures on several roads, including SR-14.
8/10/2016	None Reported	During a thunderstorm, large hail fell at Mt. Carmel and Orderville, while high winds were reported at the Bullfrog Marina.

Source: NOAA Storm Database

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Glendale from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest

and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Flash flooding is further described in the next section of this plan.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

Kane County and Glendale town have assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that annually draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Glendale does participate in the NFIP and had Flood Insurance Rate Maps developed in 1986. These maps provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 275 illustrates the potential sources for flooding in the town, however further mapping may provide additional insight to the community's risks.

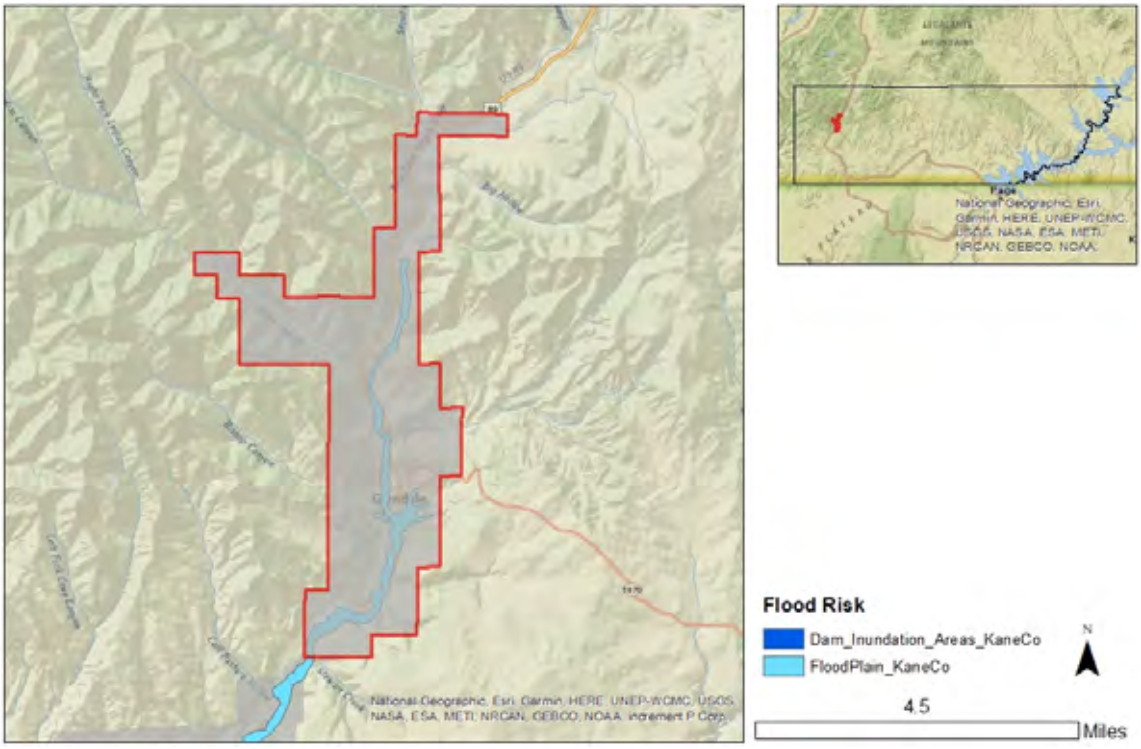


Figure 275: Glendale Flood and Dam Inundation Zones

Source: FEMA, UGRC, Utah Geological Survey

Table 297 includes an assessment of the town's exposure of assets to the flood risk areas identified in the figure above. Looking to this table, we understand that only residential and commercial parcels are identified as exposed to the floodplain and dam inundation zone locally.

Table 297: Glendale Exposure to Flood and Dam Inundation Risk

Glendale Exposure to Flood and Dam Inundation Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	35.3%	36.0%	36.0%	18.2%	N/A	0.0%

Source: Oregon department of Forestry

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land. Flash floods have been documented in Glendale and their history is described in the flood history section of this plan.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase flood insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Glendale participates in the NFIP and had the most recent Flood Insurance Rate Maps were developed for the community in 1986. Table 298 describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. A CAC and CAV took place on 8/15/2018 and 3/4/2005 respectively.

Table 298: Glendale NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$6,005	0	3	3	$333,100	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

The town does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county, including in Glendale. Table 299 describes flood events which documented Countywide impacts which likely also impacted Glendale.

Table 299: Glendale Flood Hazard Record

Glendale Flood Hazard Record		
Date	Damage/Injury	Description
7/14/2001	$,1000 property damage	Flash flooding was reported in canyons throughout Kane County. Several roads were washed out during the event.
12/19/2010	$800,000 property damage	A large storm caused flooding throughout Kane County caused the closure or blocked several roads. Significant impacts were reported on Highway 89, with water reported at one foot deep at one segment and a landslide documented which deposited a four-foot deep and 50-foot-wide debris field onto the roadway. Orderville and Glendale reported local street flooding.
9/11/2012	$2,000 property damage	Stout creek flooded, impacting a commercial fly-fishing business and some of their facilities along the creek.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.

Source: NOAA Storm Database

Highway 89, creeks, and canyons near the community are vulnerable to flooding and flash floods. In some areas of the County, blocked roadways can be especially dangerous, as residents or visitors may have increased delays to emergency services access, like medical, fire, and law enforcement. Flooding is noted to cause other events in the county, including landslides which the town is at risk to. Visitors to the area for hiking, camping, and other outdoor recreation are vulnerable to flooding, especially flash flooding which can have rapid onset and occur frequently in the canyons and drainages of Kane County.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89 near Glendale. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 276 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County. There are no faults or earthquake epicenters identified in Glendale, although a fault is identified east of the town boundary. Only one earthquake epicenter with a magnitude of 4.0 or greater is reported in the County, in the City of Kanab.

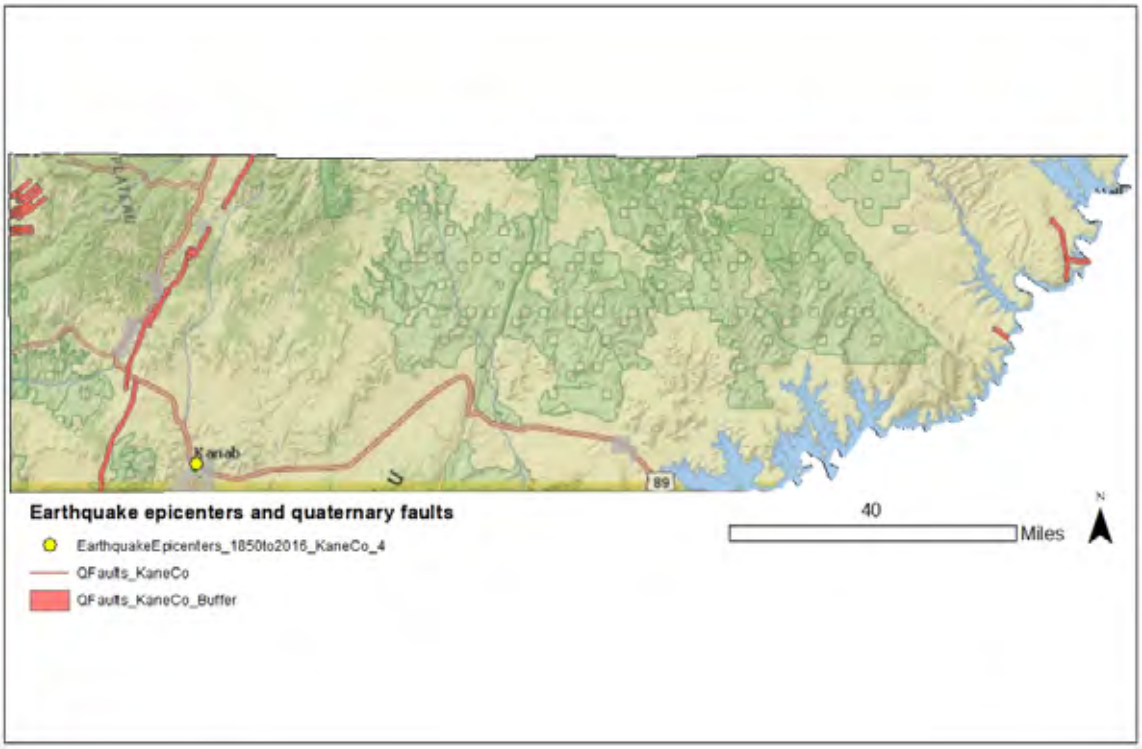


Figure 276: Kane County Earthquake Epicenters and Quaternary Faults

Source: Utah Geological Survey, UGRC

The Five County Association of Governments completed an assessment of the number of community assets that are within a quarter mile of a quaternary faulty, illustrated in Table 300. The Sevier fault is mapped within the Glendale town bounds and may impact the infrastructure or structures if an earthquake event occurs. Given the presence of the fault, the town may also be susceptible to surface fault rupture, where the ground moves at the Faultline during an earthquake. Ground shaking can cause damage and trigger other hazards throughout the impacted area.

Table 300: Glendale Exposure within a Quarter Mile of a Quaternary Fault

Glendale Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			

0.0%	11.8%	24.4%	23.6%	11.4%	N/A	100.0%

Source: Utah Geological Survey, Washington County Assessor, UDOT, UGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County's assessor roles did not have data to describe the year that structures were built. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event in Glendale.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with observed impacts increasing as the magnitude continues to increase.

While few individual earthquakes in Kane County have been recorded with a magnitude of 4.0 or greater, the community is seismically active. In 2016 clusters of earthquakes were reported near Orderville. During this event, 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016)

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed to fully assess the potential and risks of liquefaction present in Glendale.

Summary

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 277. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

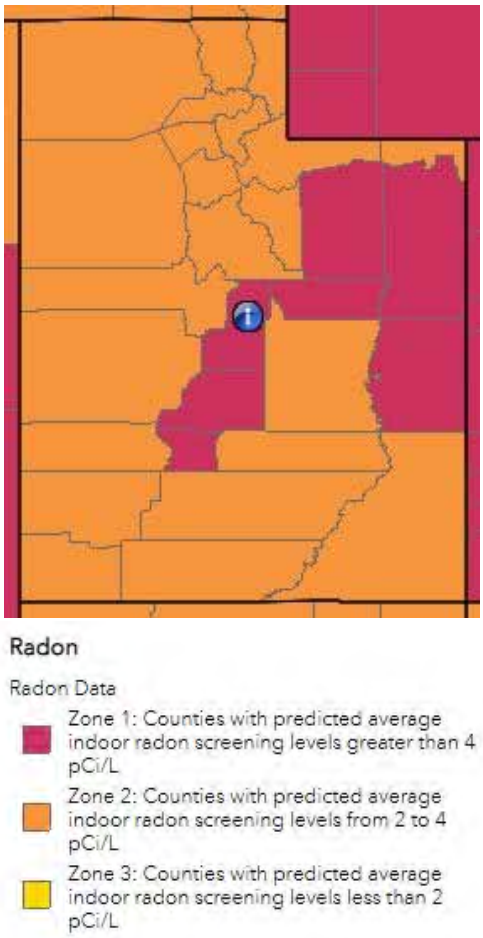


Figure 277: Estimated Indoor Radon Levels- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 301 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 301: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas of the county. The Utah Geological Survey has only identified Expansive Soil or Rock near Glendale in mapping completed in 2011. Figure 278 maps the data available near Glendale. Note that identified problem soil hazard areas have not been identified within the town boundaries.

Expansive Soils composition includes clays which interact with moisture, expanding when whetted and contracting when dry. Utilities, structures, and infrastructure can be damaged from the soil movement associated with expansion.

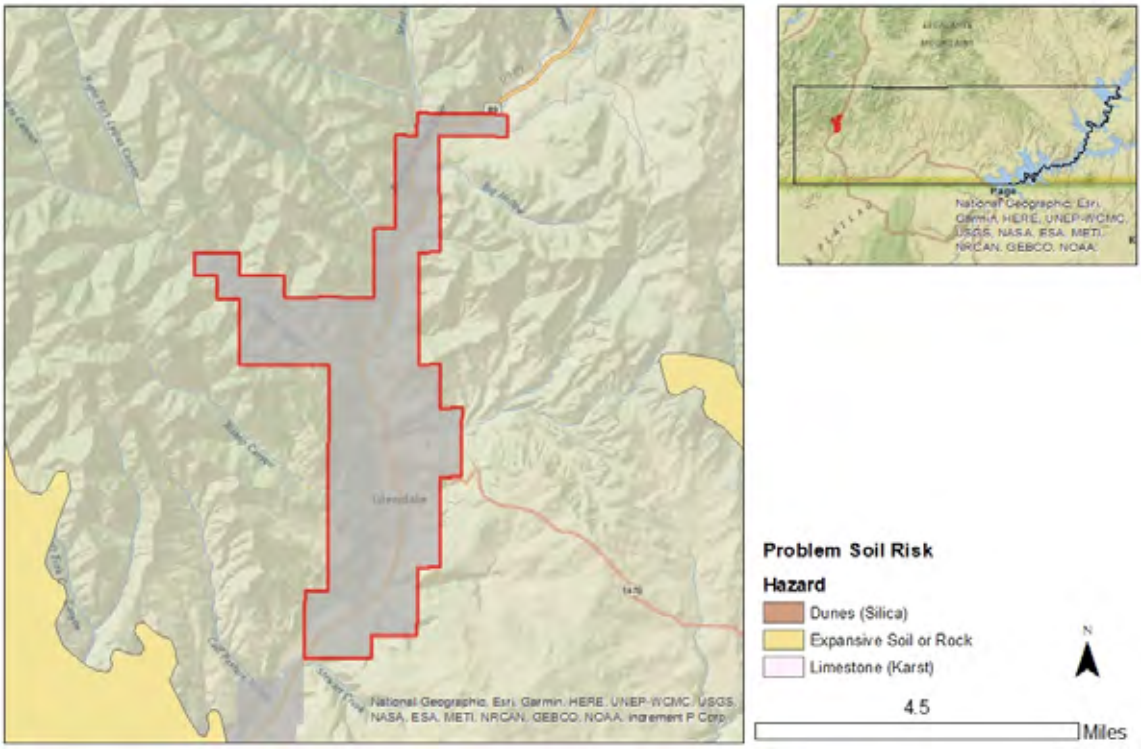


Figure 278: Glendale Problem Soils Exposure

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County. Further mapping of the area will provide greater detail to the problem soils prevalence in the community. The Town may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Glendale Town does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. County or Town records may describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site.

Summary

Drought, wildfire, and severe weather are all considered high risks in Glendale based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have direct health impacts on those exposed, problem soils are often considered to be more of a construction problem, causing damage when unmitigated.

This risk assessment identified vulnerabilities in the Town of Glendale. Much of the reported severe weather hazards, floods, and landslides impacted roadways near the community. Highway-89 is particularly susceptible based on the historic records for the area. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations.

Outdoor recreation and agriculture are economic endeavors are identified vulnerabilities to natural hazards. Visitors may select alternate destinations if they feel conditions will not be good for their intended activity. Drought, wildfire, and severe weather conditions can place additional stress on this industry. Related industries like accommodations, food service, and retail may see secondary impacts if visitation is impacted.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

The Town of Glendale did not participate in the 2016 iteration of the Natural Hazard Mitigation plan and has no actions to report on.

Glendale identified actions to include in the community mitigation strategy. Each action in Table 302 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 279.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 279: Regional Plan Goals

Table 302: Glendale 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #1	1, 2	Address stormwater water flow in developed areas.	Assess and install new culverts as identified.	M	Ongoing	M	Glendale Town, CIB, CDBG,	Glendale Town
Severe Weather #2	1, 2, 4	Maintain existing stormwater infrastructure.	Clear debris and as needed increase capacity of settling ponds on top of cliff ledges in the town.	L	Ongoing	M	Glendale Town	Glendale Town, private property owners.
Severe Weather #3	1, 2	Address stormwater water flow in developed areas.	Install drainage infrastructure to direct waters off the roadways.	L	5-years	M	Glendale Town, CDBG, CIB	Glendale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2	Prevent overflow of the drainage ditch.	Assess, repair, and increase the capacity of the Main Street irrigation ditch.	M	5-years	M	Glendale Town, CDBG	Glendale Town
Flood #2	1, 2	Address flooding reoccurrences on Center Street.	Assessment of Center Street drainage problem to inform best mitigation option. Implement recommended action.	M	5-years	M	Glendale Town, CDBG, CIB	Glendale Town
Drought #1	2	Replace aging well and infrastructure.	Complete a siting assessment for a new town well and infrastructure. Drill well and construct infrastructure.	H	5-years	H	Glendale Town, division of drinking water, CDBG, CIB	Glendale Town
Drought #2	2	Protect water sources from outside contamination	Reclaim (install a new barrier over) one of the town springs and install chlorination system.	H	5-years	H	Glendale Town, division of drinking water, CDBG, CIB	Glendale Town
Drought #3	3	inform residents about water conservation.	Provide residents with steps to conserve water in town utility bills.	H	Ongoing, annually.	L	Glendale Town	Glendale Town
Wildfire #1	6	Reduce wildfire fuel loads near town boundaries.	Fuels management in the newly annexed area near Lydia's Canyon.	M	2-years, ongoing	M	Glendale Town, BLM, Forest Service, Kane County	Glendale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #2	1, 3, 5	Reduce wildfire fuel loads on residential properties.	Host classes and coordination with the fire department to educate residents on creating defensible space.	M	Annually	L	Glendale Town	Glendale Town, Kane County
Earthquake #1	2	Protect town historic structures and their users from earthquake.	Complete an assessment of Town Hall for seismic safety and implement recommended structural and nonstructural retrofits.	H	5-years	H	Glendale Town, Preservation Utah, Federal and State Historic Tax Credit.	Glendale Town
Earthquake #2	1	Protect town historic structures and their users from earthquake.	Inform the private property owners of suspected unreinforced masonry of potential hazard.	M	Ongoing, annually	L	Preservation Utah, Federal and State Historic Tax Credit.	Glendale Town, private property owners.
Landslide #1	1	Address suspected or potential slope failures within the town limits.	Work with property owner(s) and the Utah Geological Survey to assess a suspected slope failure and bare slope on Center Street. Implement recommended mitigation activities.	M	5-years	M	Glendale Town	Glendale Town, private property owners, Utah Geological Survey
Landslide #2	2	Address suspected or potential slope failures within the town limits.	Install benching around the landslide at the Town ballpark.	H	2-years	M	Glendale Town	Glendale Town
Problem Soils #1	2	Reduce the damages caused to town roads by problem soil expansion and compaction.	Widen the excavation requirements for roads in the town code.	M	1-year	L	Glendale Town	Glendale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of Radon hazard risks.	Provide radon risk, testing, and mitigation information to residents in town utility billings.	H	Ongoing, annually	L	Glendale Town	Glendale Town

Source: Local Planning Team

Kanab

The City of Kanab is the Kane County seat and is located along Highway-89, the connector road for all the incorporated communities in the county. The city is near the Utah-Arizona border in canyon country. Large red rock cliffs border the city to the north and several canyons are accessible from the city for hiking. Kanab Creek runs through the city.

Community Characteristics

The area is located near several state parks, including the Coral Sand Dunes State Park and several trailheads, and camping areas. The city has been used for film sets of some movies which has drawn attention to the community, but generally agriculture, tourism, retail, and outdoor recreation are larger economic drivers of the area.

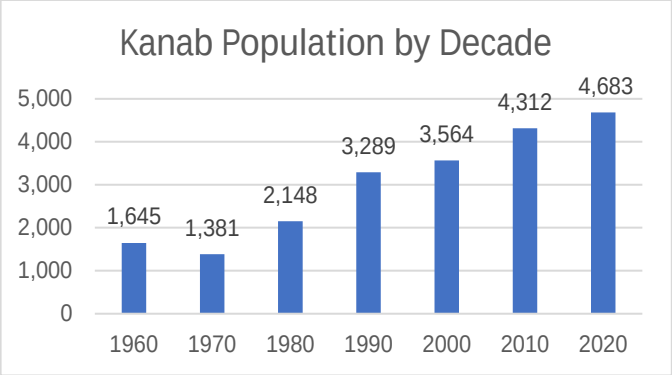


Figure 280: Kanab Population by Decade

Source: US Census Bureau

Demographics

The Kanab population is 4,683 people as of the 2020 census, although the city estimates that their population is above 5,000. Figure 280 describes the area's population from the 1960 census to present. The relative change in population is described in Figure 281 and shows that the community has experienced steady growth since 1970, with larger growth years notable in the 80s and 90s. The towns average population change since 1970 is 21.8%.

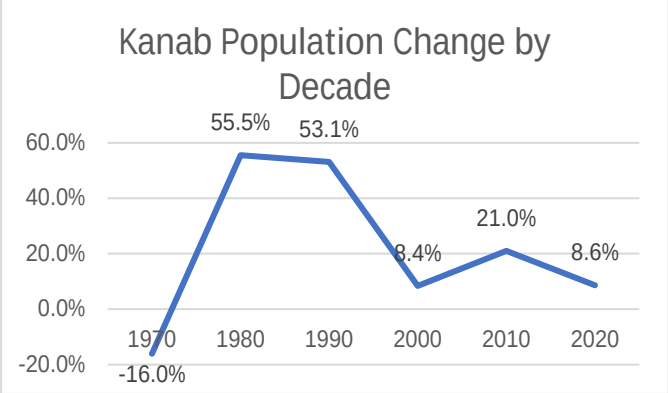
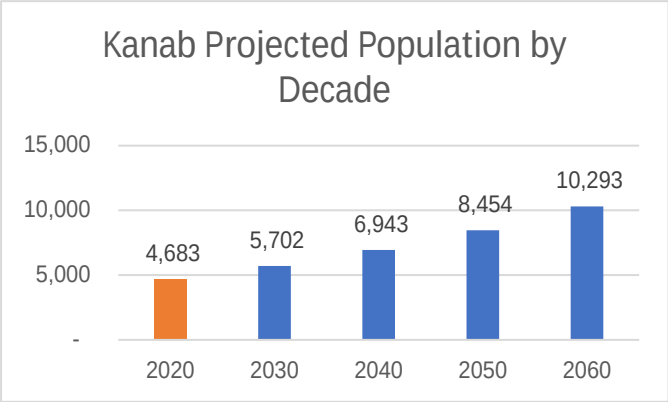


Figure 281: Kanab Population Change

Source: US Census Bureau

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population. If applied to the City of Kanab through a step-down analysis, the city may see an additional 2,275 residents in the next 40-years, bringing the population to 6,958. (Hollingshaus, et al., 2022)



Source: US Census Bureau

Using the average change in population of 21.8% for the town, the future population by 2060 was also projected. The projection is solely based on historic patterns in the town since 1970, and does not account for land availability, local policy, or other metrics relevant to population growth in the community. Figure 282 illustrates the projected population based

on average change. Based on this average, the community could see a population of 10,293 people in the community.

Economy

The Kanab economy is dominantly small business and hospitality based. The town website provides a list of local businesses, which include several recreation, accommodation, and other service businesses. The US Census Bureau publishes data about jobs and industries in an area like Kanab City. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code. Figure 283 provided allows us to see which industries support the greatest share of jobs in the city. This data demonstrates that other services, accommodation and food service, and retail trade provide a significant share of jobs locally in the community. Other services capture businesses which are involved in equipment and machinery repair, nonprofit or advocacy, personal care, pet care, and laundry service, for example. The community has a mix of several other industries present in the community which provide jobs in the town.

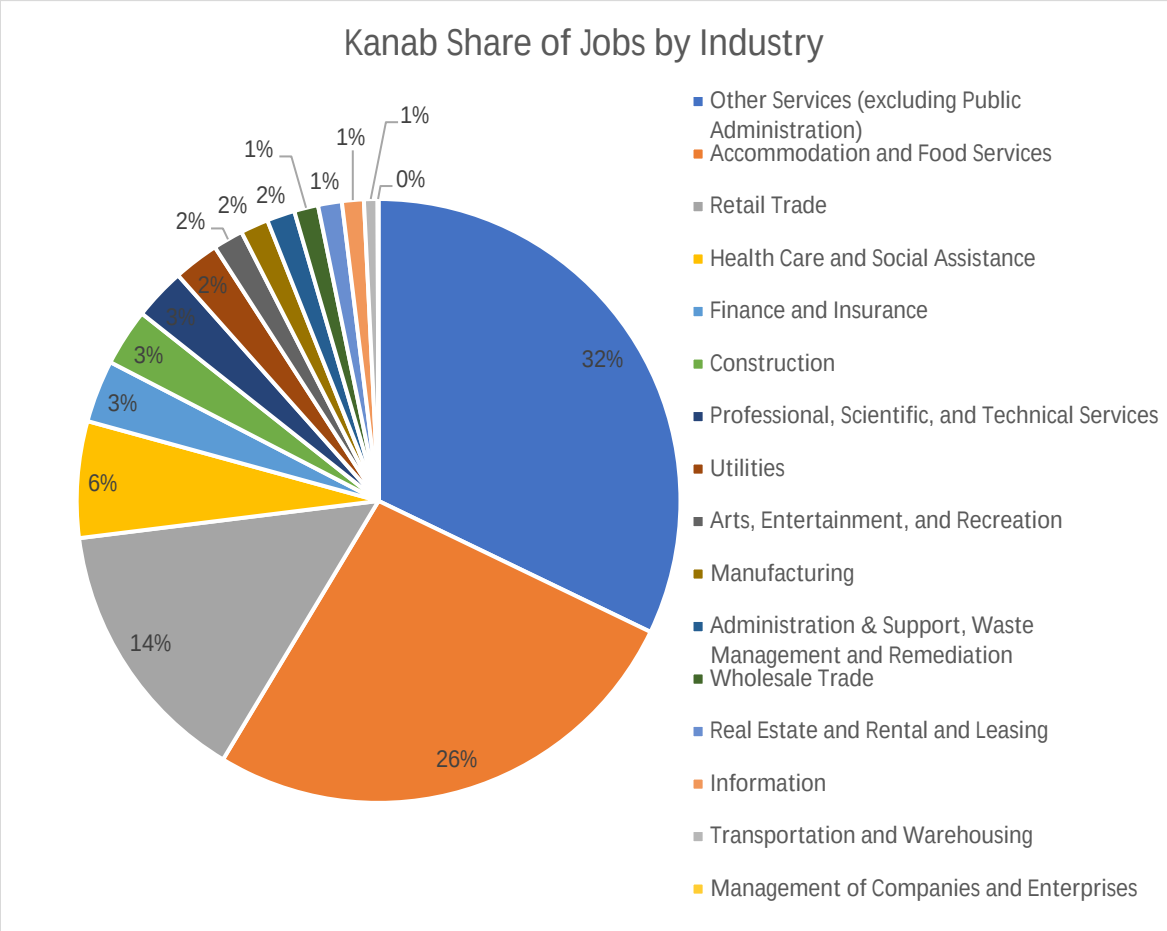


Figure 283: Kanab Share of Jobs by Industry

Source: US Census Bureau

Development

Kanab City has experienced growth in recent years, estimating that there has been a 5-10% increase in the number of subdivisions in the past several years. The area is geographically bound by a creek and steep hillsides and cliffs. Developable land is limited given these constraints.

Two new subdivisions have been approved within the city boundaries and are in the preliminary plat phase. It is estimated that these subdivisions will add 800 building lots to the City. The City expects development to continue in the coming years based on recent inquiries and approvals.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward.

Plans and Policies

Kanab develops plans and policies to guide the community development and set rules and regulations to provide for the health, safety, and public welfare of the town. These regulations and visions are described in the Land Use Ordinances, Subdivision Ordinances, Municipal Ordinances, Flood Damage Prevention Ordinance, Standards for Design and Construction, General Plan, Stormwater Impact fee facilities plan and analysis, and the Water impact fee facilities plan and analysis.

Land Use Ordinance

The Land Use ordinance includes a chapter regarding the development of sensitive lands, like hillsides, mountains, and other areas which may be more vulnerable to natural hazards. The objective in this section is to minimize the exposure to geological and natural hazards by setting requirements and standards for development in areas which may be subject to natural hazards, such as steep slopes, hillsides, drainages, streams, areas with high water table, wetlands, and other hazards.

Subdivision Ordinance

The subdivision ordinance describes requirements that buildings in flood hazard areas have plans which show the mapped 100-year floodplain, sensitive lands, and existing drainages, washes, and streams. The ordinance sets standards for stormwater drainage design, describing that new development should not increase the runoff to adjacent lots. This ordinance further encourages drought resistant landscaping and describes soils or drainage studies as a potential condition for development.

Municipal Ordinance

The municipal ordinance sets the streets department as the body in control of waters flowing on the streets from storm or flood. The document describes that weeds and grasses may be a nuisance if they are high, dry, or constitute a fire hazard. The ordinance also sets standards for extreme weather protection for businesses like kennels.

Flood Damage Prevention Ordinance

Designates a floodplain administrator as the building inspector who enforces and implements the floodplain ordinance. The special flood hazard standards set requirements for construction or improvements which fall in the SFHA, as identified in the city's Flood Insurance Rate Map (FIRM). This ordinance also describes sheet flooding, illustrated on the FIRMS as shallow flooding.

Standards for Design and Construction

The standards for design and construction set requirements and standards for municipal utilities and facilities, including roadways, drainage, stormwater, sewer, and fire hydrants. These facilities also interact with sensitive lands and hazard areas like hillsides and the floodplain. Requirements include considering hillsides when increasing the volume of traffic on a roadway, preventing stress on existing drainages in the design of new stormwater facilities, addressing flood, debris flows, or freezing risk on suspended sanitary sewer design, require water mains in the public right of way, and set standard spacing for fire hydrants in the community among the requirements.

General Plan

The city's general plan sets goals, objectives, and policies to guide other city functions, plans and policies. Typically, this plan addresses several elements, including but not limited to, land use, economy, environment, housing, and other topics important for a municipality to consider. Actions related to natural hazards include, standardizing storm drainage criterion for desired capacity, maintaining a fully staffed fire department and EMS, update flood maps and responsibly develop on hillsides and sensitive lands.

Stormwater Impact fee facilities plan and analysis

The Stormwater Impact Fee Facilities Plan and Analysis describes the environment and state of the city's stormwater infrastructure. The town has characteristics, like low infiltration, steep slopes, and monsoon rains, which contribute to significant runoff in the community. This plan maps and identifies four groups of soils present in the community and their relative infiltration rate, including soils with swelling potential and clay in the community.

Water impact fee facilities plan and analysis

The Water Impact Fee Facilities Plan and Analysis describes needed improvements to support water delivery in Kanab on a ten-year planning horizon. The plan identifies several projects to improve pressure at fire hydrants, storage tank improvements, upgrading piping, etc.

Community Assets

Kanab City is a mayor-council form of government which elects a mayor and several council members to make legislative decisions for the community. The City has several staff who aid residents, policy analysis, mapping, financial, and other assistance to operate the city.

Funding for capital improvement and infrastructure projects in the town may be funded through agreements with the County, General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

The City of Kanab operates a Fire and Police Department. The fire department has two stations which serve the community and is staffed by full time firefighters. The fire department operates Emergency Medical Services in Kanab, in partnership with the Kane County Hospital. In this partnership, the fire department staffs ambulance and EMS on Kane County Hospital owned ambulances.

The Kanab City Police Department has one station which supports eight full time and eight reserve police officers to provide law enforcement to the community. The department also includes one animal control officer.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. Kanab is on Highway 89 which is the major transportation route in and out of the city. The city has 47 miles of streets maintained by the city. The Kanab Municipal Airport is in the city boundaries and is owned and operated by the city. The airport does not receive airline service.

The City owns and operates its own water and sewer utility system. The water supply originates from 16 wells and six springs. A recent water project secures and hardens the city water storage infrastructure by adding two new water tanks on the north side of the City and replacing four-miles of water lines. Other utilities are provided by Garkane Energy, South Central Communications, and other private service providers.

The identified critical facilities described in this plan include schools, police stations, fire departments, and medical facilities.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Kanab, Utah. This assessment describes the natural hazards considered in this plan which pose risks to the town. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 303: Kanab Natural Hazard Risk Assessment below, summarizes the natural hazards in a list from high to low hazard risk as it pertains to the town.

Table 303: Kanab Natural Hazard Risk Assessment

HAZARD	RISK
SEVERE WEATHER	High
DROUGHT	High
FLOOD	High
EARTHQUAKE	Moderate
LANDSLIDE	Moderate
WILDFIRE	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Kanab's risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County sections of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Kanab has historically had to monitor the amount of water used by the community, as low supply at the settlement of the community required residential water saving and reuse. The city has engaged ins water development projects since the 1870s through dams, cisterns, and piping locally. The region has been exposed to drought for an extended period and as growth continues in the community, challenges associated with the hazard increase.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Kanab's local geology includes cliffs, slickrock, and canyon features, making it susceptible to landslide and rockfall events, particularly on the northern portion of the community. Figure 284 illustrates the areas exposed to landslide hazard near Kanab, according to Utah Geological Survey data for rural Utah.

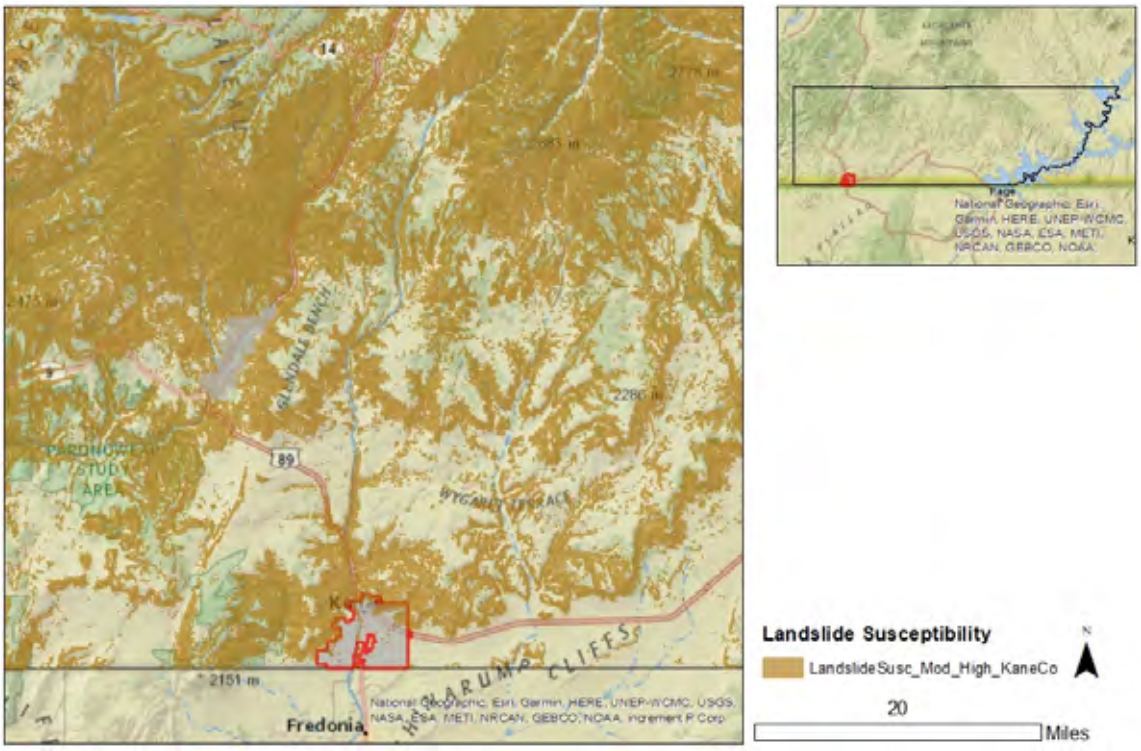


Figure 284: Kanab Landslide Susceptibility

Table 304 describes the assets in the community which are exposed to landslide susceptible areas. Parks, residential parcels, and road miles see the greatest exposure to landslide susceptible areas, according to the table. Parcels exposed to landslide risk areas can result in damage to structures, deaths, and injury among the users or residents of these spaces. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace. Parks and other open space can provide a buffer between the community and the landslide risk, although investments and infrastructure at the park may be damaged if a landslide occurs. There would also be risk to users of the park.

Table 304: Kanab Exposure to Landslide Susceptible Areas

Kanab Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
8.3%	7.1%	16.6%	15.9%	10.3%	N/A	50.0%

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Hills, slopes, and cliffs are described near the community of Kanab, which have the potential for landslide or rockfall. Landslides have been reported in the community, described in Table 305. Landslides have impacted the community, where a rockfall event caused a death along Kanab Creek in 2005.

Table 305: Kanab Landslide record

Incident Date	Location	Description
2005	Kane County	Kanab Creek rockfall resulted in one fatality

Source: Utah Geological Survey

The Utah Geological Survey has also compiled a map of historic landslides for the area, illustrated in Figure 285, which shows that evidence of a landslide exists west of the community. Potential for landslides exist throughout the community. Future growth may place more commercial and residential parcels, roads, or other infrastructure in landslide exposed areas.

Figure 285: Kanab Historic Landslides

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Kanab is the urban center for nearby farming, ranching, and outdoor recreation. The community is set in a valley with cliffs and red rock surrounding the city. Figure 286 describes the relative risk of wildfire in the town, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan. Kanab has some areas of moderate and greater wildfire risk identified in the town boundaries, dominantly near Highway 89, Kanab Creek, and near the western boundary.

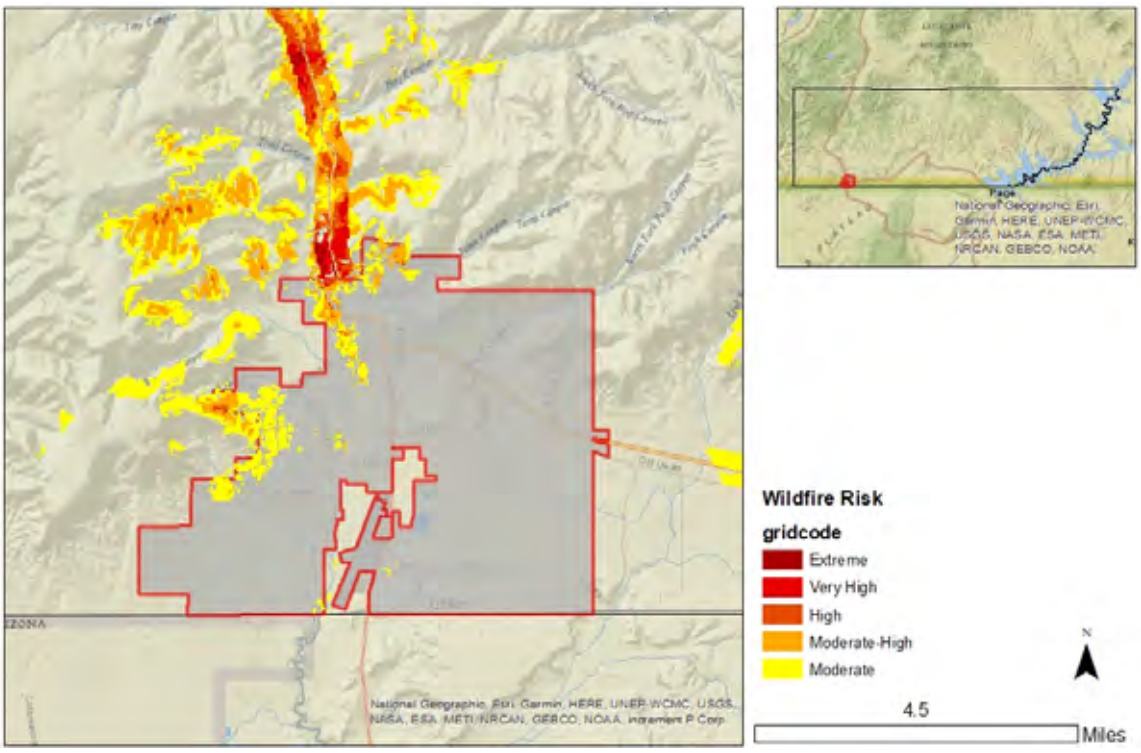


Figure 286: Kanab Wildfire Risk

Source: Oregon Department of Forestry

Table 306 includes an assessment of the town's exposure of assets to the wildfire risk areas identified in the figure above. Looking to this table, we understand which assets in the city are at risk to wildfire. Residential Parcels and Road Miles appear to see most of the exposure to wildfire risk areas. Residential areas exposed to wildfire place people and property at risk and wildfires which impact roadways can affect the access of emergency services.

Table 306: Kanab Exposure to Wildfire Risk

Kanab Exposure to Wildfire Risk				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks

	Commercial	Residential	Total			
8.3%	7.1%	16.6%	15.4%	10.3%	N/A	50.0%

Source: Oregon department of Forestry

Hazard History

Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area. Kanab has not experienced recent significant wildfires in the City boundaries, although Table 307 describes several fires which occurred near the community. The town likely saw secondary impacts from fires in the unincorporated County, including smoke or ash.

Table 307: Kanab Wildfire Record

Fire Name	Year	Acres Burned	Description
Pine Hollow Fire	2020	2,771	A lightning caused fire led to evacuations and risks to livestock, rangeland, and California Condor habitat. Campers had to evacuate from the Stateline Campground.
Wire Pass	2020	1,580	A lightning caused fire impacted trails, trailheads and powerlines. The event caused the closure of trails near the Wave.

Source: Utah Fire Info

The area is marked by low elevation, dry, desert, presenting some fire risk, especially given the number of visitors which come to the area annually. Smaller wildfires may have occurred in the town or surrounding area which were not reported on the Wildfire Info site.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that the town is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Kanab, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Kanab is in a valley at a lower elevation and sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months and thunderstorms throughout the year, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which are documented in the flood section of this plan.

Hazard History

Table 308 describes the damage and injury which occurred during severe weather events in and near Kanab. Some events in nearby towns or the unincorporated county may have also impacted the city. Further, the NOAA database reports some countywide events, which have also been included for Kanab. It is likely that events like extreme heat impact the entire county, although injuries caused by these events are localized.

Table 308: Kanab Severe Weather Record

Date	Damage/Injury	Description
9/11/1997	None Reported	Severe weather produced hail and rainfall of 2.5” in one hour near Kanab. Several homes flooded and Highway 89 was closed due to flooding.
10/2/1997	None Reported	A thunderstorm produced flash flooding and high winds across the State. Hail 0.75” in diameter were reported in Kanab and the city measured 1.41” of rain.
4/12/1998	None Reported	A snowstorm produced 9” of snow in Kanab
9/29/2004	$20,000	A severe storm produced heavy rainfall causing flash flooding near Big Water and 0.75” hail which was reported to fall two-inches deep in Kanab.
7/12/2005	1 death	Temperatures near 110 degrees led to the death of a hiker in Glen Canyon.
12/24/2008	None Reported	Kanab received 6 inches of snow during a storm.
12/29/2010	None Reported	Ten inches of snow were reported in Kanab during a snowstorm.
2/26/2011	None Reported	Eight inches of snow fell in Kanab.
3/8/2013	None Reported	Kanab reported 7 inches of snow during a storm.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Kanab reported 8.5 inches and Duck Creek Village reported 16 inches of snow during a storm.
2/22/2015	None Reported	Nine inches of snow fell in Kanab.
12/23/2016	None Reported	Kanab saw six inches of snow during a storm.
2/20/2019	None Reported	A winter storm produced eight inches of snow in Kanab, three inches of snow in Big Water, and two inches in Bullfrog Basin.

Source: NOAA Storm Database

Kanab is vulnerable to severe thunderstorms, heat, and hail, which have caused damage or injury in the area. Snow is a frequently occurring hazard but has not been tied to reported damages based on this record.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Kanab from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Flash flooding is further described in the next section of this plan.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

Kanab has nearby outdoor and recreation assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that annually draw large crowds. Certain natural hazard events exacerbate stress caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Kanab has had flood maps developed which provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 287 illustrates that the potential sources for flooding in the city, however further mapping may provide additional insight to the community's risks.

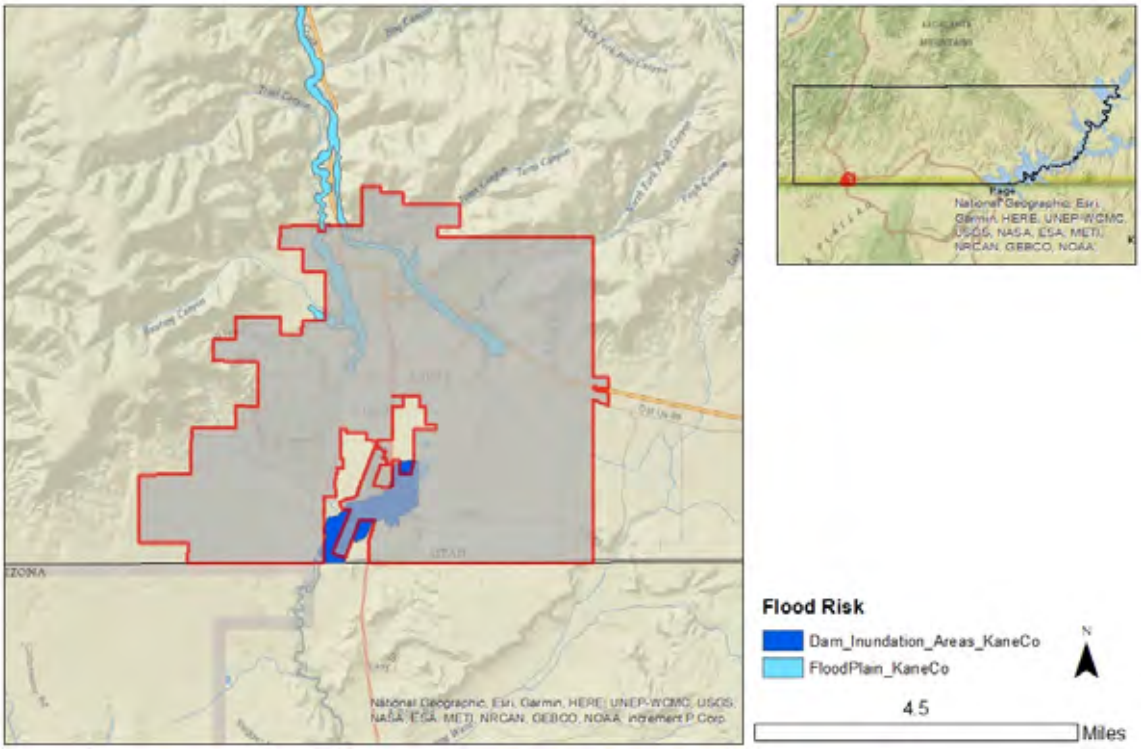


Figure 287: Kanab Flood and Dam Inundation Zones

Source: FEMA, UGRC, Utah Geological Survey

Table 309 includes an assessment of the town's exposure of assets to the flood risk areas identified in the figure above. Commercial parcels and parks see the most exposure to flood risk areas. Parks can provide a buffer between assets and flood risk areas, although damages may occur to the parks'

infrastructure. Commercial parcels may see structural damage or impacts to the products, services, or operations provided by the business. In Kane County flooding on roadways is reported frequently during events, often causing significant impacts to travel and access in the county. This will be described further in the hazard history.

Table 309: Kanab Exposure to Flood and Dam Inundation Risk

Kanab Exposure to Flood and Dam Inundation Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	12.1%	8.1%	8.4%	6.8%	N/A	16.7%

Source: Oregon department of Forestry

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land. Flash floods have been documented in Kanab and their history is described in the flood history section of this plan.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase flood insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Kanab participates in the NFIP and had the most recent Flood Insurance Rate Maps were developed for the community in 1985. Table 310 describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. A CAC and CAV took place on 8/15/2018 and 2/23/2005 respectively.

Table 310: Kanab NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$12,343	0	3	14	$3,831,900	2	$11,191

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

The city does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county, including in the City of Kanab. Table 311 describes flood events which documented impacts to Kanab or the surrounding area.

Table 311: Kanab Flood Hazard Record

Kanab Flood Hazard Record		
Date	Damage/Injury	Description
9/11/1997	$30,000 property damage	A severe storm caused flash flooding in the Kanab area, producing two and a half inches of rain in an hour. Highway 89 was closed due to flooding and four homes were flooded.
9/14/1997	$5,000 property damage	Rain fell at a rapid rate of one inch in 30 minutes near Kanab, resulting in flooding on SR-11 with water reported to be six inches deep in some places.
9/1/1998	$30,000 property damage $2,000 crop damage	Over one inch of rain fell in Kanab during a 30-minute period, flooding homes and roads.
7/14/2001	$1,000 property damage	Flash flooding was reported in canyons throughout Kane County. Several roads were washed out during the event.
8/22/2003	$50,000 property damage	A bridge was washed out and road damaged during a flash flood east of Kanab in Johnson Canyon.
10/5/2010	$20,000 property damage	A thunderstorm produced flooding throughout Kane County, damaging and blocking several roads and trails. Johnson Canyon reported basement flooding during the event.
12/19/2010	$800,000 property damage	A large storm caused flooding throughout Kane County caused the closure or blocked several roads. Significant impacts were reported on Highway 89, with water reported at one foot deep at one segment and a landslide documented which deposited a four-foot deep and 50-foot-wide debris field onto the roadway. Orderville and Glendale reported local street flooding.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.
8/26/2014	$5,000 property damage	Road damage was reported near Johnson Canyon and Buckskin Wash following flash flooding.
7/9/2017	$200,000 property damage	Flash flooding in Kanab impacted 20 homes and damaged roads and a drainage canal.
7/21/2017	$10,000 property damage	Several people were stranded after flash flooding damaged House Rock Road and Cottonwood Road.

Source: NOAA Storm Database

Flooding events in Kanab tend to occur following severe rain events, impacting homes, roadways, drainage infrastructure, and outdoor recreation. Highway 89 and canyons near the city are vulnerable to

flooding and flash floods. Flooding is noted to cause other events in the county, including landslides which Kanab is at risk to. Visitors to the area for hiking, camping, and other outdoor recreation are vulnerable to flooding, especially flash flooding which can have rapid onset and occur frequently in the canyons and drainages of Kane County.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 288 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County. There are no faults or earthquake epicenters identified in or near Kanab, although the county's only recorded earthquake epicenter with a magnitude of 4.0 or greater is reported in city.

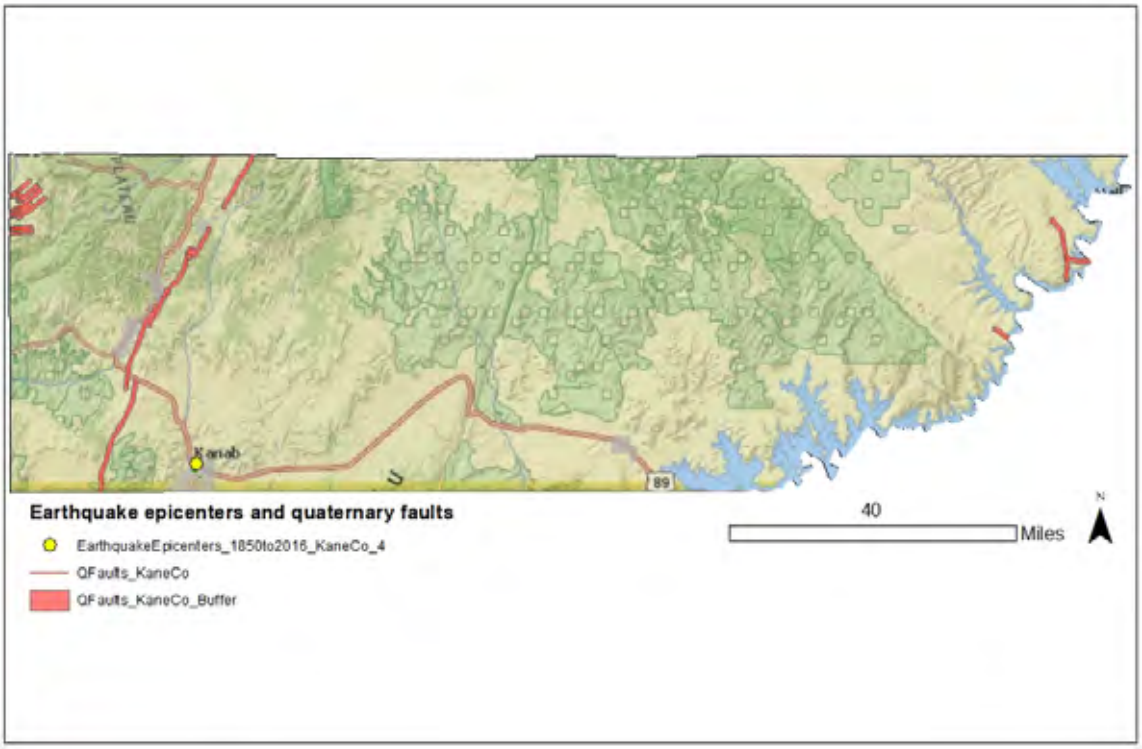


Figure 288: Kane County Earthquake Epicenters and Quaternary Faults

Source: Utah Geological Survey, UGRC

There are no mapped faults in Kanab, so the city is not at risk to surface fault rupture.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County's assessor roles did not have data to describe the year that structures were built to determine which and how many structures are more vulnerable to ground shaking. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking

event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed for Kane County to fully assess the potential and risks of liquefaction.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. One earthquake in Kanab has been reported with a magnitude 4.0 or greater, described in Table 312.

Table 312: Kanab Earthquake Events

Incident Date	Location	Description
1887	Kanab, Kane County	A 4.8 magnitude earthquake is recorded near Kanab.

Kane County is a geologically active County. In 2016 clusters of earthquakes were reported near Orderville. During this event, 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016)

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 289. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

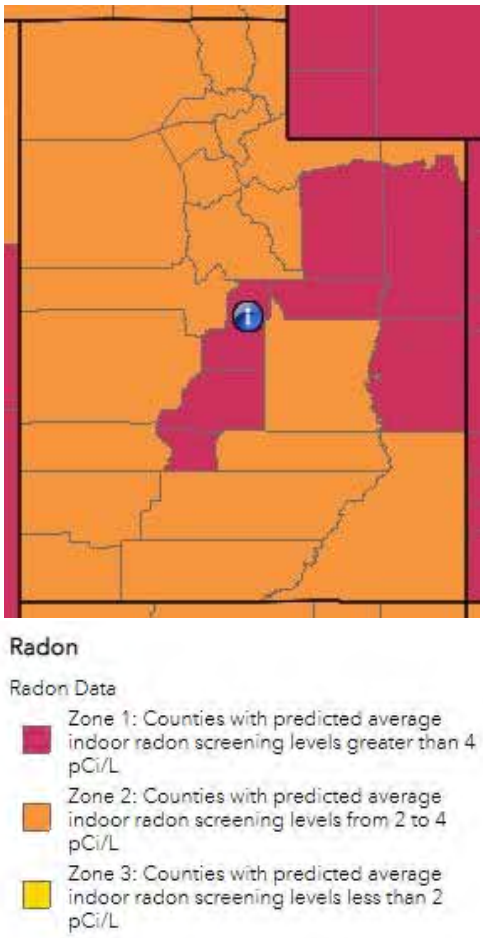


Figure 289: Estimated Indoor Radon Zones- Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 313 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 313: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas of the county, identified through Utah Geological Survey mapping completed in 2011. Figure 290 maps the data available near Kanab and shows that no problem soils have been mapped in the City boundaries.

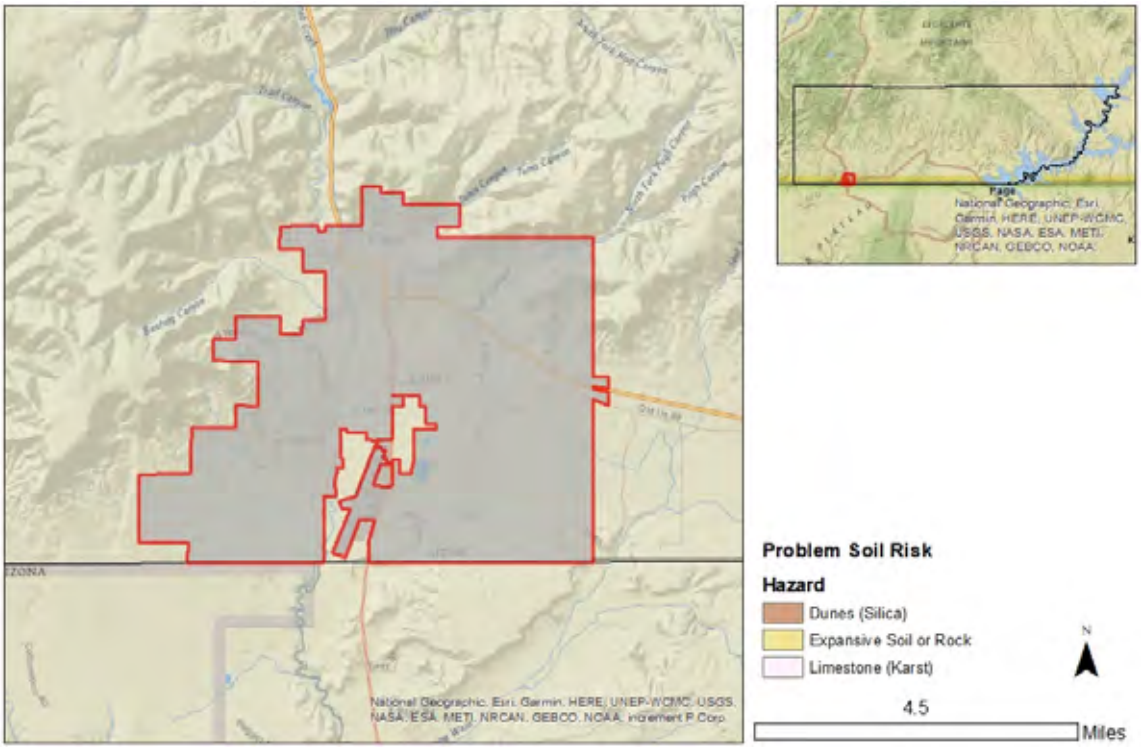


Figure 290: Kanab Problem Soils Exposure

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County. Further mapping of the area will provide greater detail to the problem soils prevalence in the community. The Town may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Kanab City does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. City or county records may describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site.

Summary

Drought, severe weather, and flood are all considered high risks in Kanab based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have direct health impacts on those exposed, problem soils are often considered to be more of a construction problem, causing structural damage overtime when unmitigated.

This risk assessment identified vulnerabilities in the city of Kanab. Much of the reported severe weather hazards, floods, and landslides impacted roadways and/or outdoor recreation ventures near the community. Highway-89 is particularly susceptible, based on the historic record for the area. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations. Floods impact the full-time residents through property

Several economic endeavors are identified vulnerabilities to natural hazards, including outdoor recreation. Visitors may select alternate destinations if they feel conditions will not be good for their intended activity. Drought, wildfire, and severe weather conditions can place additional stress on this industry. Related industries like accommodations, food service, and retail may see secondary impacts if visitation is impacted.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

Kanab City participated in the 2016 iteration of the Five County Association of Governments Natural Hazard Mitigation Plan process. In this plan they identified an action to address the problem hazard risks in the community. This mitigation strategy has been summarized in Table 314, with a column identifying progress on action. All the flood actions described in the 2016 plan are still needed. The City was recently awarded a NRCS grant to address watershed protections for flood control in the community, which include the previous plan actions. This project is undergoing an environmental assessment and actions have been included in the 2022 strategy.

Table 314: Kanab 2016 Mitigation Strategy

Strategy	Objective	Action	Timeline	Funding Source	Progress
Flood	Minimize flood damage in Kanab and the surrounding development.	Construct a levee along the creek through the north and east part of town, a distance of about 8,000 ft.	Contingent on funding	Local government operating budget, state and federal flood programs	Still needed.

Flood	Minimize flood damage in Kanab and the surrounding development.	Install adequate storm drainage for excess flows	Contingent on funding	Local government operating budget, state and federal flood programs	Still needed.
Flood	Minimize future flooding along Stout Canyon Road, House Rock Road, Barracks Road, and Spring Drive	Build and implement flood control measures, and infrastructure.	Unknown	Local, State, and Federal Funding as available	Still needed.
Flood	City Wide Flood Control	Build and implement flood control measures, and infrastructure.	Unknown	Local, State, and Federal Funding as available	Still needed.
Flood	Flood Control in Pugh Canyon near the Kanab Golf Course.	Build and implement flood control measures, and infrastructure.	5 years	Local, State, and Federal Funding as available	Still needed.
Flood	Flood Control in the Ranchos Subdivision area	Build and implement flood control measures, and infrastructure.	5 years	Local, State, and Federal Funding as available	Still needed.

The Kanab City planning team identified actions to include in the community mitigation strategy. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 291.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 291: Regional Plan Goals

- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

To address the risks and vulnerabilities identified in this chapter, Kanab City has assembled several actions, addressing each of the natural hazards that the community is at risk to in Table 315. The City code includes a sensitive lands ordnance which sets a buffer for development near landslide and rockfall prone areas. While these hazards are present in areas of the community with prominent hillsides and cliffs, the community feels that the ordinances prevent the most severe impacts of landslide on development, personal property, and life. No landslide actions have been included in the 2022 iteration of the plan.

Table 315: Kanab 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2	Minimize flood damage in Kanab and the surrounding development.	Construct a levee along the creek through the north and east part of town.	M	Contingent on funding	H	Kanab City, NRCS, FEMA, CIB	Kanab City
Flood #2	2	Minimize flood damage in Kanab and the surrounding development.	Install adequate storm drainage for excess flows	M	Contingent on funding	H	Kanab City, NRCS, CIB, CDBG	Kanab City
Flood #3	2	Minimize future flooding along Stout Canyon Road, House Rock Road, Barracks Road, and Spring Drive	Build and implement flood control measures, and infrastructure.	M	5 years	H	Kanab City, NRCS, FEMA, CIB	Kanab City
Flood #4	1, 2	City Wide Flood Control	Build and implement flood control measures, and infrastructure.	M	5 years	H	Kanab City, NRCS, CIB, CDBG	Kanab City
Flood #5	2	Flood Control in Pugh Canyon near the Kanab Golf Course.	Build and implement flood control measures, and infrastructure.	M	5 years	H	Kanab City, NRCS, FEMA, CIB	Kanab City
Flood #6	1, 2	Flood Control in the Ranchos Subdivision area	Build and implement flood control measures, and infrastructure.	M	5 years	H	Kanab City, NRCS, FEMA, CIB	Kanab City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #1	4, 6	Reduce wildfire fuels in and around Kanab.	Coordinate with county and state to identify and complete fuels management projects in Kanab.	M	Ongoing, annually	L	Kanab City, Kane County, BLM, Forest Service, DNR.	Kanab City, Kane County, DNR.
Problem Soil #1	4	Identify the extent of problem soils hazards in the community to inform city ordinances.	Work with the Utah Geological Survey to update problem soil mapping. As needed, update city ordinances to include all areas vulnerable to problem soils in the requirements for geotechnical reporting for building permits.	L	5-years	M	Kanab City, Utah Geological Survey	Kanab City, Utah Geological Survey
Severe Weather #1	5	Ensure operations at the planned City Emergency Operations Center at Kanab City Offices.	Acquire generator for the Kanab City Office.	M	5-years	M	Kanab City	Kanab City
Severe Weather #2	1, 3	Address vulnerabilities of tourists and visitors to severe weather events.	Work with local businesses and tourism partners to develop a public information campaign about extreme temperature and thunderstorm risks and vulnerabilities.	H	Ongoing	L	Kanab City	Kanab City, tourism partners, local businesses.
Earthquake #1	3	Inform residents of earthquake risks.	Public education campaign to homeowners on unreinforced masonry risks and earthquake safety techniques to follow during and after an earthquake.	H	Ongoing, annually	L	Kanab City	Kanab City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #2	2	Secure Kanab City structures which are Unreinforced Masonry construction.	Inventory structures in the city that are constructed with unreinforced masonry and plan for retrofit of structures for the safety of occupants.	L	5-years	H	Preservat-ion Utah, SHIPO mitigation grants, State and Federal tax credit.	Kanab City, Kanab City Heritage Board.
Drought #1	3	Conserve water resources.	Participate in a water conservation public education campaign to inform residents of water conservation practices. Provide information in monthly water billings.	H	Ongoing, monthly.	L	Kanab City	Kanab City, Rural Water
Drought #2	1, 2	Conserve Water Resources	Consider revising ordinances to remove greenspace landscaping requirements	M	5-years	L	Kanab City	Kanab City
Radon #1	3	Inform residents of Radon testing and mitigation.	Provide radon risk, testing, and mitigation information to residents on city website and social media pages.	H	Ongoing, annually.	L	Kanab City	Kanab City, Department of Environmen tal Quality.
Radon #2	4	Identify public facilities which may be exposed to Radon.	Complete radon tests in Kanab k-12 public schools. Work to mitigate radon if testing indicates a need.	M	5-years	L	Kanab City, Kane County School District	Kanab City, Kane County School District

Source: Local Planning Team

Orderville

The Town of Orderville is a rural town in Kane County which is situated between Zion and Bryce Canyon National Parks, Cedar Breaks and Grand Staircase-Escalante National Monuments, and the Coral Pink Sand Dunes State Park. Nearby outdoor recreation opportunities include hiking, hunting, off roading, and fishing.

The town is in the western portion of the county, near the town of Glendale along Highway-89. This area of the county is called Long Valley, which was formed by the east fork of the Virgin River. The communities of Mount Carmel and Mount Carmel Junction are both within the Orderville municipality bounds.

Community Characteristics

Orderville was settled in the late 1800s by Mormon pioneers. The area was dominantly used for agriculture and livestock grazing. The town is in a valley, near the east fork of the Virgin River and is part of the Paunsaugunt plateau region, marked by high elevation, desert, and canyons.

Demographics

The Orderville population as of the 2020 Census is 598 people, as described in Figure 292. the relative change in population is described in Figure 293 and shows that the community experienced rapid growth from 1990 to 2000 then relative stability in other years. The towns average population change since 1970 is 8.0%.

The Kem C. Gardner Policy Institute projected countywide populations in 2020, estimating that by 2060, Kane County could see approximately, 48.6% growth in their population. If applied to the Town of Orderville through a step-down analysis, the town may see an additional 290 residents in the next 40-years, bringing the population to 888. (Hollingshaus, et al., 2022)

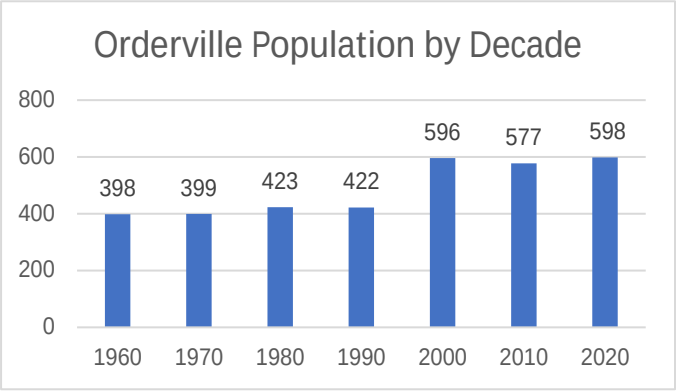


Figure 292: Orderville Population by Decade

Source: US Census Bureau

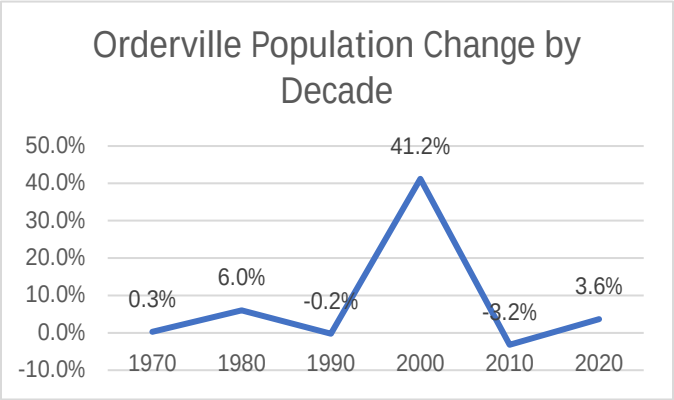


Figure 293: Orderville Population Change

Source: US Census Bureau

Using the average change in population of 8.0% for the town, the future population by 2060 was also projected. The projection is solely based on historic patterns in the town since 1970, and does not account for land availability, local policy, or other metrics relevant to population growth in the community. Figure 294 illustrates the projected population based on average change. Based on this average, the community could see growth near 812 people in the community.

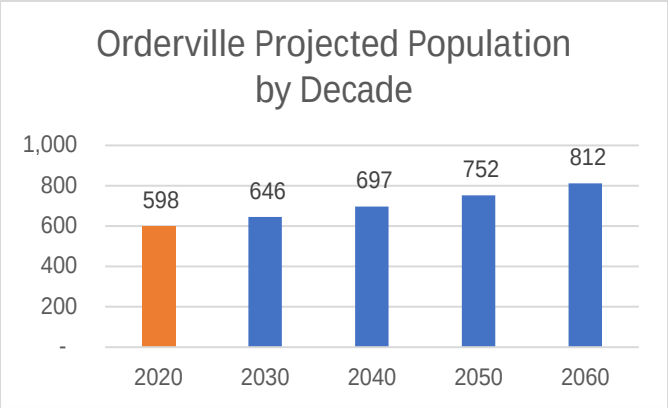


Figure 294: Orderville Projected Population Based on Average Change

Economy

The Orderville economy is dominantly hospitality based. The community is the first large town a visitor arrives at on the east side of Zion National Park, which likely contributes to the dependence on accommodation and food service jobs. The US Census Bureau publishes data about jobs and industries in an area like the Town of Orderville. This data describes the share of jobs by industry, cumulated by the North American Industry Classification System (NAICS) code. Figure 295 provides allows us to see which industries support the greatest share of jobs in the Town. This data demonstrates that after accommodations and food services, the construction and retail industries provide over a quarter of the local jobs.

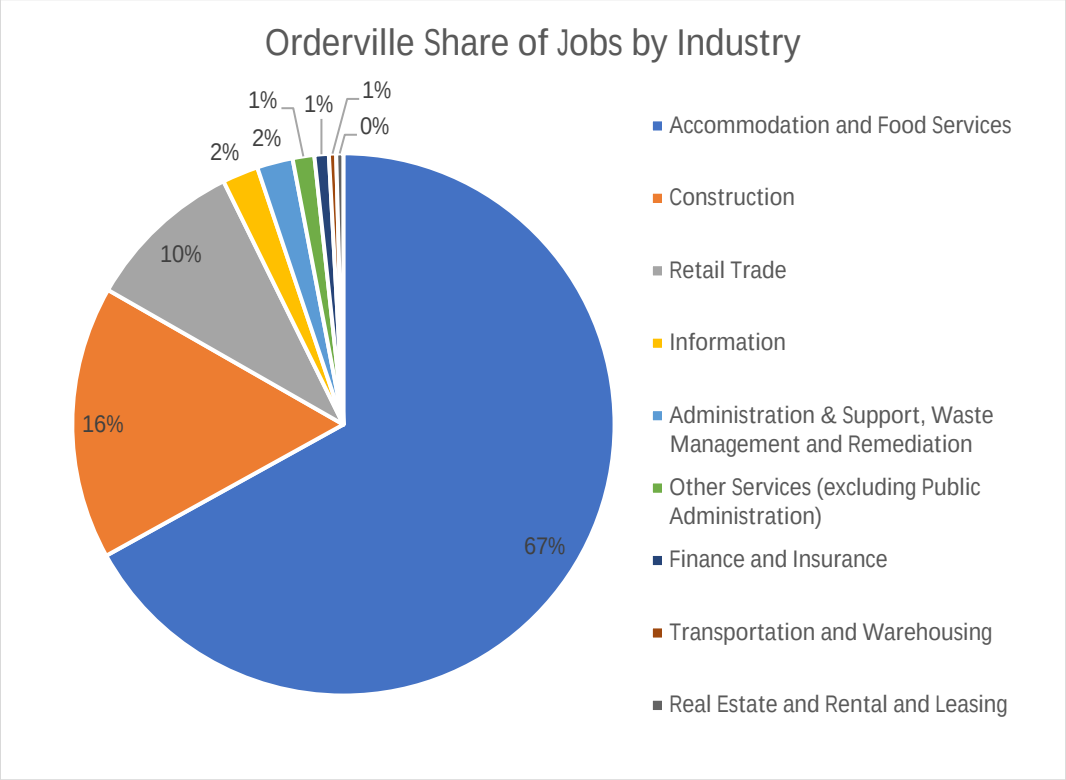


Figure 295: Orderville Share of Jobs by Industry

Source: US Census Bureau

Development

Orderville has seen substantial new development, with a new resort opening across the street from the town hall. The new development is in the northern portion of the town. The northern portion of the town has also seen a new subdivision with recent construction on the site. The two sites are separated geographically by a canyon and ridge.

Community Capabilities

An understanding of the planning mechanisms, policies, and tools that exist in the community inform mitigation is found in this section, which includes analysis of existing plans and policies, community assets, positions and roles that move government actions forward.

Plans and Policies

No plans, ordinances, or policies were made available by the town for review.

Community Assets

The Town of Orderville is a mayor-council form of government which elects a mayor and several board members to make legislative decisions for the community. A town planning and zoning committee provides recommendations to board members regarding local land use issues. Town office staff, a water and maintenance staff, fire marshal, and building inspector provide services to residents.

Funding for capital improvement and infrastructure projects in the town may be funded through agreements with the County, General Obligation or Special Tax Bonds, debt from private activities, Community Development Block Grant, and other state and federal funding sources.

Emergency Response

Orderville has its own fire station, and the Kane County Hospital supports a team of EMTs which serves the County. The Kane County Sheriff provides law enforcement support to the community. Please reference the County section of this plan for an overview of emergency response capabilities.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those assets which are essential for the function of a community. These include roadways, utilities, medical and other care facilities, and other important assets which would cause local health or safety problems if service were interrupted. Orderville is along Highway 89, with alternative access routes along SR-9 in the southern portion of the town. The identified critical facilities are the town hall, two schools, a medical clinic, and the fire department.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for the Town of Orderville, Utah. This assessment describes the natural hazards considered in this plan which pose risks to the town. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 316, summarizes the natural hazards in a list from high to low hazard risk as it pertains to the town.

Table 316: Orderville Town Natural Hazard Risk Assessment

HAZARD	RISK

DROUGHT	High
SEVERE WEATHER	High
FLOOD	High
LANDSLIDE	High
WILDFIRE	Moderate
EARTHQUAKE	Moderate
PROBLEM SOILS	Moderate
RADON	Low

The remainder of this section will describe each hazard in detail and the variables that contributed to the ranking. The section will conclude with a mitigation strategy based on Orderville's risk assessment.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County sections of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock, even loss of human life. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Orderville is seeing the impacts of drought like much of the surrounding County. Given the agrarian history of the community, nearby ranches or grazing will have seen drought impacts in recent years. Drought has a compounding effect on certain natural hazards, including wildfire, flood, severe weather, and landslides. Dry and dead vegetation become flammable fuels, which can ignite from lightning strike or human activity. Dry vegetation also does not secure topsoil as effectively and can be washed away during floods or cause landslides.

Landslide

Kane County is marked by desert cliffsides and mountainous regions, as the county sits on the western edge of the Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Orderville in the west of the county has cliffs, slickrock, and canyon features, making it susceptible to landslide and rockfall events. Figure 296 illustrates the areas exposed to landslide hazard near the town, according to Utah Geological Survey data for rural Utah.

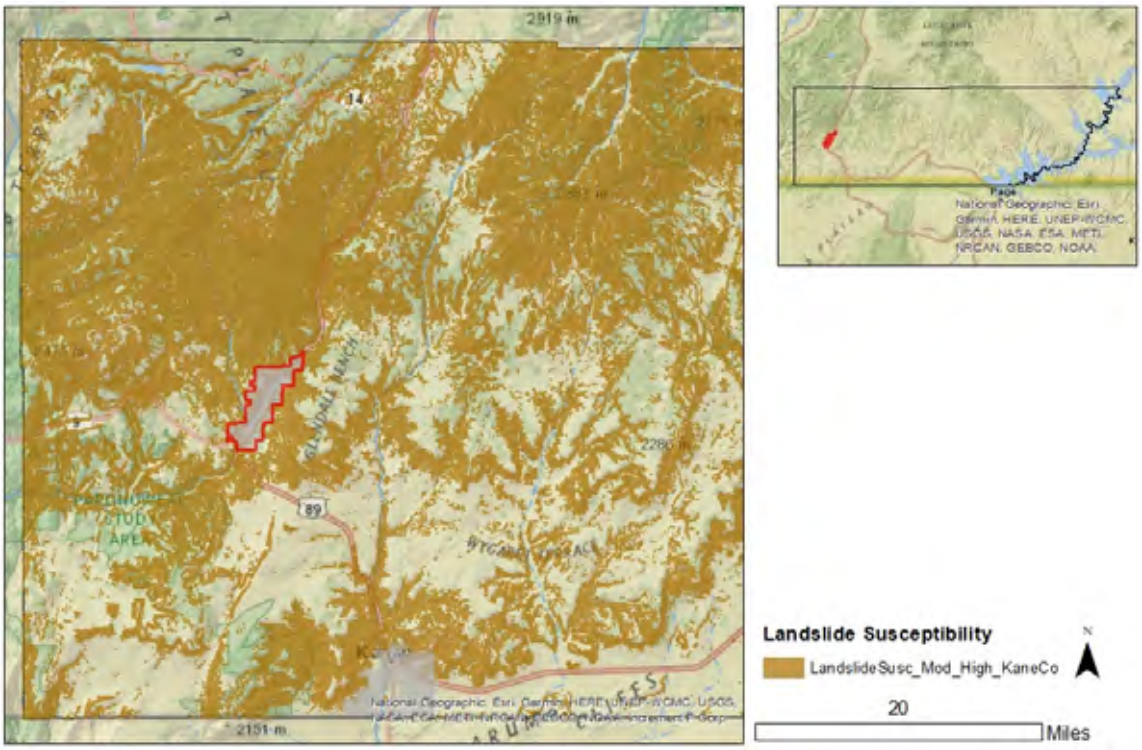


Figure 296: Orderville Landslide Susceptibility

Table 317 describes the assets in the community which are exposed to landslide susceptible areas. Over half of parks, commercial and residential parcels, and critical facilities are exposed to landslide susceptible areas. Parcels exposed to landslide risk areas can result in damage to structures, deaths, and injury among the users or residents of these spaces. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace.

Table 317: Orderville Exposure to Landslide Susceptible Areas

Orderville Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
50.0%	65.9%	56.2%	57.2%	35.1%	N/A	66.7%

Source: Utah Geological Survey, UGRC, Kane County Assessor, UDOT.

Hazard History

Hills, slopes, and cliffs are described near the community of Orderville, which have the potential for landslide or rockfall. The landslide record for the county, in Table 318, describes that there have been two landslides near Orderville, impacting the Mount Carmel Junction area.

Table 318: Orderville Historic Landslides

Incident Date	Location	Description
1932	Kane County	Landslide at Big Meadow Wash on the Zion-Mount Carmel Highway.
1983	Kane County	Landslide in Kane County at Coal Hill, near Mt. Carmel Junction.

Source:

The Utah Geological Survey has compiled historic landslide maps from across the state. The landslide record for the Orderville area is illustrated in Figure 297 and features a single landslide within the town boundaries which was mapped and reported on in 1986. The legacy landslide maps show evidence of often historic, long past landslides and inform current residents and officials of the possibility of future landslides in an area.

Figure 297: Orderville Historic Landslides

Future growth may place more commercial and residential parcels, roads, or other infrastructure in landslide exposed areas. Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Wildfire

Orderville is a rural community located in higher elevations of the County. The area is largely surrounded by agriculture and public lands, with the national monument to the north and east of the community. Figure 298 describes the relative risk of wildfire in the town, using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

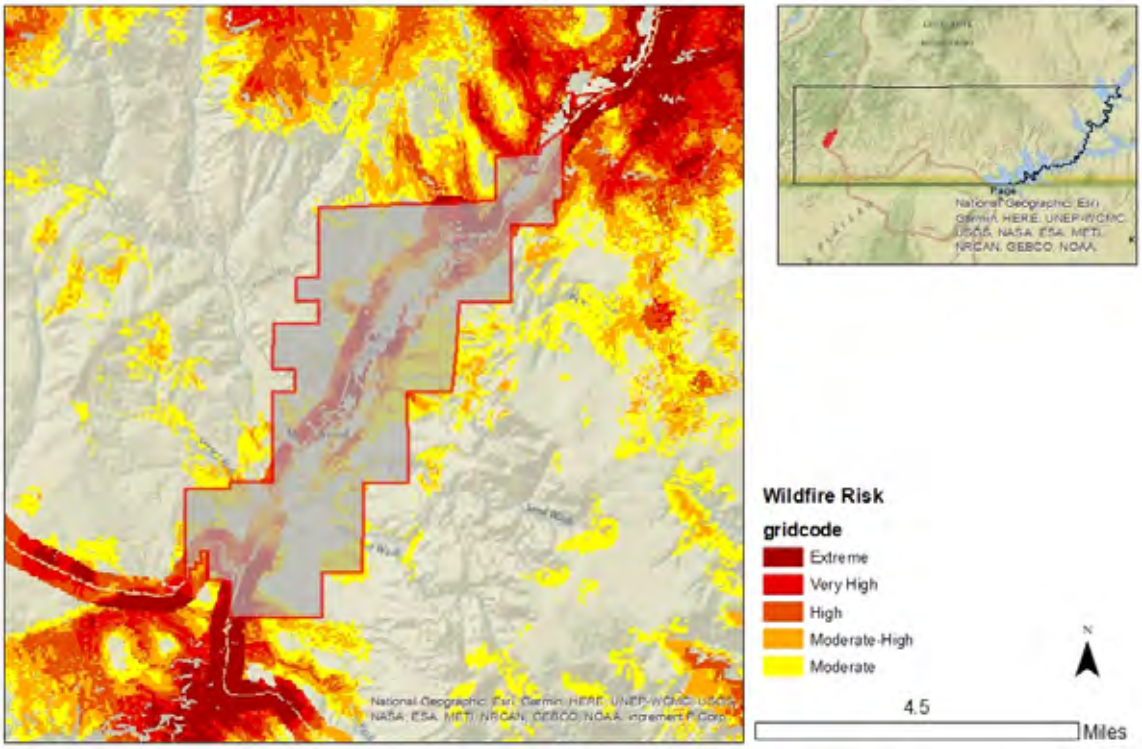


Figure 298: Orderville Wildfire Risk

Source: Oregon Department of Forestry

Orderville and the surrounding area are exposed to wildfire risks, dominantly along the East fork of the Virgin River and Highway 89. Table 319 includes an assessment of the town's exposure of assets to the wildfire risk areas identified in the figure above. Parcels, parks, and critical facilities are exposed to moderate or greater wildfire risk areas. Residential areas exposed to wildfire place people and property at risk. Critical facilities may see impacts to the provision of services during an emergency and are often a gathering place for information during an emergency.

Table 319: Orderville Exposure to Wildfire Risk

Orderville Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	100.0%	91.9%	92.7%	13.9%	N/A	100.0%

Source: Oregon department of Forestry

Hazard History

Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area. Orderville has not experienced recent significant wildfires in the town boundaries. Fires elsewhere in the County may have impacted the community with secondary impacts like smoke or ash.

The area is marked by low elevation, dry, desert, presenting some fire risk, especially given the number of visitors which come to the area annually. Smaller wildfires may have occurred in the town or surrounding area which were not reported on the Wildfire Info site.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, severe weather, flash flooding, and landslides are all hazards that the town is at risk to, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact the Town of Orderville, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

The town sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months and thunderstorms throughout the year, which can produce hail, high winds, rain, and lightning. Rapid downfalls of rain can lead to flash flooding, which is documented in the flood section of this plan. High winds have also been reported to cause damage in the area.

Hazard History

Table 320 describes the damage and injury which occurred during severe weather events in and near Orderville. Some events in nearby communities likely impacted Orderville, so reports of events which had countywide impacts or were documented near the town are also included. Snow and thunderstorms are frequently documented in the area. All the deaths from the severe weather record are attributed to hot temperatures which were likely observed across the county.

Table 320: Orderville Severe Weather Record

Date	Damage/Injury	Description
10/21/2000	None Reported	Orderville reported .75" hail during a severe thunderstorm.
7/12/2005	1 death	Temperatures near 110 degrees led to the death of a hiker in Glen Canyon.
1/24/2008	None Reported	Brian Head and other mountainous areas of Southern Utah saw 12 inches of snow fall during a winter storm.
2/3/2008	None Reported	A snowstorm produced heavy snow fall, including 11 inches produced in Orderville.
12/15/2008	None Reported	Mount Carmel Junction reported 12 inches of snow during a snow event.
12/17/2008	None Reported	A snowstorm produced 8 inches of snow in Orderville.
12/7/2009	None Reported	A severe winter storm produced 19 inches of snow in Orderville.
2/13/2012	None Reported	Eight inches of snow fell in Orderville.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Kanab reported 8.5 inches and Duck Creek Village reported 16 inches of snow during a storm.
1/30/2016	None Reported	Heavy snow caused road closures on several roads, including SR-14.
8/10/2016	None Reported	During a thunderstorm, large hail fell at Mt. Carmel and Orderville, while high winds were reported at the Bullfrog Marina.

Source: NOAA Storm Database

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides, or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Orderville from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events.

Flooding and severe weather events have a notable relationship locally. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident. Flash flooding is further described in the next section of this plan.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often because of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

Kane County and Orderville town have outdoor and recreation assets that are vulnerable to flooding. There have been record visitors to the area for attractions such as national parks, monuments, and state parks, and large functions throughout the county that annually draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

Orderville has had Flood Insurance Rate Maps developed. These maps provide important information about the severity of a flood based on elevation. Dam inundation mapping assesses areas which may be at risk of dam failure or overflow. Figure 299 illustrates that various creeks and drainages are potential sources for flooding in the town, however further mapping may provide additional insight to the community's risks.

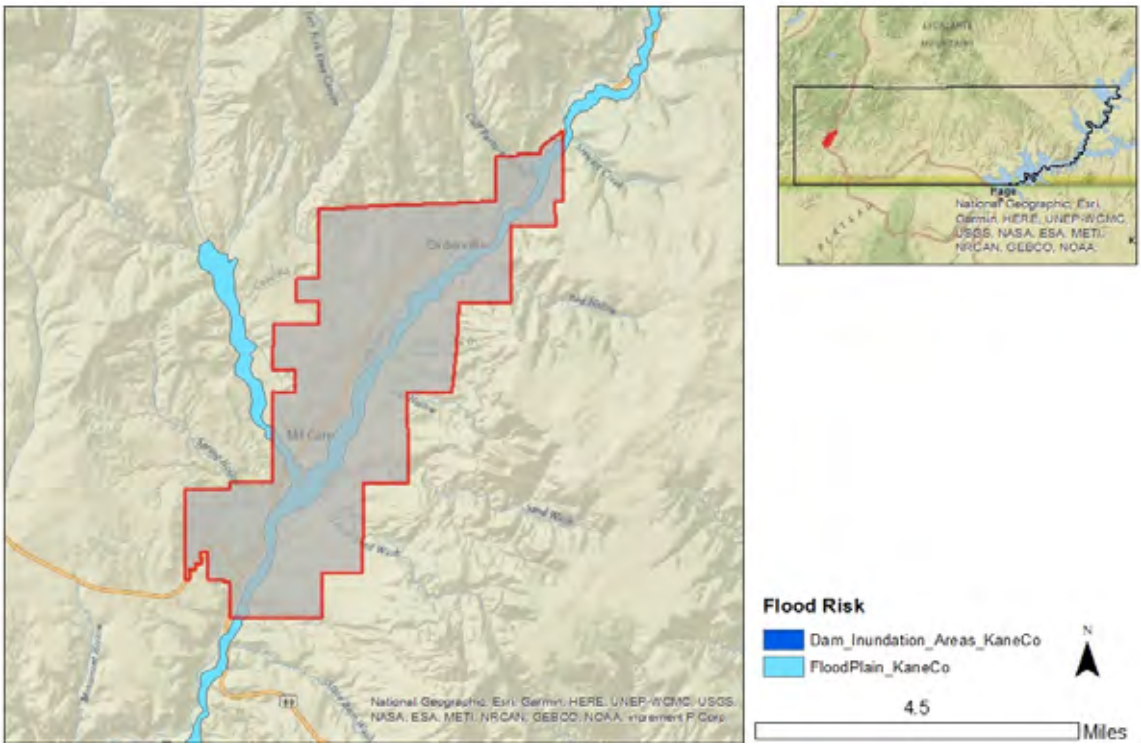


Figure 299: Orderville Flood and Dam Inundation Zones

Source: FEMA, UGRC, Utah Geological Survey

Table 321 includes an assessment of the town's exposure of assets to the flood risk areas identified in the figure above. Looking to this table, parcels, road miles, and parks are exposed to mapped flood risk areas in Orderville. Parcels may see damages and property losses, while roads and other infrastructure exposed to floods are damaged. Parks and other open space can provide buffers to the built environment for flood waters to be absorbed.

Table 321: Orderville Exposure to Flood and Dam Inundation Risk

Orderville Exposure to Flood and Dam Inundation Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	31.7%	17.6%	19.0%	21.1%	N/A	33.3%

Source: Oregon department of Forestry

Flash Flood

Flash floods are a common and damaging form of flooding in the southwest. Flash floods form following heavy rain fall on soil or ground that cannot absorb the water, which flows rapidly instead of infiltrating. A flash flood event can impact urban, rural, or open space areas and do not necessarily occur in a mapped floodplain. In outdoor recreation areas, flash flooding can leave recreators stranded if blocked by a flash flood or can injure if recreators are caught in a debris flow or flash flood. Unvegetated land or recent burn scars can be particularly vulnerable to flash flood events, which can wash away debris and mud from the land. Flash floods have been documented in Orderville and their history is described in the flood history section of this plan.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase flood insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Orderville participates in the NFIP and the Community Status Book report for Utah indicates that the Community has No Special Flood Hazard Area, which is considered a moderate to low-risk flood zone from overflowing rivers or hard rains. Table 322 describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. A CAC and CAV took place on 8/15/2018 and 3/4/2005 respectively.

Table 322: Orderville NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$442	0	0	1	$350,000	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

The town does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

There have been several damaging flooding events in Kane County, that have impacted lives and property throughout the county, including in the town of Orderville. The NOAA storm database describes no direct damages to the town. Table 323 describes flood events which impacted Orderville.

Table 323: Orderville Flood Hazard Record

Orderville Flood Hazard Record		
Date	Damage/Injury	Description
7/14/2001	$,1000 property damage	Flash flooding was reported in canyons throughout Kane County. Several roads were washed out during the event.
10/5/2010	$20,000 property damage	A thunderstorm produced flooding throughout Kane County, damaging and blocking several roads and trails. Johnson Canyon reported basement flooding during the event.
12/19/2010	$800,000 property damage	A large storm caused flooding throughout Kane County caused the closure or blocked several roads. Significant impacts were reported on Highway 89, with water reported at one foot deep at one segment and a landslide documented which deposited a four-foot deep and 50-foot-wide debris field onto the roadway. Orderville and Glendale reported local street flooding.
9/10/2013	$185,000 property damage	A severe thunderstorm caused flooding countywide. Impacts included: closure of roads in and around Grand Staircase-Escalante National Monument, flooded drainages, flooding the Paria River, flooding on Highway 89, closure of SR-9 at the east entrance of Zion, and blockage of a culvert.

Source: NOAA Storm Database

Highway 89 and other connector roads are vulnerable to flooding and flash floods throughout the county, including in Orderville. In some areas of the County, blocked roadways can be especially dangerous, as residents or visitors may have increased delays to emergency services access, like medical, fire, and law enforcement. Flooding is noted to cause other events in the county, including landslides which Orderville is at risk to. Visitors to the area for hiking, camping, and other outdoor recreation are vulnerable to flooding, especially flash flooding which can have rapid onset and occur frequently in the canyons and drainages of Kane County.

Earthquake

The Sevier Fault is the primary fault line which runs north-south through the western portion of Kane County, paralleling highway-89 near Alton, Glendale, and Orderville. Fault lines are often the originating point of large earthquakes in this region, it does not mean that earthquakes solely are experienced on or near a fault. Earthquake events occur frequently in the region at low magnitude that do not cause impacts. Large earthquakes which can cause damages have been recorded in the region, but are infrequent. Figure 300 shows the mapped quaternary fault lines and earthquake epicenters of 4.0 magnitude or greater in Kane County. There are no faults or earthquake epicenters identified in or near Orderville. Only one earthquake epicenter with a magnitude of 4.0 or greater is reported in the county, in the City of Kanab.

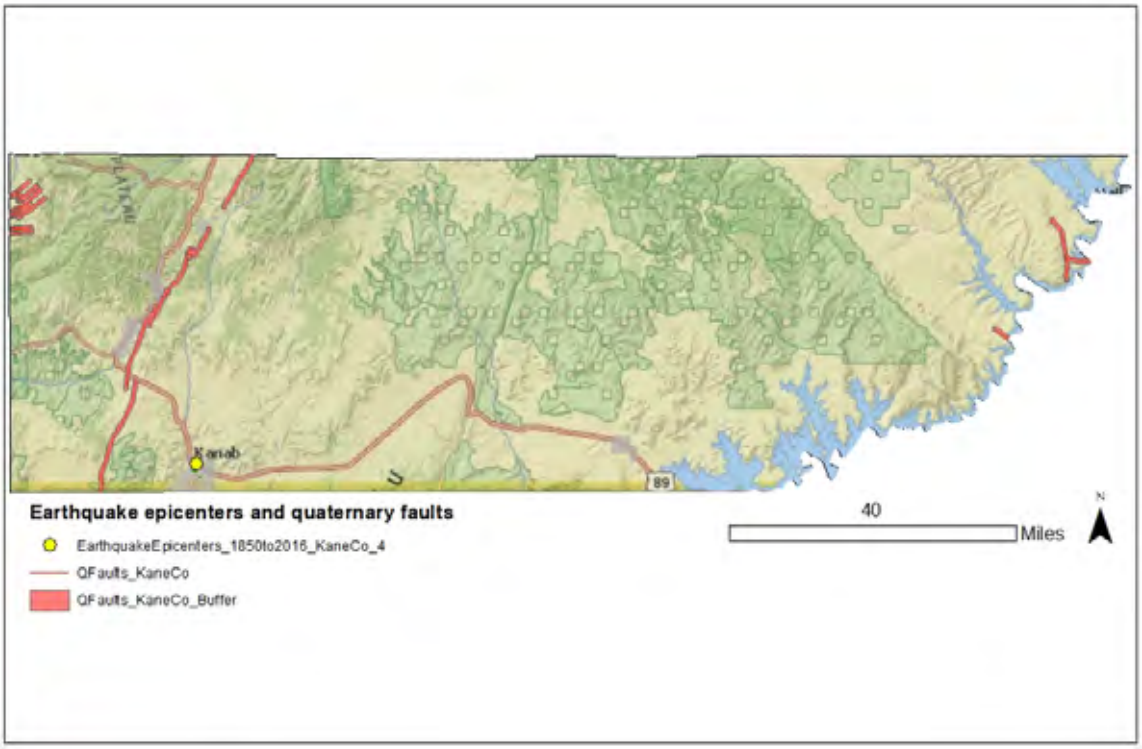


Figure 300: Kane County Earthquake Epicenter and Quaternary Fault Map

Source: Utah Geological Survey, UGRC

The Five County Association of Governments completed an assessment of the number of community assets that are within a quarter mile of a quaternary faulty, illustrated in Table 324. The Sevier fault is mapped within the Orderville town bounds and may impact the infrastructure or structures if an earthquake event occurs. Given the presence of the fault, the town may also be susceptible to surface fault rupture, where the ground moves at the Faultline during an earthquake. Ground shaking can cause damage and trigger other hazards throughout the impacted area.

Table 324: Orderville Exposure within a Quarter Mile of a Quaternary Fault

Orderville Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			

0.0%	12.2%	2.4%	3.4%	5.9%	N/A	0.0%

Source: Utah Geological Survey, Washington County Assessor, UDOT, UGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. Kane County's assessor roles did not have data to describe the year that structures were built to determine which and how many structures are more vulnerable to ground shaking. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Hazard History

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with observed impacts increasing as the magnitude continues to increase.

While few individual earthquakes in Kane County have been recorded with a magnitude of 4.0 or greater, the community is seismically active. In 2016 clusters of earthquakes were reported near Orderville. During this event, 14 earthquakes between 0.9 and 2.8 magnitude were reported 14 miles from Orderville. A cluster is defined by the University of Utah Seismographs Stations as ten or more earthquakes occurring within a 6-mile radius during a reporting period of three months. (University of Utah Seismograph Stations, 2016)

Liquefaction

The Utah Geologic Survey has published mapping of liquefaction hazards for some of the urban areas in the region, but unfortunately Kane County is not included in that study area. Liquefaction hazard is a result of strong ground shaking, where certain soil types or saturated soils lose integrity and behave like a fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move. Liquefaction has been identified as a risk in areas of the region which have riparian areas, where the soil may be more saturated. Liquefaction has been identified in and near the Zion National Park, although dominantly along the Virgin River and the Hop Valley, according to a Utah Geological Survey study. More data is needed for Kane County to fully assess the potential and risks of liquefaction.

Summary

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 301. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

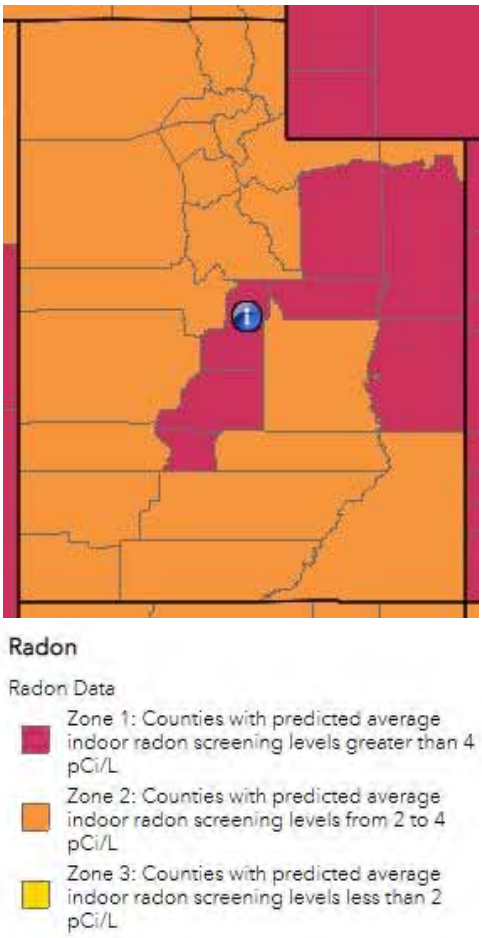


Figure 301: Estimated Indoor Radon Zones- Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 325 describes the reported findings across Kane County. The countywide average test result is 4.7 pCi/L of air across 100 reported tests. This reported average surpasses the point at which screening is required for safety indoors. Unfortunately, radon hazard is measured site by site and should not be aggregated to understand risk. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk at each site.

Table 325: Kane County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
69.0%	31.0%	30.8 pCi/L	4.7 pCi/L	100

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the statewide, self-reported testing record. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Problem soils are a problem for construction and development. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas of the county, although near Orderville, the Utah Geological Survey has only identified Expansive Soil or Rock in mapping completed in 2011. Figure 302 maps the data available in and surrounding Orderville. Expansive Soils composition includes clays which interact with moisture, expanding when whetted and contracting when dry. Utilities, structures, and infrastructure can be damaged from the soil movement associated with expansion. Table 326 describes the community assets which are exposed to mapped problem soils.

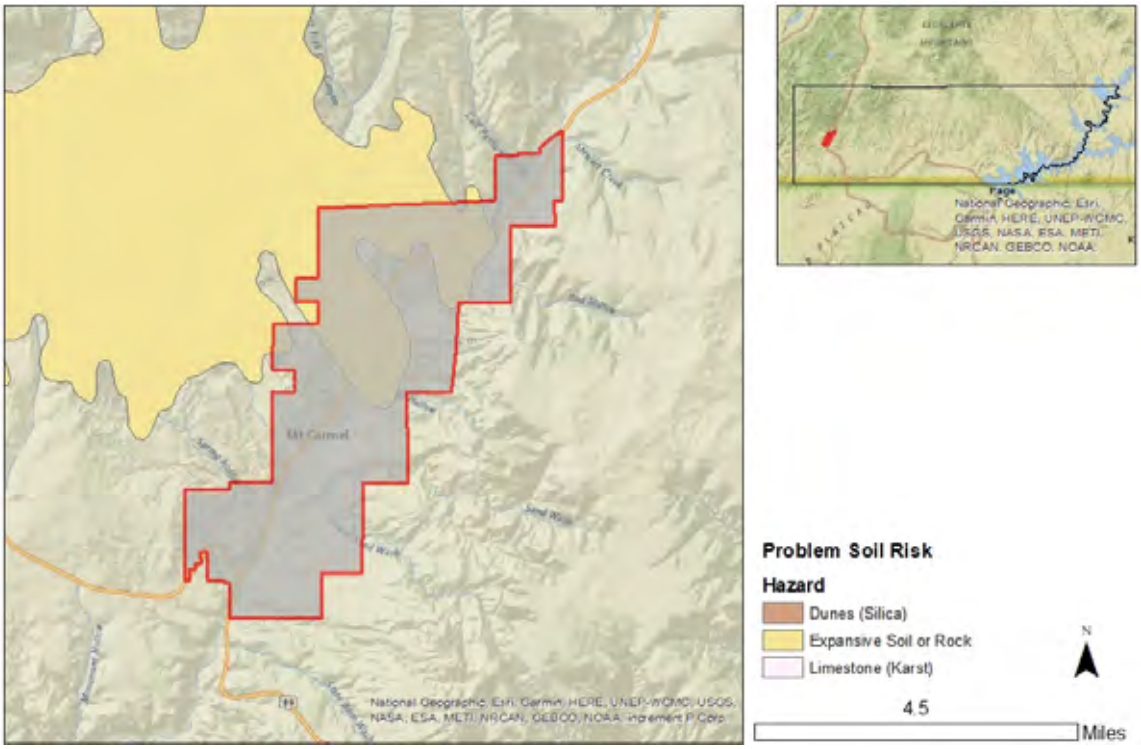


Figure 302: Orderville Problem Soils Exposure

Table 326: Orderville Exposure to Problem Soils

Orderville Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	46.3%	62.7%	61.1%	28.9%	N/A	100.0%

Source: Utah Geological Survey, Kane County Assessor, UGRC.

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. This data was not available to provide a review for Kane County. Further mapping of the area will provide greater detail to the problem soils prevalence in the community. The Town may have a greater exposure of problem soils than current estimates and there are some problem soils that are in new Utah Geological Survey mapping that are not included in older mapping files.

Orderville Town does not have a full record of impacts from problem soil damage to structures and infrastructure in the county. County records may describe the development which was required to submit soils survey reports as a condition of development and any mitigation which was completed on the site.

Summary

Drought, severe weather, flood, and landslide are all considered high risk hazards in Orderville based on their extent and history of impacting the community. Hazards like earthquake have a lower likelihood of occurrence at high magnitudes, however severe earthquakes would cause significant impacts to the area and are therefore considered a moderate hazard. Hazards like Radon and Problem soils appear to be prevalent throughout the county and are addressed dominantly at the sites of individual structures. While Radon hazard has been identified to have direct health impacts on those exposed, problem soils are often considered to be more of a construction problem, causing damage when unmitigated.

This risk assessment identified vulnerabilities in Orderville. Much of the reported severe weather hazards, floods, and landslides impacted roadways and/or outdoor recreation ventures near the community. Highway-89 is particularly susceptible based on the historic record for the area. Blocked roadways and damaged infrastructure can limit the accessibility for responders and personnel to emergency situations. Floods impact the full-time residents with traffic delays, property damage, and the potential for personal injury.

Several economic endeavors are identified vulnerabilities to natural hazards, including outdoor recreation. Visitors may select alternate destinations if they feel conditions will not be good for their intended activity. Drought, wildfire, and severe weather conditions can place additional stress on this industry. Related industries like accommodations, food service, and retail may see secondary impacts if visitation is impacted.

The vulnerabilities described in this section are the result of compiling the risk assessment, communicating with local officials, and identifying what assets and infrastructure are vulnerable to natural hazards. A description of actions which address these vulnerabilities is found in the next section of the plan.

Mitigation strategy & actions

The Town of Orderville did not participate in the 2016 iteration of the Natural Hazard Mitigation plan and has no actions to report on.

The Five County Association of Governments worked with the local planning team to develop a mitigation strategy in 2022, using the identified risks and vulnerabilities in this plan as a starting point. Strategy development also referred to previous mitigation activities taken by the community to ensure that new actions continue progress already made toward risk reduction. Actions for the 2022 iteration of the plan are in development, and suggestions for town actions are included below:

The Orderville planning team identified actions to include in the community mitigation strategy. Each action in Table 327 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 303.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 303: Regional Plan Goals

Table 327: Orderville 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	3	Inform residents of water conservation design techniques.	Encourage permeable driveways and surfaces to promote groundwater recharge.	L	Ongoing	L	Orderville Town	Orderville Town
Drought #2	3	Inform residents and agricultural interests of availability of crop insurance.	Preserve economic stability during a drought by encouraging agricultural interests to obtain crop insurance to cover potential losses due to drought. Provide	H	Ongoing, annually	L	Orderville Town	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			information at town office.					
Drought #3	2	Reduce town consumption of water where available.	Assess town facilities and where identified, replace unused grass areas with native vegetation on town owned property.	H	5-years	M	Orderville Town	Orderville Town
Drought #4	2	Set standards for water consumption during drought conditions.	Establish drought policies with tiered actions to implement at different severities of drought conditions.	M	5-years	L	Orderville Town	Orderville Town
Drought #5	2	Plan for and build in redundancies in the water system	Assess and identify capacity for town infrastructure to install redundancies and harden the water system in the town.	M	5-years.	L	Orderville Town	Orderville Town
Drought #6	1, 3	Plan for water consumption on future development.	Set standards for development to use drought tolerant and native vegetation.	M	5-years	L	Orderville Town	Orderville Town
Severe Weather #1	3	Inform residents and visitors of severe weather risks.	Educate residents and visitors of the dangers of extreme temperatures (hot and cold) and severe weather events and the steps they can take to protect themselves during an event. Information to be available at the town office.	H	Ongoing, annually	L	Orderville Town	Orderville Town
Severe Weather #2	3	Reduce vulnerability on extreme temperature days in the town.	Partner with local cities and towns to identify community structures which could be used as daytime cooling centers during extreme heat days in areas of high vulnerability.	L	Ongoing	L	Orderville Town	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #3	3	Inform visitors of severe weather risks.	Distribution of severe weather information like heat, lightning, and severe thunderstorms to recreation equipment retailers or outfitters to share with their clientele.	H	Ongoing	L	Orderville Town	Orderville Town
Severe Weather #4	2	Protect critical town owned equipment.	Installing and maintaining surge protection on critical electronic equipment at town operated facilities.	H	5-years	L	Orderville Town	Orderville Town
Earthquake #1	1, 2, 4	Coordinate with critical facilities to secure critical equipment.	Partner with hospitals, clinics, and other critical facilities to brace generators, elevators, and other vital equipment.	M	Ongoing	L	Orderville Town, critical facilities, county facilities	Orderville Town, critical facilities, county facilities
Earthquake #2	1, 2	Set code to reduce earthquake impacts on equipment and users.	Require the anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc).	H	Ongoing	L	Orderville Town	Orderville Town
Earthquake #3	2	Secure critical infrastructure from ground shaking.	Using flexible piping when extending water, sewer, or natural gas service.	M	Ongoing	M	Orderville Town, utility companie s	Orderville Town, utility companies
Earthquake #4	2	Protect users of public facilities from damages and injury during earthquake.	Installing window film on town owned property to prevent injuries from shattered glass.	M	5-years	L	Orderville Town	Orderville Town
Earthquake #5	3	Inform residents about earthquake risks and vulnerabilities.	Developing an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses. To be available at the town office and town outreach events.	M	Ongoing, annually	L	Orderville Town	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #6	1, 2	Set code to reduce earthquake impacts on masonry structures.	Requiring new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	H	Ongoing	L	Orderville Town	Orderville Town
Earthquake #7	3	Inform residents about earthquake risks and vulnerabilities.	Educating homeowners on safety techniques to follow during and after an earthquake.	M	Ongoing, annually	L	Orderville Town	Orderville Town
Earthquake #8	1, 2	Collect data to inform mitigation activities.	Inventory structures in the town that are constructed with unreinforced masonry and plan for retrofit of structures for the safety of occupants.	L	5-years	M	Orderville Town, Preservation Utah, State and Federal Tax Credit.	Orderville Town
Flood #1	2	Reduce street flooding and improve drainage system.	Maintain and clean drainages and culverts in the town.	M	Annually	L	Orderville Town	Orderville Town
Flood #2	1, 2	Improve data to inform flood mitigation.	Participate in flood mapping and the national flood insurance program.	M	Unknown	L	Orderville Town, Kane County, FEMA	Orderville Town, Kane County, RiskMAP Coordinator
Flood #3	6	Include stormwater infiltration as a method to address flooding	Limiting the percentage of allowable impervious surface within developed parcels in high flood risk areas.	L	Ongoing	L	Orderville Town	Orderville Town
Flood #4	1	Include stormwater controls with all new development.	Require developers to construct on-site retention basins for excessive stormwater and as a firefighting water source.	H	Ongoing	L	Orderville Town	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #5	2	Reduce street flooding and improve drainage system.	Increasing drainage or absorption capacities with detention and retention basins, relief drains, spillways, drain widening/dredging or rerouting, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, or channel redirection.	M	Ongoing	M	Orderville Town	Orderville Town
Flood #6	2, 4	Remove critical equipment and infrastructure form known flood risk areas.	Working with utility companies to raise utilities or other mechanical devices above expected flood levels.	M	Ongoing	L	Orderville Town, utility companie s	Orderville Town, utility companies
Flood #7	2, 4	Remove critical equipment and infrastructure form known flood risk areas.	Coordinate with UDOT to assess bridges, culverts, and stormwater drainage infrastructure for capacity along Highway 89.	M	Ongoing	L	Orderville Town, UDOT, Kane County	Orderville Town, UDOT, Kane County
Flood #8	3	Inform visitors and residents of flood risk areas.	Partner with park rangers, outdoor outfitters and other recreation industry partners to inform visitors of the flood hazard risks.	M	Ongoing, annually	L	Orderville Town	Orderville Town
Wildfire #1	1, 2	Set standards for development in interface areas	Adopt the Wildland Urban Interface Code.	H	5-years	L	Orderville Town	Orderville Town
Wildfire #2	1, 2	Set standards for development in interface areas	Using zoning and/or a special wildfire overlay district to designate high-risk areas and specify the conditions for the use and development of specific areas.	M	5-years	L	Orderville Town	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #3	1, 2, 3	Set standards for development in interface areas	Encouraging the use of non-combustible materials (i.e., stone, brick, and stucco) for new construction and renovations in wildfire hazard areas.	M	Ongoing	L	Orderville Town	Orderville Town
Wildfire #1	3, 5, 6	Inform residents about defensible space on personal property	Coordinate yard clean ups and education about Firewise landscaping in unincorporated and incorporated communities.	H	Ongoing, annually	L	Orderville Town	Orderville Town
Wildfire #1	4, 6	Reduce fuel loads in and surrounding the town.	Complete fuels management on town owned land and support efforts from partnering agencies like, BLM, NPS, DNR, and other local, state, or federal agencies.	M	Ongoing, annually	L	Orderville Town, BLM, DNR, USFS, Kane County	Orderville Town, BLM, DNR, USFS, Kane County
Wildfire #1	1, 2	Reduce vulnerability of natural gas and propane fuels.	Require that large propane tanks or other external fuel sources have protective measures.	M	Ongoing	L	Orderville Town	Orderville Town
Wildfire #1	1, 2, 4, 6	Protect critical facilities, equipment, and infrastructure from wildfire.	Coordinate with local utility providers to mitigate hazardous fuels around utility infrastructure.	M	Ongoing	L	Orderville Town, utility companie s	Orderville Town, Utility companies
Wildfire #1	2, 6	Protect critical facilities, equipment, and infrastructure from wildfire.	Assess critical facilities to ensure that materials are flame resistant and landscaping is Firewise.	M	Ongoing	L	Orderville Town	Orderville Town
Landslide #1	2, 6	Reduce the vulnerability of steep slopes.	Applying soil stabilization measures, such as planting soil stabilizing vegetation on steep, town owned slopes.	L	Ongoing	M	Orderville Town, DNR, NRCS	Orderville Town

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	2, 6	Reduce the vulnerability of steep slopes.	Using debris-flow measures that may reduce damage in sloping areas, such as stabilization, energy dissipation, and flow control measures.	M	Ongoing	M	Orderville Town, DNR, NRCS	Orderville Town
Landslide #1	1, 2	Implement development standards for structures near steep slopes.	Establishing setback requirements and using large setbacks when building roads near slopes of marginal stability.	M	Ongoing	L	Orderville Town	Orderville Town
Landslide #1	2, 4	Installing catch-fall nets for rocks at steep slopes near roadways.	Coordinate with the County and UDOT to assess the need for and install catch-fall nets for steep slopes on vulnerable roadways.	L	Ongoing	M	Orderville Town, Kane County, UDOT.	Orderville Town
Landslide #1	6	Protect damaged slopes and vegetation from sliding.	Develop a plan for revegetation of steep slopes following a natural hazard like a debris flow, landslide, flood or wildfire which has damaged the existing vegetation.	L	Ongoing	M	Orderville Town, DNR, USFS, BLM, Kane County	Orderville Town, DNR, USFS, BLM, Kane County
Radon #1	3	Inform residents of radon risk and mitigation.	Provide radon risk, testing, and mitigation information to residents.	H	Ongoing, annually	L	Orderville Town	Orderville town, partner with Utah DEQ
Radon #2	4	Reduce radon risks and exposure in public facilities.	Partner with the County School District to complete tests in Kane County Schools.	M	5-years	L	Orderville town, Kane County, Kane County School District	Orderville town, Kane County, Kane County School District
Problem Soil #1	4	Collect data to inform mitigation	Work with the Utah Geological Survey to update problem soil mapping.	L	Ongoing	L	Orderville Town, UGS	Orderville town, UGS, Kane County

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Problem Soil #2	4	Collect data to inform mitigation	Inventory locations where problem soils have caused damages to properties in the town.	L	Ongoing	L	Orderville Town, UGS	Orderville town, UGS, Kane County
Problem Soil #3	1, 2	Set development standards to reduce impacts of problem soils.	Require soils survey for all new development to identify problem soils.	H	Ongoing	L	Orderville Town	Orderville Town
Multi-Hazard #1	6	Preserve land vulnerable to natural hazards.	Consider acquiring land in identified natural hazard risk area for public open space use.	L	Ongoing	H	Orderville Town	Orderville Town

Source: Local Planning Team

Washington County

Community Characteristics

Washington County is bordered by Iron County, Kane County, Mohave County Arizona, and Lincoln County Nevada. According to the U.S. Census Bureau, the county has a total area of 2,430 square miles. Within Washington County there are several federal and state highways, the most prominent being Interstate 15 (I-15) and State Routes (SR) 9, 17, 18, and 59. St. George is the Washington County seat and the southernmost Utah city along the I-15 corridor. I-15 runs in a southwest-northeast direction through the county and provides direct access to the metropolitan areas of Las Vegas to the south and Salt Lake City to the north.

Geography and Climate

Washington County is the business and cultural center for southwestern Utah and is a major gateway to nearby Zion National Park in the eastern part of the county. The northeastern edges of the Mojave Desert, Zion National Park, and the Pine Valley Mountains are all visible from the Metropolitan area. These geographic areas of the County support the thriving outdoor recreation industry in the County.

The hallmark of Washington County is its geology, which is at the intersection of three distinct landscapes: The Great Basin, the Colorado Plateau, and the Mohave Desert. While the geography of these three differ, they have one thing in common, aridity. The County was settled as an agricultural region for its favorable warm climate. Three major rivers, the Virgin, Santa Clara, and Ash Creek fed from precipitation and snowmelt at higher elevations, support this region. Elevations in Washington County range from 2,178 to 10,194 feet in elevation. The lowest point in the state of Utah is in the Beaver Dam Wash in Washington County, where water seasonally flows out of Utah, into Arizona. The climate has more in common with the Desert Southwest than the rest of Utah, with scorching hot summers and mild winters.

Most of the County population base is in the St. George Metropolitan Statistical Area. This area experiences summers characterized by hot, dry weather with average maximum temperatures of 100 degrees at lower elevations and relatively mild winters. The average annual precipitation is 8.9 according to the St. George Area Chamber of Commerce, with most of the rainfall occurring from December to March.

Demographics

Washington County has been the fastest growing county in the state for the past decade and is projected to continue to be so. County population increased 230% since 1990, and 16% since 2010, described in Table 328. The Kem C Gardner institute predicts that Washington County will see a projected change in population of over 508,000 people by 2065, a 229% change from the 2015 population estimate. (Kem C. Gardner Policy Institute , 2017) Washington county is expected to see the most growth of any of Utah's counties over the next 50 years[16].

[16] Utah hazard plan pg 10

Table 328: Population Percent Change for Washington County

Washington County Population Percent Change							
	1960	**1970**	**1980**	**1990**	**2000**	**2010**	**2018**
Apple Valley	na	na	na	na	na	na	14.0%
Enterprise	8.7%	-1.7%	7.2%	3.4%	37.3%	33.2%	-4.4%
Hildale	na	na	110.2%	31.3%	43.0%	43.9%	7.0%
Hurricane	-1.6%	12.5%	88.9%	47.2%	110.7%	66.6%	19.3%
Ivins	-18.9%	77.9%	338.0%	171.7%	173.0%	51.8%	21.6%
La Verkin	-5.7%	26.8%	153.6%	50.9%	91.5%	19.7%	5.1%
Leeds	na	38.5%	44.4%	16.5%	115.4%	49.9%	-4.3%
New Harmony	-16.7%	-25.7%	50.0%	-13.7%	88.1%	8.9%	-13.0%
Rockville	na	na	na	16.7%	35.7%	-0.8%	30.2%
Santa Clara	-8.8%	-6.9%	302.6%	112.8%	99.4%	29.7%	18.6%
Springdale	na	-26.6%	41.8%	6.6%	66.2%	15.8%	-26.7%
St. George	12.5%	38.3%	85.2%	116.8%	74.2%	46.8%	12.8%
Toquerville	-10.0%	-6.1%	49.7%	76.2%	86.5%	50.5%	48.2%
Virgin	-15.6%	-4.0%	42.0%	35.5%	72.1%	51.3%	-11.1%
Washington	2.3%	68.5%	312.3%	35.8%	95.0%	129.2%	35.4%
Unincorporated County	-27.9%	40.6%	-20.7%	103.9%	140.9%	19.3%	5.4%
Total	4.4%	33.1%	90.7%	86.3%	86.1%	52.9%	16.2%
na: Data not available							

Source: US Census and American Community Survey

Economy

Washington County is the most urban county in southwestern Utah, and most closely resembles the economies of northern Utah. While it started as an agricultural region, tourism and winter residences began to change the character of the region beginning in the 1960s. Visitation to National Parks further spurred growth as Zion National Park became an international destination and a part of the National Parks "Grand Circle."

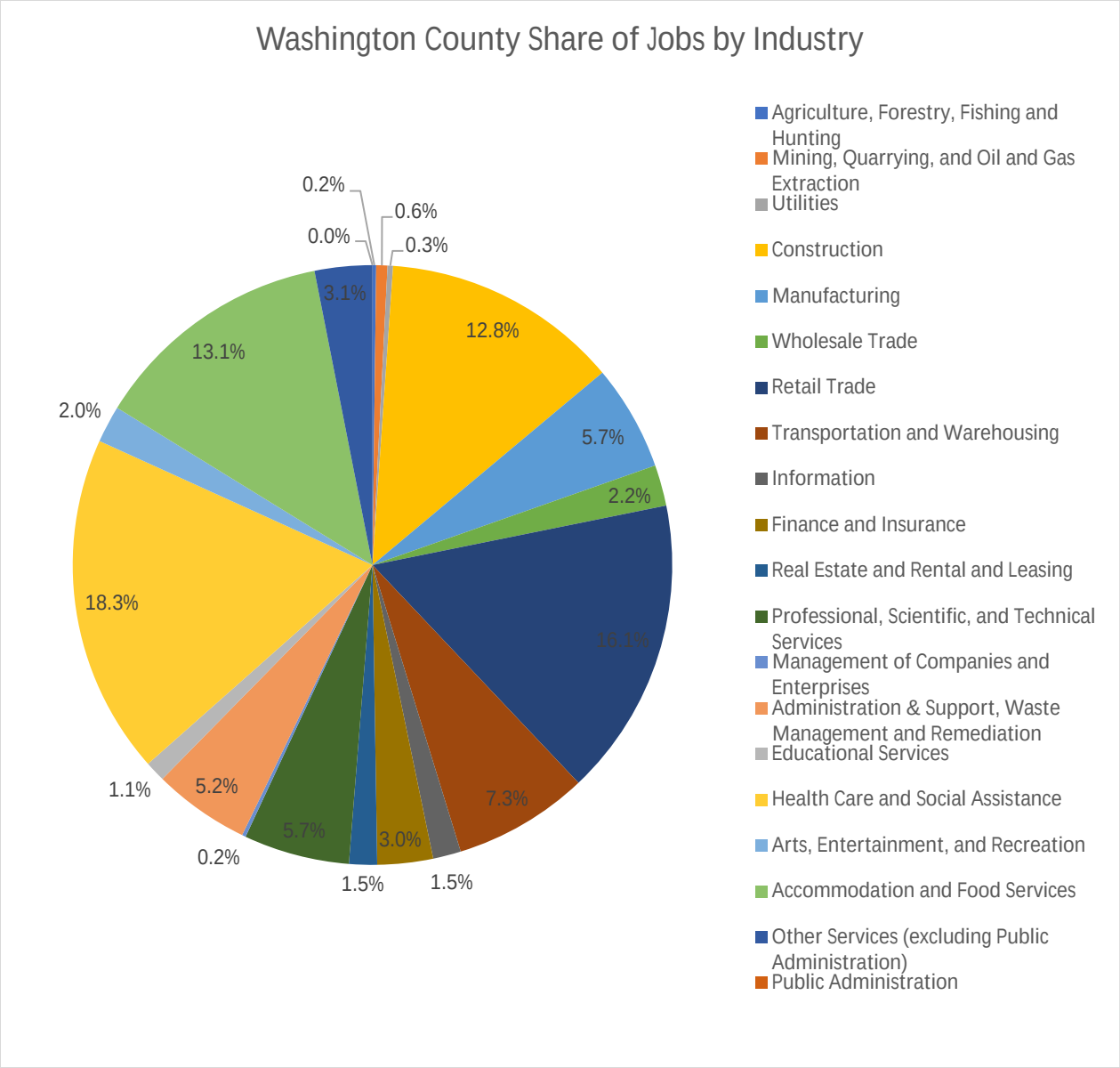


Figure 304: Washington County Share of Jobs by Industry

Source: US Census Bureau, On The Map, 2018.

As of 2018, there ar 52,975 private primary jobs Countywide in Washingon County. Concentrations of jobs are greatest in and near the St. George Metropolitan area. Figure 304 demonstrates the share of jobs by industry Countywide. While this estimate includes the jobs within municipalities in the county, it reflects the major industries throughotu the county, job quanntities, and identifies potential economic vulnerabilities to natural hazards. In Washington County, retail, health care and social assistance, and accomodation and food services are the largest industries with 16.1%, 18.3%, and 13.1% of jobs respectively. Construction activities also occupy a significant share of jobs in the County.

Development

Most of the communities in Washington County are incorporated and urban in character. The County includes several rural, unincorporated communities. Residential development in the county is strong and primarily within incorporated communities. A majority of the industrial and commercial activities in the county are found in the St. George Metropolitan Statistical Area. The neighboring communities are experiencing some of this commercial development, especially Washington City and Hurricane City.

While many people are relocating to the area for the wealth of public lands and recreation amenities, the limited quantity of private land is a constraint to growth. In addition to the National Parks, recreation on BLM and US Forest Service lands attract new residents and visitors alike. There is a substantial amount of private land that are near, adjacent to, or within the forest lands and managing the urban-forest interface is becoming a critical issue.

Capabilities

Washington County coordinates social and essential services to residents throughout the county. The County employs and emergency management staff and law enforcement for public safety. Several planners and public works professionals develop long and short-range plans and oversee capital projects. A GIS staff provide mapping capabilities and data management for the County.

Several commissions provide governance and decision making in Washington County. A county commission made up of three elected commissioners who make decisions for the County, adopt county plans and ordinances, hold public hearings for new projects, etc. The Planning Commission advises on planning and zoning issues in the community, including holding hearings regarding planning and zoning issues.

Committees

Washington County has other committees and authorities that speak to natural hazard risks and move mitigation actions forward. The Hillside and Slope Committee supports decision making throughout the County as it pertains to construction and activities on or near identified steep slopes. This body is made up of local engineers and geology professionals who can provide input and advice on areas with steep slopes relative to proposed development.

Another local hazard related entity is the Flood Control Authority which is made up of local public works, floodplain, water management, and elected officials from Washington County, St. George, Santa Clara, and Washington City. This group meets monthly to identify and address local flooding concerns in the area. Activities include identifying mitigation actions to protect the area from flooding damages and impacts.

Plans and Policies

Washington County sets plans, codes, and ordinances to govern and regulate development throughout the region. This plan has identified and summarizes existing codes, ordinances, and plans that describe natural hazards. This can include but is not limited to: identifying hazards as a problem, setting regulations and enforcement mechanisms in the community, or future planning and objectives to mitigate hazards.

County Code

The Washington County Codes and Ordinances address natural hazards in several different capacities. Chapter 20 is dedicated to identifying construction that is subject to geologic, flood, or other natural hazards, and specifies the types of reporting, documentation, and other actions that must take place before construction may commence on the site. In some cases, the developer may be required to document how they will mitigate the natural hazards on the site contingent for the approval of their application.

The county identifies steep slopes as a concern for development and has additional requirements for construction to take place in identified areas to reduce risks from landslides and rockfall. Geotechnical analysis is required in certain cases to identify potential risks from flooding, problem soils, landslides and rockfall.

General standards for development identify that a site should preserve the existing topography and natural features. Further the county does not include areas of identified natural hazard risk in the allowable buildable land calculation to determine density. A fire protection plan must be reviewed by the local fire district for development approval. Landscaping should be primarily xeriscape, which avoids excess water use and addresses drought via conservation.

Special Flood Hazard Zone- An identified Floodplain and erosion study are included in the ordinances and structures cannot be constructed, located, extended, or altered in these zones. This is not to say that flooding and erosion cannot occur outside of this zone. Development must be permitted in special flood hazard areas.

Expansive soils and excessive soil erosion are identified as potential problem soils challenges in the community in the code, which may require mitigation before development or County approval of development may proceed.

Construction Design Standards

The Construction Design Standards describe requirements for construction to meet zoning ordinances and requirements for building in the county. This document describes soil, flood, and landslide hazards including requirements to mitigate and prohibit certain activities that could cause or exacerbate existing hazards. This includes the requirement for geotechnical reporting to evaluate for expansive, collapsible soils, shallow groundwater, and slope stability. Flooding requirements include providing adequate drainage on a site and prohibiting new construction from blocking or diverting natural drainages.

General Plan

The Washington County General Plan (Amended August 2012) classifies open space areas, which include public lands, drainage channels and washes, unstable soils, reservoirs, steep slopes, etc. In terms of open space land preservation, the County General Plan provides as a goal, "Identify open space areas…and provide protection from development in the areas identifies. Areas that may be hazardous in nature and are of an open space character should be maintained as open space in order to protect the health, safety, and welfare of the present and future residents…" Growth as it relates to natural hazard conflicts is further managed through implementation of policy statements which: disallow development within identified FEMA 100-year floodplains; implementing greater setbacks from major washes, streams, and drainage channels; encourage public lands to incorporate a buffer zone between private and public lands; and, incorporation of wildfire protection measures.

Vision Dixie

The Vision Dixie planning process identified how residents in the County and stakeholders would like to see Washington County grow and change in the coming years. One of the goals identified in the Vision Dixie planning process was to protect the land and features that bring character to communities. Communities do this through ordinances protecting and setting standards for development on or near hillsides, ridges, and steep slopes. Communities are recommended to map and set ordinances to protect this community interest. Other recommendations identified in this process include the use of subdivision requirements and site improvement standards, which require certain construction on a site to protect from flooding, prevent poor air and water quality, and to supply adequate drainage, parking, and sidewalk standards for users.

Critical Lands Plan

A Critical Lands Resource Guide was developed to supplement and provide definitions for the Vision Dixie planning process. The resource guide defined critical lands to preserve to protect life and safety, recreation and open space, and the survival of plant and animal species. This guide identifies that economic growth should locate in areas to avoid threat from critical land hazards like landslides and floods. Communities can gain more information about critical lands through mapping and including critical lands in development reviews.

Washington County has demonstrated an awareness to and dedication to mitigating natural hazards through their existing plans and policies. The County has staff capacity and personnel who address natural hazards through their planning, building, public works, GIS, and emergency services departments. The County capabilities and characteristics complement the natural hazard data and described in the Hazard Identification chapter of this document to make up the Hazard Risk Assessment for Washington County.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for Washington County, Utah. This assessment describes the natural hazards considered in this plan which pose risks to Washington County. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 329 below, summarizes the natural hazards in a list from High to low hazard risk as it pertains to unincorporated Washington County.

Table 329: Washington County Hazard Risks

HAZARD	RISK
SEVERE WEATHER	1- High
DROUGHT	2- High
WILDFIRE	3- High
FLOOD	4- Moderate
EARTHQUAKE	5- Moderate
LANDSLIDE	6- Moderate
RADON	7- Low
PROBLEM SOILS	8- Low

The remainder of this section will describe each hazard in greater detail and the variables that contributed to the risk ranking. The section will conclude with a mitigation strategy based on Washington County's risk assessment.

Wildfire

Washington County has experienced many fires, both human and naturally caused. The county is marked by low elevation, dry desert and alpine desert geographies, presenting some risk. Several organizations respond to wildfires in Utah, including the Forest Service, Bureau of Land Management, National Parks Service, and County fire departments. These agencies coordinate and report active fires on the Utah Fire Info website, which informs community members of the mitigation activities and active wildfires in an area.

Table 330 describes the wildfires in Washington County that have received FEMA Fire Management Assistance Declarations. These assistance grants provide matching funds to assist in fire control and suppression.

Table 330: FEMA Fire Mitigation Assistance Grant Designations

Fire Name	Year	Acres Burned	Other Impacts
Veyo West Fire (FM-5321-UT)	2020	2,618	Two-homes destroyed, and 800 homes were threatened.
Saddle Fire (FM-5130-UT)	2016	2,300	A lightning caused fire caused evacuation of 100 homes and threatened hundreds of residents. Estimated cost of $14.2 million with a fire that burned for two months.
Utah Mill Flat Fire (FM-2831-UT)	2009	12,600	Destruction and damage to homes and mandatory evacuations of 170 residents.
Utah Blue Springs Fire (FM-2564-UT)	2005	12,000	Closed Interstate 15 Southbound lanes. 375 homes were threatened, and 1200 people were evacuated. Three outbuildings and 14 power poles were burned, causing some power outages. Cost of the fire is estimated at $3.3 million.
Utah Brookside Fire (FM-2521-UT)	2004	Unknown	500 homes were threatened.

Source: FEMA Region 8 Fire Management Assistance Grant (FMAG), ABC 4 News "Saddle Fire to Cost Taxpayers 14 Million", Wildfire Today "District Ranger about escaped resource benefit fire: 'We just felt helpless and sick'", Salt Lake Tribune "Mill Flat Fire roaring out of control", KSL "Blue Springs Fire Contained".

Most fires in Washington County have been addressed by BLM, forest service or other entities. These fires are documented on the Utah Wildfire Info website going back to 2017. The fires that have impacted Washington County are listed in Table 331.

Table 331: Washington County Fire History

Fire Name	Year	Acres Burned	Description
Turkey Farm Road	2020	11,993	Human caused by fireworks. Suppression costs exceeded $2.5 million.
Veyo Road	2020	2,263	Human Caused fire that burned 9 power poles, causing outages for more than 500 customers.
Cottonwood Trail	2020	1,600	Fire caused by a blown tire on a motor vehicle. Led to delays and detours from I-15 and damage to nearby trailheads.
West Valley	2018	11,716	Fire caused by an abandoned campfire.
Jarvis Fire	2006	50,697	A human caused fire which exceeded $1 million to fight.
Bull Complex	2006	43,571	Fire started by lightning strikes on June 27 and burned mostly pinyon, juniper and grass near Motoqua.
Kolob	2006	17,632	The largest wildfire in Zion National Park in recorded history, burning 10,516 in the park and was human caused.
Westside	2005	66,900	Caused evacuations in the town of Gunlock.
Duzak	2005	19,295	Duzak fire burned a total 590,440 acres between Nevada and Utah. Impacts and evacuations in Motoqua, Utah.
Hawkins	2004	35,427	Fire near Enterprise was started by lightning.
Square	2004	17,146	The Square fire complex fire cost approximately $1.5 million to suppress.
Apex	2003	29,930	A human ignition fire that cost approximately $4.3 million and impacted culturally significant areas of the Shivwits Reservation.

Source: Utah Wildfire Info, St. George News "Veyo Road Fire spreads to 2,260 acres overnight; 9 power poles destroyed in blaze", St. George News "Few losses, no casualties reported while battling 4 fires thanks to coordinated firefighting efforts", Get Gephardt Daily "Update: Growth on West Valley Fire slows; remains 55% contained", Deseret News "Ten Charged for southern Utah wildfire", Deseret News "Crews mopping up on Bull complex of fires", KSL "Bull Complex Fire Expected to Be Contained Friday", National Parks Service "ZNP fire management fire factsheet", Salt Lake Tribune "New wildfire bears down on southern

Utah town", Las Vegas Sun "Goodsprings fire contained, others fanned by winds", Las Vegas Sun "Firefighters gaining ground on Duzak fire", KSL "Hawkins Fire is 15% Contained", Deseret News "Dixie's Square Fires are fully contained", KSL "Families of Boys Who Started Apex Fire to Pay $390,000".

Many of fires in Washington County are human caused. In 2020, of the County's 160 wildfires, 133 are attributed to human causes, including the Turkey Road Fire, which makes up more than 50% of the acres burned in that year. (Utah Wildfire Info, 2020) Fires from natural causes were most often triggered by lightning strike.

Figure 305 describes the relative risk of wildfire in the county, which considers the fuel types, land uses, and density metrics to set a risk level for an area. Based on this assessment, municipalities and the area directly surrounding larger or more dense cities and towns have a heightened risk to wildfire as population centers could be impacted. Other areas that are at risk to wildfire in the county include much of the northern and eastern portions of the county.

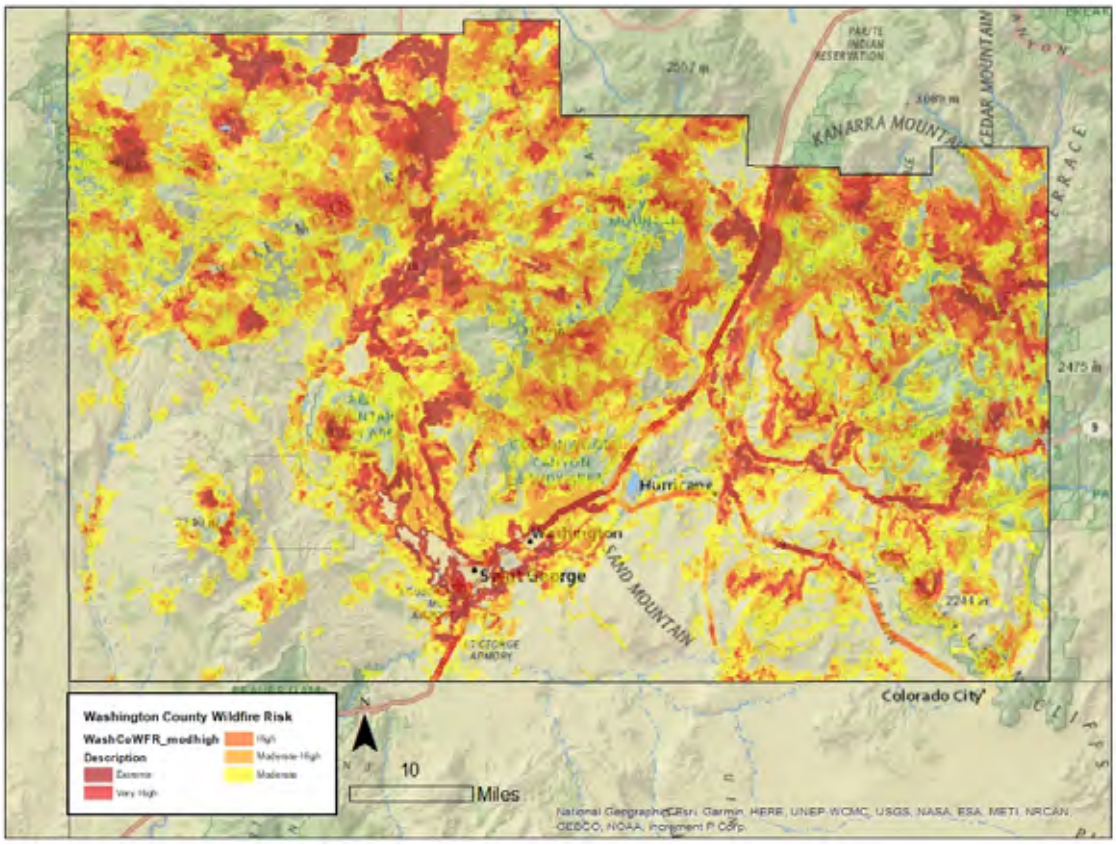


Figure 305: Washington County Wildfire Risk

Source: Oregon Department of Forestry

Table 332 includes an assessment of the unincorporated county exposure of assets to the wildfire risk areas identified in figure 13. Looking to this table, we understand what assets in the county are at risk to wildfire. Table 5 describes that nearly all residential parcels in Washington county are at risk to wildfire and 75.6% of roadways are at risk. Critical facilities, including fire, police, and medical facilities, and schools are at risk to wildfires with near 87.7% exposed to areas considered moderate to high wildfire risk. The number of current residential parcels in the county indicate that there is a high risk to

residential parcels. This is likely to increase as the county population grows and more people locate in wildland urban interface areas.

Table 332: Washington County Wildfire Exposure

Washington County Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
87.7%	45.9%	97.9%	92.0%	75.6%	N/A	N/A

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and can blow into watershed areas, impacting water quality for a region. Much of the higher elevations of Washington County, outside of urban areas, contribute to the Forest, Riparian, and Drinking Water assets for the area, increasing the relative risk to these areas.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate change conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, flash flooding, and landslides are all hazards that Washington County is at risk to and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Washington County has four main quaternary faults described in Figure 306. While earthquakes are frequent in the region, these are typically low magnitude earthquakes that do not cause impacts. Since pioneer settlement there have been two earthquakes with a greater magnitude than 5.0.

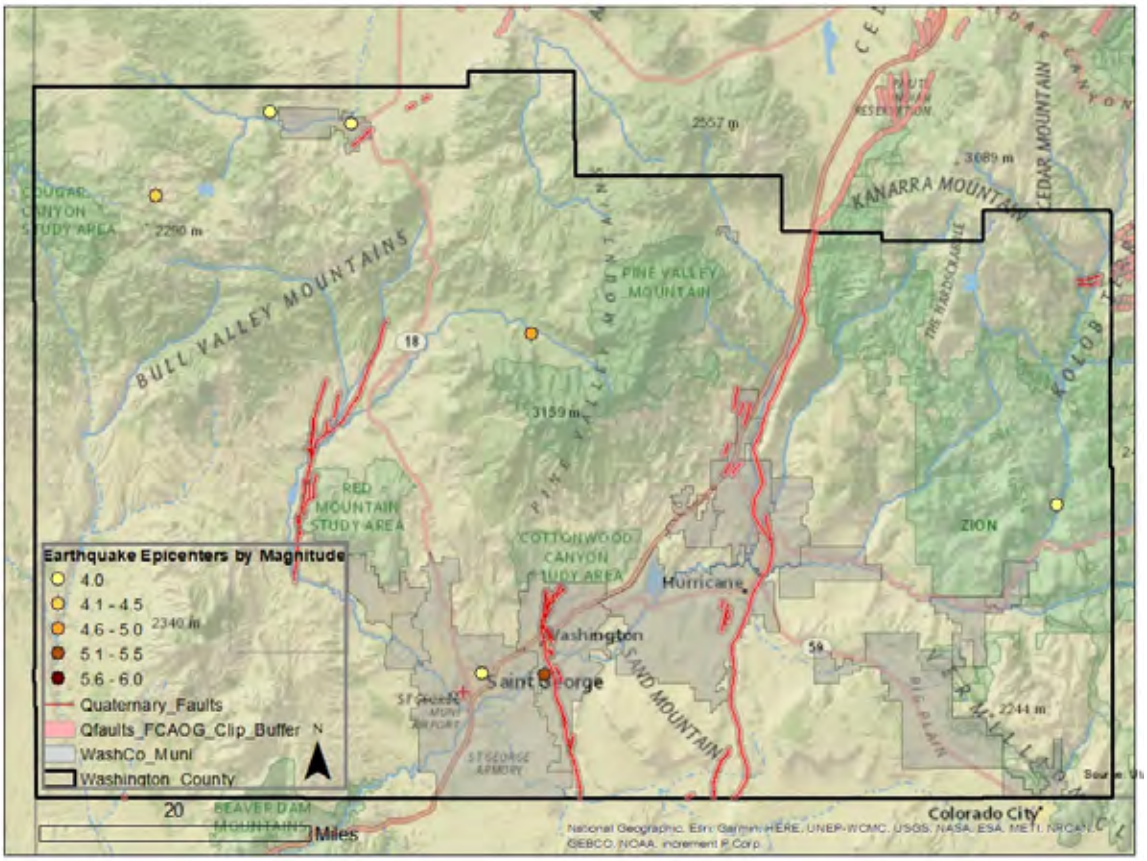


Figure 306: Washington County Quaternary Faults and Earthquake Epicenters

The Five County Association of Governments completed an assessment of the number of community assets that are within a quarter mile of a quaternary faulty, illustrated in Table 333. The unincorporated county has very little overlap with infrastructure or parcels and the quaternary faults. Despite the limited exposure to quaternary faults, the county is still at risk to earthquake events, as ground shaking can be experienced miles from the epicenter. This shaking can cause damage and trigger other hazards throughout the impacted area.

Table 333: Washington County Exposure within a quarter mile of Quaternary Fault

Washington County Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	1.6%	2.2%	2.2%	1.1%	N/A	N/A

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with impact potential increasing as the magnitude continues to increase. In the region, the Hurricane fault has the potential to cause up to a 7.0 magnitude earthquake. High magnitude earthquakes are less frequent and an average of 18 are recorded globally each year.

Table 334 shows the ten recorded earthquake events with a magnitude of 4.0 or greater in Washington County, with the largest event being a 6.34 magnitude event in 1902. A 1992 event with an epicenter in Washington City and a magnitude of 5.6 impacted multiple municipalities in the south end of the county. This earthquake damaged structures throughout the county and triggered other hazards, including a landslide event near Springdale which destroyed three homes. This earthquake was caused by the Hurricane Fault. (Wayman, 2016)

Table 334: Washington County Earthquake History

Incident Date	Location	Magnitude
1881	Enterprise	4.05
1891	St. George	4.81
1902	Washington County	6.34
1902	Washington County	4.81
1903	St. George	4.05
1914	Enterprise	4.05
1920	St. George	4.05
1936	Washington County	4.05
1992	Washington City	5.93
2016	Enterprise, Washington County	4.35

Source: University of Utah Seismology

Several structures in Washington County are at risk to earthquake due to the type of construction that they have. Seismic code was adopted and enforced by the state of Utah beginning in 1975. Structures built before that are typically unreinforced masonry and do not perform as effectively during a shaking event. This construction type can topple during shaking and damage property and people in and outside of the structure.

Liquefaction

The Utah Geologic Survey has also published mapping of liquefaction hazards, which can occur as a result of strong ground shaking during an earthquake. This mapping is limited in scope and has not been

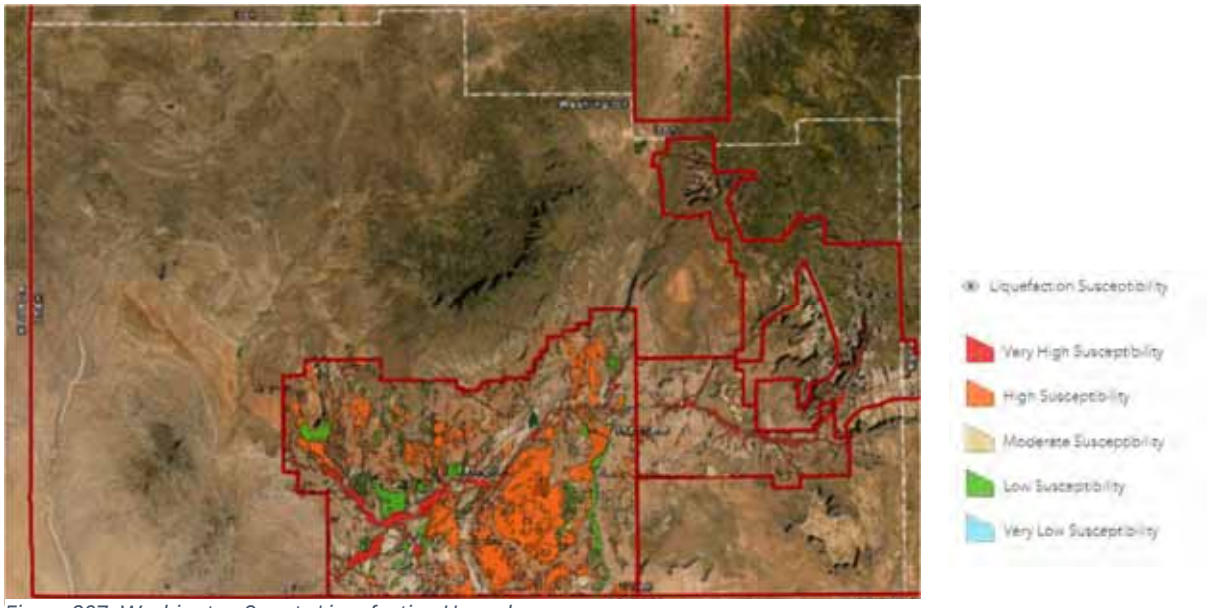


Figure 307: Washington County Liquefaction Hazard

completed for the entire County. Mapped areas are outlined in red. Figure 307 shows that very high liquefaction susceptibility can be observed along riparian areas of the Virgin River, Santa Clara River, and La Verkin Creek. The base of the Hurricane cliffs also shows a high risk of liquefaction. High susceptibility is mapped north of St. George and in the Washington City/Hurricane areas. In these zones, strong shaking events can cause the soil and rock to lose their integrity and become fluid. Liquefaction is a primary concern near built environments as it can damage structures and infrastructure as the ground and rock move.

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Problem Soils

Problem soils are a problem for construction and development in Washington County. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas. The County has requirements for development to address problem soils using geologic assessments pre-construction to mitigate and avoid adverse effects on properties. Washington County code prohibits development on areas with expansive soils. New developments applications will be reviewed to ensure that they address expansive soils among other hazards in the application. The code details that an investigation must include conclusions and recommendations concerning the effects that soil conditions at a site may have on foundation and structural stability and includes shrinking or swelling of soil potential.

Five County used Problem Soil Susceptibility data that describes the extent of problem soils for some additional portions of the county, primarily the southwest and north eastern areas of the county. Figure 308 maps the data available and Table 335 shows the exposure of Washington county assets, infrastructure, and parcels to problem soils. Expansive Soils and Limestone or Karst Features are prevalent in the Unincorporated County. There are presently a small percentage of parcels and 15% of road miles located in mapped problem soil areas. Problem soils can create some challenges for structural integrity as changes in weather and soil moisture change, which in some cases can lead to soil expansion or collapse.

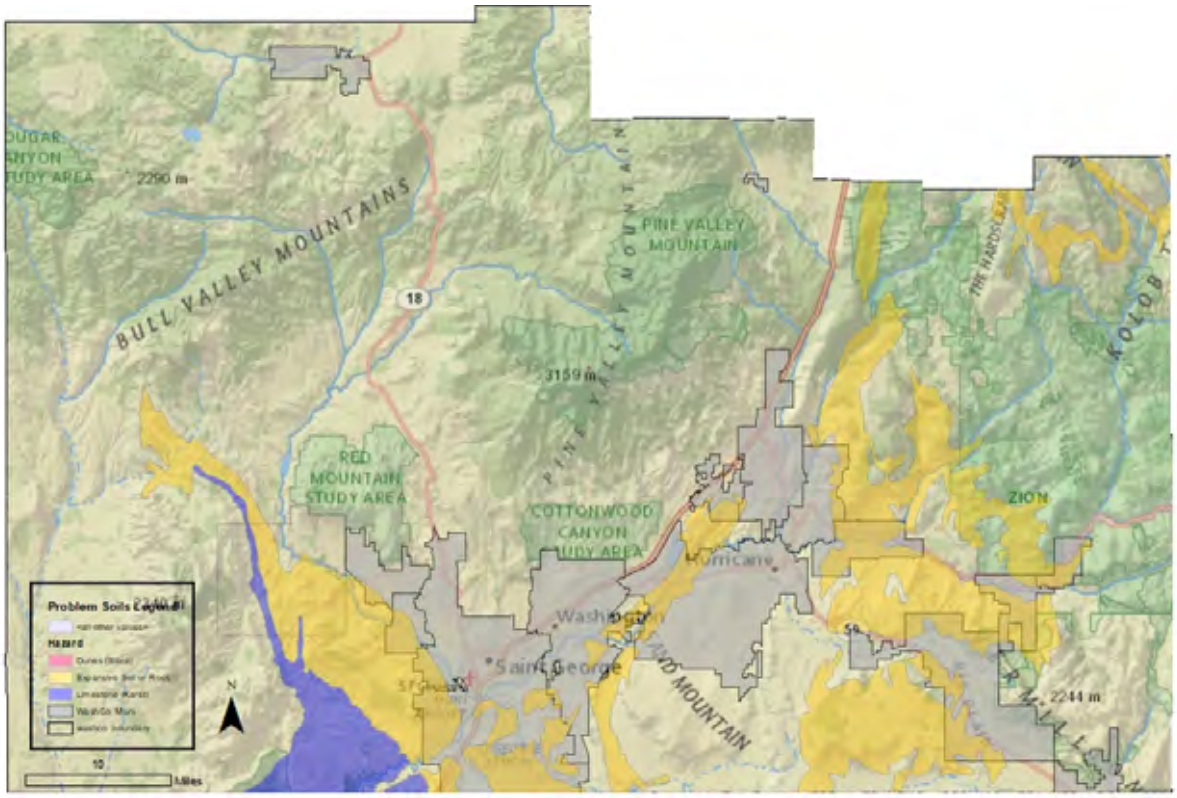


Figure 308: Washington County Problem Soils Mapping

Table 335: Washington County Exposure to Problem Soils

Washington County Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	7.6%	2.6%	2.8%	15.0%	N/A	N/A

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region. This data is limited in its scope and only includes the areas around the St. George Metropolitan Area to Zion National Park. Washington County could benefit from problem soil mapping susceptibility mapping for the unmapped portions of the county. Considering the extent of various problem soils in the newly completed mapping, it is likely that the rest of the county has a greater exposure of problem soils than current estimates and there are some problem soils that are in the new mapping that are not included in older mapping files.

Landslide

Washington County is marked by desert cliffsides and mountainous regions. The geology in this area is a unique meeting of the Mojave Desert and Colorado Plateau. The unique landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Some of the geology in the area is notably formed by landslide events. Zion National Park, for example has features that point to historic landslides as formative to the current landscape. There have been several landslides countywide since pioneer settlement in the area.

Table 336 describes the historic events in Washington County. This list does include impacts within municipal areas.

Table 336: Washington County Landslide Events

Incident Date	Location	Description
1915	St. George, Washington County	Human caused landslide in St. George and Cottonwood Canal.
1920	Washington County	Debris flow at Zion National Park.
1930	Black Ridge/Kane & Washington County	Landslide near Black Ridge.
	Washington County	Debris flow at Andersen Ranch in Zion National Park.
1941	Washington County	Landslide at Zion National Park.
1953	Grafton, Washington County	Debris flow near Grafton.
1954	Hurricane, Washington County	Debris flow near Hurricane.
1955	Rockville, Washington County	Debris flow near Rockville.
1983	Washington County	NCDC Landslide.
1984	Washington County	Landslides in Washington County.
2005	Washington County	A series of landslides in Zion National Park, with a slide covering a portion of Kolob Canyon Road at the North end of the Park.
2010	Rockville, Washington County	A rock weighing approximately 450 tons rolled downslope, shattering into smaller rocks, damaging outbuildings, 2 vehicles, and a home.
2011	Washington County	Landslide in Washington County.
2013	Rockville, Washington County	A large rock fell from the cliff and rolled downslope, hitting a home, garage, and vehicle. Two residents were killed.

Figure 309 describes the landslide and rockfall areas considered to have moderate or greater risk in the county, which covers much of the land in the Bull Valley Mountains, Pine Valley Mountains, Zion National Park and nearby mesas and cliffsides.

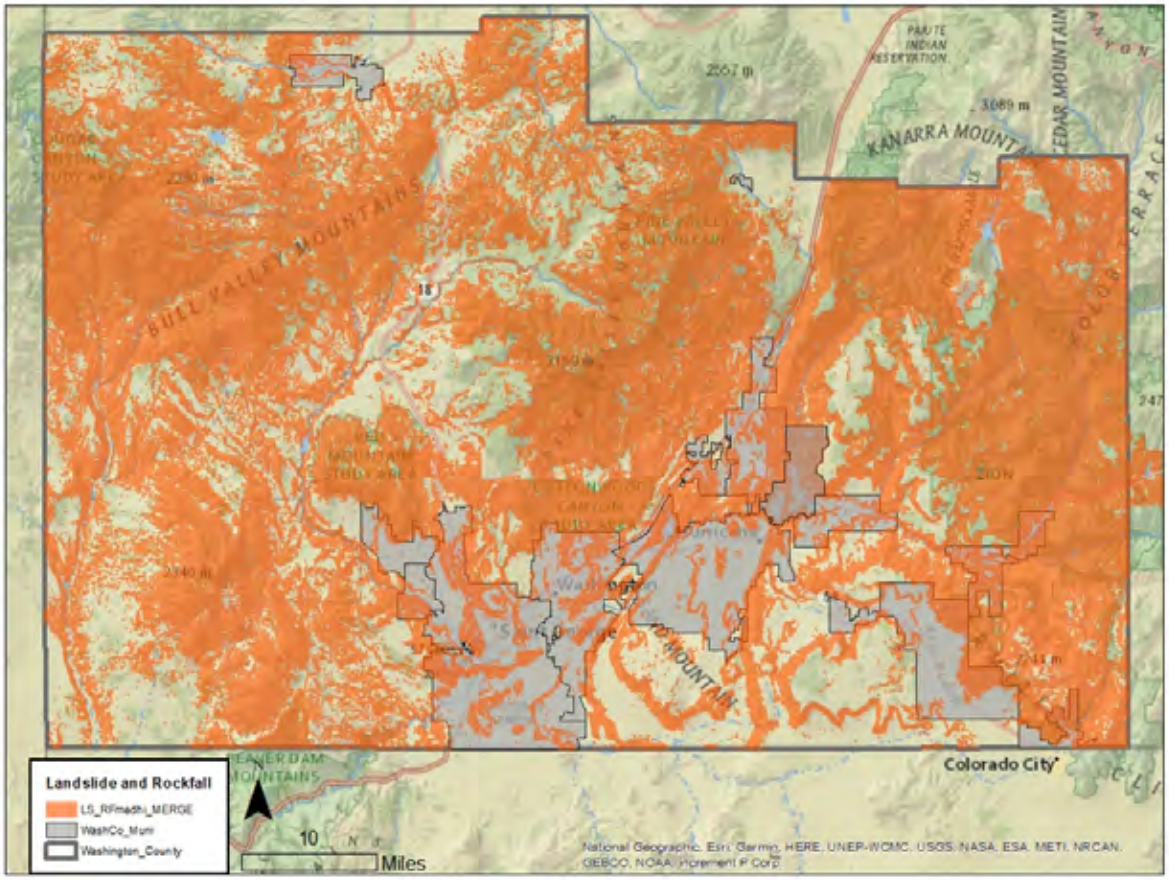


Figure 309: Washington County Landslide Susceptibility

Table 337 illustrates that roads are the most at-risk asset to landslides in Washington County, with 66.0% of road miles in the unincorporated county in a moderate to high landslide susceptible areas. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace. The 21.3% of parcels exposed to landslide and rockfall hazards can result in damage to structures, deaths, and injury among the users or residents of these spaces.

Table 337: Washington County Exposure to Landslide Susceptible Areas

Washington County Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	18.4%	21.4%	21.3%	66.0%	N/A	N/A

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences flooding often as a result of severe weather, which causes flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over the sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be detrimental to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses.

In addition to the resident population, Washington County has significant outdoor and recreation assets that provide additional vulnerability. There have been record visitors to the area for attractions such as Zion National Park, and several large functions throughout the county that draw large crowds. Certain natural hazard events exacerbate stresses caused by surges in visitation, especially for visitors who are unfamiliar with weather and geologic conditions in the desert. Throughout the region's history there have been reports of stranded hikers and travelers due to severe storms, flash flooding, debris flow, and other natural events.

There have been several damaging flooding events in Washington County, that have impacted lives and property throughout the county. Table 338 describes the total estimated losses in life, injuries, and property and crop damages in events from 1996 to present. For comparison, we have included an assessment of both countywide totals and unincorporated county totals.

Table 338: Washington County Summary of Flood Impacts

Washington County Flooding Impacts				
	Deaths	Injuries	Property Damage	Crop Damage
Countywide	26	25	$ 344,815,000	$ 42,200
Unincorporated County	25	11	$ 327,405,000	$ 32,200

Source: NOAA Storm Database

There have been approximately 37 flooding events that have caused damages or losses the unincorporated County since 1996, with a total of over 200 events reported countywide by NOAA during that timeframe. This includes a January 2005 event, which caused $300,000,000 in property damages—the costliest flooding event recorded for the County. Washington County also has experienced Utah's most deadly flash flooding event, reported in Hildale and Zion National Park in 2013 which killed 20 people. (Smith, Floods: Utah's deadliest natural disaster, 2020)

Flood Mapping

Flood maps are completed by FEMA and used for local regulations of construction in observed flood risk areas. These maps provide important information about the likelihood of a flood happening in each area. Figure 310 describes the 100-year floodplain, and the dam inundation zone for the County.

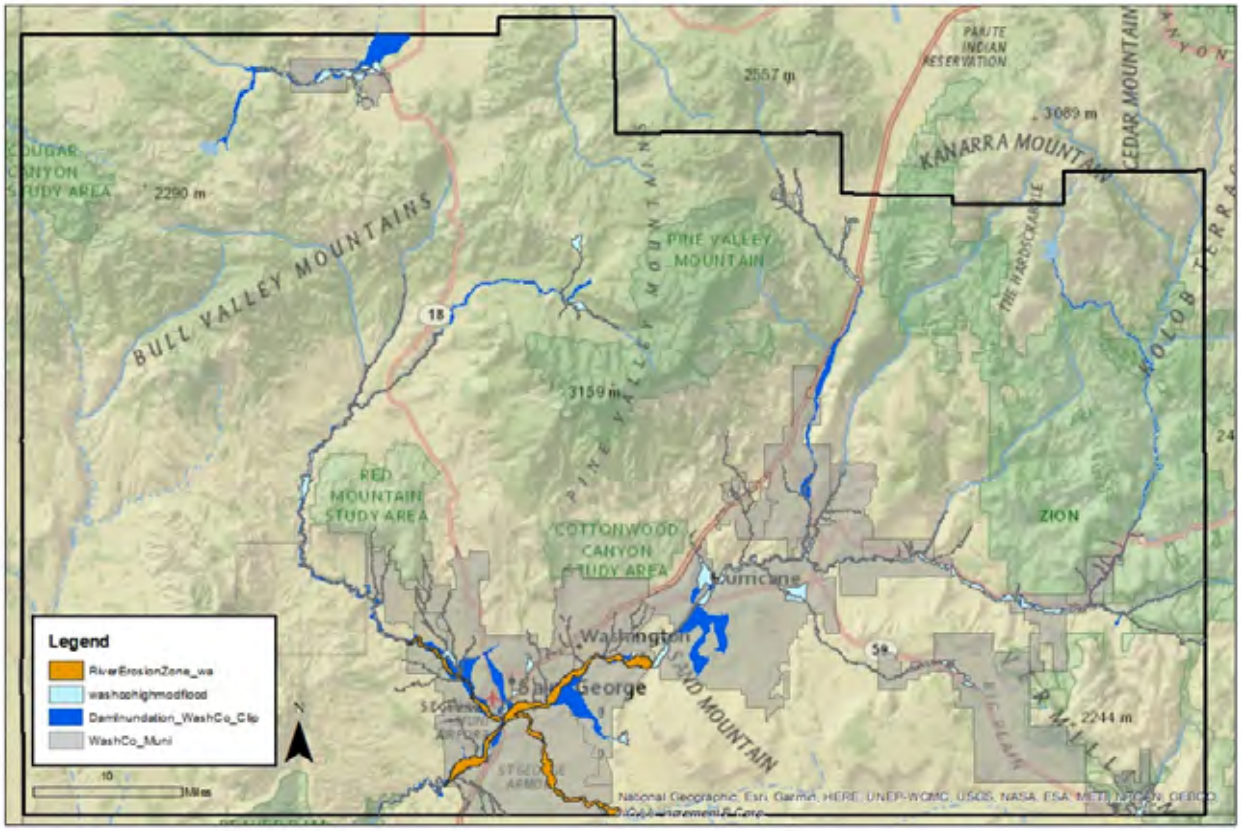


Figure 310: Washington County Floodplain and Dam Inundation Zones

For the purpose of this analysis, the Five County Association of Governments merged Dam Inundation areas with floodplains to understand the total assets that could be at risk within a mapped flood area. Table 339 shows the combined exposure to the floodplain and dam inundation zones in the unincorporated county.

Table 339: Washington County Exposure to Floodplain and Dam Inundation Zones

Washington County Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	County Parks
	Commercial	Residential	Total			
0.0%	9.7%	9.1%	9.1%	7.7%	N/A	N/A

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Washington County structures outside of the mapped zones are not free of flooding risk. It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020)

Washington County participates in the NFIP and had the most recent Flood Insurance Rate Maps were developed for the community in 2009. Table 340 describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. There are two properties that are considered repetitive loss in the County, meaning they have flooded and made a claim through their flood insurance on two occasions.

Table 340: Washington County NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$24,889	0	5	51	$16,563,500	14	$191,937

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Washington County does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Soil Erosion

The soil erosion zone is mapped for Washington City, St. George, Santa Clara, and some unincorporated areas near these municipalities. Erosion zone intended to reduce damages due to erosion during flooding and uses similar data as the FEMA 100-year floodplain, according to the River Sustainability Study. This study was completed following 2005 flooding which caused significant erosion damages to community assets, property, and open space. (JE Fuller Hydrology and Geomorphology, Inc. , 2005) These zones are based on the geomorphic, historical, quantitative, and engineered structures analysis to develop the erosion zone.

Five County performed the same assessment on Soil Erosion to understand the interaction of certain assets and features of the community's interaction with the erosion zone. Only one residential parcel and 0.1% of road miles in the unincorporated county falls in the mapped erosion zone. Given the limited scope of the available mapped data, soil erosion may pose additional risks elsewhere in the county.

Severe Weather

There have been 56 severe storm events which resulted in injury, loss of life, or property and crop damages across Washington County. Table 341 summarizes the impacts and losses experienced from severe weather events that impacted the region and county. While this list seeks to narrow to a Washington County representation of impacts, given the widespread and often regional impact of weather, some natural events may have had injuries, deaths, or damage in other counties.

Table 341: Washington County Summary of Severe Weather Impacts

Severe Weather Type	Injuries	Death	Property Damage	Crop Damage
Cold/wind Chill	0	0	$ 20,000	$ 100,000
Hail	0	0	$ 2,000	$ 3,000
Heat	0	4	$ -	$ -
Heavy Rain	0	0	$ 2,000	$ -
Heavy Snow	1	0	$ 20,000	$ 4,000
High Wind	10	0	$ 1,294,000	$ 212,200
Lightning	2	0	$ 410,000	$ -

Strong Wind	0	0	$ 1,000	$ -
Thunderstorm Wind	0	0	$ 171,000	$ 25,000
Tornado	0	0	$ 30	$ -
Winter Storm	10	0	$ 767,000	$ 5,000
Grand Total	**23**	**4**	**$ 2,687,030**	**$ 349,200**

Source: NOAA, accessed July 30, 2020.

High winds and winter storms have caused the most injuries and property damages. The impacts from these events include damage and destruction to homes, roofs, garages, trees, and crops due to wind gusts of over 70 miles per hour during some events.

Severe weather events can trigger cascading hazards, including flash flooding, wildfire, landslides or debris flow. These hazard events can compound losses or damage experienced from the initial severe weather event. Given the existing risk to Washington County from these hazards, understanding the potential for triggering other events can help to plan for and mitigate such events. One hazard is the relationship between flooding and severe weather events. Flash flooding is common and dangerous in the southwest and is often the result of precipitation. In some cases, a storm can be miles away from the location of the flash flooding incident.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

The Utah Geologic Survey drafted a summary document of Washington County's radon risk indicated that soil derived from the shale and granite from the Pine Valley Mountain formations has the greatest potential for high levels of indoor radon. (Solomon, 1996) This soil type is common in locations south of St. George.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality reported on radon tests by county for that year. Table 342 describes that out of 797 tests completed in Washington County, just over 11% fall in the greater than 4

Pci/L which requires mitigation to live or work in a structure safely. There is not data to indicate whether these tests are for residential or other uses.

Table 342: Washington County Radon Testing Results 2019

Washington County 2019 Radon Testing Results from short-term tests				
<4 pCi/L	>=4 pCi/L	Max. pCi/L	Avg. pCi/L	# of Tests
88.3%	11.7%	31.9	2.2	797

Drought

The Five County Region has experienced 7 periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe weather. The Virgin River watershed is identified as a drought prone water source, according to the Washington County Water Conservation District.

Monitoring drought generally occurs across several climate division. Washington County lies in the Dixie division, which includes only southwestern Washington County. Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Mitigation strategy & actions

Washington County participated in the 2016 iteration of the Five County Association of Governments Natural Hazard Mitigation Plan process. In this plan they identified several actions to address the hazard risks in the community. This mitigation strategy has been summarized in Table 343, with a column identifying progress on action.

Table 343: Washington County 2016 Mitigation Strategy

Strategy	Objective	Action	Timeline	Funding Source	Progress
Problem Soils #1	Lessen the risk to buildings from problem soils.	Address problem soils at the building/construction level by requiring all	Ongoing	Private funds/ developer; Local government operating budget;	Unknown

		subdivision proposals to have a geotechnical report.		Utah Geologic Survey operating budget.	
Problem Soils #2	Lessen the risk to buildings from collapsible and expansive soils.	Through mapping, identify areas which contain collapsible and expansive soils. Require soils testing at the building/construction level and ensure that engineer's recommendations are followed.	Ongoing	Private funds/ developer; Local government operating budget.	Unknown
Landslide #1	Increase the level of knowledge related to landslides.	Increase public education related to landslide hazards by distributing Utah Geological Survey (UGS) landslide informational brochures to local municipality level emergency management, engineering and planning departments.	Ongoing	Local, jurisdictional level.	Unknown
Landslide #2	To reduce landslide risk as it relates to the built environment.	Address landslide risk at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Unknown
Landslide #3	To reduce landslide risk as it relates to the built environment.	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Unknown

Landslide #4	To reduce landslide risk as it relates to the built environment.	Drafting/updating zoning and/or landslide ordinances to prevent development of structures near debris flows, landslides, and rock fall areas.	Minimal	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Unknown
Landslide #5	Prevent damage to structures from rock fall in unincorporated areas of Washington County.	Adopt zoning regulations to prevent development of structures in identified rock fall or geologically unstable areas to minimize losses in the unincorporated areas of Washington County.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Unknown
Wildfire #1	Promote public awareness campaign for property owners living in Wildland-Urban Interface areas; Adhere to the Wildland-Urban Interface Code	Mailings; Printed Information; Public Service Announcements; Social Media; Building code inspections.	Ongoing	State and Federal wildfire grant programs	Washington County Emergency Services employs a Wildfire Specialist that works to organize and distribute information to Washington County citizens. Working with State and Federal partners to enforce the WUI Code.
Wildfire #2	Fuels reduction.	Continue interagency fuel treatments that are adjacent to and within communities at risk.	All ongoing	Local government operating budget; Special Service District operating budget; private property owner	Working with local, state and federal partners to identify and address urban interface locations and initiate fuel reduction projects. Ongoing

Wildfire #3	Fuels reduction.	Develop cheatgrass focus areas, to include fire tolerant vegetation and strategic fuel breaks to protect communities at risk.	All ongoing	Local government operating budget; Special Service District operating budget; private property owner	Working with local, state and federal partners to identify and address urban interface locations and initiate fuel reduction projects. Ongoing
Wildfire #4	Fuels reduction.	Encourage landowner mitigation and defensible space work.	All ongoing	Local government operating budget; Special Service District operating budget; private property owner	Unknown
Wildfire #5	Fuels reduction.	Increase fuels reduction (mowing, fuel breaks/green stripping) along major highways to decrease fire starts off the interstate.	All ongoing	Local government operating budget; Special Service District operating budget; private property owner	Working with local, state and federal partners to identify and address urban interface locations and initiate fuel reduction projects. Ongoing
Wildfire #6	Develop and update the existing community fire plans	Look for funding and interest among the communities to update their plans.	Unknown	Local government operating budget; Special Service District operating budget; private property owner	Developed a Community Wildfire Handbook to assist local communities in developing wildfire community councils.
Wildfire #7	Provide early warning for wildfire in the Kolob Mountain area.	Develop and provide an early warning system for the Kolob Mountain area for use in wildland fire emergencies.	This is a long-term strategy with undetermined timelines.	Local private and government funding, state and federal grant funds as available.	Unknown

Wildfire #8	Provide early warning for wildfire in the Pinto area.	Develop and provide an early warning system for the Pinto area for use in wildland fire emergencies.	This is a long-term strategy with undetermined timelines.	Local private and government funding, state and federal grant funds as available.	Unknown
Wildfire #9	Reduce the potential of the threat to life and property from wildland fires.	Develop, enhance and maintain firebreaks around the unincorporated communities in the Wildland-Urban Interface throughout Washington County.	This is a long-term strategy with undetermined time lines.	Local private and government funding, state and federal grant funds as available.	Working with local, state and federal partners to identify and address urban interface locations and initiate fuel reduction projects. Ongoing.
Flood #1	Minimize future flood damage in the unincorporated County.	Implement zoning to prevent development of structures near all rivers, creeks, lakes and dry washes	Ongoing	Local government operating budget; State and Federal flood and planning grant programs	Unknown
Flood #2	To reduce flooding risk as it relates to the built environment.	Address flood control at the building/construction level by requiring all subdivision proposals to have a storm water drainage system.	Ongoing	Private funds/ developer.	Unknown
Flood #3	To reduce flooding risk at the community level.	Clear debris and other material from all waterways.	Ongoing	Related public/private property owners.	Ongoing monitoring and maintenance of waterways.
Flood #4	Minimize future flood damage in Dammeron Valley area of Washington County.	Provide flood channel modification to redirect flooding along State Road 18 to historic washes away from residences (Dammeron Valley area of Unincorporated County.	Unknown	Local government operating budget; State and Federal flood grant programs	Channel and drainage work completed in the Dammeron Valley community by Washington County Public works. Washington County is working with

					NRCS on environmental requirements and design for the detention basin east of the community.
Flood #5	Minimize future flood damage in Diamond Valley area of unincorporated Washington County.	Remove debris and provide flood protective features along Rock Hollow Wash to prevent residential flooding.	Unknown	Local government operating budget; State and Federal flood grant programs	Debris has been removed. Washington County public works is working with NRCS to provide Erosion protection on the Rock Hollow wash and detention basin refurbishing.
Flood #6	Minimize future flood damage in Manganese area of Unincorporated Washington County.	Purchase isolated property to reserve as open space to resolve access problems during flood events. (Manganese area of Unincorporated Washington County)	Unknown	Local government operating budget; State and Federal flood grant programs	Not completed yet
Flood #7	Minimize future flood damage in Dixie Deer area of Unincorporated Washington County.	Modify flood channel away from residences to prevent flooding. (Dixie Deer area of Unincorporated Washington County).	Unknown	Local government operating budget; State and Federal flood grant programs	Drainage channel are routinely cleaned and maintained by WC Public Works.
Flood #8	Stabilize Santa Clara River for future flood events.	Provide grade stabilization to limit scouring near Dixie Drive Bridge and through Santa Clara City. (Washington County, St. George and Santa Clara City).	Unknown	Local government operating budget; State and Federal flood grant programs	Completed in cooperation with NRCS.

Flood #9	Stabilize grade of Santa Clara River to limit scouring.	Provide grade stabilization to limit scouring of the Santa Clara River near the Lower Gunlock Bridge. (Gunlock area of Unincorporated Washington County)	Unknown	Local government operating budget; State and Federal flood grant programs	Completed in Cooperation with NRCS.
Flood #10	Provide Flood protective features along Slaughter Creek in the Motoqua area of Unincorporated Washington County).	Provide Flood protective features along Slaughter Creek in the Motoqua area of Unincorporated Washington County).	Unknown	Local government operating budget; State and Federal flood grant programs	Erosion control completed by WC Public works.
Flood #11	Stabilize the Santa Clara River against future flooding events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Santa Clara River. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	This is a long-term strategy with undetermined times lines.	Local funding, state and federal grant funds as available.	Riverbank stabilization and hardening completed in cooperation with NRCS. Limiting Development is ongoing.
Flood #12	Stabilize the Slaughter Creek and Beaver Dam Wash against future flooding events.	Stabilize riverbanks and hardened bank structure and infrastructure along Slaughter Creek and Beaver Dam Wash. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts.	This is a long term strategy with undetermined time lines.	Local funding, state and federal grant funds as available.	Riverbank stabilization and hardening completed in cooperation with NRCS. Limiting Development is ongoing

Flood #13	Stabilize the Shoal Creek against future flooding events.	Stabilize riverbanks and hardened bank structure and infrastructure along Shoal Creek. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	This is a long-term strategy with undetermined time lines.	Local funding, state and federal grant funds as available.	Riverbank stabilization and hardening completed in cooperation with NRCS. Limiting Development is ongoing
Flood #14	Provide early warning of structure failure on the South Creek Dam to downstream residents on Rockville, Virgin, La Verkin, Hurricane, Washington, and St. George.	Develop and provide and early warning system for the South Creek Dam, located above Rockville, Utah	This is a long-term strategy with undetermined time lines.	Local private and government funding, state and federal grant funds as available.	Not yet completed
Flood #15	Improve flood plain management activities by exceeding the minimum Nation Flood Insurance Program standards. Decrease flood insurance Rates.	Each community will voluntarily participate in the FEMA Community Rating system which will help to keep communities safer, reduce flood insurance rates, and improve flood plain management activities.	Ongoing	Local, State, and Federal Funding Sources	Unknown
Earthquake #1	Promote building safety through non-structural improvements.	Increase public education related to earthquake hazards by distributing Utah Seismic Safety Commission informational brochures to County and City emergency management agencies.	Ongoing	County and City operating budget; Utah Seismic Safety Commission operating budget.	Unknown

Earthquake #2	To reduce earthquake risk as it relates to the built environment.	Continued dedication/vigilance in enforcing the seismic standards established in the International Building Code (IBC).	Ongoing	County or City government operating budget (where applicable).	Unknown
Earthquake #3	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #1: Utilize the Earthquake Map provided in this plan as a tool to assess earthquake risks as it relates to any building/subdivision proposals. If deemed necessary, jurisdiction should require the builder/developer to conduct a site-specific earthquake hazard identification/mapping study.	Ongoing	Private funds/ developer.	Unknown
Earthquake #4	To reduce earthquake losses by mapping and identifying earthquake hazard areas.	Action #2: At the County level, contract with Utah Geological Survey (UGS) to formally study/map earthquake hazard areas.	3 to 5 years	Local government operating budget; Utah Geologic Survey operating budget.	Unknown

Five County Association of Governments worked with the local planning team for Washington County to develop a mitigation strategy, using the identified risks in this plan as a starting point. Strategy development also referred to previous strategies to ensure that new actions continue progress already made toward risk reduction.

The Washington County planning team identified actions to include in the community mitigation strategy. Each action in Table 344 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 311.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 311: Regional Plan Goals

Table 344: Washington County 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2, 6	Remove and replace unused turf at county owned facilities.	Assess County owned facilities and replace unused turf landscaping with drought tolerant vegetation.	L	5-years	M	Washington County, State of Utah,	Washington County
Severe Weather #1	1, 3, 4	Public health and connecting residents and visitors to spaces which are climate controlled.	Develop & publish a list of public facilities which could be used as daytime cooling centers. List would be posted to the County EM Facebook page during severe heat events.	M	1-year, ongoing	L	Washington County	Washington County, cities, and towns.
Wildfire #1	1, 3, 5, 6	Inform and assist unincorporated communities in local level mitigation.	Develop a toolkit with wildfire mitigation information and practices. Distribute to unincorporated communities, encouraging the use of a wildfire committee or council. Assist council in facilitating fuels mitigation.	H	2-years, ongoing	M	Washington County	Washington County, Fire service districts.
Flood #1	2, 4	Maintain existing stormwater infrastructure in the County.	Assess detention basins and river crossings near Dammeron Valley and Gunlock for capacity. Where needed, repair or expand infrastructure.	M	Ongoing	L	Washington County Public Works.	Washington County Public Works.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	1, 3	Communicate landslide and rockfall risk to residents and property owners.	Prepare and distribute a pamphlet regarding landslide and rockfall risks. Start a public education campaign communicating landslide and rockfall risks to new property owners at the time of sale.	H	2-years, ongoing	L	Washington County Emergency Management, Utah Geological Survey	Washington County Emergency Management, local developers, and realtors
Landslide #2	1, 2, 6	Address landslide and flood risks on Virgin River.	Inventory bank stability and landslide risks on the Virgin River. Where identified, implement bank stabilization measures.	H	5-years	H	Washington County, NRCS, FEMA & Virgin Town.	Washington County & Virgin Town.
Earthquake #1	1, 2, 4	Coordinate with the Washington County School District to assess and provide structural/nonstructural retrofits in identified schools with suspected unreinforced Masonry.	Complete an assessment of Enterprise Elementary to determine the extent of URM and identify structural or nonstructural retrofit needs.	M	5-years	H	Washington County School District, Washington County, FEMA	Washington County & Washington County School District.
Earthquake #2	1, 2, 4	Coordinate with the Washington County School District to assess and provide structural/nonstructural retrofits in identified schools with suspected unreinforced Masonry.	Complete an assessment of Dixie High School ROTC building to determine the extent of URM and identify structural or nonstructural retrofit needs.	M	5-years	H	Washington County School District, Washington County, FEMA	Washington County & Washington County School District.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #3	1, 2, 4	Coordinate with the Washington County School District to assess and provide structural/nonstructural retrofits in identified schools with suspected unreinforced Masonry.	Complete an assessment of Springdale School to determine the extent of URM and identify structural or nonstructural retrofit needs.	M	5-years	H	Washington County School District, Washington County, FEMA	Washington County & Washington County School District.
Earthquake #4	1, 2	Assess county owned facilities for unreinforced masonry and structural/nonstructural retrofit needs.	Inventory County owned buildings built or have portions of the structure constructed before seismic code implementation.	M	5-years	M	Washington County	Washington County
Earthquake #5	1, 2	Assess county owned facilities for unreinforced masonry and structural/nonstructural retrofit needs.	Using inventory results, implement needed seismic retrofits to secure County facilities.	L	5-years	H	Washington County	Washington County
Earthquake #6	5	Maintain training, staff, and equipment to respond to an earthquake event.	Continue County and regional training, equipment, and education for emergency responders during earthquake events. Engage in regular trainings and equipment maintenance.	H	Ongoing	L	Washington County	Washington County
Earthquake #7	3	Inform residents of earthquake hazard, risks, and preparedness actions.	Provide earthquake preparedness and response public outreach on the County emergency management Facebook Page annually.	H	Ongoing	L	Washington County Emergency Mgmt.	Washington County Emergency Mgmt.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of Radon gas risk, testing availability, and mitigation options.	Develop a public education campaign for radon testing and mitigation in homes. Post information to the County emergency management Facebook page annually.	H	Ongoing	L	Washington County Emergency Mgmt.	Washington County Emergency Mgmt.
Problem Soils #1	1, 2	Use best practices and standards for development in areas exposed to geologic hazards.	Adopt a Geologic Hazard Ordinance.	M	2-years	L	Washington County Community Develop., Utah Geologic Survey	Washington County Community Development

Figure 312: Washington County 2022 NHMP Mitigation Strategy

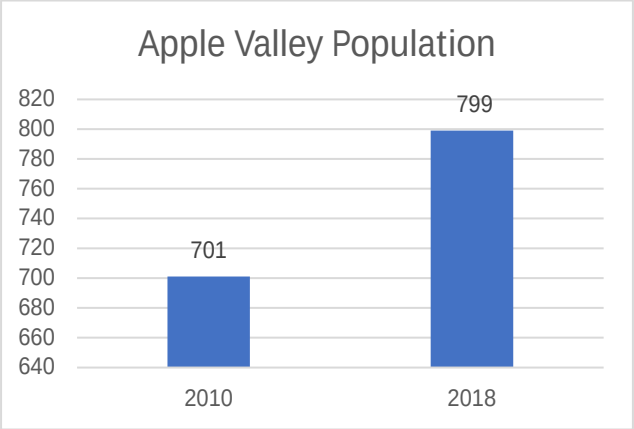
Apple Valley

Apple Valley, Utah is a rural southwestern community surrounded by red rock vistas. The community lies in a valley at the base of several mesas and buttes in the area. This community sees significant visitation from outdoor recreators and visitors. The community is located on SR-59 between Hildale and Hurricane Utah. People began moving to what is called "Big Plains" in the 1930s and Apple Valley was developed through a subdivision development in the 1980s. The area incorporated as a town in 2004.

Apple Valley is near Zion National Park but has its own nearby outdoor recreation and attraction for recreators. Several mesas and mountains draw hikers, mountain bikers, and off highway vehicles to the area for tourism.

Demographics

Apple Valley has a population of 799 people as of the 2018 American Community Survey, described in Figure 313. Records of Apple Valley's participation in the US Census are limited to the time since 2004 when they incorporated, thus only the 2010 census has been included with the 2018 ACS estimate to provide a more recent guess at the local population. The 2020 census is not yet available to include in this document. Comparing the 2010 census to the



2018 estimate, growth in population is approximately 13% between the years.

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Apple Valley, the community could see around 2,280 people living in the community in the next 45-years[17].

Economy

The area surrounding Apple Valley Town has a history of farming, ranching, and grazing. Figure 314 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool. Construction has become a large share of the jobs in Apple Valley, which may point to the rapid growth of the region. Retail trade and professional, scientific, and technical services are also industries that support several jobs in the area.

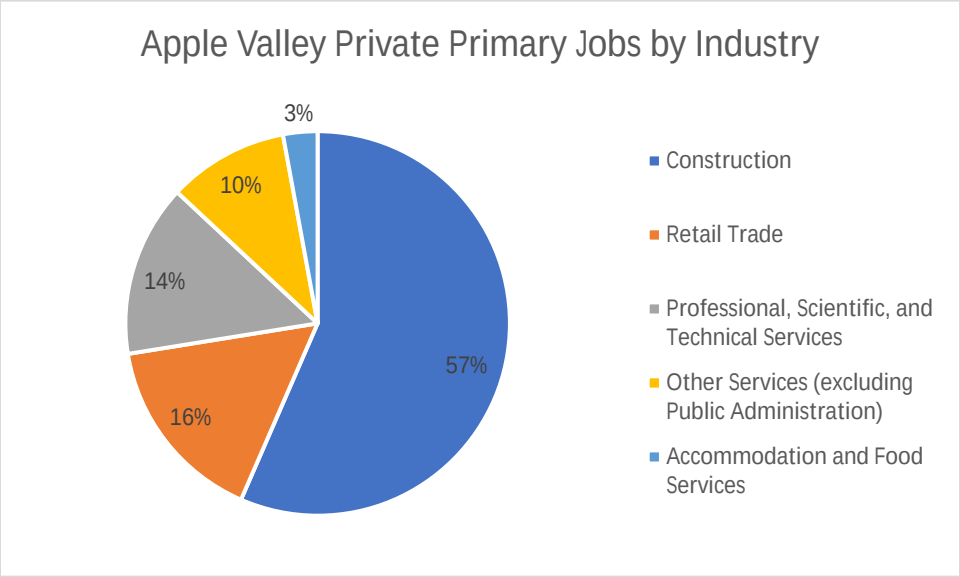


Figure 314: Apple Valley Share of Private Primary Jobs by Industry

Development

In the past several years, development in Apple Valley has been minimal, with single lots seeing new homes. The town is expecting to see subdivisions in the coming years.

Community Capabilities

Apple Valley first held elections for council, clerks, planning commission, and board of adjustments in 2005. The community is served by town staff which support the general operations of government. In 2005 Apple Valley became responsible for the town fire department. Apple Valley has supported a volunteer fire department since that time and has a fire station, which also holds the town office.

2011 Apple Valley created Big Plains Water and Sewer Special Service District, which merged the infrastructure from two water companies. The water system has seen several improvements over the

[17] This estimate is created using the 2015 ACS population estimate for Apple Valley, which was 996, and adding 229% of this population estimate to the population for that year.

years, and there are planned projects in Apple Valley to secure water for residential and commercial use in the community. Other utilities are provided to Apple Valley by private companies.

Washington County provides law enforcement to Apple Valley through the Sheriff's office. Emergency Medical Services (EMS) is also provided through the County.

Plans and Policies

Apple Valley has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. This section provides an overview of Apple Valley plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

General Plan

The General Plan (2005) describes community objectives to accommodate growth and community needs. Some policies and objectives relate to the development and growth of the community identify natural hazard conditions prevalent to the area. Provisions addressing natural hazards include: the need to mitigate erosion and other geologic hazards, regulating construction in and near the floodplain, maintaining standards for yards and property, the use of natural landscaping, maintaining sufficient culinary water quantity, adequate fire hydrants.

Codes and Ordinances

Apple valley has codes and ordinances which address construction in and maintenance of property to avoid and mitigate natural hazard impacts. Land use, subdivision, municipal code and ordinance documents and municipal resolutions document legal frameworks for Apple Valley addressing natural hazards. Ordinances describe requirements to address steep slope provisions for construction, soils and slope assessments by engineers, using native plants and water efficient landscaping, and stormwater drainage requirements for development. For a full description of the specific codes and ordinances that relate to natural hazards, please refer to the Apple Valley Code.

Water Studies and Evaluations

Several water studies and evaluations exist for the Big Plains Water and Sewer Special Service District (BPWSSSD), which explain the features, challenges, and assets that the community has in relation to its culinary and wastewater systems. Specific to natural hazards, these documents explain soil conditions in certain areas of the infrastructure which require mitigation to ensure long standing use and a description of the water systems and piping to support fire flow capacity.

Risk Assessment

Apple Valley is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Apple Valley planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 345 describes the relative risks of hazards in the community.

Table 345: Apple Valley Hazard Risk

HAZARD	RISK

DROUGHT	1. High
WILDFIRE	2. High
SEVERE WEATHER	3. High
FLOOD	4. Moderate
EARTHQUAKE	5. Moderate
PROBLEM SOILS	6. Moderate
RADON	7. Moderate
LANDSLIDE	8. Low

A detailed description and mapping of each of the natural hazards that impact Apple Valley can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Appley Valley include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Apple Valley is a community marked by its rural nature. Homes and property in the community are nestled below buttes, mesas, and along hillsides, which often have some distance between neighboring properties. The community has open space and hillsides surrounding the community on all sides.

Figure 315 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in Washington County that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

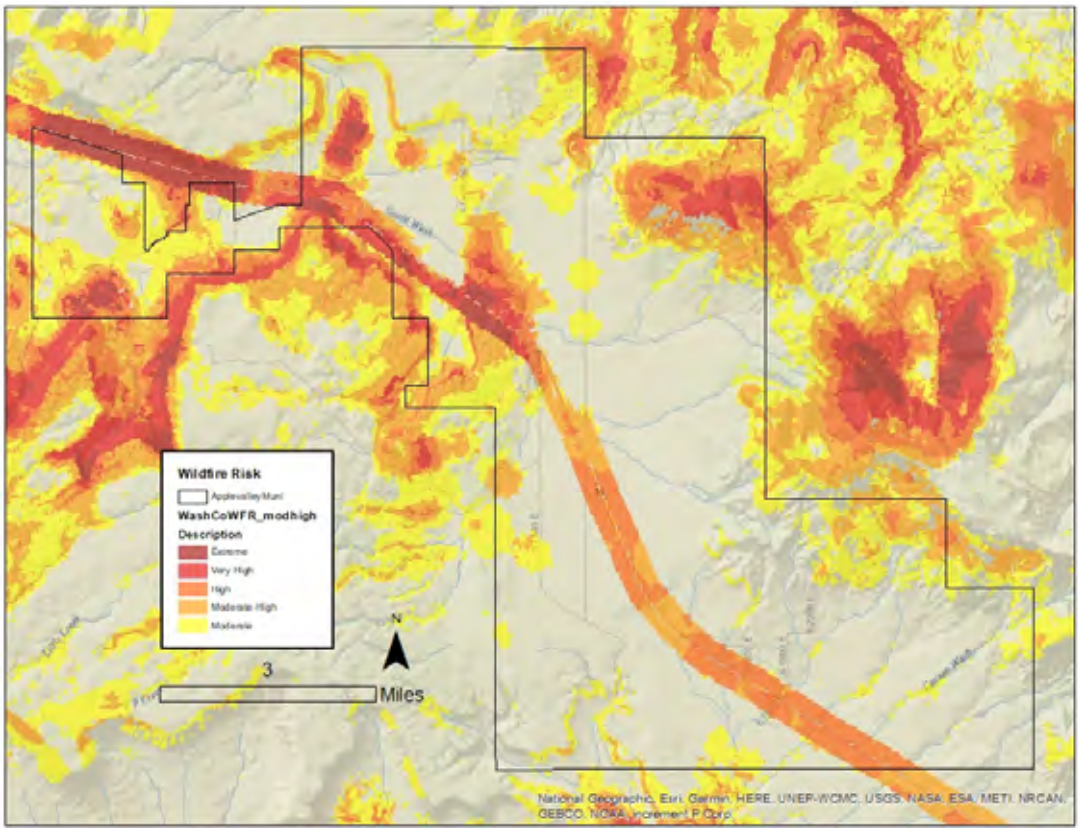


Figure 315: Apple Valley Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 346 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels, critical facilities, and miles of roadway in Apple Valley. A medical clinic and fire station are identified in areas considered moderate to extreme risk to wildfire. A high percentage of parcels, and road miles are considered at risk to wildfire in the community. All commercial parcels are in an area of moderate or greater wildfire risk, which can have implications for the local economy. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods.

Table 346: Apple Valley Wildfire Risk

Apple Valley Exposure to Wildfire Risk

Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	100.0%	81.6%	82.2%	36.1%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. The plan references the Utah Wildfire Info database, which tracks recent wildfires from 2017 and fires designated under Fire Mitigation Assistance Grant program from FEMA. No fires documented on either source have impacted Apple Valley.

While fires may not have been documented on these databases, wildfire has impacted Apple Valley in recent years. A 2020 fire, which burned 49 acres destroyed a home and killed a man attempting to prevent damage to his home. This event occurred approximately two miles outside of Apple Valley, but the event demonstrates the potential for a fire event which could impact the community.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Apple Valley, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 316 shows the mapped earthquake epicenters and fault lines near Apple Valley. The Hurricane Fault zone is approximately six miles west of the Apple Valley Town Boundary. The nearest epicenter was a 4.05 magnitude dated to 1936 in Zion Canyon, approximately 13 miles northeast of the town.

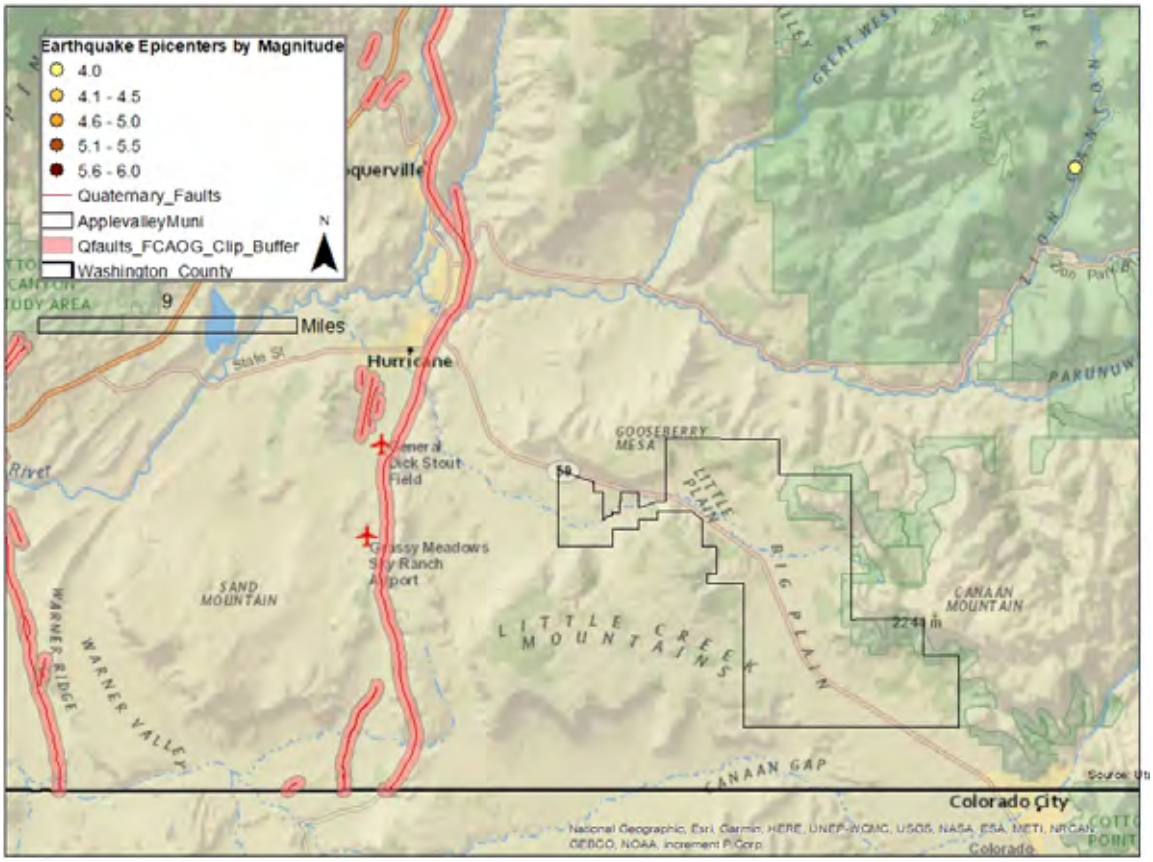


Figure 316: Apple Valley Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Faults are not mapped in Apple Valley, and thus Five County cannot complete an assessment of the interaction of community assets with quaternary faults. Another identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. According to Washington County Assessors data, six structures in Apple Valley were built before the adoption of seismic code requirements. It is estimated that the six structures account for 1.7% of total structures in the town boundary. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

Apple Valley does not have recorded earthquake epicenters of 4.0 magnitude or greater in the town boundary. The community can still experience shaking from events elsewhere in the region. The 1992 earthquake in Washington City produced ground shaking miles away from the epicenter, as far as Cedar City and Springdale.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Apple Valley.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 317 depicts the flood and dam inundation exposure in Apple Valley. As described by the map, the 100-year floodplain is mapped in the northwest portion of the community and Apple Valley is not exposed to dam inundation zones.

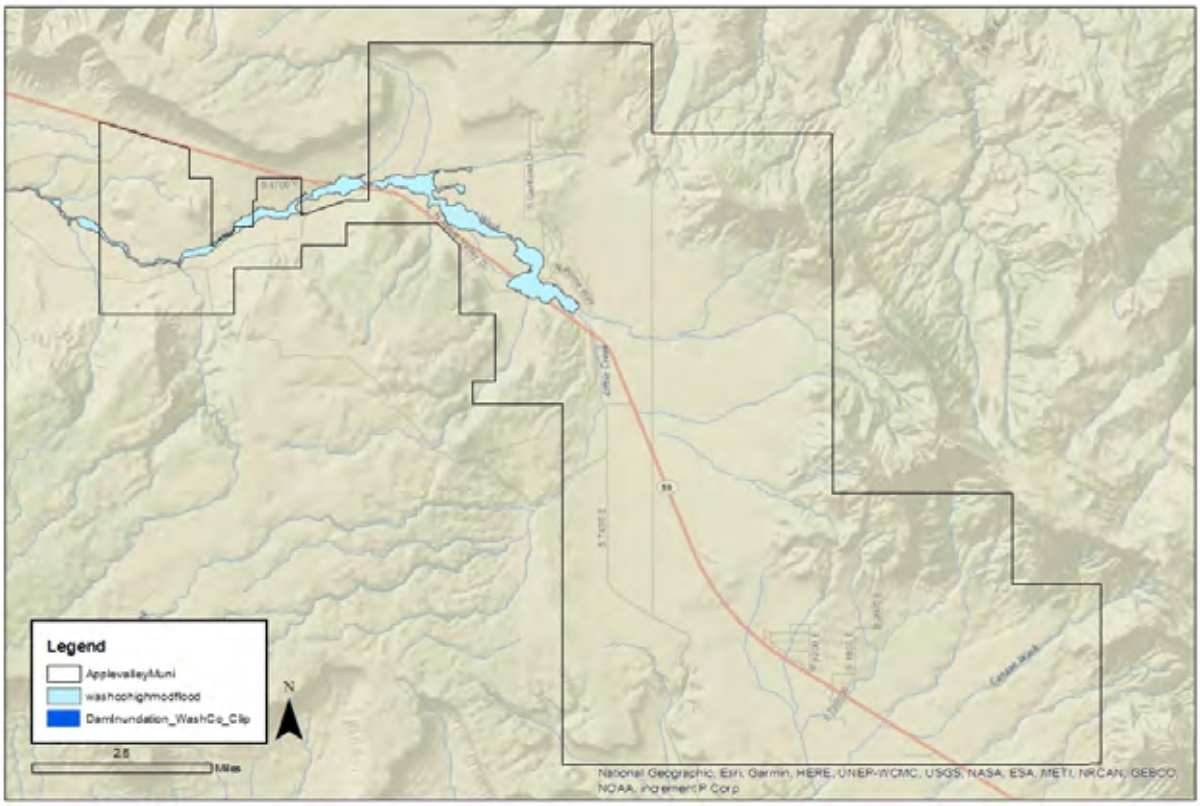


Figure 317: Apple Valley Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 347 describes that Apple Valley commercial properties are at greatest exposure to the mapped floodplain. Flooding in a commercial structure can result in damages to property and goods. Some residential properties and road miles are exposed to the mapped 100-year floodplain, which indicates that some access to communities, and personal property may be vulnerable to flooding.

Table 347: Apple Valley Exposure to Flooding and Dam Inundation

Parcels			Road Miles	Rail Miles	Local Parks	Critical Facilities
Commercial	Residential	Total				
30.0%	6.7%	7.4%	1.9%	N/A	N/A	0.0%

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Apple Valley property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National

Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 348: Apple Valley NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$2,308	0	1	1	$140,000	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Apple Valley participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 348 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. Apple Valley has not reported repetitive losses and the community does not participate in the Community Rating System (CRS).

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 349 depicts the flooding events which have impacted Apple Valley and the surrounding area.

Table 349: Apple Valley Reported Flood Events

Date	Damage/Injury	Description
8/22/2018	$50,000	Heavy rain caused flooding of Apple Valley Homes

Source: NOAA Storm Database

The area surrounding Apple Valley are subject to flash floods following rain events. Only one event described impacts to Apple Valley, describing $50,000 in property damage and flooded homes. Some flooding events which are documented for neighboring communities may have impacted Apple Valley but said impacts on the town may not have been documented. Refer to the section for Hildale, Hurricane, or Washington County for a description of flood events which occurred outside of Apple Valley.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire. Long term climate trends indicate that severe weather events are expected to become more frequent and increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 318 maps the landslide susceptible areas in Apple Valley. The eastern portion of the County, which is marked by cliffs, mesas, and buttes, is susceptible to landslides.

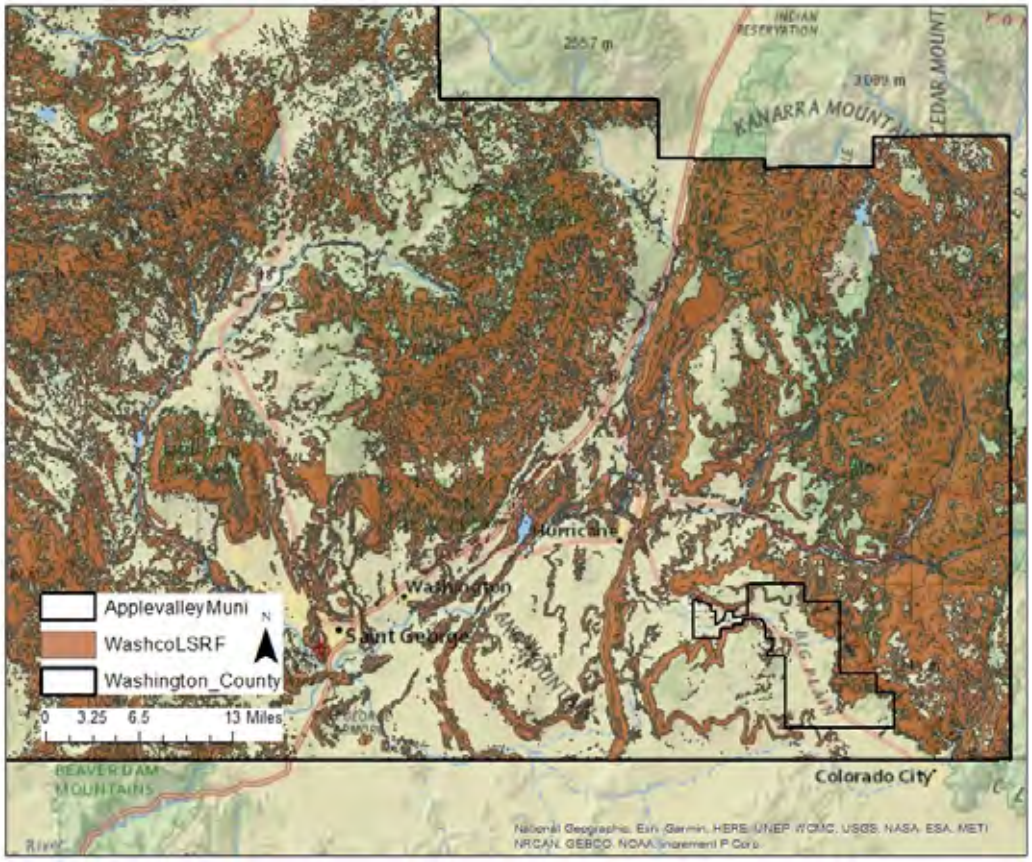


Figure 318: Apple Valley Landslide Susceptibility

Source: Utah Geological Survey

Apple Valley Town is exposed to landslide susceptible areas throughout the community. Table 350 describes the exposure of certain community assets to landslide susceptible areas. Commercial parcels are most exposed to landslide susceptible areas, compared to residential parcels and assets. Commercial endeavors impacted by landslide may see physical damage to structures, property, delays in goods, extended repair, and cleanup of the space, all of which can impact the daily operations of a business. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 350: Apple Valley Susceptibility Exposure

Apple Valley Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	40.0%	23.3%	23.8%	10.0%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

There are no landslides reported that have directly impacted Apple Valley.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 319. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

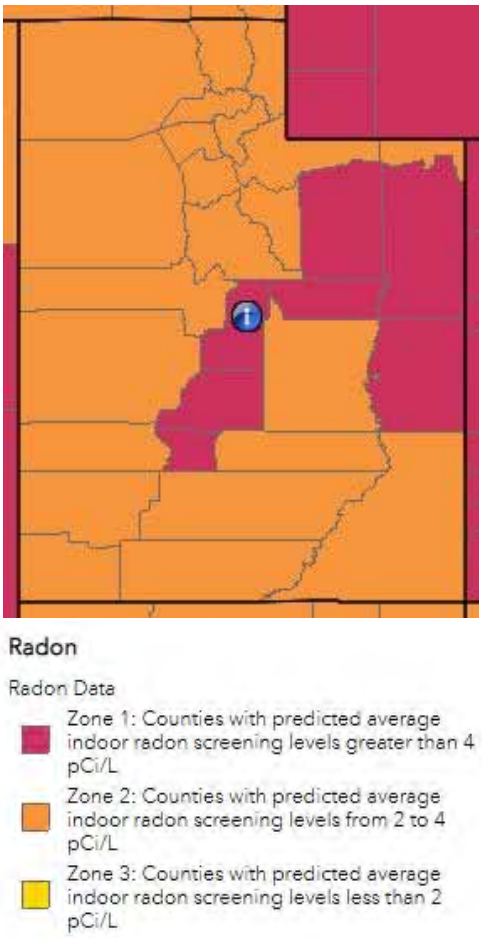


Figure 319: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 351 describes the reported findings across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 351: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Apple Valley, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Apple Valley is in a valley between mesas and buttes, which sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months. Thunderstorms are the weather hazard that frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Five of these events had direct impacts on Apple Valley, documented in Table 352. While damages or injury are often not reported, it is likely that these events impact travel and access to the community. Severe winds and winter storms are common to this area and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Apple Valley, the area likely saw extreme heat during these events which could cause impacts on residents and visitors.

Table 352: Apple Valley Severe Weather Record

Date	Damage/Injury	Description
12/29/2010	None Reported	Apple Valley received eight inches of snow during a winter storm.
8/24/2011	None Reported	A tornado was spotted west of Apple Valley, but the event produced no damages.
2/13/2012	None Reported	Apple Valley received six inches of snow during a winter storm.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/7/2013	None Reported	Apple Valley received eight and a half inches of snow during a winter storm.
12/23/2016	None Reported	Apple Valley received six inches of snow during a winter storm.

Source: NOAA Storm Database

Severe weather will continue to impact Apple Valley as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Apple Valley's Codes and Ordinances describe an awareness of potential hazards due to soil types in the community. Codes describe requirements for geotechnical reports describing certain soil types and how they will be mitigated. Refer to the town ordinances for further detail about specific situations which may require soils reports.

Figure 320 illustrates where the Utah Geological Survey has mapped problem soils for Washington County. Apple Valley has mapped susceptibility to expansive soils and rock in the north and west portions of the community.

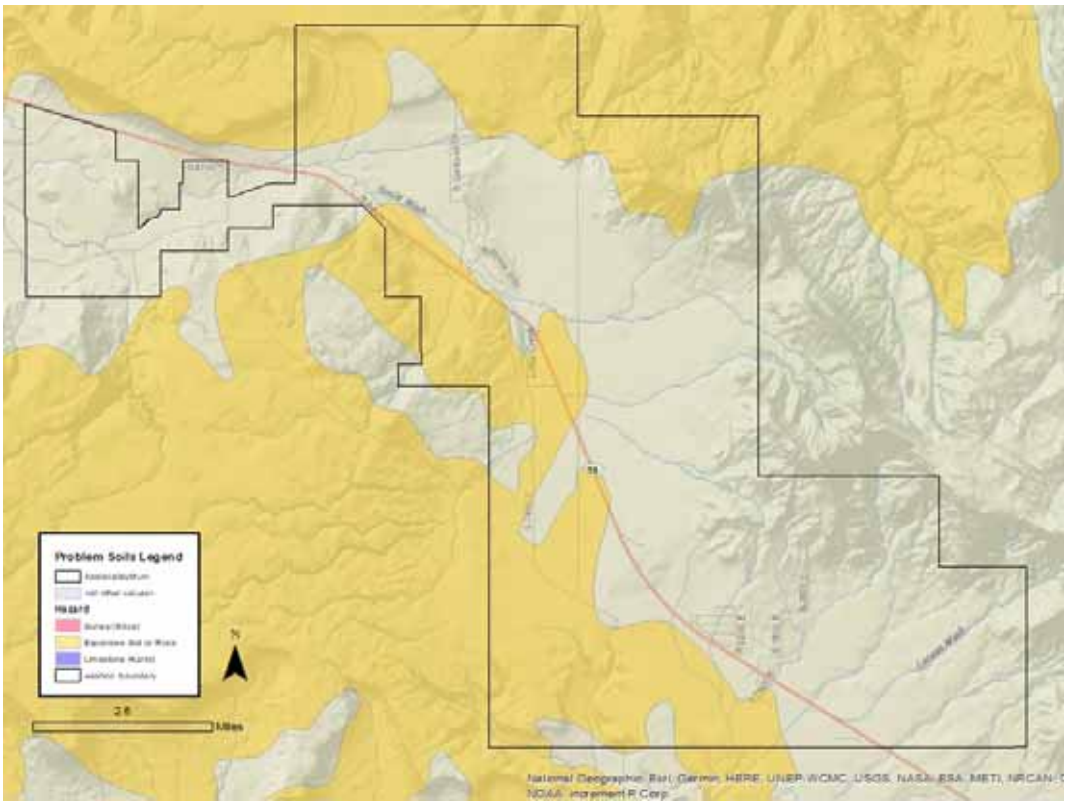


Figure 320: Apple Valley Problem Soils Map

Source: UGS, AGRC

Apple valley parcels and road miles are exposed to problem soils, as demonstrated by Table 353. Commercial parcels have the greatest exposure at 50% of commercial parcels in an area with mapped problem soils. Problem soils can expand and contract with soil moisture and have the potential to damage structures and infrastructure sitting on the soil surface.

Table 353: Apple Valley Exposure to Problem Soils

Apple Valley Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	50.0%	23.0%	23.8%	36.7%	N/A	N/A

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region. Apple Valley is not inside the study boundaries at the time of this writing.

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Apple Valley is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. The only hazard that exposes critical facilities in the community is wildfire. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Apple Valley has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 354 describes progress made on Apple Valley's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 354: 2016 Apple Valley Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Apple Valley Storm Management Project- Prevent flooding in homes and private property	Implement projects from the Storm Water Management Plan, such as install curb and gutter, storm drain boxes, divert water into Gould Wash, collect easements, install culverts and ditches to discharge water into the wash.	5 years	Apple Valley, CIB, CDBG, FEMA	

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Apple Valley has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are informed by the risk assessment. Each action in Table 355: Apple Valley 2022 NHMP Mitigation Strategy includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 321.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 321: Regional Plan Goals

Table 355: Apple Valley 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	1, 2, 6	Secure water infrastructure and storage capacity.	Connect the town water systems with piping to protect existing wells.	M	Dependent on available funding.	H	CIB, Division of Drinking Water	Apple Valley
Flood #1	1, 2, 6	Implement stormwater drainage systems.	Complete paving and stormwater infrastructure in the town.	M	Dependent on available funding.	H	CIB, FEMA, CDBG.	Apple Valley

Source: Local Planning Team

Enterprise

Enterprise is roughly the halfway point from cedar city to St. George, via the center of the county, off I-15. State Road 18 and SR 219 run through the community. SR 18 connects St. George to Enterprise north south through the center of the county, SR 219 runs west of Enterprise to the Utah-Nevada Border.

Enterprise was settled by Mormon pioneers as part of the cotton mission for cattle grazing. The Enterprise Reservoir was the foundation of growth in the community. Diverted shoal creek. An earthquake in Pine Valley in the early 1900s allowed the reservoir to acquire water rights from residents of other communities relocating after the event.

The reservoir continues to sustain the community and agricultural pursuits. Groundwater has been added to the community to bolster water assets. Altitude of 5,400 feet makes the climate more like that of Iron County, than the low elevation desert of southern Washington County.

Demographics

As of the 2018 American Community Survey, Enterprise has a population of 1635 people, described in Figure 322. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area. Enterprise's population saw growth between 2000 and 2010, similar growth was recorded across the County. Prior to 1990, the population remained stable.

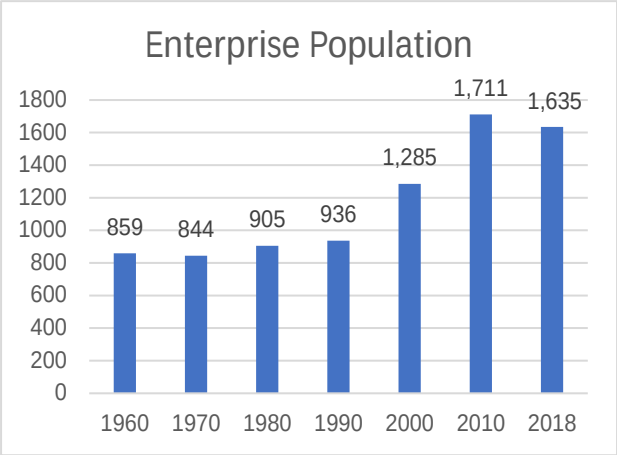


Figure 322: Enerprise Population by Decade

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Enterprise, the community could see around 3,872 people living in the community in the next 45-years[18].

Economy

Enterprise has an economic history of agriculture, which has been maintained in the community culture today. Figure 323 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool, according to the 2018 American Community Survey estimates. Industries with the largest share of jobs in the community include healthcare and social assistance, retail trade, construction, and accommodation and food services. Agriculture endeavors make up 4% of jobs in the community.

[18] This estimate is created using the 2015 ACS population estimate for Enterprise, which was 1,691, and adding 229% of this population estimate to the population for that year.

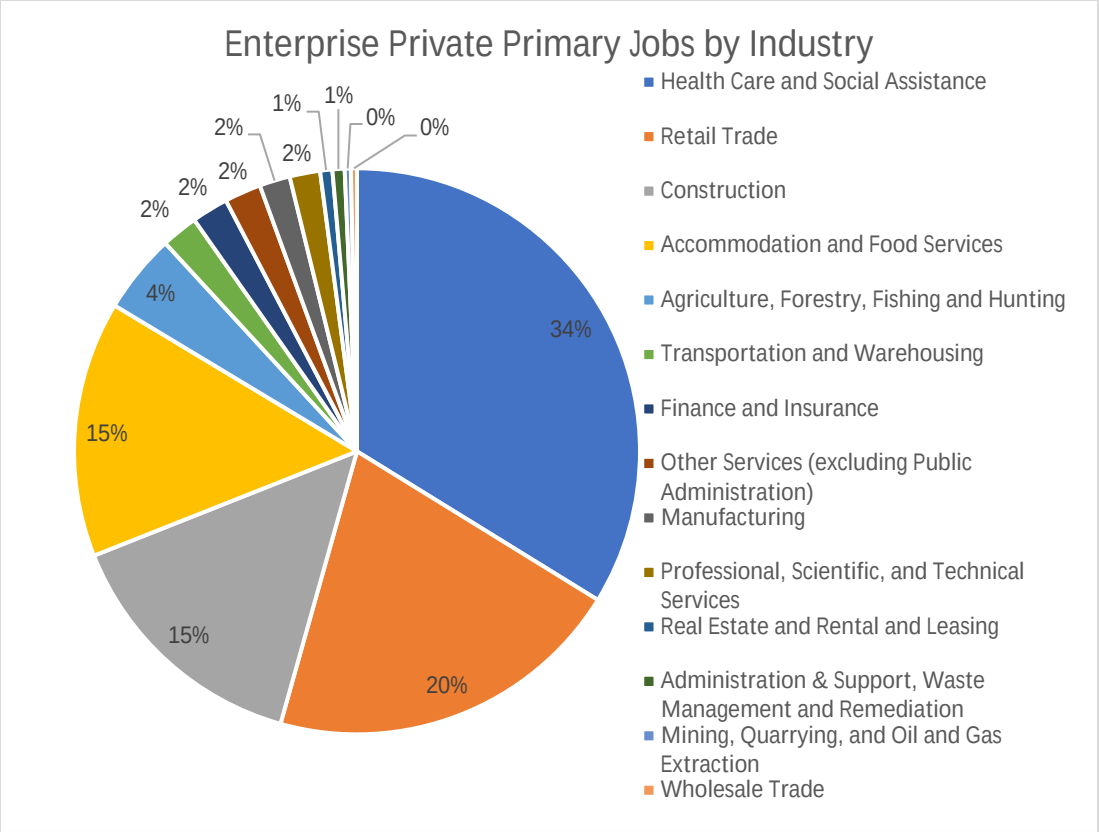


Figure 323: Enterprise Share of Private Primary Jobs by Industry

Development

Enterprise has recently seen five residential subdivisions approved with some beginning construction. This new development is beginning on the east, north, and center areas of the city. Several new developments are in areas which were formerly agricultural land.

Community Capabilities

Enterprise is governed by a mayor and city council, who engage in legislative activities for the community. A planning commission reviews new development permit applications, zone change activities, and contribute to the community general plan.

City administrative staff include a city administrator, planner, treasurer, recorder, and receptionist. Enterprise provides several emergency services to the community, including fire, EMT, law enforcement, and animal control. A town marshal is the primary law enforcement officer for the City. Enterprise partners with the Washington County Sheriff's Department for additional law enforcement service to the area. Fire and EMT service is provided by trained volunteers from the community.

Enterprise operates water, power, and sewer utilities for residents. Water in the community originates from Cold clear springs and two wells for culinary water, landscaping, and fire suppression uses. Gas utilities are not available in the community. Enterprise has an agreement with Washington County to provide solid waste and garbage service to the City.

Plans and Policies

Enterprise has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. This section provides an overview of Enterprise plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Enterprise codes and ordinances describe conditions and requirements in the community to limit certain hazard events and their impacts. Provisions in the code include, but are not limited to, use of open space to protect from natural hazard areas, considerations of natural flood plain and placement of development in flood risk areas, the need for drainage and fire protection like fire hydrants and limiting debris that may cause a fire risk.

Risk Assessment

Enterprise is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Enterprise planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 356 describes the relative risks of hazards in the community.

Table 356: Enterprise Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. High
EARTHQUAKE	4. Moderate
WILDFIRE	5. Moderate
RADON	6. Moderate
LANDSLIDE	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Enterprise can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Enterprise include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Enterprise is an agrarian community in north central Washington County. The community has few neighboring cities or towns and is surrounded by mountainous open space. The community also has water shed and drinking water assets in the nearby reservoir, which provides culinary water to the community. Water assets can be at risk to wildfires when ash and debris flow into the water source.

Figure 324 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Enterprise that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

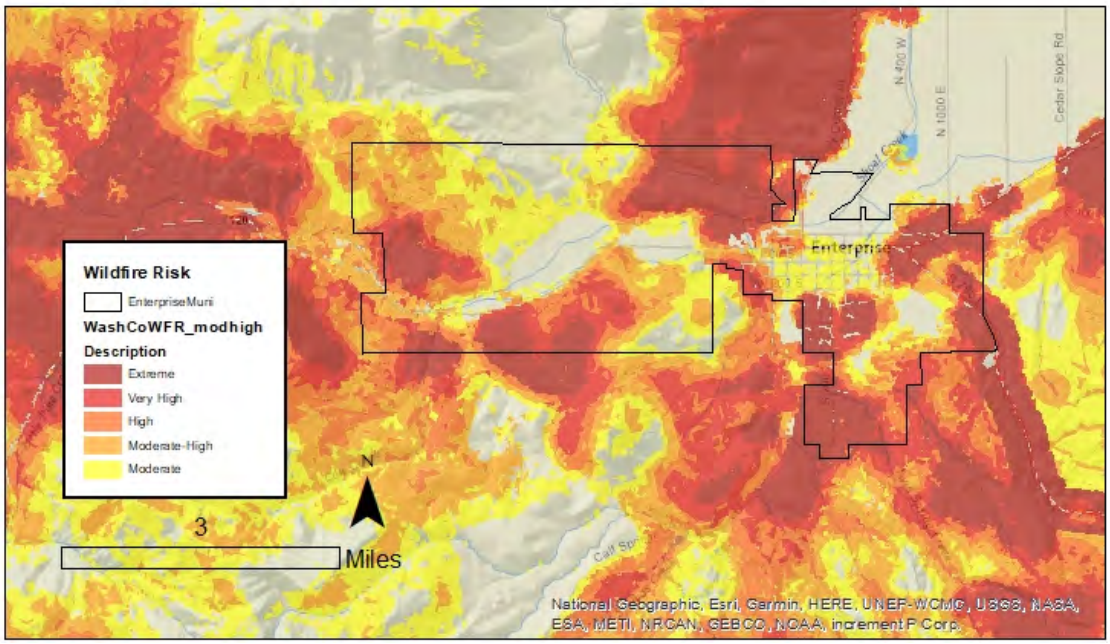


Figure 324: Enterprise Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 357 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels, critical facilities, and miles of roadway in Enterprise. Eighty percent of critical facilities in the community are exposed to wildfire risk. A large percentage of parcels, and road miles are considered at risk to wildfire in the community. All commercial parcels are in an area of moderate or greater wildfire risk, which can

have implications for the local economy. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods.

Table 357: Enterprise Wildfire Risk

Enterprise Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
80.0%	95.7%	90.3%	90.6%	42.8%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. No fires documented on either source have impacted Enterprise as of July 2020. Smaller fires may have occurred that impacted the Enterprise area that are not recorded on either source.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Enterprise, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 325 shows the mapped earthquake epicenters and fault lines near Enterprise. The Enterprise fault runs through the southeast section of the community. The city also has recorded a 4.05 magnitude earthquake inside the city boundary in 1914.

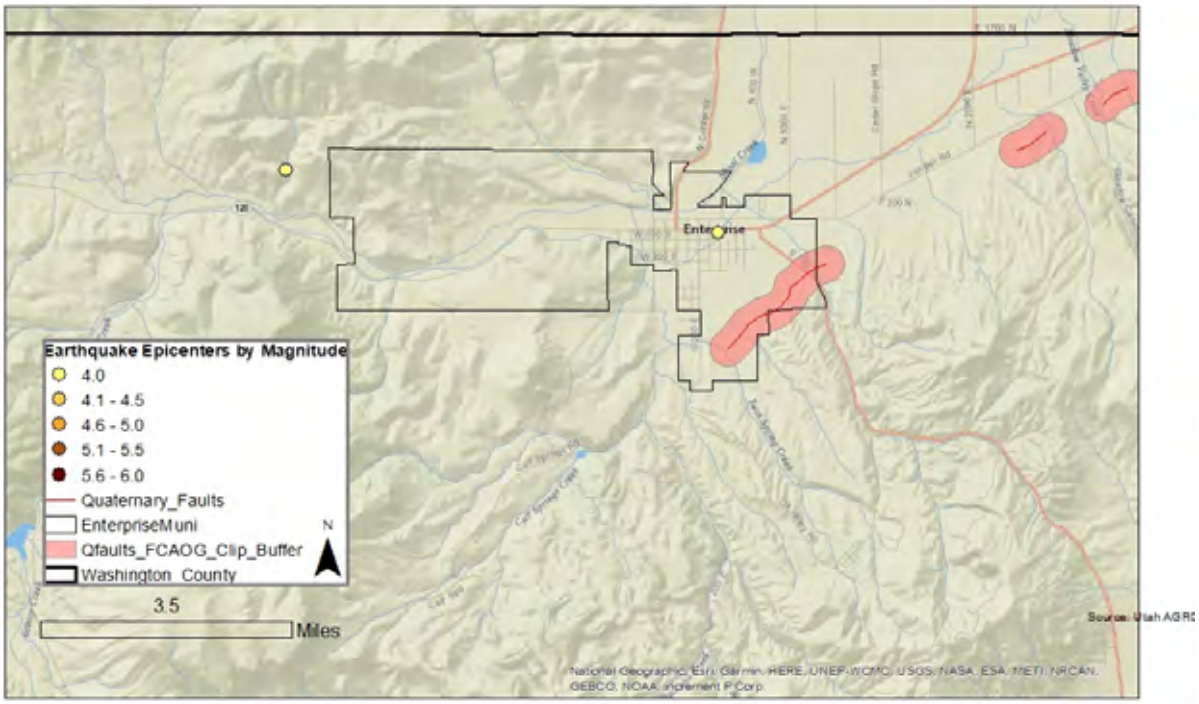


Figure 325: Enterprise Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

While there is a fault identified in the Enterprise City boundaries, minimal parcels and road miles are exposed. Table 358 describes the exposure of community assets to the fault. The fault interacts with residential parcels in the southeast portion of the community.

Table 358: Enterprise Exposure to Quaternary Faults

Enterprise Exposure to Quaternary Faults						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	0.7%	0.7%	5.8%	N/A	N/A

Source: UGS, Garfield County Assessor, AGRC

Another identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. According to Washington County Assessors data, 184 structures were built before the adoption of seismic code requirements in Enterprise, approximately 25% of the total structures in the city boundaries. One critical facility is identified as being constructed pre-1975. Southern Utah has a pride in their pioneer history, which often

includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement. A table of listed magnitude has been included in appendix x.

Three earthquake epicenters have been reported near Enterprise, as described in Table 359. Two of these earthquakes are recorded within a mile of the community. Earthquakes from miles away can be felt and cause damages to a community. One such event in Pine Valley caused damages to the town of Hebron, a historic town which was near Enterprise. Shaking from this earthquake was felt as far north as Salt Lake City, according to local history of the event. (Alder & Brooks, 2007)

Table 359: Enterprise Earthquake Epicenter Record

Date	Location	Magnitude
1881	1 mile west of Enterprise.	4.05
1914	In Enterprise municipal boundary	4.05
2016	12 miles southwest of Enterprise.	4.30

Source: USGS, University of Utah

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Enterprise.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 326 depicts the flood and dam inundation exposure in Enterprise. As described by the map, the 100-year floodplain and dam inundation zone extend through the community.

Figure 326: Enterprise Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 360 describes that Enterprise commercial properties are at greatest exposure to the mapped floodplain. Flooding in a commercial structure can result in damages to property and goods. A large portion of residential parcels and road miles are also exposed to map flood and inundation areas, which indicates that some access to the community, residents, and personal property may be vulnerable to flooding.

Table 360: Enterprise Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	53.2%	43.6%	44.2%	42.8%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Enterprise property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 361: Enterprise NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$2,915	0	2	4	$969,200	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Enterprise participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 361 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. Enterprise has not reported repetitive losses and the community does not participate in the Community Rating System (CRS). The community received a Community Assistance Visit in 2011 and a Community Assistance Contact in 2019 from FEMA.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 362 describes the flooding events which have impacted Enterprise and the surrounding area.

Table 362: Enterprise Reported Flood Events

Date	Damage/Injury	Description
8/29/2000	$52,000	A monsoon caused flooding throughout Washington County. Damages include $2,000 in crop damage.
7/15/2004	$10,000	A thunderstorm caused flash flooding, which damages several mobile homes and caused street flooding.
10/20/2004	$80,000	A thunderstorm system caused flooding throughout southwest Utah, including much of Washington County.
7/16/2014	$100,000	Heavy rain flooded homes, businesses, and streets throughout enterprise.
9/27/2014	$350,000	Flooding was reported across Washington County and in Zion National Park. Enterprise saw flooded roads and businesses due to heavy rain.

Source: NOAA Storm Database

Enterprise is susceptible to flash floods following rain events. Only two events described direct impacts to Enterprise, both of which impacted streets and residences. Some flooding events recorded for the unincorporated county surrounding Enterprise, may have also impacted the community.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows, like that seen following the Brian Head Fire in Iron and Garfield Counties. Long-term climate trends indicate that severe weather events are expected to become more frequent and increase in magnitude, which will influence flooding locally.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 327 maps the landslide susceptible areas in Enterprise.

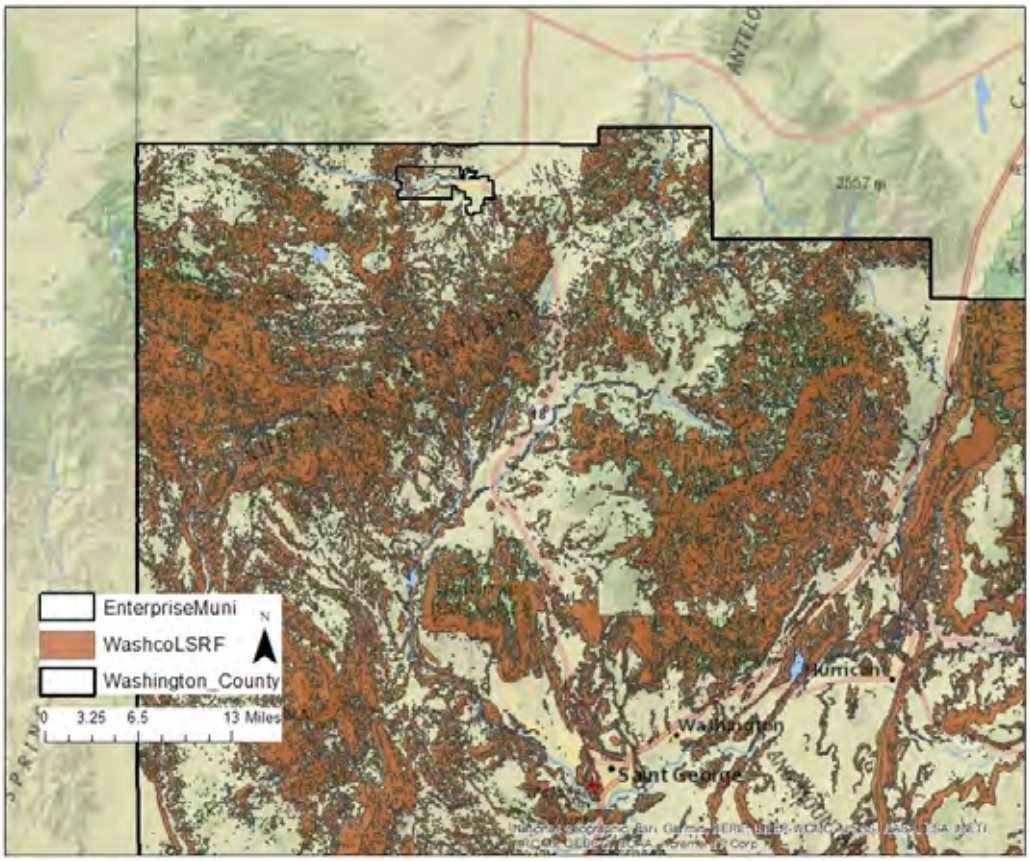


Figure 327: Enterprise Landslide Susceptibility

Source: Utah Geological Survey

Enterprise is exposed to landslide susceptible areas primarily in the west portion of the community. Table 363 describes the exposure of community assets to landslide susceptible areas. Exposed assets in the community include residential areas and road miles. People and property are vulnerable to landslides, which can damage homes, vehicles, and cause injury or death. On roadways, landslides can place debris on or cause damage to roadways. Such damages can block traffic and make access to the community a challenge. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 363: Enterprise Landslide Susceptibility Exposure

Enterprise Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	0.0%	3.7%	3.5%	3.4%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

There are no landslides reported that have directly impacted Enterprise, although based on the assessment and the mountain terrain in which the town is located, landslides are a possibility for the community.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 328. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

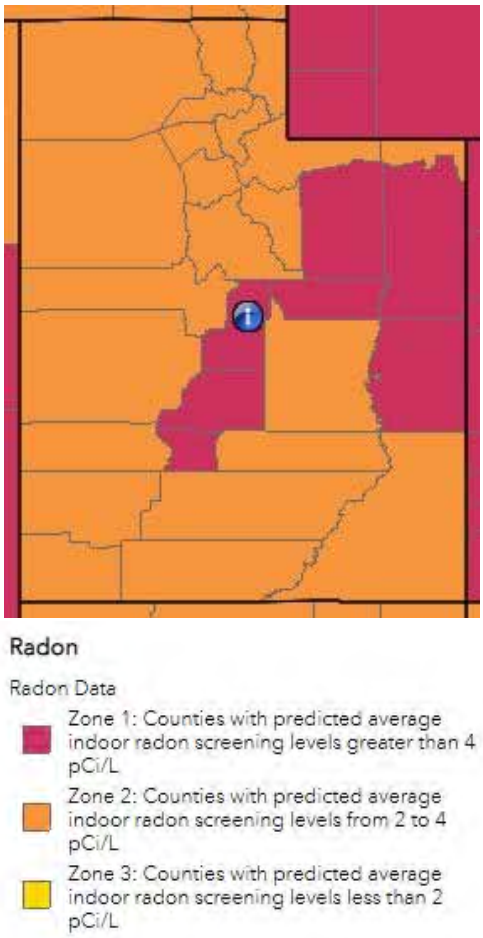


Figure 328: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 364 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 364: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Apple valley, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Enterprise is a northern Washington County community and sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months. Thunderstorms are the weather hazard that frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Table 365 describes the recorded severe weather events in Enterprise. While damages or injury are often not reported for Enterprise, it is likely that severe weather events impacted travel and access to the community. Severe winds and winter storms are common to this area and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest and while the deaths reported during the 2013 events did not occur in Enterprise, the area likely saw extreme heat during these events which could cause impacts on residents and visitors.

Table 365: Enterprise Severe Weather Record

Date	Damage/Injury	Description
5/30/1986	Unknown	A thunderstorm produced high winds, downing powerlines in Enterprise and starting a small grass fire. A tornado was spotted associated with this storm.
2/7/1998	None Reported	Enterprise recorded 14 inches of snow following a storm.
4/8/2005	None Reported	Enterprise recorded 10 inches of snow following a storm.
5/7/2006	None Reported	High winds, measuring 60 kts were recorded in Enterprise.
9/30/2009	None Reported	High winds with gusts of 58 MPH recorded in Enterprise.
10/4/2009	None Reported	High winds produced gusts of 61 MPH recorded in Enterprise.
4/5/2010	None Reported	High winds produced gusts of 58 MPH recorded in Enterprise.
4/27/2010	None Reported	Very strong winds were recorded, with a maximum gust of 63 MPH measured in Enterprise.
6/16/2010	None Reported	High winds produced gusts of 59 MPH in Enterprise.
2/6/2011	None Reported	High winds produced a peak wind gust of 61 MPH.
3/20/2011	$5,000	Strong winds produced a peak wind gust of 86 MPH in Enterprise. Property damage reported in Cedar City.
4/7/2011	None Reported	High winds produced peak wind gusts of 59 MPH in Enterprise.
5/15/2011	None Reported	High winds produced peak wind gusts of 58 MPH in Enterprise.
3/6/2012	None Reported	High winds produced peak wind gusts of 65 MPH in Enterprise.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
1/30/2016	2 injuries	28 inches of snow reported during winter storm that impacted southwest Utah. Injuries occurred in vehicle accidents on I-15. The storm continued for four days.

3/5/2017	$80,000 10 injuries	High Winds produced wind gusts of 65 MPH in Enterprise. Wind caused damage region wide and visibility issues on roadways due to blowing dust, causing several traffic accidents from Milford to Cedar City.
2/20/2019	None Reported	Five inches of snow reported in Enterprise following a winter storm.
11/27/2019	None Reported	11 inches of snow accumulated in Enterprise during a snowstorm.

Source: NOAA Storm Database

Severe weather will continue to impact Enterprise as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Problem Soils

Enterprise's Codes and Ordinances describe certain situations which would require a geotechnical report for development, although they do not describe specific soluble or expansive soils prevalent to the County. Figure 329 illustrates where the Utah Geological Survey has mapped problem soils for Washington County. As demonstrated by the map, problem soils have not been mapped in the Enterprise municipal boundaries.

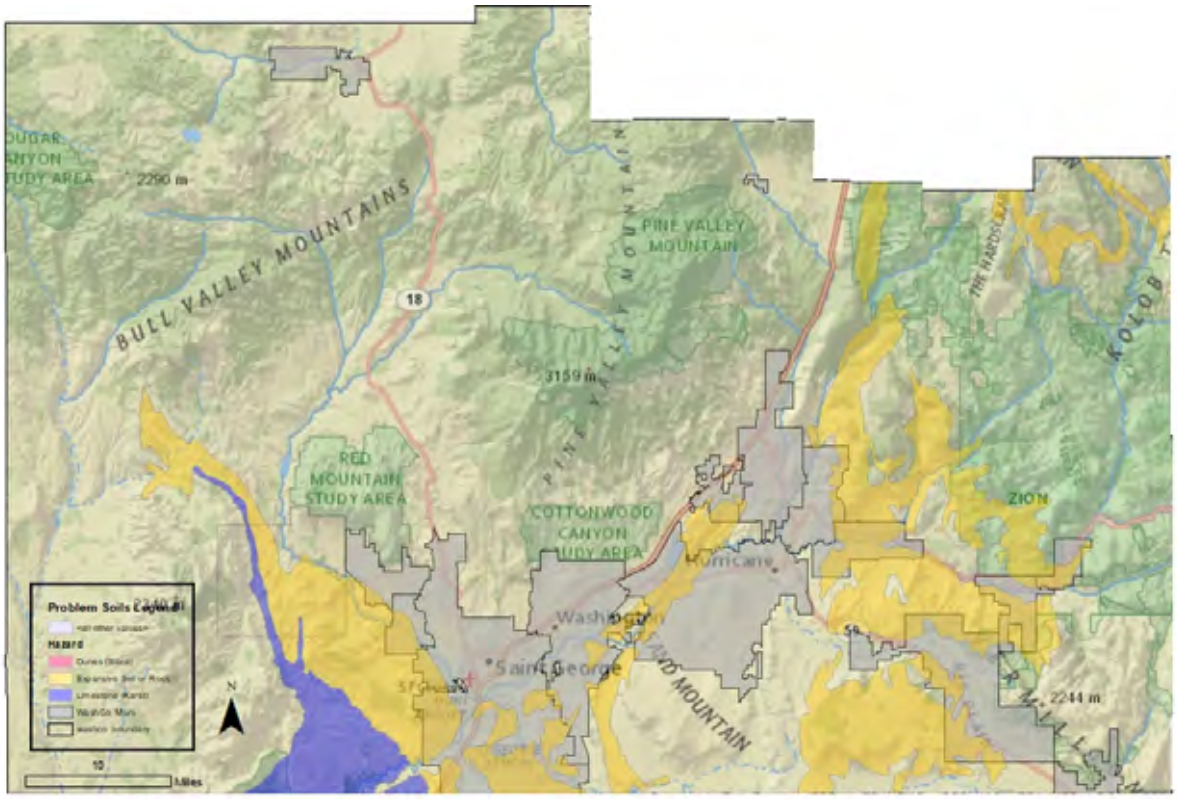


Figure 329: Washington County Problem Soils Map

Source: UGS, AGRC

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil

types such as clay, which can be challenging to the region. Enterprise is not inside the study boundaries at the time of this writing.

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Enterprise is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. The only hazard that exposes critical facilities in the community is wildfire. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Enterprise has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 366 describes progress made on Enterprise's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 366: 2016 Enterprise Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Minimize structural damage from floods.	Provide flood protective features along Spring Creek to prevent flooding on residences in downtown Enterprise City.	Unknown	Local government operating budget; State and Federal flood grant programs	Complete

Source: 2017 Five County Association of Governments NHMP

Hildale

Hildale is a community that was settled by pioneers for agriculture in the mid-1800s along the Utah/Arizona Border in eastern Washington County. The community lies in the Short Creek Valley and the Arizona Border separates the city from neighboring Colorado City. Hildale and neighboring Colorado City share many services, resources, and infrastructure. Hildale City incorporated in 1963.

The northeast border of the community is a series of cliff faces, which includes several outdoor recreation opportunities, including Water Canyon, which draw visitors to the area.

Demographics

The 2020 census indicates that the Hildale population is 1,127, a decrease of more than 50% from the previous three censuses, as described in Figure 330 and Figure 331. Several factors could contribute to this number, both related to data challenges and changes in the local community make-up. Hildale has seen a significant turnover in residential tenure in the community, with longtime residents with large families leaving the city, and smaller sized families moving into or remaining in the community.

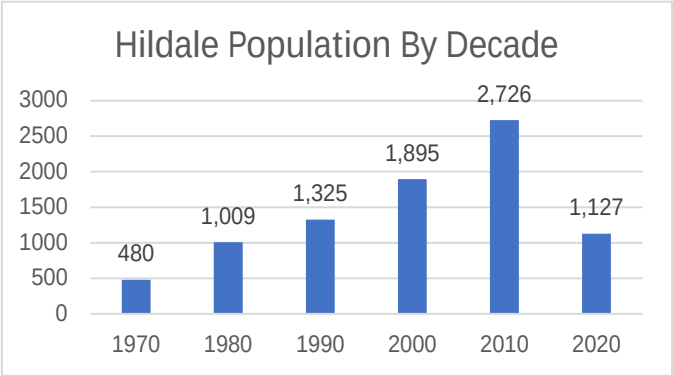


Figure 330: Hildale Population by Decade

Source: US Census Bureau

The City may have experienced challenges in residents completing the census due to Covid-19 and the potential for public concerns about privacy or the questions being asked in the survey. A census information committee which was to encourage participation was stalled early in discussion. The City is considering a request to review the 2020 census to better engage the community.

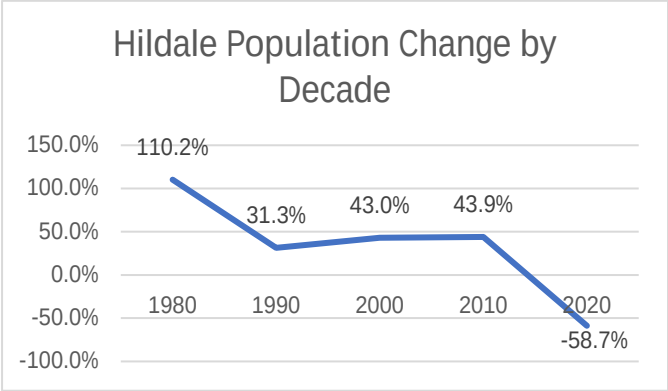


Figure 331: Hildale Population Change

Source: US Census Bureau

Hildale's population has observed steady growth from 1980 to 2010, with rates between 31% and 43% each decade. Despite the documented decline in the 2020 census, the average population change by decade is 33.9%, showing that overall, the community has grown since incorporation. Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Hildale, the community could see around 9,626 people living in the community in the next 45-years[19].

[19] This estimate is created using the 2015 ACS population estimate for Hildale, which was 2,926, and adding 229% of this population estimate to the population for that year.

Economy

Hildale has an economic history of agriculture, which has been maintained in the community culture today. Figure 332 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool, according to the 2018 American Community Survey estimates. Industries with the largest share of jobs in the community include construction, manufacturing, and retail trade. The community has limited jobs in the mining, extraction, arts, and recreation industries.

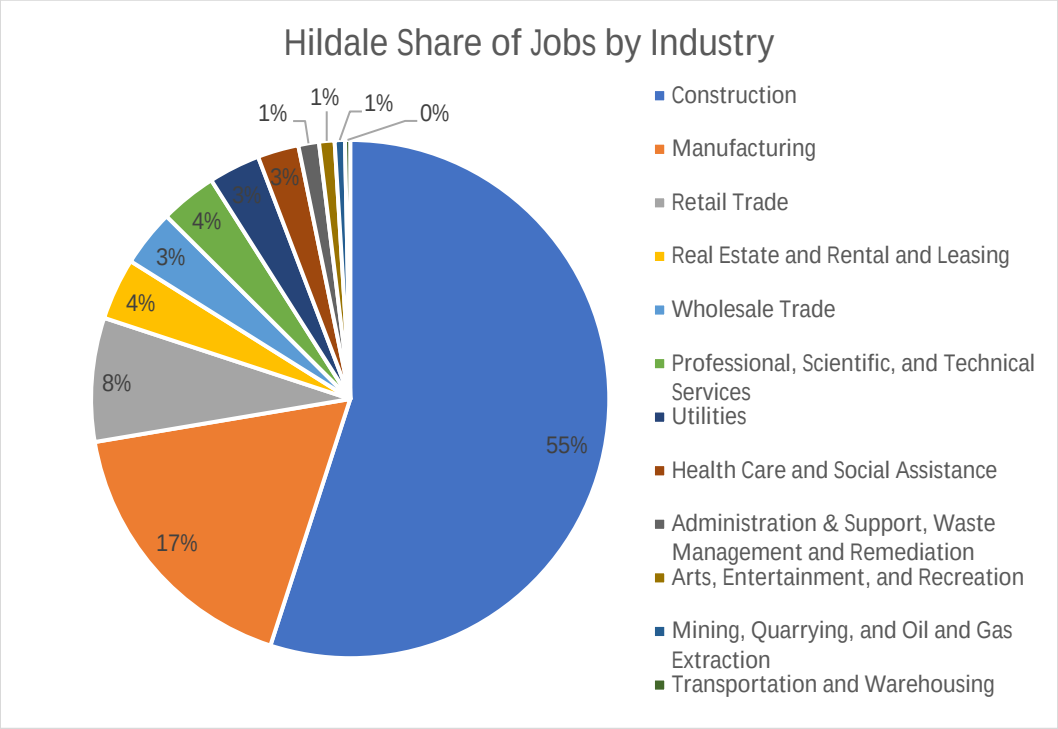


Figure 332: Hildale Share of Private Primary Jobs by Industry

Source: US Census Bureau

Development

The Hildale City General Plan describes development trends in the community as of 2016. Development is concentrated between the highway and public lands to the north and east. Most of the land is either vacant, open space, or agriculture. Residential development in the community is comprised of mostly single-family homes.

The City has indicated that water utilities continue to see new connections, demonstrating that there is new development in the community. Infill is a significant source of development in the community, with new residential properties being constructed regularly in town. The community also expects continued development outside of the downtown, in the northwest corner of the community where several hundred homes are proposed to be built in the next seven years.

The town has also annexed a large portion of land into the city boundaries in fall of 2021. The Annexation boundary extends north and west along the boundary with Apple Valley. This addition has brought in approximately four-square miles of land to the city boundary Figure 333 illustrates the area added to the town.

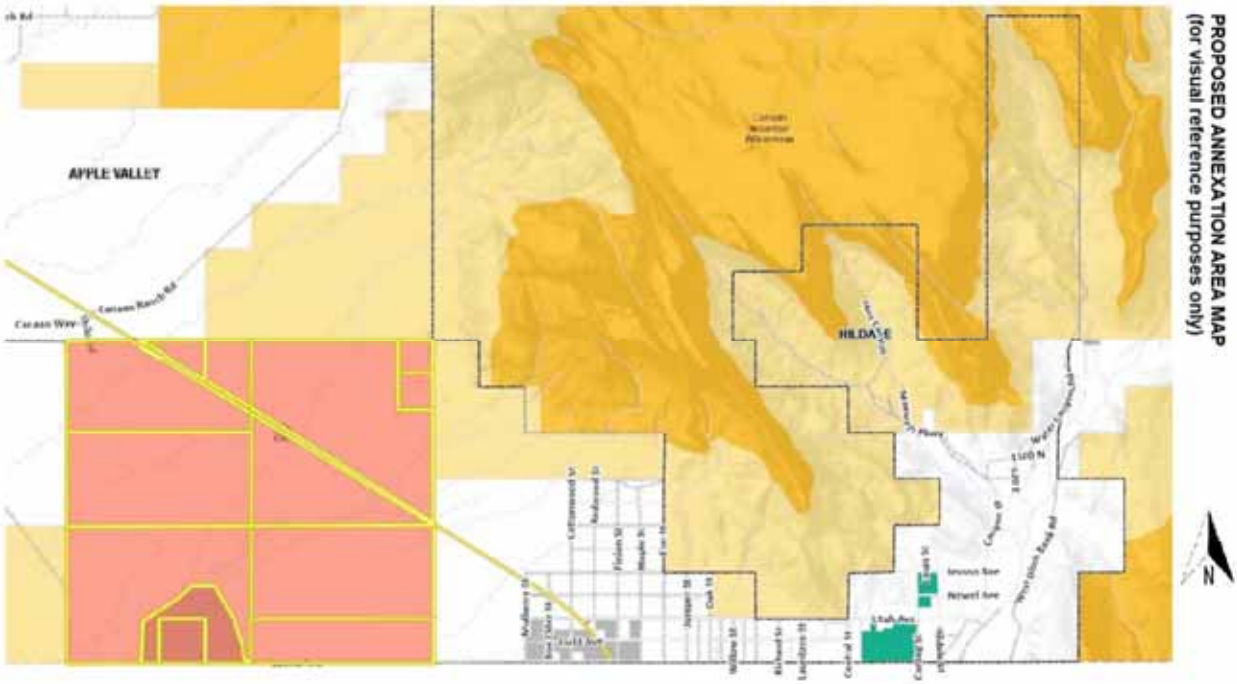


Figure 333: Hildale Proposed Annexation Map

Source: Utah Public Meeting Notice Website for Hildale City

Community Capabilities

Hildale is governed by a mayor and city council, who engage in legislative activities for the community. A planning commission reviews new development permit applications, zone change activities, and contribute to the community general plan.

City administrative staff include a city manager, planner, treasurer, recorder, public works, and building and planning staff. Hildale provides several emergency services to the community, including fire, EMT, and law enforcement. The Hildale-Colorado City Utility Department operates wastewater, water, and gas utilities for residents. Hildale City operates a municipal fiber network which provides internet service to residents through participating Internet Service Providers.

Critical infrastructure includes the water, electric, gas, internet, and other communication systems in the community. There is a high-pressure natural gas line at the propane facility owned by the city. The structure is elevated and protected by fencing.

Plans and Policies

Hildale has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Hildale plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Several of the community codes and ordinances detail requirements to address natural hazard challenges in the community. Ordinances address problem soils, landslide, earthquake, flooding, and drought using policy. Said ordinances describe where structures can be built relative to identified hazard risk areas, requirements for developing spaces which may be exposed to hazards, technical reporting for hazards, routine requirements to identify and mitigate hazardous geology, and recommendations that the city would like to see of development, new and existing. See the Hildale Municipal ordinances for details about ordinances addressing natural hazards.

General Plan

The Hildale General Plan describes the long-term visitation for the community. Elements of the plan describe goals, policies, and actions to meet this long-term vision. Natural Hazards are described as challenges to the community that impact residents, public safety, property, and other essential assets in the community. The General plan describes challenges and strategies to address flooding, wildfire, severe weather, and drought. Actions include coordinating with federal, state, interstate, and regional partners. Some actions identify specific areas of the community which are challenged by natural hazards, specifying actions to suit an identified location. Actions range from creating and adopting policy for the community to addressing hazards through structural changes and collaboration with other agencies.

Risk Assessment

Hildale is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Hildale planning team to develop a ranking the highest risk hazards based on probability, frequency, and local exposure of the hazard. Table 367: Hildale Hazard Risk describes the relative risks of hazards in the community.

Table 367: Hildale Hazard Risk

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. High
RADIUM	3. High
SEVERE WEATHER	4. Moderate
WILDFIRE	5. Moderate
EARTHQUAKE	6. Moderate
LANDSLIDE	7. Moderate

RADON	8. Low
PROBLEM SOIL	9. Low

A detailed description and mapping of each of the natural hazards that impact Hildale can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hildale include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the City includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Hazard History

Washington County and Hildale City are part of the Dixie Climate area. This area is roughly made up of geographically and climate similar areas to compare temperature, water content, and other measures. The Washington County section describes the palmer drought index for the Dixie Climate area up to 2020. The Palmer Drought Index relies on average precipitation. According to this table, there have been several instances of extended drought conditions in the area.

Local reporting from the Hildale-Colorado City Water System describes that water levels in the well serving the community are 100-feet below normal levels during the 2021 water year. This is reflected in other communities throughout the state of Utah who are experiencing deficits and shortage in their normal water supply.

Further challenges to the community's water include the prevalence of radium at above allowable levels in the community wells. Radium contamination is described further in the Radium section of this plan; however, it is important to identify the compounding conflicts which water quantity and contaminants can pose on a community's water system.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 334 depicts the flood and dam inundation exposure in Hildale. Dam inundation is not mapped in Hildale. The 100-year floodplain is observed along several of the creeks in the eastern portion of the community. Washes in the community commonly are dry throughout the year, but fill with water and runoff during severe storms. These areas are identified by the community as a great concern for flooding locally.

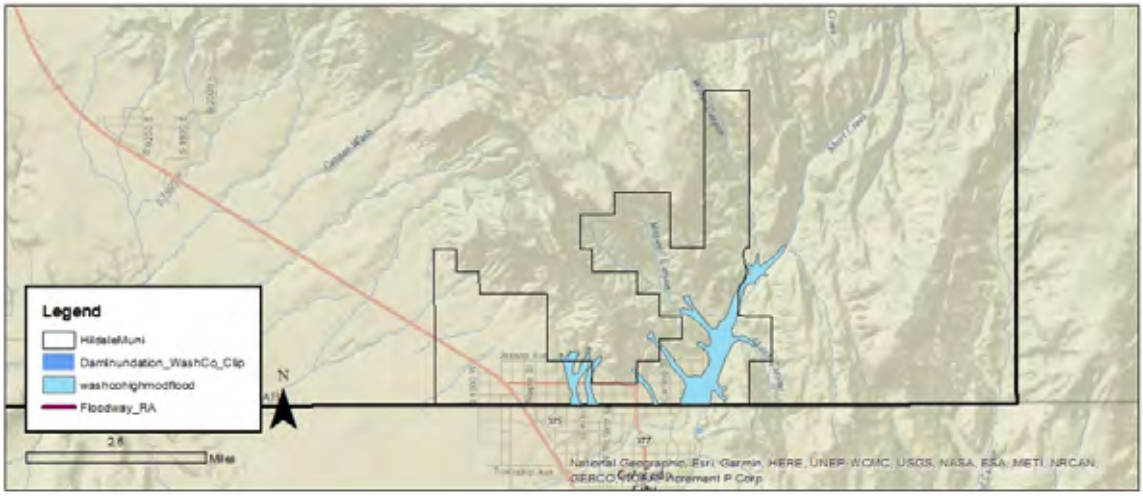


Figure 334: Hildale Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 368 describes that Hildale residential parcels are at greatest exposure to the mapped floodplain. Residents, visitors, and personal property may be vulnerable to flooding impacts. A portion of critical facilities are exposed to flooding which can impact operations during a flood event.

Table 368: Hildale Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
25.0%	10.9%	39.6%	34.3%	11.8%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Hildale property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 369: Hildale NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$9,722	0	8	9	$1,360,900	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Hildale participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 369 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. Hildale has not reported repetitive losses and the community does not participate in the Community Rating System (CRS). The community received a Community Assistance Visit in 2015 and a Community Assistance Contact in 2019 from FEMA.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the City. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 370 describes the flooding events which have impacted Hildale and the surrounding area.

Table 370: Hildale Reported Flood Events

Date	Damage/Injury	Description
8/29/2000	$52,000	A monsoon caused flooding throughout Washington County. Damages include $2,000 in crop damage.
10/21/2004	None Reported	A thunderstorm system caused flooding throughout southwest Utah, including much of Washington County. Hildale reported flooding in basements and creeks during this event.
9/14/2015	$750,000 20 deaths 3 Injuries	A thunderstorm caused flash flooding initially in Short Creek, flooding highway 59. A second flood swept vehicles off the road, killing thirteen occupants. Damages included damage to homes, vehicles, utilities, and roads throughout the community.

Source: NOAA Storm Database, New York Times, ABC4

Review of news sources show the 2015 flash flood, which occurred in Hildale, is Utah's most deadly flash flood event on record. (Smith, Floods: Utah's deadliest natural disaster, 2020)

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Radium

Radium is a naturally occurring radioactive metal which forms as the result of the decay of uranium and thorium in the environment. As radium decays, it becomes the element Radon, which is a gas which can pose health hazards covered elsewhere in this plan. Radium is present in the environment, generally at low levels, posing little threat to humans. Radium can be introduced to the environment in high quantities after certain types of mining, oil and gas piping, and other types of human activity.

When Radium is concentrated in high levels, exposed persons are vulnerable to long term health impacts. High levels of radium in the environment can create a hazard to humans and has been attributed to increased risk for several diseases, including lymphoma, bone cancer, lung cancer, increased risk to tissue and organ cancers, leukemia, and aplastic anemia depending on the type of exposure (US EPA, 2002).

Radium 226 and 228 are on the list of contaminants which are monitored by the Environmental Protection Agency (EPA) in compliance with the Safe Drinking Water Act. The EPA has established a maximum contaminant level (MCL) of 5 picocuries per liter (pCi/L) of combined radium-226 and radium-228 in drinking water (US EPA, 2002).

Hazard History

Radium has been documented in the Hildale-Colorado City Water System's Power Plant Well exceeding the EPA contaminant level for Radium-228. The Utah Department of Environmental Quality submitted a Notice of Violation to Hildale City in 2019, documenting that the running annual average of the contaminant was nearly twice the allowable limit at the well, which makes up most of the system's water source. In response to receiving the notice of violation, the community was required to inform the public of the contamination and begin addressing the problem. Hildale has worked with engineers to develop a plan to address the water challenges, which outlines the current problem and a selection of alternatives. The plan will be coupled with a Water Master Plan, which will describe needs and capital projects system wide.

Radium contamination has the potential to impact the entire community and neighboring Colorado City for users who are connected to the public culinary water system. Given that this problem is immediate and ongoing, the community has ranked this as a high-risk hazard in their risk assessment.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Hildale, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Hildale is in a valley at the foot of several canyons, which sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months. Thunderstorms are the weather hazard that frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. While NOAA does not have severe weather events reported for Hildale, such events have occurred in the community, impacting roads, infrastructure, property, and residents. Namely, some of the flash floods which have impacted the community have been caused by heavy rain fall. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads.

Extreme heat is a challenge throughout the southwest, causing personal injury and death. Certain activities and jobs can place additional risk to heat exposure, including recreation and outdoor jobs during the hottest months. Two such events are described in Table 371, and while the deaths reported did not occur in Hildale, extreme heat was likely observed region wide.

Table 371: Severe Heat Record

Date	Damage/Injury	Description
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.

Source: NOAA Storm Database

Severe weather events are frequently occurring in this region and are likely to impact Hildale in the future. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment.

Wildfire

Hildale is a small city in southeastern Washington County. Hildale is bounded by dramatic mesas and cliffs to the north and Colorado City to the south. The community also has water shed and drinking water assets from the canyons to the north, which provides culinary water to the community. The area is largely surrounded by open space and unincorporated County. Nuisance weeds, like cheat grass, are identified as a fuel type throughout the community which contribute to the rapid spread of fires in the community.

Figure 335 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Hildale that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

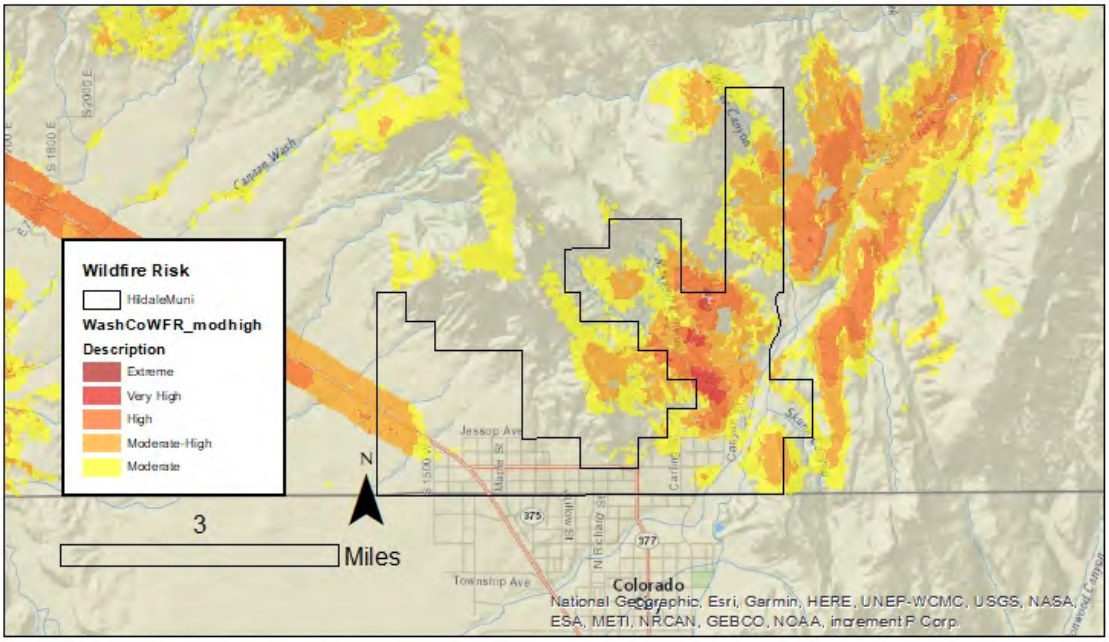


Figure 335: Hildale Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 372 further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts parcels and miles of roadway in Hildale, which could damage property, impact public health and safety, or impact local economies. Residential and commercial parcels see the most exposure, with over 20% of parcels exposed, which can impact health and safety of residents and pose risks to property. Wildfires that interact with roadways can challenge response and recovery efforts and the travel of people and goods.

Table 372: Hildale Wildfire Risk

Hildale Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	21.8%	29.4%	28.0%	17.2%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

The community describes that there is very little wildland urban interface, outside of the Water Canyon area and in the creek bed. The creek has a natural fire break and there are no homes nearby. Some commercial and residential development is present in Water Canyon and are at elevated risk of wildfire, compared to much of the rest of the community. An identified wildfire risk comes with the recently annexed land in the northwest of the community, which has added area with flammable pinyon and juniper fuels and some nearby subdivisions.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. No significant wildland fires documented on either source have impacted Hildale as of July 2020. The City referenced smaller fires which have impacted yards and structures, or smaller wildfires in the community.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Hildale, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 336 shows the mapped earthquake epicenters and fault lines in Washington County. Neither the Utah Geological Survey nor US Geological Survey have identified faults in the community. The closest fault is located approximately 16 miles east in Kane County, in the Sevier/Toroweap fault zone. Given the location of the faults, a large earthquake on either or both faults would disrupt transportation to and from the community, potentially isolating Hildale and nearby communities during an event.

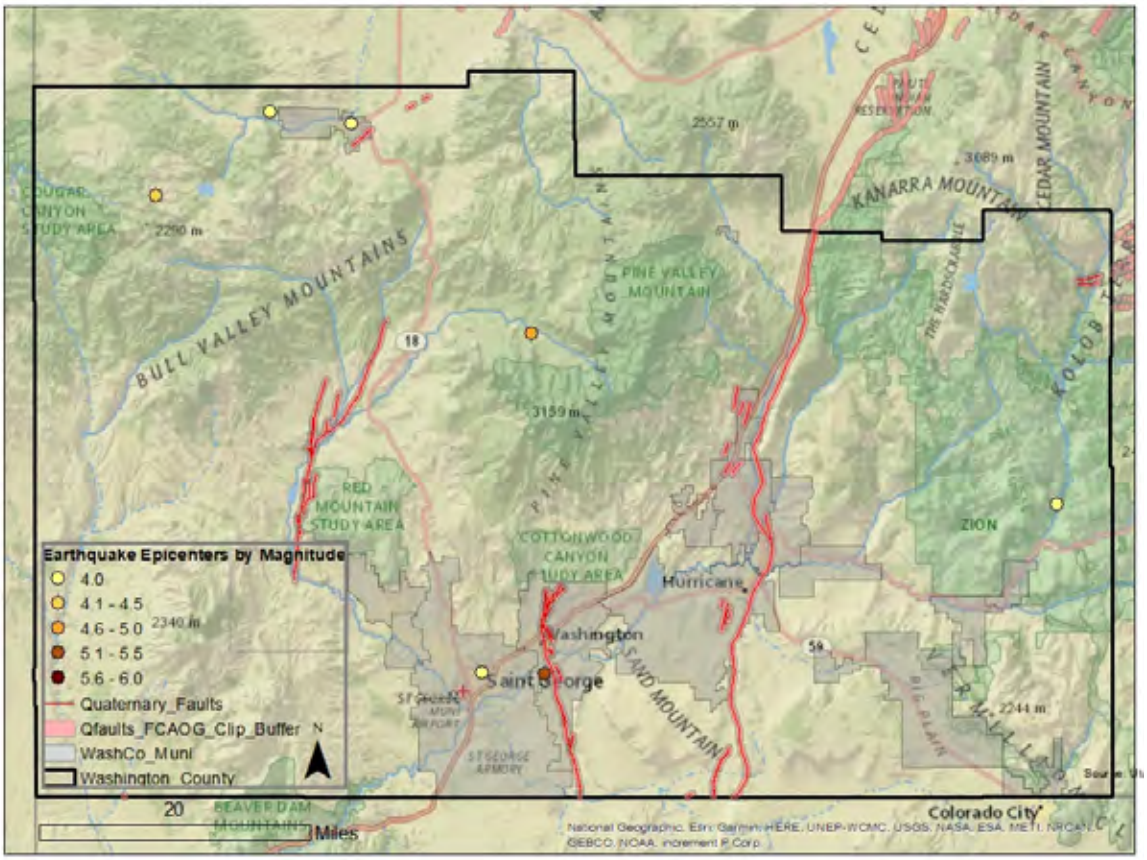


Figure 336: Washington County Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

Since there are no mapped quaternary faults in the community, an assessment of the assets that are within a quarter mile of quaternary faults cannot be completed.

Ground Shaking

Earthquakes can produce ground shaking or tremors at different magnitudes. The shaking can be a hazard for structures, infrastructure, and natural features, triggering a myriad of other hazards.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. According to Washington County

Assessors data, 75 structures were built before the adoption of seismic code requirements in Hildale, approximately 25% of the total structures in the city boundaries. One critical facility is identified as being constructed pre-1975. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

Earthquake events which cause strong shaking have been documented throughout the southwest. Only one earthquake event has an epicenter documented near Hildale, as described in Table 373.

Table 373: Hildale Earthquake Epicenter Record

Date	Location	Magnitude
1936	17.5 miles north of Hildale in Zion National Park	4.05

Source: USGS, University of Utah

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. There is not data available about liquefaction susceptibility for Hildale.

Landslides

The mountainous and cliff side topography common in the southwest are where landslides typically occur. The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Figure 337 maps the landslide susceptible areas in Hildale. Hildale is outside of the Utah Geological Survey's updated mapping study boundary.

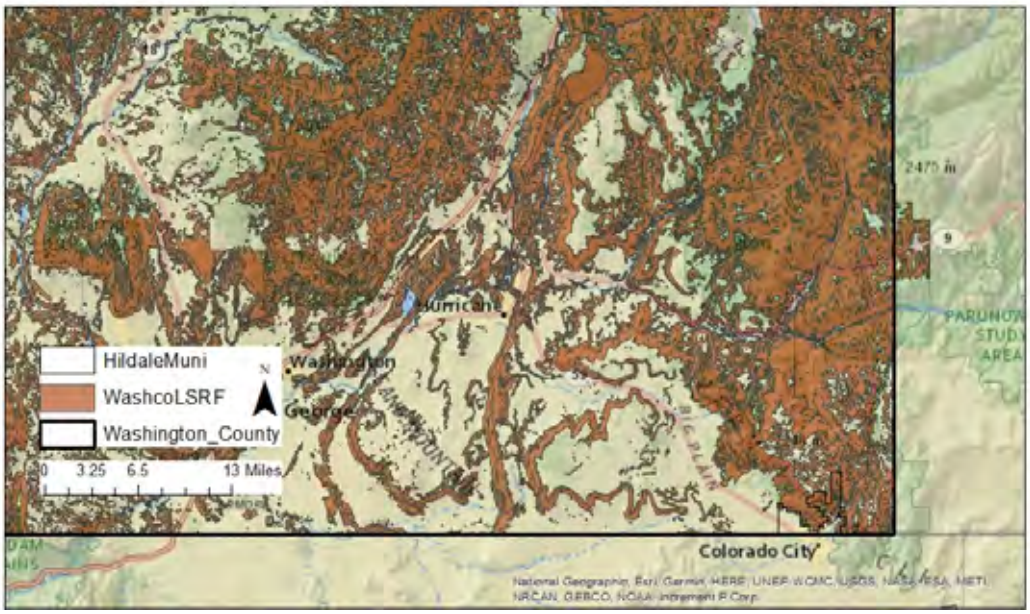


Figure 337: Hildale Landslide Susceptibility

Source: Utah Geological Survey

Hildale is exposed to landslide susceptible areas primarily in the north and eastern portions of the community, where the community is bounded by canyons and cliffsides. There are few homes and commercial endeavors in this area. The community identified a cut back hillside near a road. Oversaturation, wind, or shaking on this slope could put debris on the road causing delays and damages.

Table 374 describes the exposure of community assets to landslide susceptible areas. Exposed assets in the community include critical facilities, commercial and residential parcels, and road miles. People and property are vulnerable to landslides, which can damage homes, vehicles, and cause injury or death. On roadways, landslides can place debris on or cause damage to roadways. Such damages can block traffic and make access to the community a challenge. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 374: Hildale Landslide Susceptibility Exposure

Hildale Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	12.7%	17.1%	16.3%	8.9%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

State and federal sources, and news sources do not describe landslides impacting people and property in Hildale as of this writing. Local documentation describes a 2019 landslide which occurred in the community. This event did not impact people or property but does demonstrate the potential for these hazards. Future development in landslide areas may increase risks to the community.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 338. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

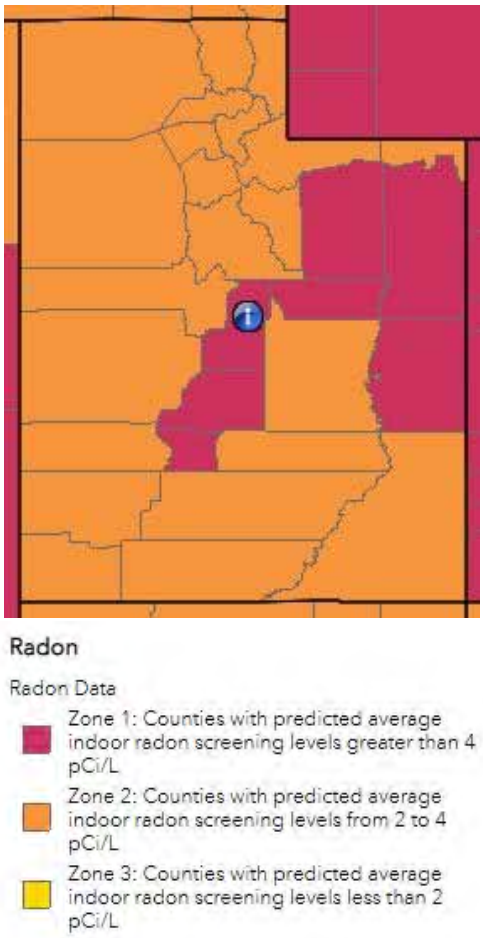


Figure 338: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 375 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 375: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the City level. Knowing that Radium is a risk in the community and that basements are common in structures in the City, there is the potential locally for radon concentrations indoors. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Problem Soils

Hildale's Codes and Ordinances describe certain situations which would require a soils or geotechnical report for development, and they also reference a need to ensure that soils do not have swell-shrink or soluble characteristics pre-construction. Figure 339 illustrates where the Utah Geological Survey has mapped problem soils for Washington County. As demonstrated by the map, problem soils have not been mapped in the Hildale municipal boundaries.

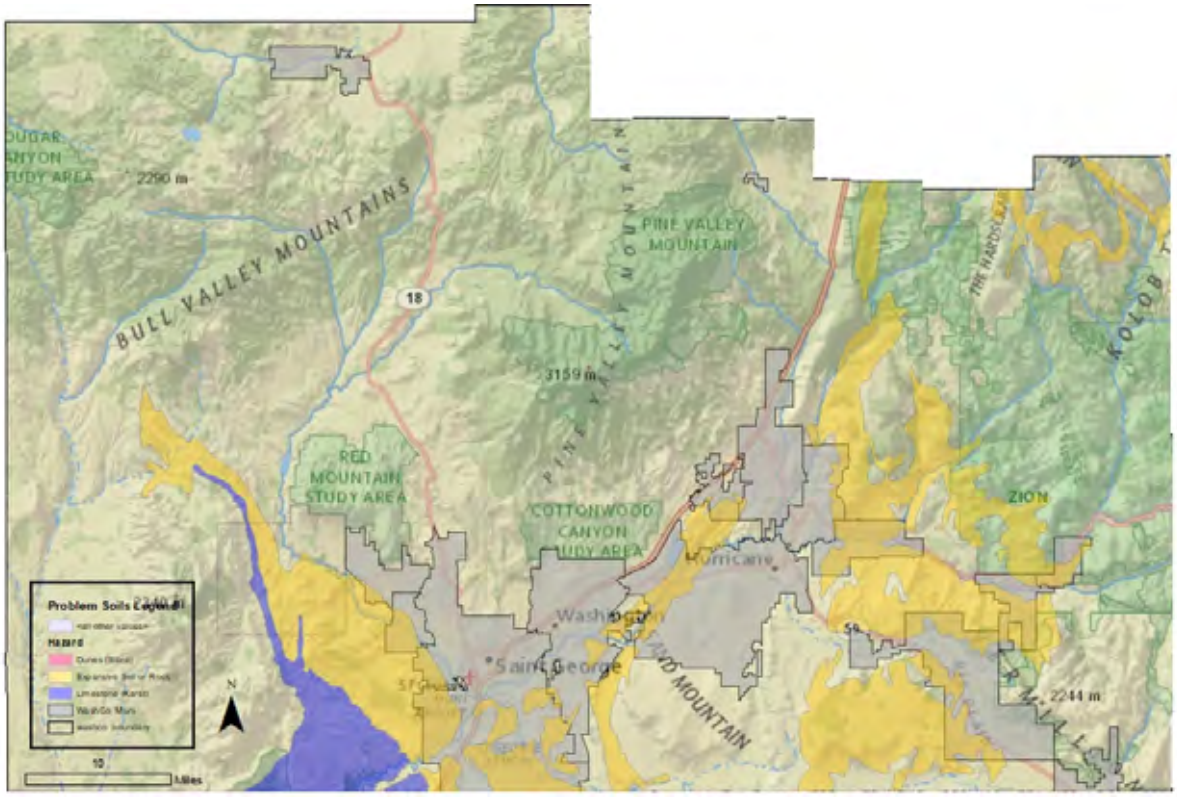


Figure 339: Washington County Problem Soils Map

Source: UGS, AGRC

Hildale City Code includes requirements for new construction to conduct testing and mitigate problem soils, like expansive soils, to develop a site. The City also describes impacts of blue clay expansive soils on building foundations in the area, causing the foundation to crack and building to shift with the underground soils expansion and contraction. Several of these structures are vacant.

UGS has developed new mapping for other communities in the region, which may provide a clearer picture of the challenges that exist to construction and development, including the presence of soil types such as clay, which can be challenging to the region. Hildale is not inside the study boundaries at the time that this plan was written.

The community and the county do not have a comprehensive record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed. Anecdotal evidence of community impacts has been described. While the impacts have not caused bodily injury or

death, problem soils cause economic damages, requiring structural repair or causing structures to sit vacant in the community.

Summary

Hildale is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. The only hazard that exposes critical facilities in the community is wildfire. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Hildale has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 376 describes progress made on Hildale's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 376: 2016 Hildale Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	To reduce flooding risk at the community level.	Clear debris and other material from all waterways.	Ongoing	Related public/private property owners.	Still Needed.

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Hildale has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are informed by the risk assessment. Each action in Table 377 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 340.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 340: Regional Plan Goals

Table 377: Hildale 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi Hazard #1	5	Plan for emergency response	Update Emergency Operations Plan.	L	2-years	M	Hildale City	Hildale City
Flood #1	1, 2, 6	Infrastructure and Public Safety	Construct erosion reduction measures on Water Canyon Road.	M	5-years	H	Hildale City	Hildale City
Flood #2	1, 2, 6	Use natural systems to mitigate hazards.	Construct erosion reduction measures on Short Creek.	M	5-years	H	Hildale City	Hildale City
Flood #3	2, 5	Use enforcement mechanisms for public safety.	Control and enforce illegal dumping in Short Creek.	H	1-year; ongoing	L	Hildale City	Hildale City
Flood #4	1, 2	Community planning to limit hazard exposure.	Adopt an erosion hazard ordinance to protect vulnerable areas prone to erosion.	M	1-year	L	Hildale City	Hildale City
Wildfire #1	6	Use natural systems to mitigate hazards.	Vegetation restoration in Short Creek and washes to reduce flammable fuels and protect the creek.	M	Ongoing	L	Hildale City, DNR.	Hildale City
Wildfire #2	6	Use natural systems to mitigate hazards.	Continue invasive species and fuels management practices in the city.	H	Ongoing	L	Hildale City, DNR.	Hildale City
Wildfire #3	2	Community planning for mitigation.	Adopt Wildland Urban Interface Code.	M	1-year	L	Hildale City	Hildale City
Earthquake #1	2	Infrastructure and Public Safety	Engage in seismic retrofits of city owned buildings constructed before the adoption of the Utah Building Code.	M	5-10-years	M	Hildale City, CIB, FEMA.	Hildale City
Problem Soil #1	1, 2, 4	Acquire updated date for the city to inform decisions.	Work with the Utah Geological Survey to complete updated mapping of problem soil risks in the community.	L	5-years	L	Hildale City	Hildale City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Problem Soil #2	1, 2	Community planning to limit hazard exposure.	Assess the existing building code requirements for problem soils testing and mitigation to ensure they are effectively managing the risks.	M	5-years	L	Hildale City	Hildale City
Severe Weather #1	5	Infrastructure and Public Safety	Purchase generators for critical facilities and infrastructure operation during power outage.	H	2-years	M	Hildale City, Washington County	Hildale City
Landslide #1	6	Use natural systems to mitigate hazards.	Applying soil stabilization measures, such as planting soil stabilizing vegetation on steep, publicly owned slopes.	M	5-years	M	Hildale City, DNR	Hildale City
Landslide #1	1, 3	Inform the Community of risks.	Coordinate with property owners in areas of identified steep slope to mitigate risks on the property.	L	2-years	L	Hildale City	Hildale City
Drought #1	2	Use natural systems to mitigate hazards.	Replace unused turf with native vegetation on City owned properties.	M	5-years	M	Hildale City	Hildale City
Radium #1	1, 2	Improve facilities to address and mitigate risks.	Construct new water processing and filtration facilities to improve water quality.	H	5-10-years	H	Hildale City, Colorado City, Washington County, Division of Drinking Water, CIB.	Hildale City
Radon #1	3	Inform the Community of risks.	Provide radon risk, testing, and mitigation information to residents.	H	1-year; ongoing	L	Hildale City, DEQ.	Hildale City

Source: Local Planning Team

Hurricane

Hurricane was settled in the mid-1800s year by Mormon pioneers. At early in settlement, it is rumored that John Snow, one of the community leaders, said after a severe weather event in the area was like a hurricane and named the hillside Hurricane Hill, thus the namesake for the city of Hurricane.

A nearby fault line shares Hurricane's name. The Hurricane Fault borders the community, visible by the stark uplift in the cliffsides to the east. The community also has a view of the Pine Valley Mountains to the west of the community. SR-9 runs through the community, connecting Hurricane to I-15 and the communities to the southeast, like La Verkin, Virgin, and Apple Valley.

Two state parks fall within the city boundaries, Quail Creek State Park and Sand Hollow State Park both serve as reservoirs for the region and opportunities for outdoor recreation for visitors and residents. Boating, paddling, and swimming are popular on the reservoirs, in addition to land-based activities like off road vehicles, mountain biking and hiking in the state parks. Hurricane City owns 17 municipal parks and has access to ample outdoor recreation throughout the region.

Demographics

As of the 2020 Census, Hurricane has a population of 20,036 people, described by Figure 341: Hurricane Population by Decade. Locally, the city states that this number is likely higher, estimated at 23,000.

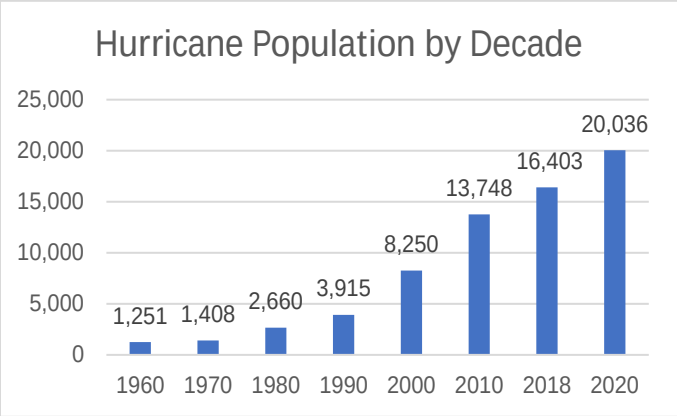


Figure 341: Hurricane Population by Decade

Source: US Census Bureau

When comparing population changes year to year, it is observed that Hurricane has experienced growth since 1970, with the most rapid growth being observed from 1990 to 2000 and 1970 to 1980, described in Figure 342. Growth appears to have slowed to a 26% increase in 2020.

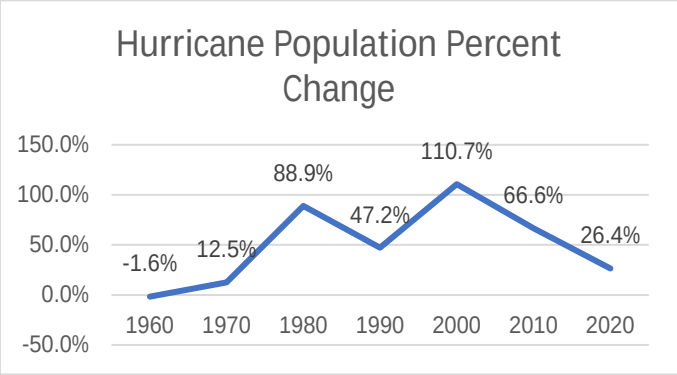


Figure 342: Hurricane Population Change

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Hurricane, the community could see around 48,343 people living in the community in the next 45-years[20].

[20] This estimate is created using the 2015 ACS population estimate for Hurricane, which was 14,694, and adding 229% of this population estimate to the population for that year.

Economy

Hurricane City has agricultural roots that date back to the settlement of the County by European pioneers. Agriculture has historically held a prominent use of land, but much of the land has transitioned to use for housing. The regional economy has expanded with the new development. Figure 343 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool, according to the 2018 American Community Survey estimates. Industries with the largest share of jobs in the community include retail trade, transportation and warehousing, and construction.

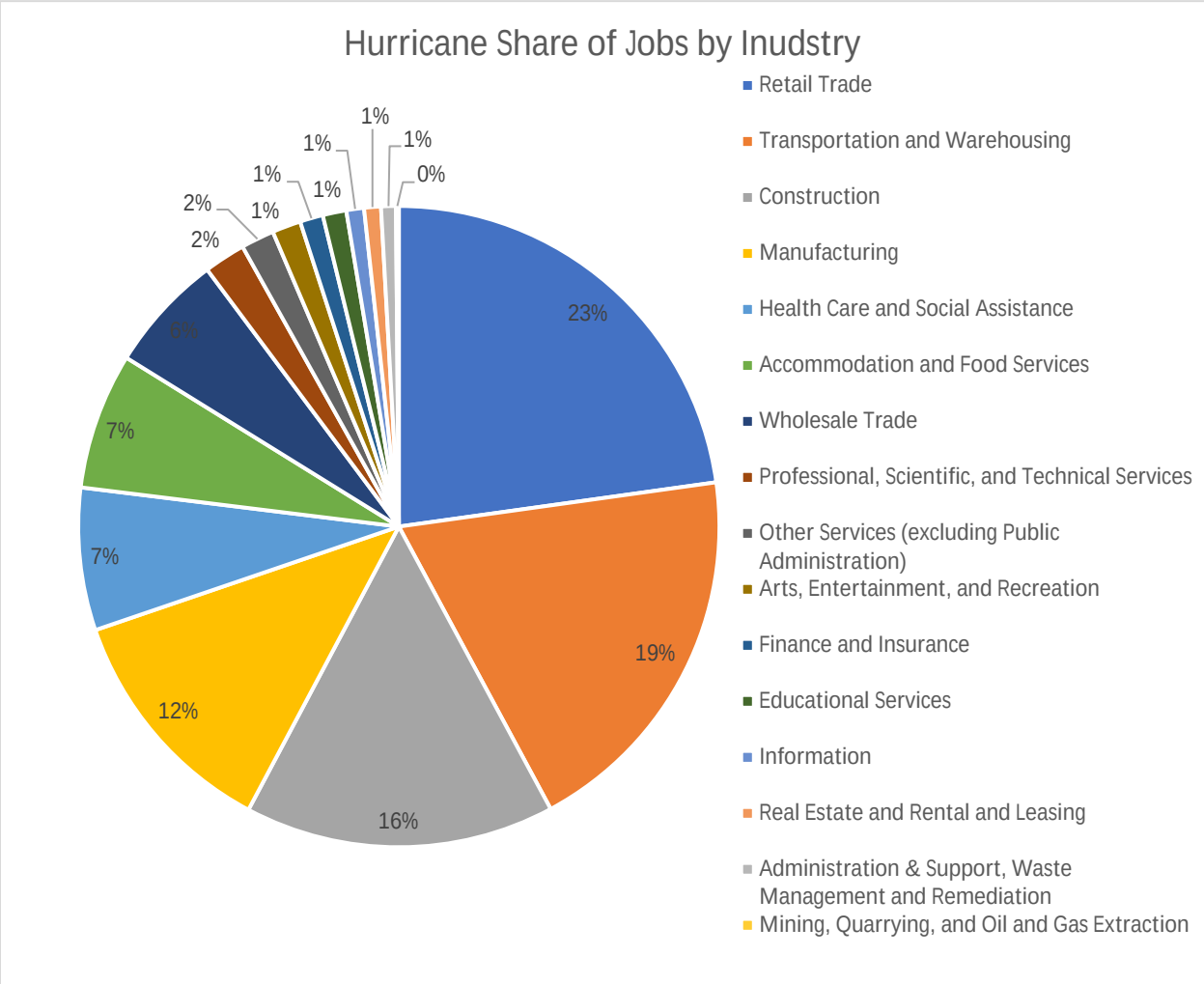


Figure 343: Hurricane share of Private Primary Jobs by Industry

Development

The Hurricane City General Plan (2021) describes development trends in the community as of 2020. Over half of the city is zoned residential agricultural, with half or one acre lots. 70% of the city is undeveloped and most of the land uses are zoned for residential use, leaving only 14% for commercial and other uses.

New development in Hurricane includes the planned expansion of the Intermountain Healthcare Clinic to include a 24/7 emergency department. (St. George News, 2021) The site is 28-acres large near SR-9.

The department will serve area residents and tourists several outdoor recreation destinations, including Zion National Park.

There have been several other new developments ongoing or planned in the community, including growth on Sand Hollow Road, commercial infill downtown, a new government center, an equestrian center, and substantial development of residential units throughout the community. Much of the historic agricultural lands are being rezoned for development.

Community Capabilities

Hurricane is governed by a mayor and city council, who engage in legislative activities for the community. Several boards and committees advise council on actions and make decisions for the community. Committees include:

- Airport Board
- Appeals Board
- Joint Utility Committee
- Planning Commission
- Power Board
- Redevelopment Agency
- Water Board

A planning commission reviews new development permit applications, zone change activities, and contribute to the community general plan. The community has a full-time planning staff who assist residents with.

The community water board is responsible for reviewing the city's water supply and distribution system. Manages culinary and irrigation systems. An agreement with the Washington County Water Conservancy District for wholesale water delivery helps cover areas and times when municipal supply cannot keep up with demand.

City administrative staff oversee the day-to-day operations of the city. Include: recorder, city manager, treasurer, city attorney. Departments provide specific and specialized skills to address city ongoings and needs, per local ordinances. Capacity in departments include, but are not limited to building and code enforcement, engineering, police, emergency management, and animal control, GIS mapping, planning and zoning, public works, Parks department and Sky mountain golf course, streets, power, and water and irrigation.

The Hurricane Valley Fire Special Service District provides Emergency medical and fire suppression services to the area.

Plans and Policies

Hurricane has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Hurricane's plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Hurricane City includes several ordinances that address natural hazards by setting guidelines for design and development, requirements for reporting and assessment of a site preconstruction, permitting requirements, or description for areas specific to mapped hazard areas like flooding.

General Plan

The Hurricane General Plan (2020) describes the long-term vision for the community. Elements of the plan describe goals, policies, and actions to meet this long-term vision. Natural Hazards are described as challenges to the community that impact residents, public safety, property, and other essential assets in the community. The General plan describes challenges and strategies to address flooding, landslide, drought, and geologic hazards. A large portion of the available land in the community is undeveloped, some of which is not developable due to hazards and sensitive environments. To further protect the community, Hurricane has strategized policies and strategies which address natural hazards in the general plan. Policies include adopting and updating municipal ordinances for sensitive lands and hillsides and geologic hazards. The community also details a strategy to purchase or dedicate waterways, floodplains, and washes for trails and recreation in the community.

Drought hazards are discussed at length. They describe coordinating with the Washington County Water Conservancy District to engage the public with drought and conservation education. The city also prioritizes updating their own standards and landscaping to conserve water. And limit turf grass and promote low water use landscaping like xeriscaping.

Risk Assessment

Hurricane is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Hurricane planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 378 describes the relative risks of hazards in the community.

Table 378: Hurricane Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. High
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Moderate

RADON	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Hurricane can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hurricane include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include City offices, schools, medical facilities, fire stations, and police stations and emergency services facilities.

Wildfire

Hurricane is a city in southeastern Washington County. The community is bounded by the Hurricane cliffs to the east and I-15 to the northwest. Several state roads are in Hurricane, including SR-9 to the north, SR-7 to the south, SR-318 to Quail Creek State Park and SR-59 to Hildale. The community also has two reservoirs in the west, which are water assets and recreational opportunities for visitors. The area is largely surrounded by open space and unincorporated County.

Figure 344 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Hurricane that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

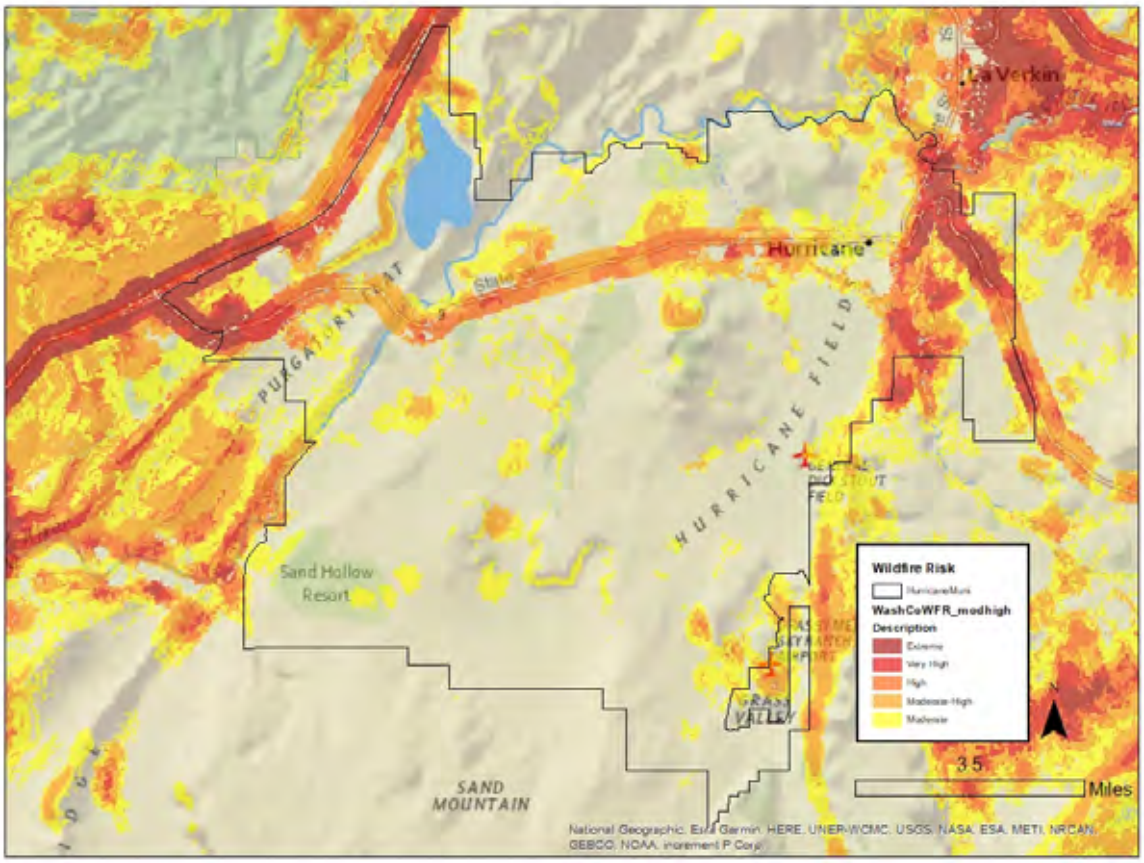


Figure 344: Hurricane Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 379: Hurricane Wildfire Risk further describes the community's risk by measuring community assets that fall in identified risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Hurricane, which could damage property, impact public health and safety, or impact local economies. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods.

Table 379: Hurricane Wildfire Risk

Hurricane Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
43.5%	80.0%	54.4%	55.9%	29.7%	N/A	66.7%

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. No fires documented on either source have impacted Hurricane as of July 2020. Smaller fires may have occurred that impacted the area that are not recorded on either source.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Hurricane, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. **Figure** 325 shows the mapped earthquake epicenters and fault lines in Hurricane. Hurricane has the Anderson section of the Hurricane fault running north to south, on the east side of the city. From the city, the hurricane cliffs mark the location of the fault as the area has uplifted. Other faults in the community include the Volcano faults to the west of the Hurricane Fault.

No earthquakes have been identified with an epicenter in the municipal boundary.

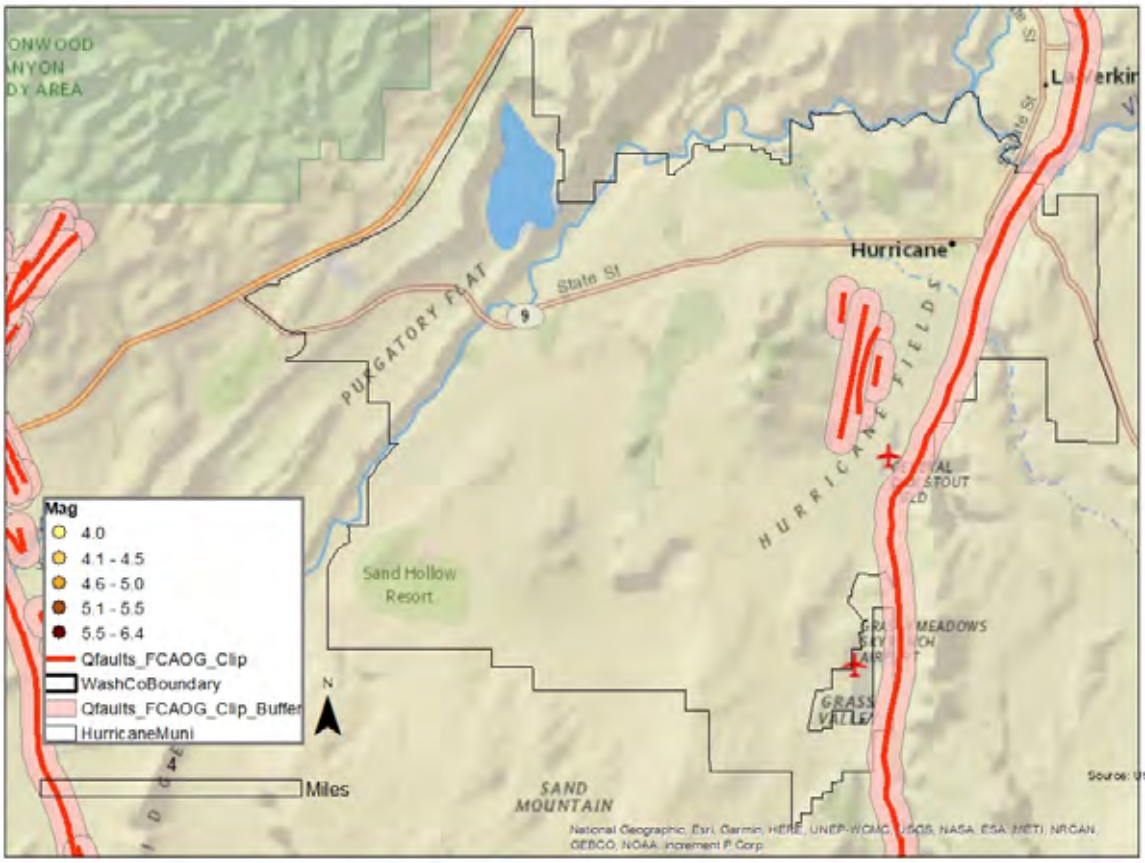


Figure 345: Hurricane Earthquake Epicenter and Quaternary Faults

Source: UGS, Garfield County Assessor, AGRC

While there is a fault identified in the Hurricane City boundaries, minimal parcels and road miles are exposed. Table 380 describes the exposure of community assets to the fault. Faults interact with community assets in the east portion of the community. Residential parcels have the highest exposure to the quaternary faults, which can cause personal property damage and impact residents.

Table 380: Hurricane Exposure to Quaternary Faults

Hurricane Exposure to Quaternary Faults						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			

4.3%	4.0%	11.2%	10.8%	6.3%	N/A	0.0%

Source: UGS, Garfield County Assessor, AGRC

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. According to Washington County Assessors data, 589 structures were built before the adoption of seismic code requirements in Hurricane, approximately 7.4% of the total structures in the city boundaries. One critical facility is identified as being constructed pre-1975. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for the urban portion of Washington County, which includes Hurricane City, as illustrated in Figure 346. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid. The map indicates that Hurricane has high to moderate susceptibility to liquefaction in the developed areas of the community and near the sand hollow state park. The area surrounding the Virgin River and Gould's Wash show the highest liquefaction susceptibility to the community, although several areas are noted to be at high susceptibility to liquefaction.

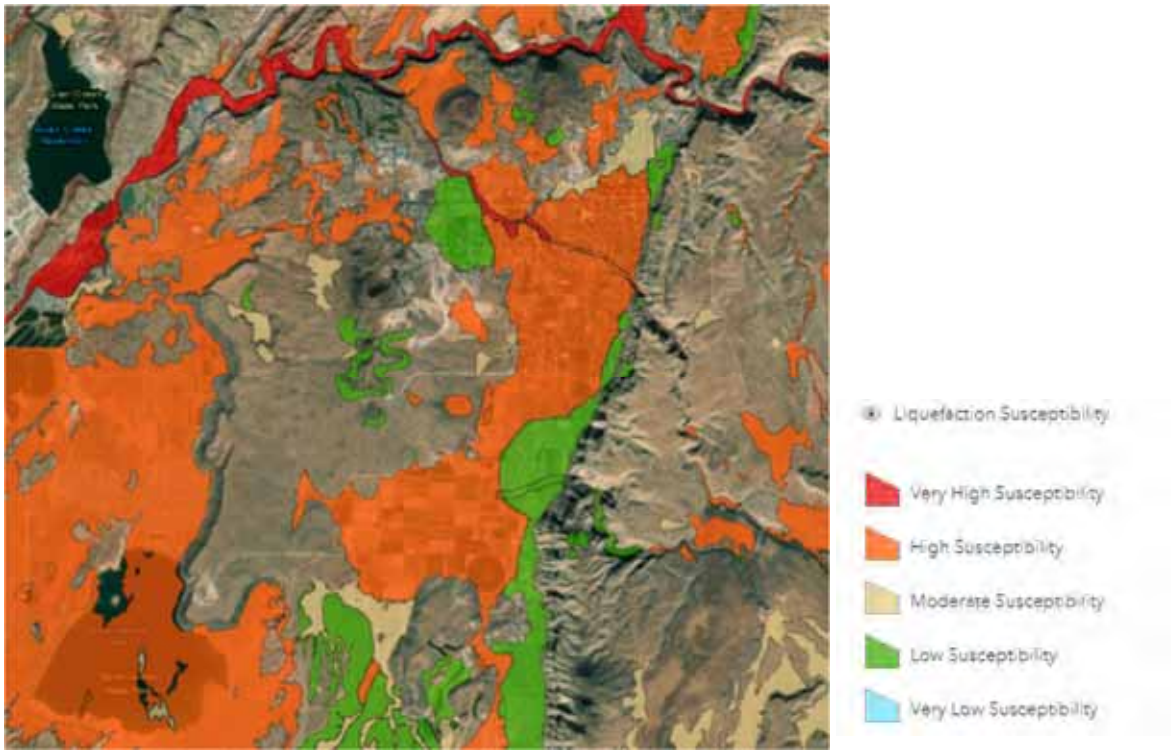


Figure 346: Hurricane Liquefaction Susceptibility

Source: Utah Geological Survey

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters of 4.0 magnitude or greater have been reported in Hurricane City as of 2020.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 347 depicts the flood and dam inundation exposure in Hurricane. Dam inundation zones are centered around Quail Creek and Sand Hollow State Parks and extend up and down the virgin river, overlapping with the mapped floodplain in the community. The 100-year floodplain also is observed in Hurricane in the center of the community, along Gould's Wash and into the downtown area.

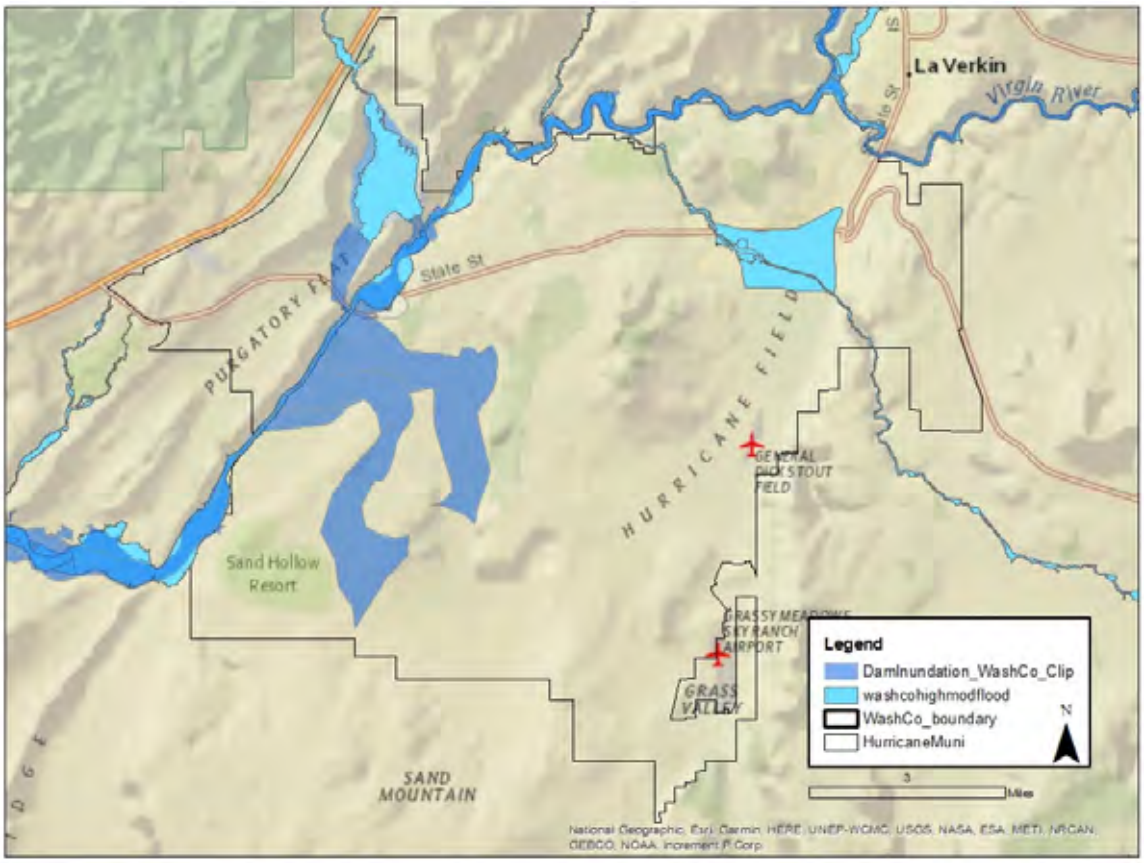


Figure 347: Hurricane Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 381 describes the Hurricane community assets exposed to dam inundation and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Commercial parcels are comparatively most exposed to flood and dam inundation zones, which can result in impacts to the local economy. A portion of critical facilities are exposed to flooding which can impact operations and response to emergencies during a flood event.

Table 381: Hurricane Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
30.4%	42.2%	24.0%	25.0%	18.6%	N/A	33.0%

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Hurricane property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 382: Hurricane NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$15,461	0	16	34	$8,799,100	2	$6,249

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Hurricane participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 382 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. Two claims have been submitted, and there are no repetitive losses recorded for the community. Hurricane has not reported repetitive losses and the community does not participate in the Community Rating System (CRS). The community received a Community Assistance Visit in 2011 and a Community Assistance Contact in 2019 from FEMA.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. The area also sees winter snowstorms, which can cause flooding from rapid melting and runoff, which are documented in the severe weather section. Table 383 describes the flooding events which have impacted Hurricane and the surrounding area.

Table 383: Hurricane Reported Flood Events

Date	Damage/Injury	Description
8/10/1997	$100,000	Flash flooding reported in Washington and Kane Counties. In Hurricane, a river gauge on the Virgin River went from 82 to 4451 CFS in less than 3-hours.
9/15/1997	$40,000	Heavy rain caused flooding in homes near SR-59 after water pooled on the road.
8/8/2001	None Reported	One foot of flood water was recorded on Highway 59.
8/21/2003	None Reported	Flash flooding recorded on North Creek.
10/21/2004	$20,000	A severe storm caused flash flooding throughout Washington County.

Source: NOAA Storm Database

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides

or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk to humans when events interact with the built environment and recreation opportunities. Figure 348 maps the landslide susceptible areas in Hurricane.

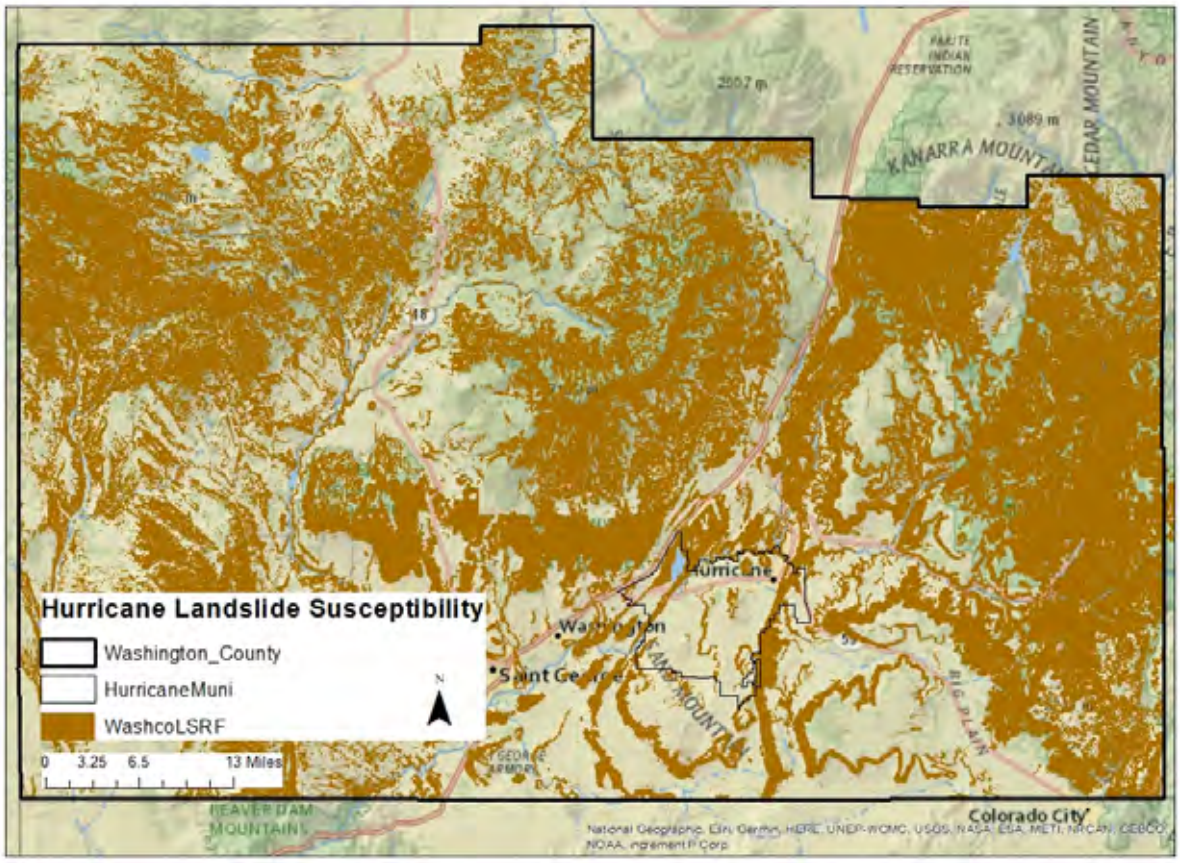


Figure 348: Hurricane Landslide Susceptibility

Source: Utah Geological Survey

Hurricane is exposed to landslide susceptible areas primarily in the north, west, and east portions of the community. In these areas, the community is bounded by cliff and hillsides. Table 384 describes the exposure of community assets to landslide susceptible areas. Exposed assets in the community include critical facilities, commercial and residential parcels, and road miles. People and property are vulnerable to landslides, which can damage homes, vehicles, and cause injury or death. On roadways, landslides can place debris on or cause damage to roadways. Such damages can block traffic and make access to the community a challenge. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 384: Hurricane Landslide Susceptibility Exposure

Hurricane Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	12.7%	17.1%	16.3%	8.9%	N/A	11.1%

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Landslides that interact with humans and property can have financial, health, life and public safety impacts. Table 385 describes the landslide events reported for Hurricane city.

Table 385: Hurricane Landslide Hazard Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Event description
1954	Hurricane, Washington County	N/A	N/A	Debris Flow

Sources: NOAA Storm Events Database, accessed 8/1/2020; FEMA Disaster Declarations, accessed 8/1/2020; UGS Preliminary Landslide History Database of Utah 1850-1978.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to

invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 349. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

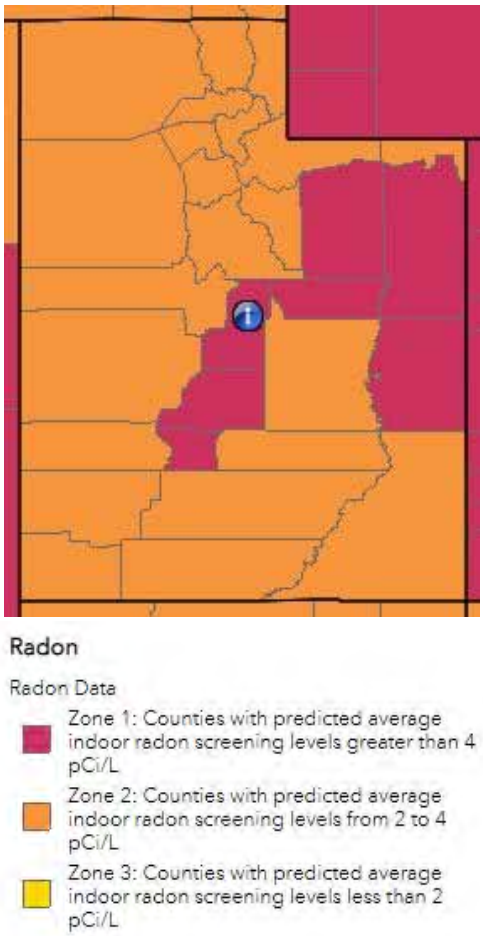


Figure 349: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 386 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 386: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Hurricane, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Hurricane is in a valley at the foot of several canyons, which sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. The area has recorded snow during winter months. Thunderstorms are the weather hazard that frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Hurricane has six reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 387. While the deaths reported during the 2013 events did not occur in Hurricane, the area likely saw extreme heat during these events which could cause impacts on residents and visitors.

Table 387: Hurricane Severe Weather Record

Date	Damage/Injury	Description
7/18/1994	None Reported	Wind gusts in Hurricane were estimated at 70-75 MPH and rainfall pooled 2-3 feet of water on SR-9 near Hurricane and I-15.
10/16/1999	None Reported	High winds were reported at 58 MPH.
1/5/2003	$100,000	High winds caused shingles to be blown off roofs and carports to be damaged in Hurricane.
6/12/2010	$8,000	Thunderstorm caused high winds which damaged trees and roofs in Hurricane.
12/7/2013	None Reported	Snow fall in Hurricane totaled six inches, causing traffic delays.
2/22/2019	None Reported	Hurricane reported three inches of snow during a winter storm.

Source: NOAA Storm Database

High winds tend to be particularly strong and impactful in Hurricane City, causing over $100,000 in reported damages. Severe weather will continue to impact Hurricane as weather events are frequently occurring in this region. Winter storms, high wind and snow can cause damages to structures and infrastructure. The flooding events caused by weather events are reported in the flooding section of this assessment. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Hurricane's Codes and Ordinances describe certain situations which would require a soils or geotechnical report for development. Figure 350 illustrates where the Utah Geological Survey has mapped problem soils for Hurricane. There are several types of prevalent problem soils in the region, including types that expand and contract with changes in soil moisture and dissolving with soil moisture.

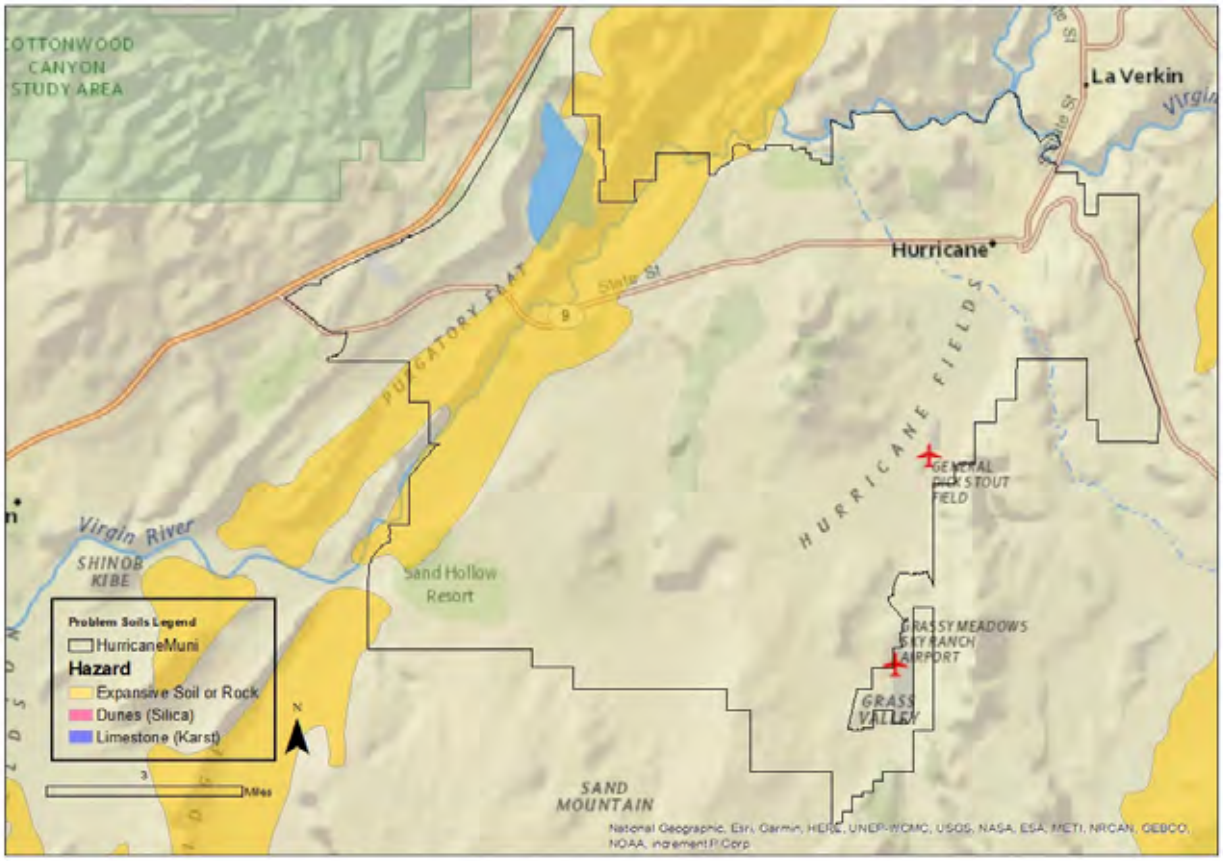


Figure 350: Hurricane Problem Soils Map

Source: UGS, AGRC

Community assets, infrastructure, and property are exposed to problem soils, with the greatest exposure being in critical facilities. Problem soils are often challenging to structures and infrastructure, as when the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure. Table 388 describes the infrastructure and assets which interact with mapped problem soil areas.

Table 388: Hurricane Problem Soil Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
17.4%	13.2%	14.0%	13.9%	10.8%	N/A	0.0%

Source: Utah Geological Survey, Washington County Assessor, UDOT

UGS has developed new mapping for other communities in the region, which provides greater detail to mapped problem soils. Hurricane is included in this mapping study area. Maps for Hurricane city described below show that the updated mapping shows greater extent of problem soils throughout the community and that more types of problem soils are prevalent to the area. This section includes maps of the soil types, but greater detail can be found in the Hazard Identification chapter describing problem soils.

Caliche

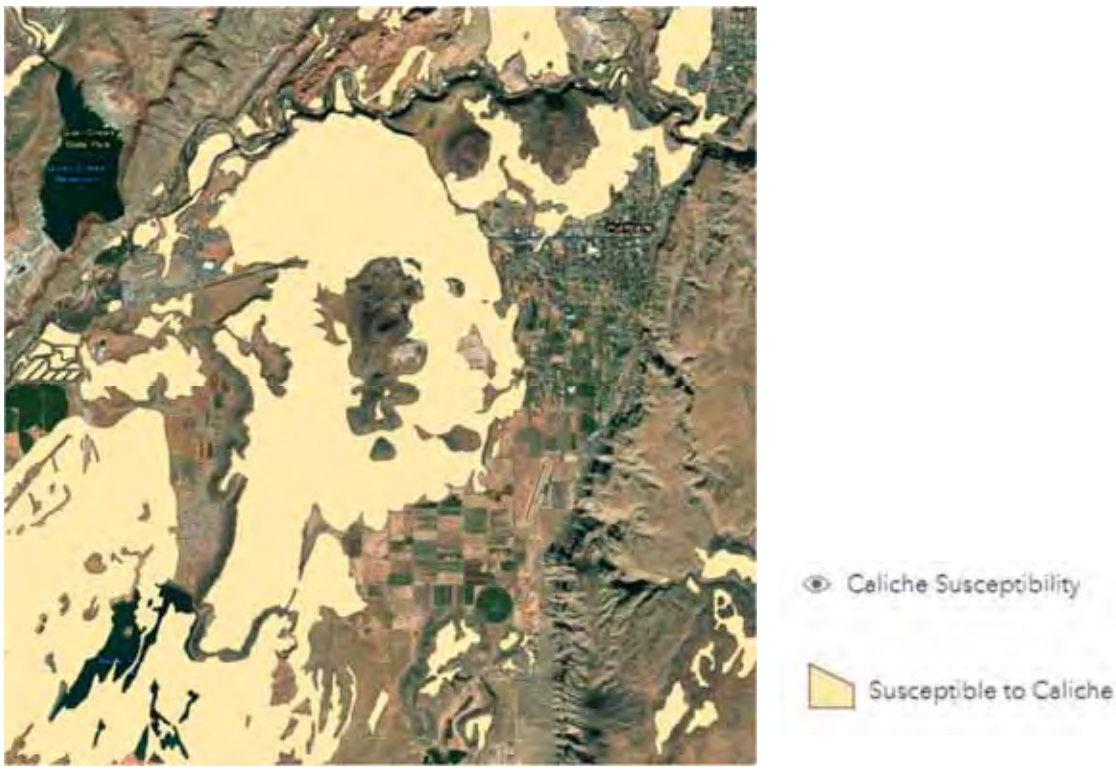


Figure 351: Hurricane City Caliche Susceptibility

Collapsible Soil

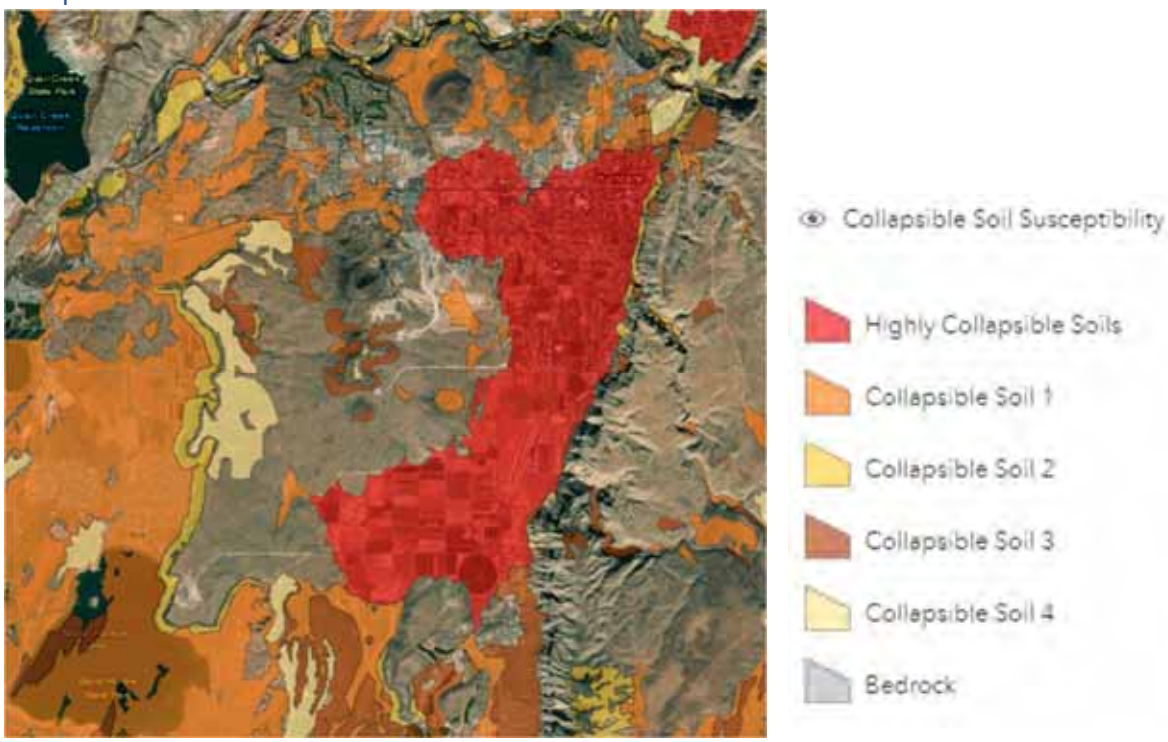


Figure 352: Hurricane Collapsible Soil Susceptibility

Expansive Soil

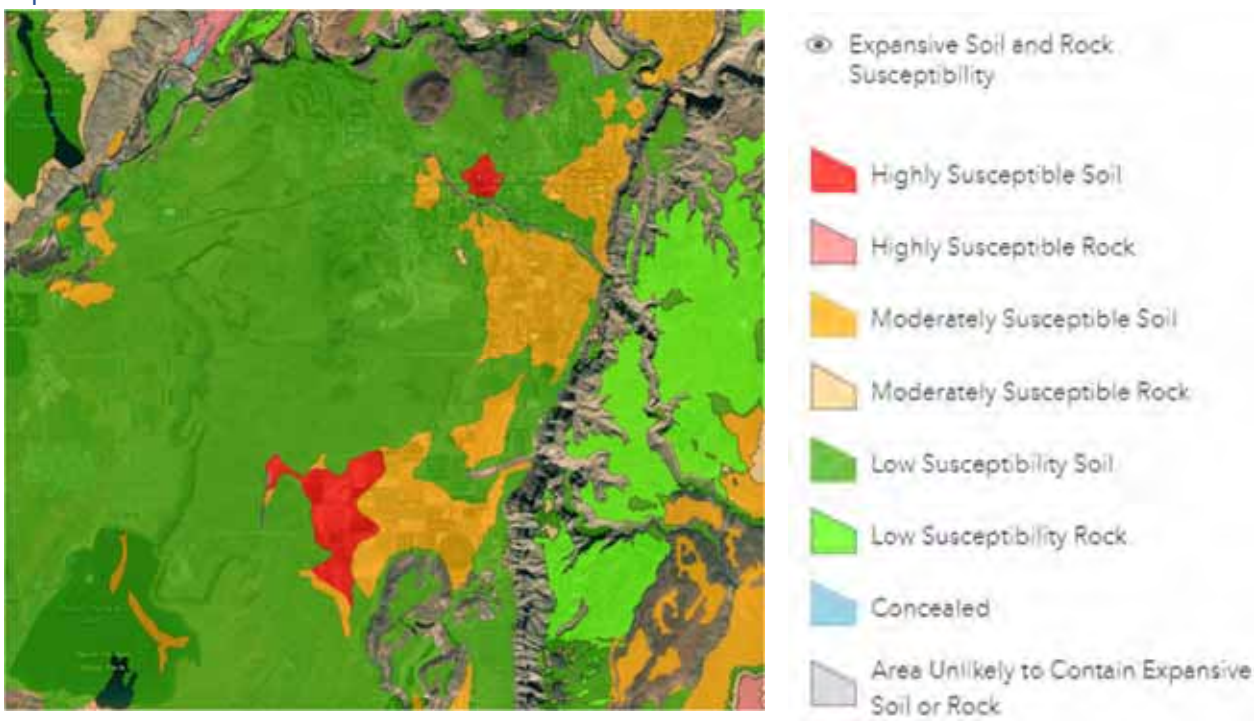


Figure 353: Hurricane Expansive Soil and Rock Susceptibility

Piping and Erosion

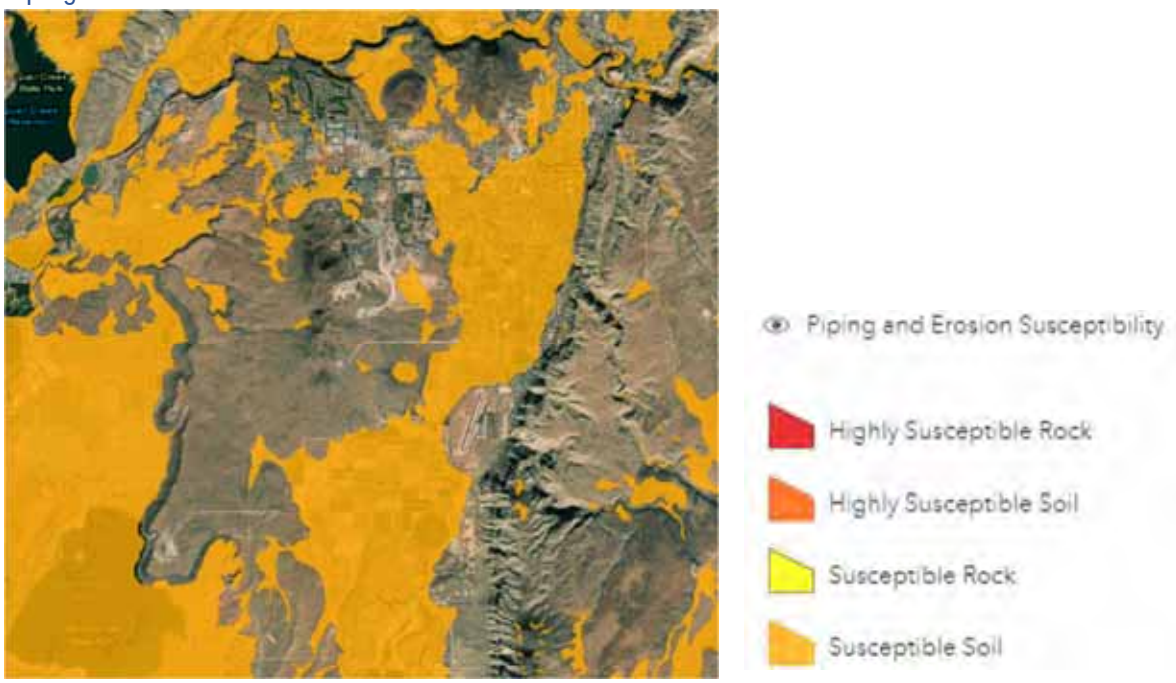


Figure 354: Hurricane Piping and Erosion Susceptibility

Shallow Bedrock

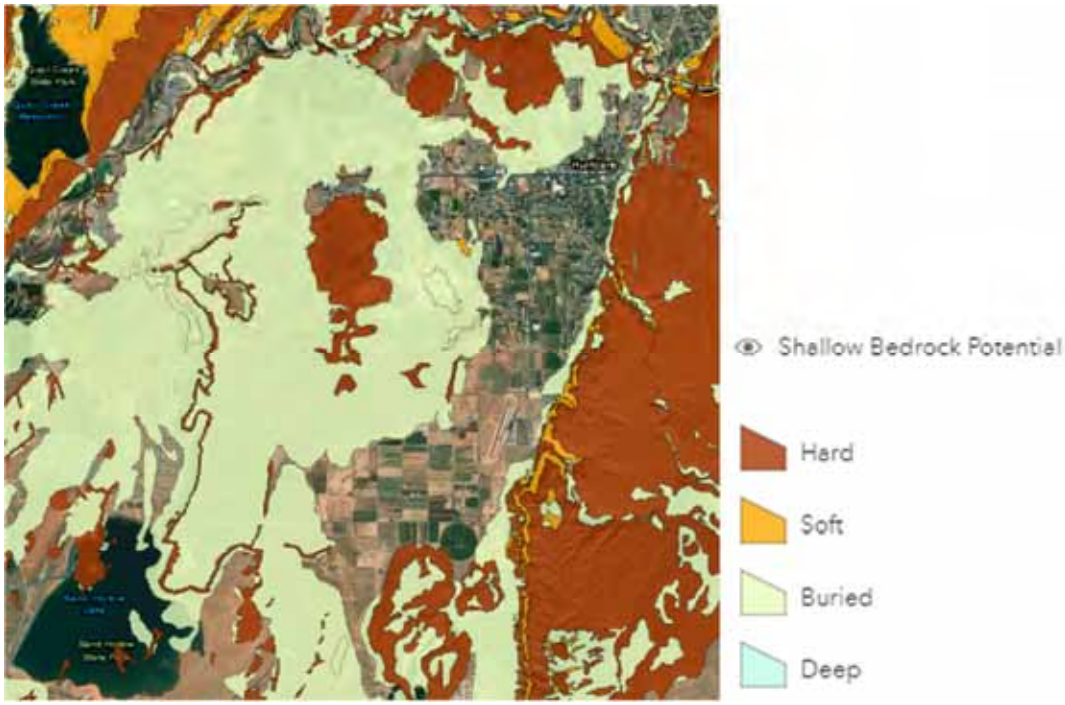


Figure 355: Hurricane Shallow Bedrock Potential

Soluble Soil and Rock

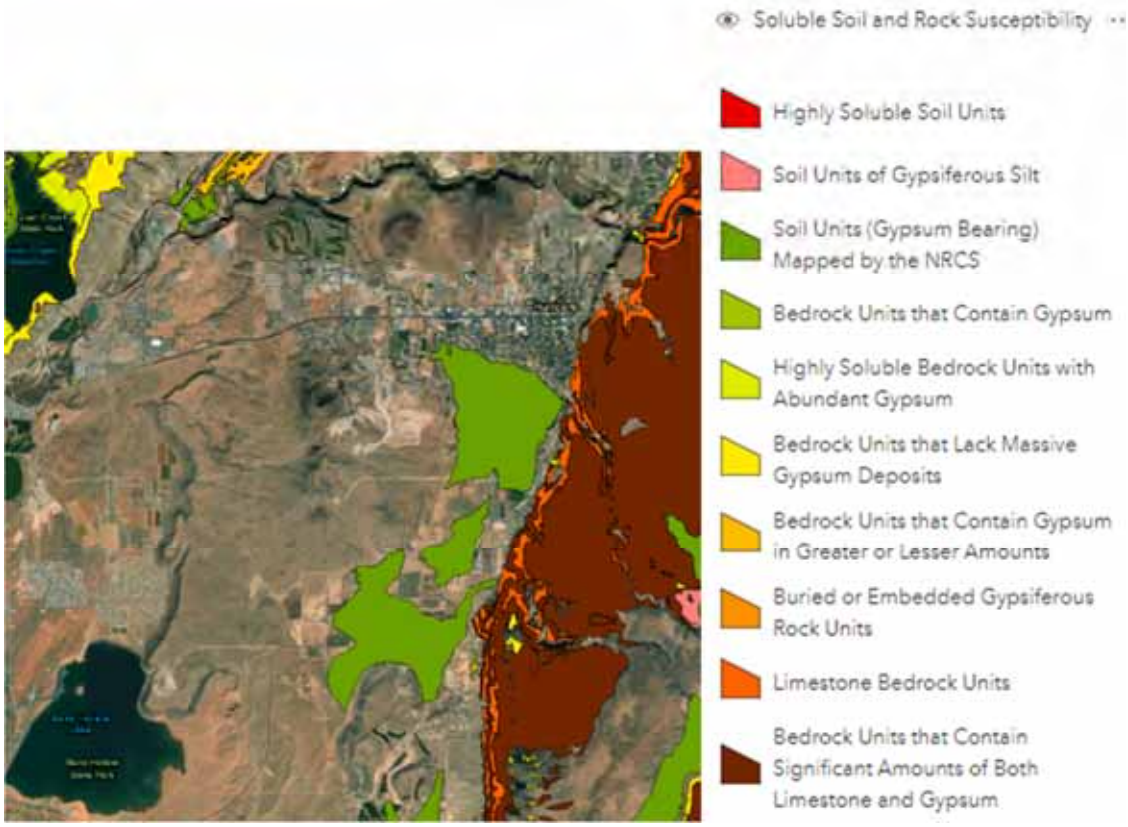


Figure 356: Hurricane Soluble Soil and Rock Susceptibility

Wind-Blown Sand

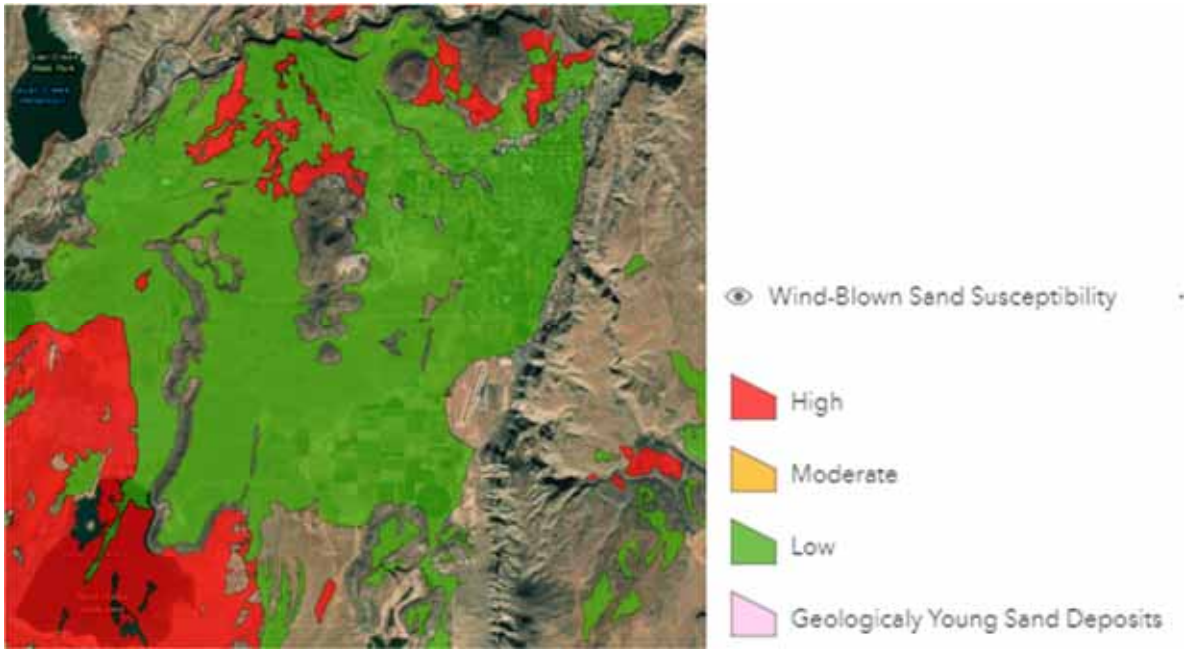


Figure 357: Hurricane Wind-Blown Sand Susceptibility

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Hurricane is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. Critical facilities in Hurricane are exposed to several natural hazards, including problem soils, flooding and dam inundation, landslides and rockfall, and wildfire. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Hurricane has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 389 describes progress made on Hurricane's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 389: 2016 Hurricane Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Minimize structural damage from floods.	Construct a retention basin on Gould's Wash above Hurricane City to prevent flooding in Hurricane City.	Unknown	Local government operating budget; State and Federal flood grant programs.	In progress, still needed.

Source: 2017 Five County Association of Governments NHMP

The Hurricane City planning team identified actions to include in the community mitigation strategy. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 358.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 358: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Hurricane has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 390, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 390: Hurricane 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2, 6	Reduce stormwater runoff.	Encourage permeable driveways and surfaces to promote groundwater recharge.	L	Ongoing	L	Hurricane City	Hurricane City
Drought #2	1	Protect agriculture industry from drought impacts.	Preserve economic stability during a drought by encouraging agricultural interests to obtain crop insurance to cover potential losses due to drought.	H	Ongoing	L	Hurricane City	Hurricane City
Drought #3	2	Improve infrastructure which provides critical services to residents.	Expand water storage capacity for municipal water.	M	5-10 years	H	Hurricane City	Hurricane City
Drought #4	2	Conserve water resources.	Replace unused grass areas with native vegetation on City owned property.	M	5-years	M	Hurricane City	Hurricane City
Drought #5	1, 2, 3	Develop policies to address drought	Establish drought policies with tiered actions to implement at different severities of drought conditions.	H	5-years	M	Hurricane City	Hurricane City
Drought #6	2	Improve infrastructure which provides critical	Plan for and build in redundancies in the water system.	M	5-10 years	H	Hurricane City	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		services to residents.						
Flood #1	1, 2	Improve infrastructure to reduce flood risk to residential areas.	Construct detention basin on Gould Wash.	H	3-years	H	NRCS, Hurricane City, Washington County.	Hurricane City, Washington County.
Flood #2	1, 2	Improve infrastructure to reduce flood risk to residential areas.	Rehabilitate Frog Hollow detention basin	H	5-years	H	Hurricane City, Washington County.	Hurricane City, Washington County.
Flood #3	1, 2	Reduce stormwater run off.	Limiting the percentage of allowable impervious surface within developed parcels.	L	5-years	L	Hurricane City	Hurricane City
Flood #4	1, 2	Improve policies to reduce flood risk to residential areas.	Preparing and adopting a stormwater drainage plan and ordinance.	M	5-years	M	Hurricane City, CIB.	Hurricane City
Flood #5	1, 2	Improve infrastructure to reduce flood risk to residential areas.	Assess and as needed, increasing drainage or absorption capacities with detention and retention basins, relief drains, spillways, drain widening/dredging or rerouting, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, or channel redirection.	M	Ongoing	M	Hurricane City, NCRS, FEMA, CIB, CDBG	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #6	1, 2	Improve infrastructure to reduce flood risk to residential areas.	Working with utility companies to raise utilities or other mechanical devices above expected flood levels.	M	Ongoing	L	Hurricane City, utility companies	Hurricane City, utility companies
Severe Weather #1	3	Inform residents of extreme temperatures risk.	Educate residents and visitors of the dangers of extreme temperatures (hot and cold) and severe weather events and the steps they can take to protect themselves during an event.	H	Ongoing, annually	L	Hurricane City	Hurricane City
Severe Weather #2	3, 4	Coordinate with local businesses to inform visitors of severe weather risk.	Developing a lightning brochure for distribution by recreation equipment retailers or outfitters.	M	Ongoing, annually	L	Hurricane City	Hurricane City
Severe Weather #3	2	Protect and secure city equipment.	Installing and maintaining surge protection on critical electronic equipment.	H	5-years	L	Hurricane City	Hurricane City
Severe Weather #4	1, 2	Use codes and ordinances to protect structures from severe weather.	Ensuring the development and enforcement of building codes for roof snow loads.	H	5-years	L	Hurricane City	Hurricane City
Severe Weather #5	1, 2	Use codes and ordinances to protect structures from severe weather.	Require or encourage wind engineering measures and construction techniques.	H	5-years	L	Hurricane City	Hurricane City
Severe Weather #6	1, 2	Use codes and ordinances to	Anchor bolts, Laminated or impact-resistant	H	5-years	L	Hurricane City	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		protect structures from severe weather.	glass, Reinforced pedestrian & garage doors, Window shutters, Waterproof adhesive sealing strips, Interlocking roof shingles, etc.					
Wildfire #1	1, 2	Use codes and ordinances to protect structures from wildfire.	Adopt the Wildland Urban Interface Code.	H	2-years	L	Hurricane city	Hurricane City
Wildfire #2	1, 2	Use codes and ordinances to protect structures from wildfire.	Using zoning and/or a special wildfire overlay district to designate high-risk areas and specify the conditions for the use and development of specific areas.	M	2-years	L	Hurricane city	Hurricane City
Wildfire #3	1, 2	Use codes and ordinances to protect structures from wildfire.	Encouraging the use of non-combustible materials (i.e., stone, brick, and stucco) for new construction and renovations in wildfire hazard areas.	M	2-years	L	Hurricane city	Hurricane City
Wildfire #4	1, 2	Use codes and ordinances to protect structures from wildfire.	Protecting propane tanks or other external fuel sources.	L	2-years	L	Hurricane city	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #5	1, 4	Protect critical infrastructure in vulnerable hazard areas.	Coordinate with local utility providers to mitigate hazardous fuels around utility infrastructure.	M	Ongoing	L	Hurricane City, utility companies	Hurricane City, Utility companies
Wildfire #6	2, 4, 5	Protect critical facilities in vulnerable hazard areas	Assess critical facilities to ensure that materials are flame resistant and landscaping is Firewise.	H	Ongoing	M	Hurricane City, local hospital/clinic, fire and police stations, schools.	Hurricane City, local hospital/clinic, fire and police stations, schools.
Earthquake #1	1, 2	Use codes and ordinances to protect structures from earthquake.	Requiring bracing of generators, elevators, and other vital equipment in hospitals and clinics.	M	2-years	L	Hurricane city	Hurricane City
Earthquake #1	2	Protect and secure city equipment.	Brace generators owned by the city.	H	5-years	M	Hurricane City	Hurricane City
Earthquake #2	3, 4	Inform residents and organizations of earthquake hazard,	Participate in great earthquake shakeout.	H	Ongoing	L	Hurricane City	Hurricane City
Earthquake #3	1, 2	Use codes and ordinances to protect structures from earthquake.	Require the anchoring rooftop-mounted equipment (i.e., HVAC units, satellite dishes, etc).	H	2-years	L	Hurricane city	Hurricane City
Earthquake #4	2	Use seismically resilient materials for critical infrastructure.	Using flexible piping when extending water, sewer, or natural gas service.	M	Ongoing	M	Hurricane City, CIB, CDBG,	Hurricane City.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #5	2, 5	Protect and secure critical facilities	Installing window film to prevent injuries from shattered glass at critical facilities.	M	2-years	M	Hurricane City	Hurricane City
Earthquake #6	3, 4	Inform residents and organizations of earthquake hazards.	Developing an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.	H	Ongoing	L	Hurricane City	Hurricane City, local businesses/ schools.
Earthquake #7	1, 2	Use codes and ordinances to protect structures from earthquake.	Requiring new masonry chimneys greater than 6 feet above a roof to have continuous reinforced steel bracing.	M	2-years	L	Hurricane city	Hurricane City
Earthquake #8	3	Inform residents of earthquake hazards.	Educating homeowners on safety techniques to follow during and after an earthquake.	H	Ongoing	L	Hurricane City	Hurricane City
Earthquake #9	1, 2, 3, 4	Collect data to inform mitigation. Inform residents of potential hazards.	Inventory structures in the City that are constructed with unreinforced masonry and plan for retrofit of structures for the safety of occupants.	L	Ongoing	L	Hurricane City, State and Federal Historic Tax Credit, Preservation Utah	Hurricane City
Landslide #1	1, 2	Identify and reduce landslide hazards.	Applying soil stabilization measures, such as planting soil stabilizing vegetation on steep, publicly owned slopes.	M	Ongoing	M	Hurricane City, FEMA, BLM, DNR	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #2	1, 2	Identify and reduce landslide hazards.	Using debris-flow measures that may reduce damage in sloping areas, such as stabilization, energy dissipation, and flow control measures.	M	Ongoing	M	Hurricane City, FEMA, BLM, DNR	Hurricane City
Landslide #3	1, 2	Use codes and ordinances to protect structures from landslide.	Establishing setback requirements and using large setbacks when building roads near slopes of marginal stability.	M	2-years	L	Hurricane city	Hurricane City
Landslide #4	1, 2, 4	Identify and reduce landslide hazards.	Installing catch-fall nets for rocks at steep slopes near vulnerable roadways.	M	5-years	M	Hurricane City, UDOT, Washington County	Hurricane City
Radon #1	3	Inform residents of Radon Hazard	Provide radon risk, testing, and mitigation information.	H	Annual, ongoing	L	Hurricane City, Utah DEQ	Hurricane City
Problem Soils #1	2, 4	Collect data to inform mitigation actions	Work with the Utah Geological Survey to update problem soil mapping.	L	5-10 years	L	Hurricane City, UGS.	Hurricane City
Problem Soils #2	1, 2	Collect data to inform mitigation actions	Inventory locations where problem soils have caused damages to properties.	L	Ongoing	L	Hurricane City	Hurricane City
Multi-Hazard #1	3	Inform residents of natural hazard events	Provide community information regarding natural hazards and vulnerabilities at the September preparedness fair.	H	Annually ongoing	L	Hurricane City	Hurricane City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi-Hazard #2	3, 4	Review and update risk data and actions to address natural hazards.	With local planning team, complete reviews of the progress on actions	H	Annually, ongoing	L	Hurricane City	Hurricane City
Multi-Hazard #3	3	Inform visitors of natural hazard events	Providing educational materials to local businesses/hotels for visitors use to understand natural hazard risks while recreating.	H	Annually, ongoing	L	Hurricane City	Hurricane City
Multi-Hazard #4	2	Conserve land at risk to natural hazards.	Inventory land at greatest risk to natural hazards and consider acquiring land in identified natural hazard risk area for public open space use.	H	5-10 years	H	Hurricane City	Hurricane City

Source: Local Planning Team

Ivins

Ivins City is located on the south side of Snow Canyon State Park, overlooked by towering sandstone cliffs, with lava flows throughout the community. Ivins City has ample arts and recreation opportunities through the Tuacahn Center for the Arts, Coyote Gulch Art Village, Snow Canyon State Park, and several resorts that operate in the community.

Ivins City was settled in the early to mid-1920s by families seeking to farm in the area. A small community developed in the following decade and the community incorporated into the Town of Ivins in 1935.

Demographics

As of the 2018 American Community Survey, Ivins has a population of 8,211 people, described in Figure 359. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

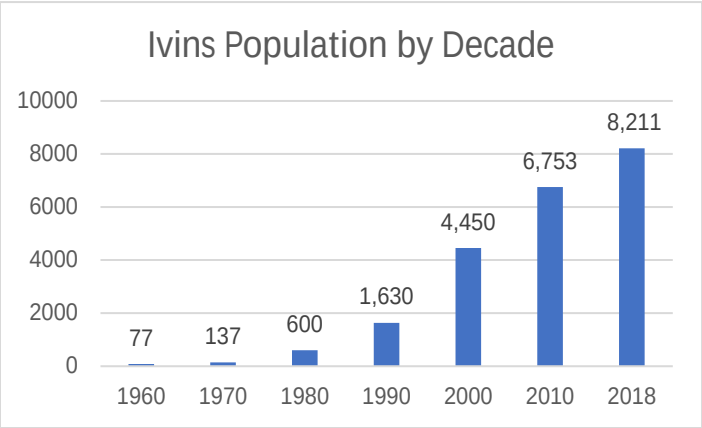


Figure 359: Ivins Population by Decade

Source: US Census Bureau

Ivins population has been increasing with time, with the most rapid changes observed between 1970 and 1980, where growth is recorded at over 300% change. Growth has been slowing since 2000, with the most recent estimated change near 22%, shown in Figure 360.

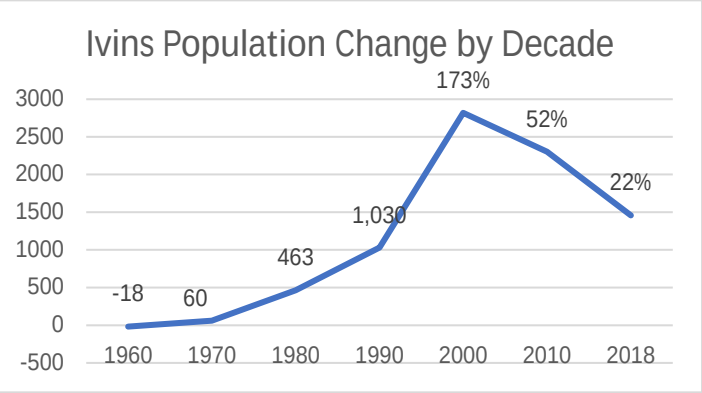


Figure 360: Ivins Population Change

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Ivins, the community could see 24,365 people living in the community in the next 45-years[21].

Economy

Agriculture was a driving force for settlement of much of southwestern Utah, which is reflected in Ivins history. The local economy has grown and developed since the early 1900s. Figure 361 describes an analysis of the share of jobs by industry from the US Census Bureau OnTheMap tool, according to the 2018 American Community Survey estimates. Industries with the largest share of jobs in the community include accommodation and food services, health care and

[21] This estimate is created using the 2015 ACS population estimate for Ivins, which was 7,406, and adding 229% of this population estimate to the population for that year.

social assistance, and construction. Arts, entertainment, and recreation also occupy a large portion of the local economy and is a very visible industry observed through the local theater and arts organizations, recreation amenities, and resorts in the community.

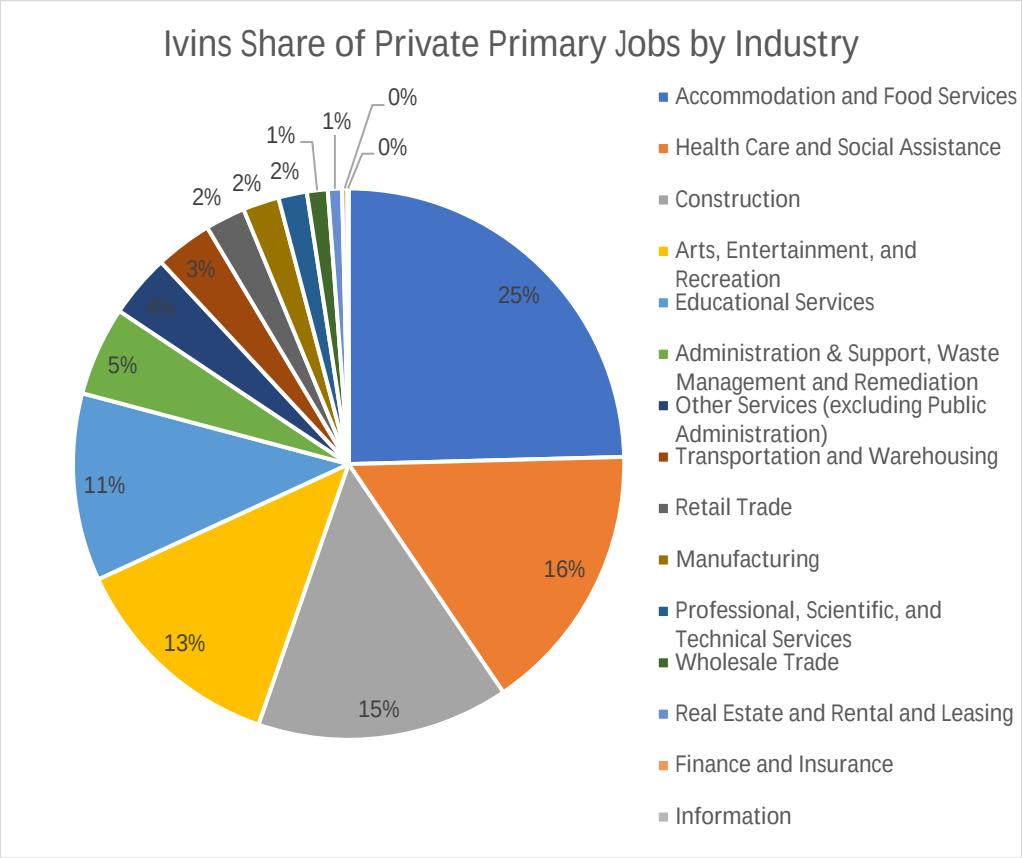


Figure 361: Ivins share of Private Primary Jobs by Industry

Development

The Ivins City General Plan (2015) describes development trends in the community as of 2015. As of the writing of the general plan, 36% of the community was developed and 14.5% is considered permanent open space, leaving 49% in undeveloped space. Some of this undeveloped space may not be developable due to geologic hazard or sensitive lands.

The City continues to develop mostly as a bedroom community to St. George with the majority of the development coming from single family home construction. However, for the past 3 years, the City has seen some multi-family construction occurring on the south side of near Old Highway 91. Commercial development in Ivins City is modest with a handful of small shops, but there are plans for some larger scale resort developments on the east side of the City such as Black Desert Resort and Sentierre Resort that are still in their initial stages of development.

Community Capabilities

Ivins is governed by a mayor and city council, who engage in legislative activities for the community. Several boards and committees advise council on actions and make decisions for the community. Committees include:

- Planning Commission
- Sensitive Lands Committee
- Arts Commission
- Emergency Preparedness Committee

A planning commission reviews new development permit applications, zone change activities, and contribute to the community general plan. The Building and Zoning department assists residents with permit and inspections, plan checks, and other activities which support development which follows city code and the general plan.

The sensitive lands committee provides recommendations to the planning commission and city council about plans and plan elements, ordinances, and applications which may be in sensitive land areas. The body advises the city council on matters relating to sensitive land areas.

The arts commission supports art relating funding and opportunities in the community. Members are appointed by City Council and participate in reviewing an Arts Master Plan, recommending to City Council about plan revisions, arts funding, and appointments to the arts commission.

The Emergency Preparedness Committee has engaged in rapid disaster and resilience training in the community. The committee has implemented disaster boxes in neighborhoods throughout the community, where any resident will be able to access the box during an emergency. Each box includes radio devices and instructions to contact emergency services during a natural disaster or other emergency event. Other activities implemented by this committee include food growing and storage for emergency preparedness and resilience.

City administrative staff oversee the day-to-day operations of the city. Include: city attorney, city manager, treasurer, director of finance, recorder, fleet manager, and business license administrator. Departments provide specific and specialized skills to address city ongoings and needs, per local ordinances. Capacity in departments include, but are not limited to building and code enforcement, engineering, public safety (fire, EMT, and police), building and zoning, and public works, and emergency management.

Public safety is provided by an interlocal agency, the Santa Clara-Ivins Public Safety Department, which provides police, fire, and emergency medical services to residents of the neighboring communities.

Plans and Policies

Ivins has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Ivins' plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Ivins City has developed ordinances to address natural hazards. The community includes cod which requires the use of the International Building Code and sets methods by which flooding losses can be reduced.

General Plan

The Ivins General Plan (2015) describes the long-term vision for the community. Elements of the plan describe goals, policies, and actions to meet this long-term vision. Natural hazards including landslide, problem soils, drought, and flooding are addressed in the community general plan. The community included policies which describe preserving the natural state of floodplain, washes, and hillsides to reduce hazard risks on the site. Policies also preface the promotion of water conservation and desert landscaping measures in the city.

Moderate Income and Affordable Housing Plan

The Moderate-Income Housing Plan (2019) challenges elderly residents on a fixed income may face in relation to housing. Housing costs including maintenance and utilities can be a challenge which may make residents more vulnerable to extreme temperatures and weather if these costs are too high. The Ivins general plan describes that weatherization, home rehabilitation programs, and utility assistance can help residents afford maintenance and utilities. In the west, with high heat in the summer and low temperatures in the winter, access to heating and cooling indoors is essential.

Water Conservation Plan

The Water Conservation Plan (2018) reports how Ivins City will conserve water in compliance with the Water Conservation Act of Utah, which requires an overall water use reduction goal and every five years a documented progress report, public comment, and plan update. The plan describes that the Washington County Water Conservancy District has met a 25% conservation goal. The city has also seeking to reduce water usage by 10% between 2017 and 2027 and maintain system water losses to 7%. Review the plan here for detail about the five-year conservation strategies.

Sewer Master Plan

The Sewer Master Plan provides an evaluation of the Ivins City wastewater system and sets objectives for improvements. Some improvements are in response to impacts from natural hazards, including severe storms and flooding, which cause backups or other damage.

Transportation Master Plan

The transportation plan sets the expected needs and growth of transportation infrastructure in the community. The plan describes current development status and exposure to hazard areas including slopes and the floodplain. Two projects in this plan include storm drainage improvements on Old Highway 91.

Risk Assessment

Ivins is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Ivins planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 391 describes the relative risks of hazards in the community.

Table 391: Ivins Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
FLOOD	3. High
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
RADON	6. Low
LANDSLIDE	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Ivins can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Ivins include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Ivins is a city in southern Washington County. The community is bounded by Snow Canyon on the north and east, Santa Clara City to the south, and the Paiute Reservation to the west. Old Highway 91 runs through the southwest portion of the community, parallel to the Santa Clara River. The Ivins reservoir is in the northwest of the community. Wildlands and open space border the community to the north and south.

Figure 362 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Ivins that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

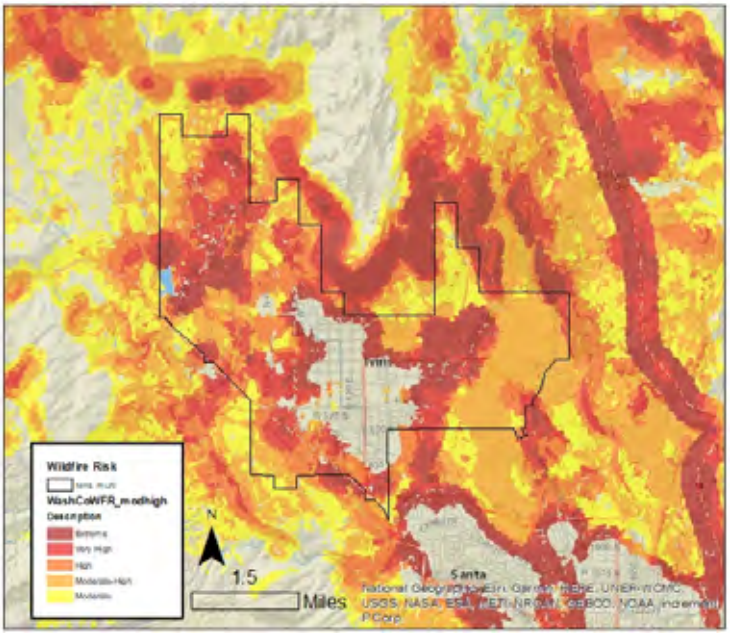


Figure 362: Ivins Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 392 further describes Ivins City's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Ivins, which could damage property, impact public health and safety, or impact local economies. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods. Critical Facilities impacted by wildfire can have challenges providing services during emergencies.

Table 392: Ivins Wildfire Risk

Ivins Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
50.0%	61.7%	57.0%	57.0%	60.8%	N/A	63.6%

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. No fires documented on either source have impacted Ivins as of July 2020. Smaller fires may have occurred that impacted the area that are not recorded on either source.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Ivins, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah tend to be small and barely felt in communities, but there are several faults in the state that have the potential to produce severe earthquakes. The Southwest has a history of large earthquakes which cause impacts. Figure 363 shows the mapped earthquake epicenters and fault lines in Ivins.

No earthquake epicenters with magnitude greater than 4.0 have been identified in the municipal boundary.

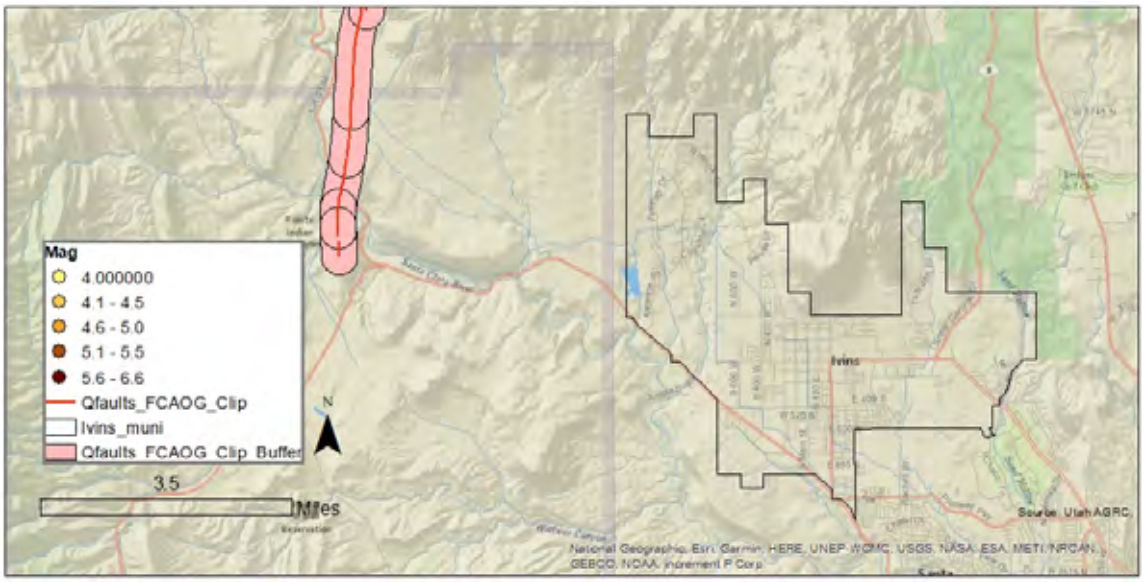


Figure 363: Ivins Earthquake Epicenter and Quaternary Faults

Source: UGS, Washington County Assessor, AGRC

There are no faults in the municipal boundary, with the closest mapped as a segment of the Gunlock Fault approximately four miles northwest of the city boundary.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event.

According to Washington County Assessors data, 77 structures were built before the adoption of seismic code requirements, approximately 1.9% of the total structures in the Ivins municipal boundaries. Southern Utah has a pride in their pioneer history, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for the urban portion of Washington County, which includes Ivins City. Liquefaction is a secondary hazard that can occur

following strong shaking, where the soil loses its structure and becomes fluid. Figure 364 indicates that Ivins has low to high susceptibility to liquefaction in the community.

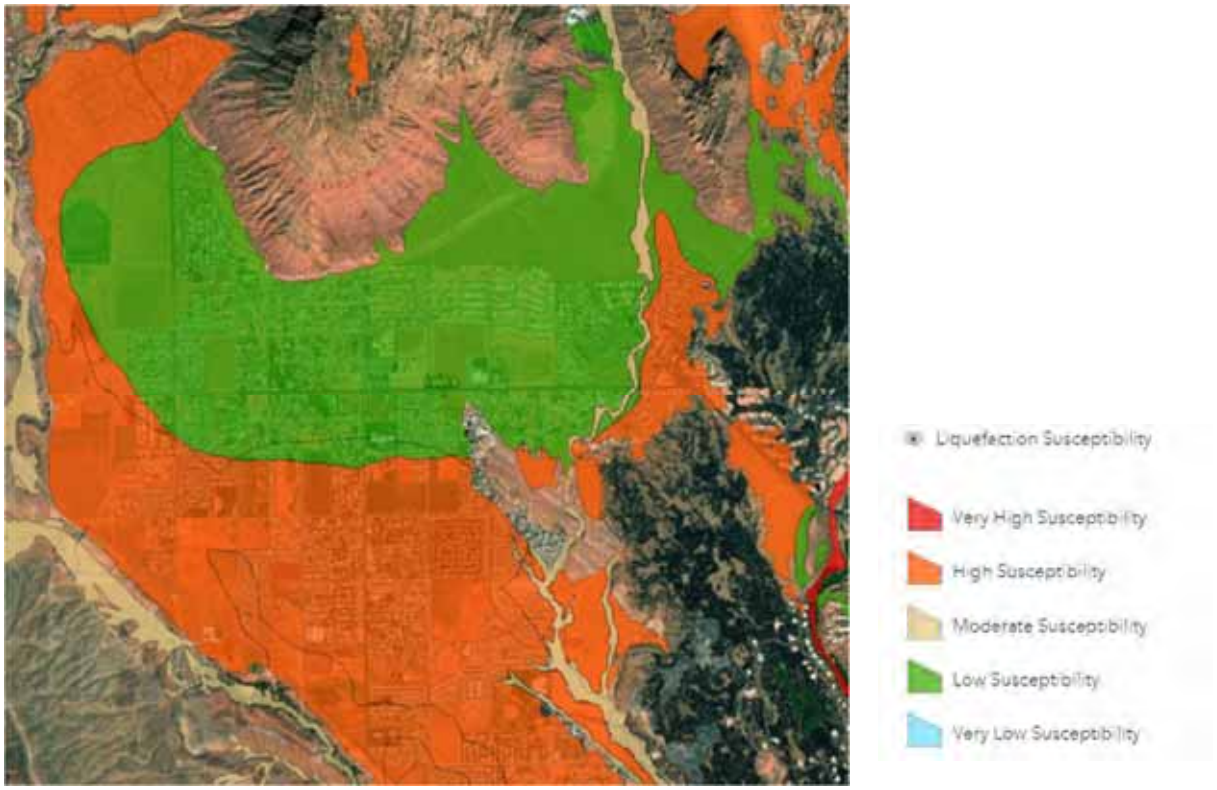


Figure 364: Ivins Liquefaction Susceptibility

Source: Utah Geological Survey

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters of 4.0 magnitude or greater have been reported in Ivins as of 2020. The closest earthquake occurred in St. George approximately 6.5 miles away and was likely felt in Ivins.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 365 depicts the flood and dam inundation exposure in Ivins. Dam inundation is mapped to the southwest of the community, along the Santa Clara River, and may interact with the Highway-91 thoroughfare in the community. Floodplains are observed

throughout the community, predominantly running north to south directional channels and washes, which lead to the Santa Clara River.

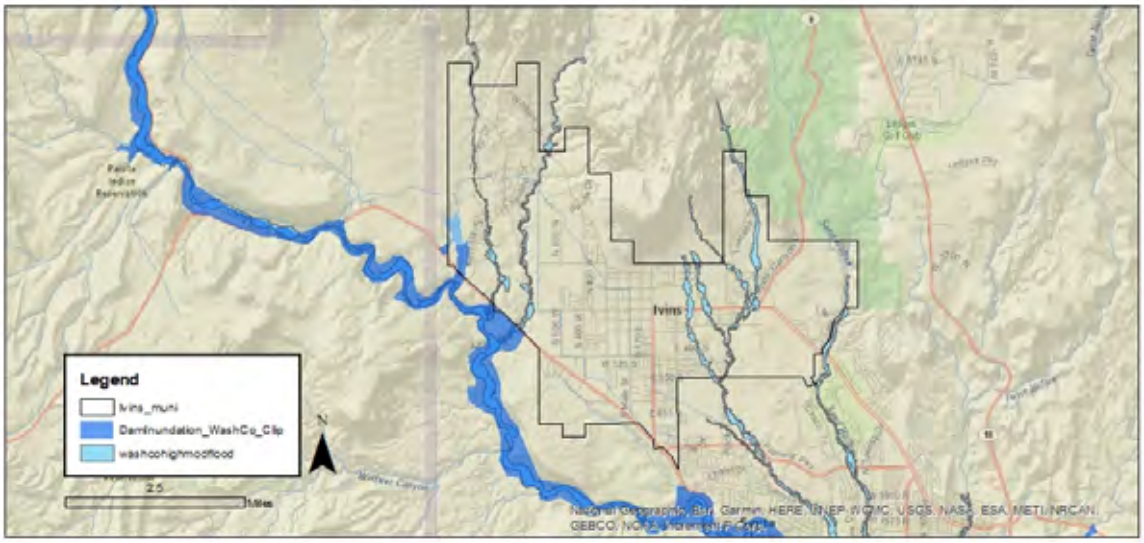


Figure 365: Ivins Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 393 describes the Ivins community assets exposed to dam inundation and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Local parks and commercial parcels are most exposed to flood and dam inundation per the map. Parks and open space can provide a buffer for flooding in communities, where flood prone areas do not damage personal property, economic assets, or cause injury to residents or visitors. Commercial properties at risk to flooding may see physical damages to the property, loss of inventory or business during and/or after a flood event, depending on the extent of damages.

Table 393: Ivins Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	11.7%	5.8%	5.9%	3.8%	N/A	27.3%

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Ivins property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 394: Ivins NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$16,209	0	0	44	$14,280,000	4	$19,409

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Ivins participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 394 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. Four claims have been submitted, and there are no repetitive losses recorded for the community. Ivins does not participate in the Community Rating System (CRS). The community received a Community Assistance Visit in 2015 and a Community Assistance Contact in 2019.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 395 describes the flooding events which have impacted Ivins and the surrounding area. Damages from flash flooding total above $150,000 for the community, from events occurring during monsoon season.

Table 395: Ivins Reported Flood Events

Date	Damage/Injury	Description
8/2/2005	$35,000	During a thunderstorm, a spotter reported 3.88” of rain in Ivins over a few hours. The storm caused seven Ivins homes to flood.
8/27/2007	$120,000	A severe storm dropped 1.77 inches of water, resulting in damage to 12 homes from flash flooding.
8/4/2008	None Reported	Heavy rain produced flash flooding in Snow Creek Canyon.
8/7/2008	None Reported	A severe storm caused flash flooding on streets in Ivins, damaging one home.

Source: NOAA Storm Database

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk to humans when events interact with the built environment and recreation opportunities. Figure 368 maps the landslide susceptible areas throughout Washington County, with Ivins Municipal Boundary. Landslide susceptible areas are mapped to the north and southwest portion of the Ivins boundary, where hillsides and steep cliffs mark the terrain.

Figure 366: Ivins Rockfall Hazard

Source: Utah Geological Survey

Figure 367: Ivins Landslide Hazard

Source: Utah Geological Survey

Rockfall is a type of landslide which is described as the displacement of rocks or boulders. Rockfall areas may have a long runout where the boulder has built speed and continues to move, even once off the slope, which can impact structures and infrastructure at the bottom of a hill or cliff.

Figure 8 describes the identified rockfall areas in Ivins and areas of high hazard susceptibility are in the northern portion of the community, south of Snow Canyon State Park. Some susceptible areas are in drainages northwest of the community, and in the open space to the south.

Landslides represent a more general term for lands, soils, or rock that move on the ground. Landslides are often attributed to steep slopes. As observed in Figure 9, the northern portion of the community, near Snow Canyon State Park and Tuacahn Theater are exposed to some landslide risk, with the highest risk notably on southwest facing side of Red Mountain.

Figure 10 describes in a summary the exposure for the county, with the City of Ivins outlined, showing a comparison for the rest of the surrounding area.

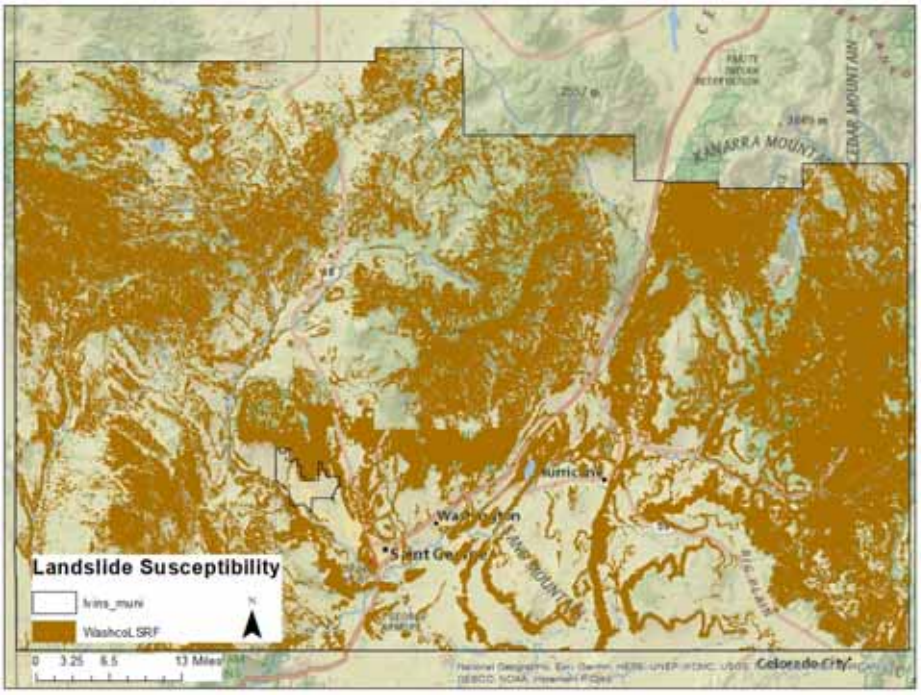


Figure 368: Washington County Landslide and Rockfall Susceptibility

Source: Utah Geological Survey

Ivins is exposed to landslide susceptible areas primarily in the north and southwest portions of the community, where the city is bounded by cliffs and hillsides. Table 396 describes the estimated exposure of community assets to landslide susceptible areas. Exposed assets in the community include critical facilities, commercial and residential parcels, and road miles. People and property are vulnerable to landslides, which can damage homes, vehicles, and cause injury or death. On roadways, landslides can place debris on or cause damage to roadways. Such damages can block traffic and make access to the community a challenge. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 396: Ivins Landslide Susceptibility Exposure

Ivins Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	3.3%	7.9%	7.8%	6.6%	N/A	9.1%

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Landslides that interact with humans and property can have financial, health, life and public safety impacts. To date, there have not been landslides reported impacting the City of Ivins.

Figure 369: Map of existing landslides

Utah Geological Survey

Maps from the Utah Geological Survey identify landslide boundaries which are on the steep slopes to the north of the city, and in the open space southwest of Ivins. Both areas are presently undeveloped, but future uses may expose structures and infrastructure to landslide risk and damage.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 370. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

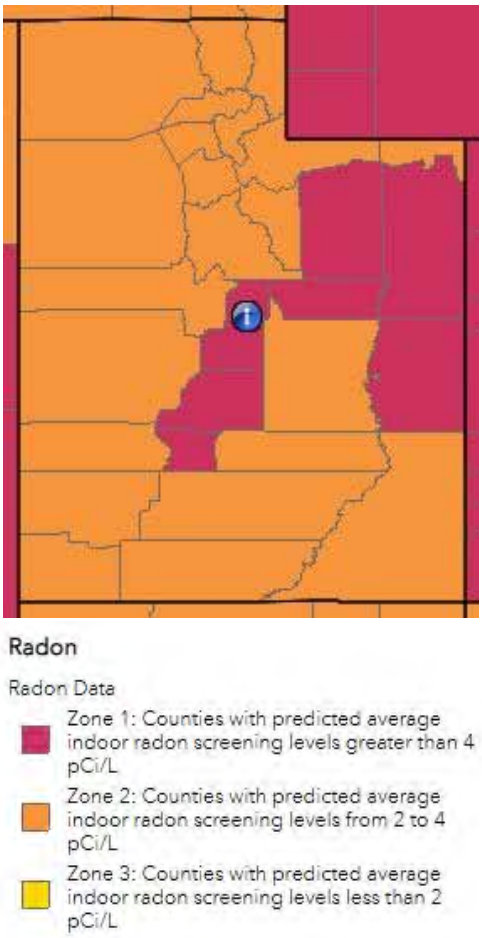


Figure 370: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied. Unfortunately data for specific cities and towns is not available.

Table 397 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 397: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Ivins, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Ivins is in a valley at the foot of a canyon, which sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. A river runs near the community and a major roadway, which can be subject to flooding. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Ivins has three reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 398. While the deaths reported during the 2013 events did not occur in Ivins, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers are most vulnerable to these extreme temperatures.

Table 398: Ivins Severe Weather Record

Date	Damage/Injury	Description
9/9/1998	$35,000	Wind gusts of 70 MPH were reported in Ivins causing $25,000 in Crop Damage and $10,000 in property damage.
1/5/2003	$100,000	High Winds were observed throughout Washington County with 70 MPH recorded in Ivins.
7/30/2007	None Reported	Thunderstorms caused flash flooding, dropping over an inch of rain in 20-minutes. Dry washes in Ivins were running with water.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures contributed to the death of a hiker in Kane County.

Source: NOAA Storm Database

High winds are a frequently observed hazard in Ivins, causing $135,000 in reported damages. Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. Figure 371 through Figure 377 illustrate where the Utah Geological Survey has mapped various problem soils for Ivins. According to the planning team, the dominant soils identified to have impacts on structures and construction in the community include collapsible and expansive soils. To address these soil types, the community requires geological testing and mitigation for development.

Caliche

Figure 371: Ivins Caliche Susceptibility

Collapsible Soil

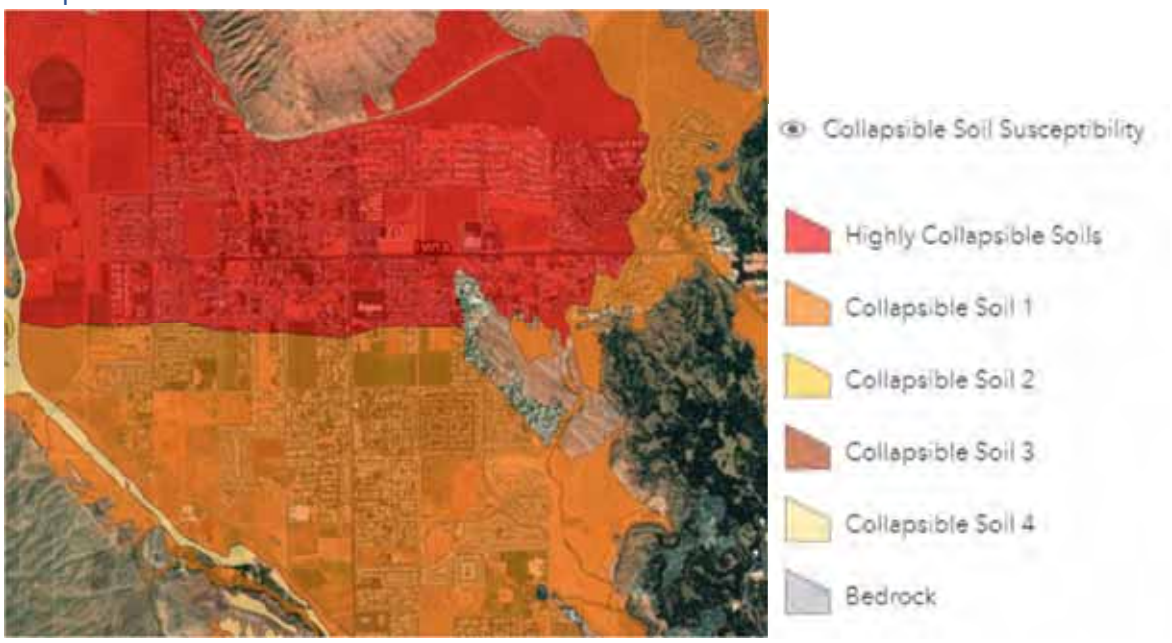


Figure 372: Ivins Collapsible Soil Susceptibility

Expansive Soil

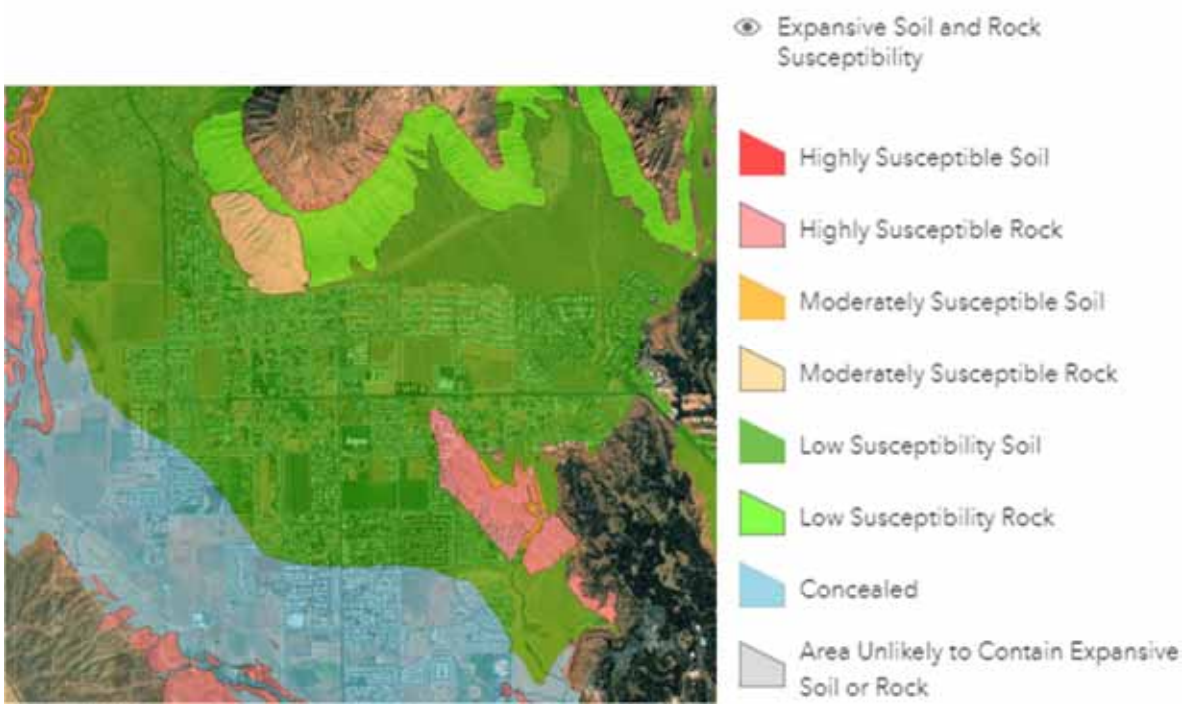


Figure 373: Ivins Expansive Soil and Rock Susceptibility

Piping and Erosion

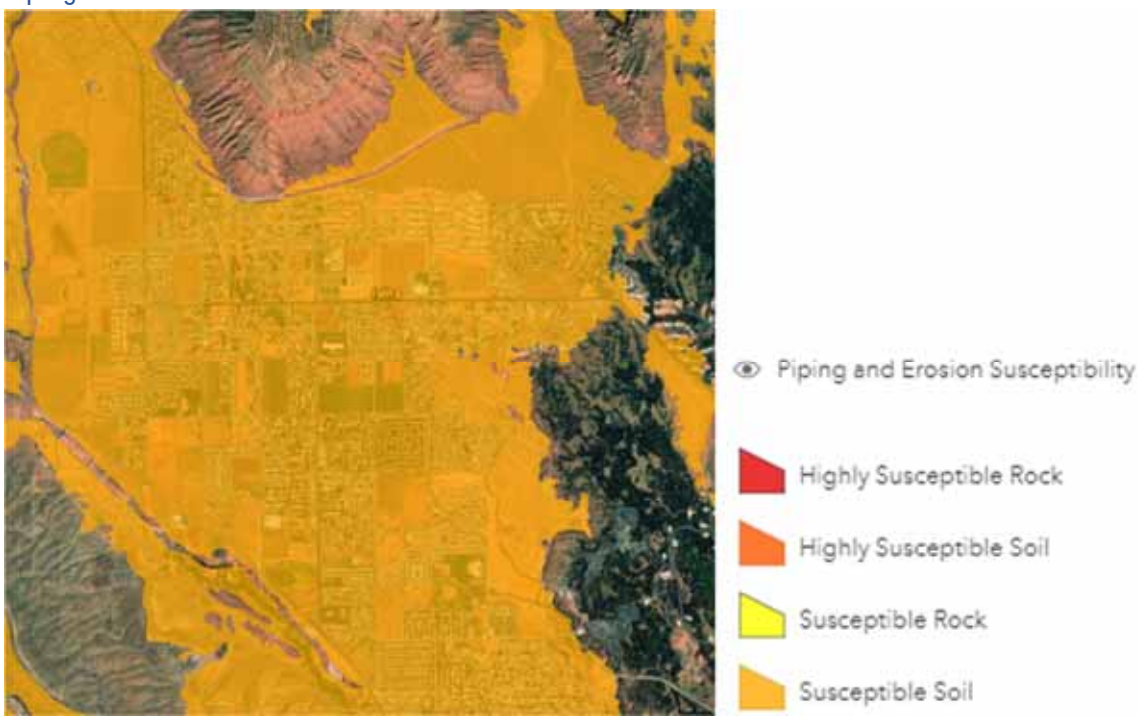


Figure 374: Ivins Piping and Erosion Susceptibility

Shallow Bedrock

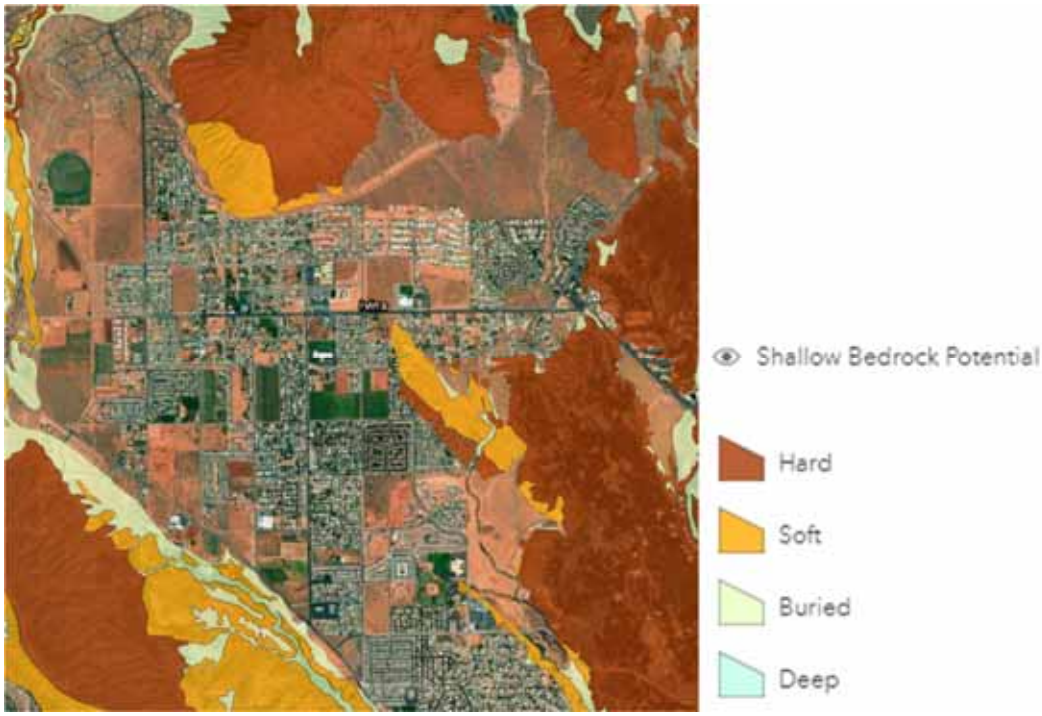


Figure 375: Ivins Shallow Bedrock Potential

Soluble Soil and Rock

Figure 376: Ivins Soluble Soil and Rock Susceptibility

Wind-Blown Sand

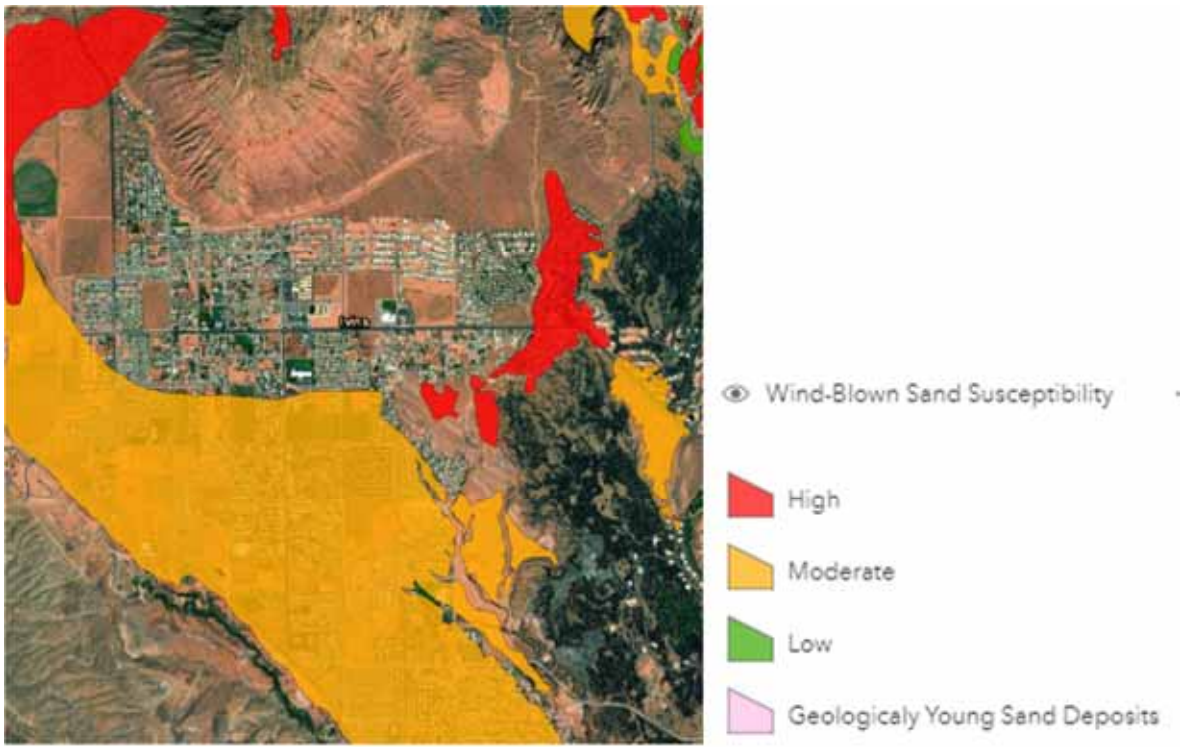


Figure 377: Ivins Wind-Blown Sand Susceptibility

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Ivins is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts on the tourism industry in the area following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. Critical facilities in Ivins are exposed to several natural hazards, including landslides and wildfire. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Ivins has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 399 describes progress made on Ivins' mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 399: 2016 Ivins Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Problem Soils #1	Lessen the risk to buildings from problem soils.	Address problem soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Ongoing
Problem Soils #2	Lessen the risk to buildings from problem soils.	If jurisdiction does not have trained staff to review the geotechnical report, the jurisdiction can, upon request, have Utah Geological Survey (UGS) perform a review of the report.	Ongoing	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	Ongoing
Flood #1	Mitigate property damage from high intensity storms	Construct various storm drain projects as identified as priority 2 in the 2016 Ivins Storm Drain Master Plan	Phased over 10 years	Ivins is bonding for $1.5M. Bond will be paid back with impact fees and user rates. A grant from NRCS has delivered another $1M from the Emergency Watershed Protection program.	Unknown

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Ivins has assembled several actions, addressing each of the natural hazards that they are at risk to. These actions are detailed in Table 400. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 378.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 378: Regional Plan Goals

Table 400: Ivins 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi-Hazard #1	3, 5	Provide residents with information	Identify new locations to install and inform residents about disaster boxes in Ivins City neighborhoods.	H	5-years	L	Ivins City	Ivins City Emergency Preparedness Committee, Ivins City.
Problem Soils #1	1, 2, 6	Reduce risk to structures and infrastructure.	Address problem soils at the building/construction level by requiring all subdivision proposals to have a geotechnical report.	H	Ongoing	L	Private funds/ developer; Local government operating budget; Utah Geologic	Ivins City

							Survey operating budget.	
Radon #1	3	Provide residents with information	Provide radon risk, testing, and mitigation information to residents.	H	1-year / ongoing	L	City budget	Ivins City
Radon #2	4	Reduce risk to structures and infrastructure.	Participate in radon testing in local public schools.	M	1-year	L	Ivins City, Washington County, Washington County School District	Ivins City, Washington County, Washington County School District
Drought #1	2	Secure water sources.	Construct a reservoir in Ivins City to support local irrigation needs.	H	10-year	H	Washington County Water Conservancy District	Ivins City, Washington County Water Conservancy District.

Source: Local Planning Team

La Verkin

With the Pine Valley Mountains to the north, and Hurricane Hill to the east, La Verkin City has incredible access to the outdoors, beautiful vistas, and is steeped in local history. The city was settled by Latter-day Saint pioneers as a farming community in 1899. The local record indicates that these settlements experienced periodic natural hazard events that impacted crops and farming, at the time, the mainstay of the local economy.

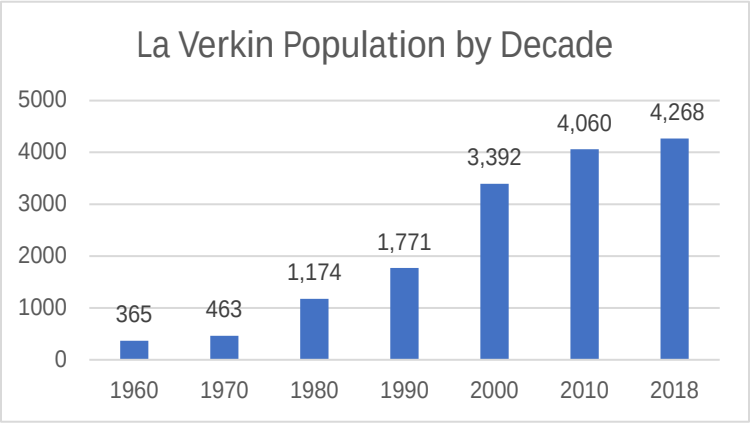


Figure 379: La Verkin Population by Decade

Source: American Community Survey Table DP05 5-Year Estimates.

Demographics

As of the 2018 American Community Survey, La Verkin has a population of 4,268 people, described in Figure 379. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

When comparing population changes year to year, it is observed that La Verkin has experienced growth since 1970, with the most rapid growth being observed from 1970 to 1980, described in Figure 380. Growth appears to have slowed to 5.1% based on the 2018 estimate. The average growth experienced between 1960 and 2010 is 56%.

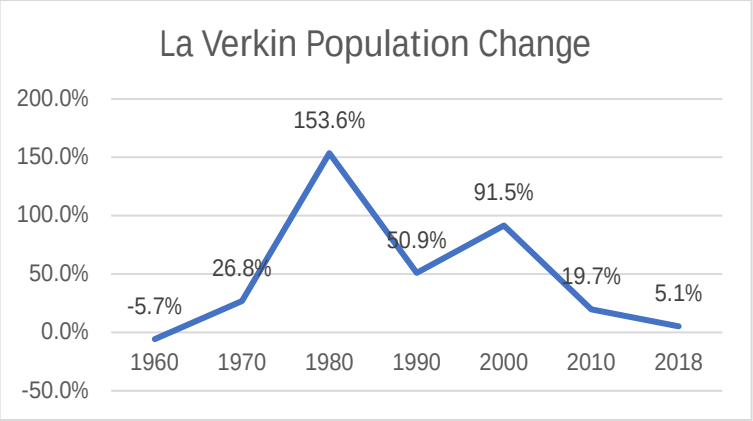


Figure 380: La Verkin Population Change

Source: American Community Survey Table DP05 5-Year Estimates.

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to La Verkin, the community could see around 13,673 people living in the community in the next 45-years[22].

Economy

Today La Verkin's economy is based on accommodation and food services, construction, and manufacturing industries, although there is still a share of the economy that is reliant on agriculture. Data sourced from the US Census tool On the Map details the share of jobs by industry in La Verkin,

[22] This estimate is created using the 2015 ACS population estimate for La Verkin, which was 4,156, and adding 229% of this population estimate to the population for that year.

seen below in Figure 381. This chart does not include mining, quarrying, and oil and gas extraction; utilities; information; finance; management of companies and enterprises; educational services; arts, entertainment, and recreation; and public administration industries, as they do not make up a share of La Verkin's economy according to this data. There are a total of 408 private primary jobs in La Verkin City as of 2018 estimates.

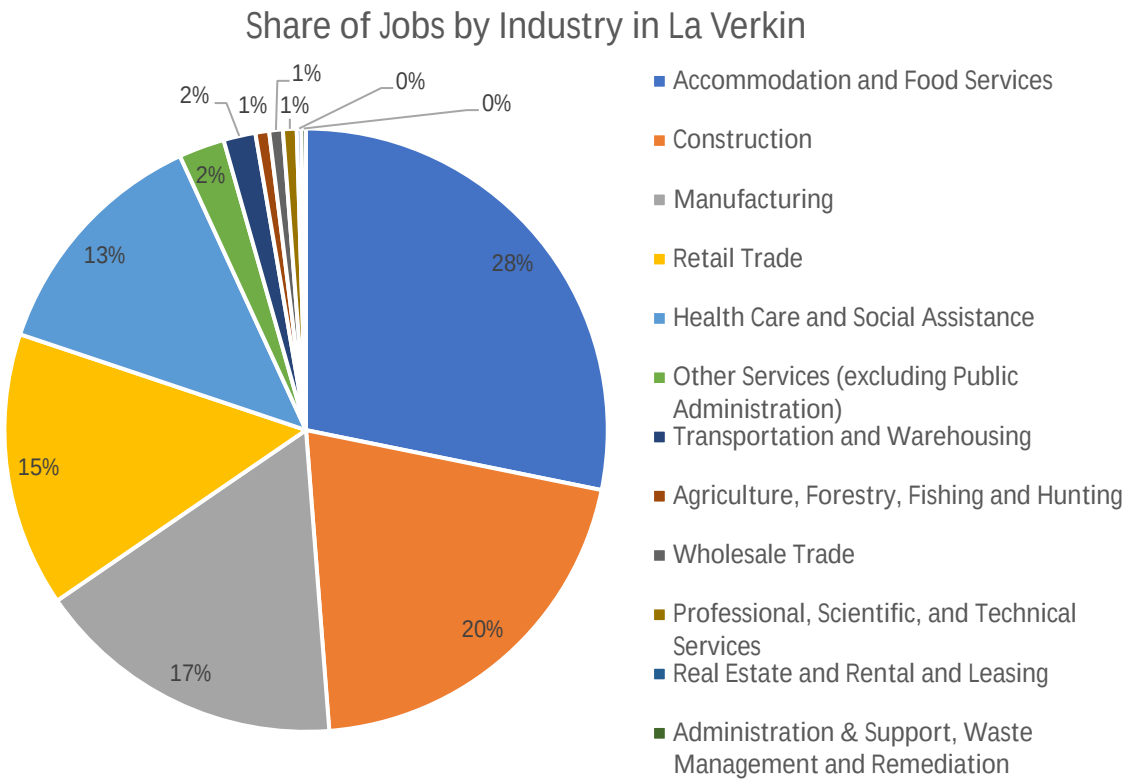


Figure 381: La Verkin Jobs by Industry

Source: U.S.Census Bureau, Center for Economic Studies, LEHD, 2018.

Community Capabilities

La Verkin is governed by a mayor and city council of five elected members. The City government includes a public works department and administrative department which consists of the administrator, treasurer, recorder, clerk, and attorney. Community boards include a Planning Commission, Board of Adjustments, and Beautification and Trails.

Public safety in La Verkin includes a city police department and the Hurricane Valley Fire District. The police department employs several full and part time officers and provides victim advocate, code enforcement, animal control, and police services. (La Verkin City , n.d.) The Hurricane Valley Fire District is a volunteer department that serves the entire Hurricane Valley. The Hurricane Valley Fire District supports a Community Emergency Response Team (CERT) and has a local contact for La Verkin specific activities. (Hurricane Valley Fire Special Service District , n.d.) CERT educates local volunteers on community natural hazard exposure and potential vulnerabilities, equipping this group to support the local response to a natural hazard event that could impact the community.

Religious institutions are a cultural resource that can engage community members in preparedness and neighborhood level response. The local Latter-Day Saint (LDS) church engages with the community to identify potentially vulnerable residents and coordinate neighborhoods to be more resilient to disasters. This engagement to all residents willing or interested in participation, not just church parishioners. There are two LDS church locations and the Mountain View Bible Church located in La Verkin.

Development

La Verkin is experiencing substantial growth in the north end of the city, with approximately 30 new single family dwelling units under construction. The project is estimated to add about 400 single family dwellings in the next five to ten years. There is an interest in developing housing and commercial development in the eastern area of town, above the La Verkin bench bordering Virgin, which could bring up to 1,000 homes to La Verkin.

Plans and Policies

La Verkin is an incorporated community that adopts local ordinances and plans to govern and set standards for development in the city. Five County staff reviewed these local plans and policies to understand potential existing Mitigation projects, goals, or policies that address natural hazards. A summary of the local language in the general plan and local zoning code that describe natural hazards can be found below.

Municipal Code

The La Verkin City Council has adopted municipal code and a general plan which include elements of natural hazard mitigation. These elements generally regulate the placement of development and in relation to steep slopes, the floodplain, and areas containing problem soil. When construction is planned in areas of geologic concern, the developer must meet certain criteria and be approved by the local planning commission to continue the development of the site.

The community has also adopted the Wildland Urban Interface (WUI) code in partnership with the local Hurricane Valley Fire District, which supplements the existing building and fire codes in a city to identify and address areas with homes and where development could occur relative to the wildfire risk of the area.

General Plan

The La Verkin City General Plan (2018) describes goals and objectives for development in the community. General plans describe the status and needs of housing, economy, open space, and other community metrics and details goals and objectives to address this need.

In La Verkin, there is a focus on development being sensitive to the surrounding natural landforms. The General Plan identifies the need to limit development on steep slopes and hillsides and near other sensitive landforms. Development should mitigate the effects of natural hazards. Other incentive to limit development is to preserve views of ridges from the valley. The city is also interested in working to prepare for natural hazards, particularly as it pertains to coordinating with community-based preparedness efforts.

The city also expresses support for rehabilitating old properties and waterwise landscaping in the city. These actions address severe weather and drought, encouraging energy and water conservation in the community.

Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for La Verkin City. This assessment describes the natural hazards considered in this plan of greatest risk to La Verkin City. The Planning Process and methodology chapter describes the variables and process in greater detail. Table 401 below shows the natural hazards listed from high to low risk as it pertains to La Verkin City.

Table 401: La Verkin Hazard Risks

HAZARD	RISK
EARTHQUAKE	1. High
DROUGHT	2. High
SEVERE WEATHER	3. Moderate
WILDFIRE	4. Moderate
LANDSLIDE	5. Moderate
FLOOD	6. Moderate
RADON	7. Low
PROBLEM SOILS	8. Low

The remainder of this section will describe each hazard in greater detail and the variables that contributed to the risk ranking. The section will conclude with a mitigation strategy based on La Verkin City's risk assessment.

Wildfire

The southern portion of La Verkin City is at greatest risk to wildfire and has recently seen dry conditions due to the ongoing drought, with low water content in plants in the area. Confluence Park, on the southwest boundary of the City with neighboring Toquerville, is noted to have high risk to wildfire by the UTWRAP mapping tool, seen in Figure 382. The County currently has plans to provide additional water to address the dry conditions at the park.

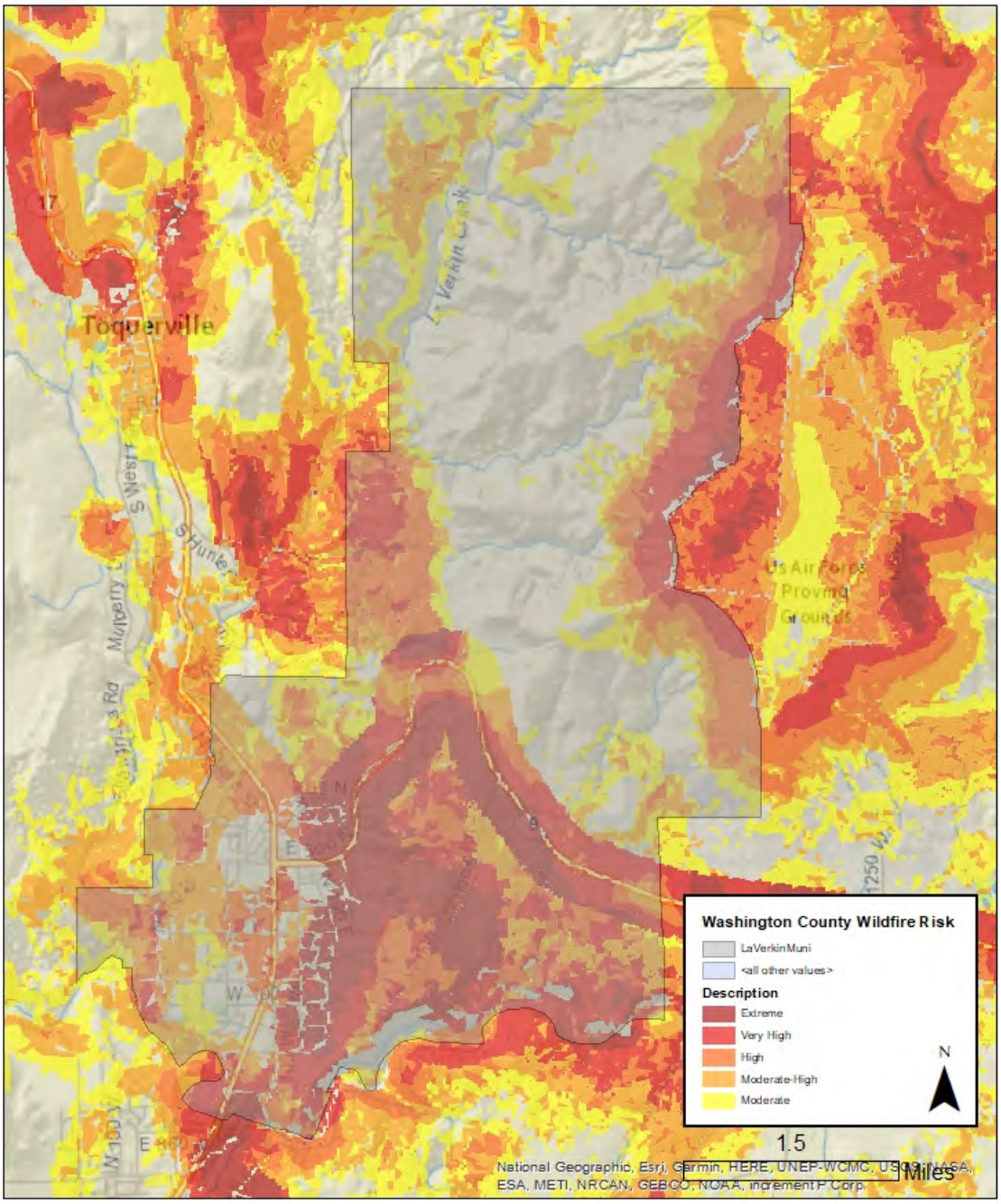


Figure 382: La Verkin Wildfire Risk Exposure

Source: Oregon Department of Forestry, accessed 2020

The Five County assessment shows that there are community assets within La Verkin City that have a risk to wildfire, summarized in Table 402. Over 70% of critical facilities, parcels, and road miles are at moderate or greater risk to wildfire, which are significant vulnerabilities to this hazard.

Table 402: La Verkin Wildfire Risk Exposure

La Verkin Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
80.0%	71.8%	73.2%	73.2%	85.1%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, UDOT, accessed 2020.

There have been no large wildfire events in La Verkin City, although the risks and impacts from a wildfire event in the city limits would be impactful and leave critical facilities, residences, businesses, and transportation routes vulnerable. The proximity to the Virgin River also poses risks to water quality following wildfire events in the community and areas downstream. Continuing drought conditions and long-term climate impacts heighten the risk and impact of wildfire in the southwest.

Earthquake

La Verkin City parallels the Hurricane Fault, which is visible to the city on Hurricane Hill. This fault line is likely to cause future earthquakes and ground movement, with the potential to impact La Verkin and the surrounding area's structures, infrastructure, and populations. While most earthquakes in the Southwest are low magnitude, with minimal damage, the Hurricane Fault can produce up to a 7.0 magnitude earthquake, dependent on location along the fault. (Biek, 2019) Events of these size are infrequent, with an average of 18 being recorded annually across the globe. (Hayes) While a strong earthquake has a low probability, impacts would be significant, as seen in a Washington County earthquake in 1992.

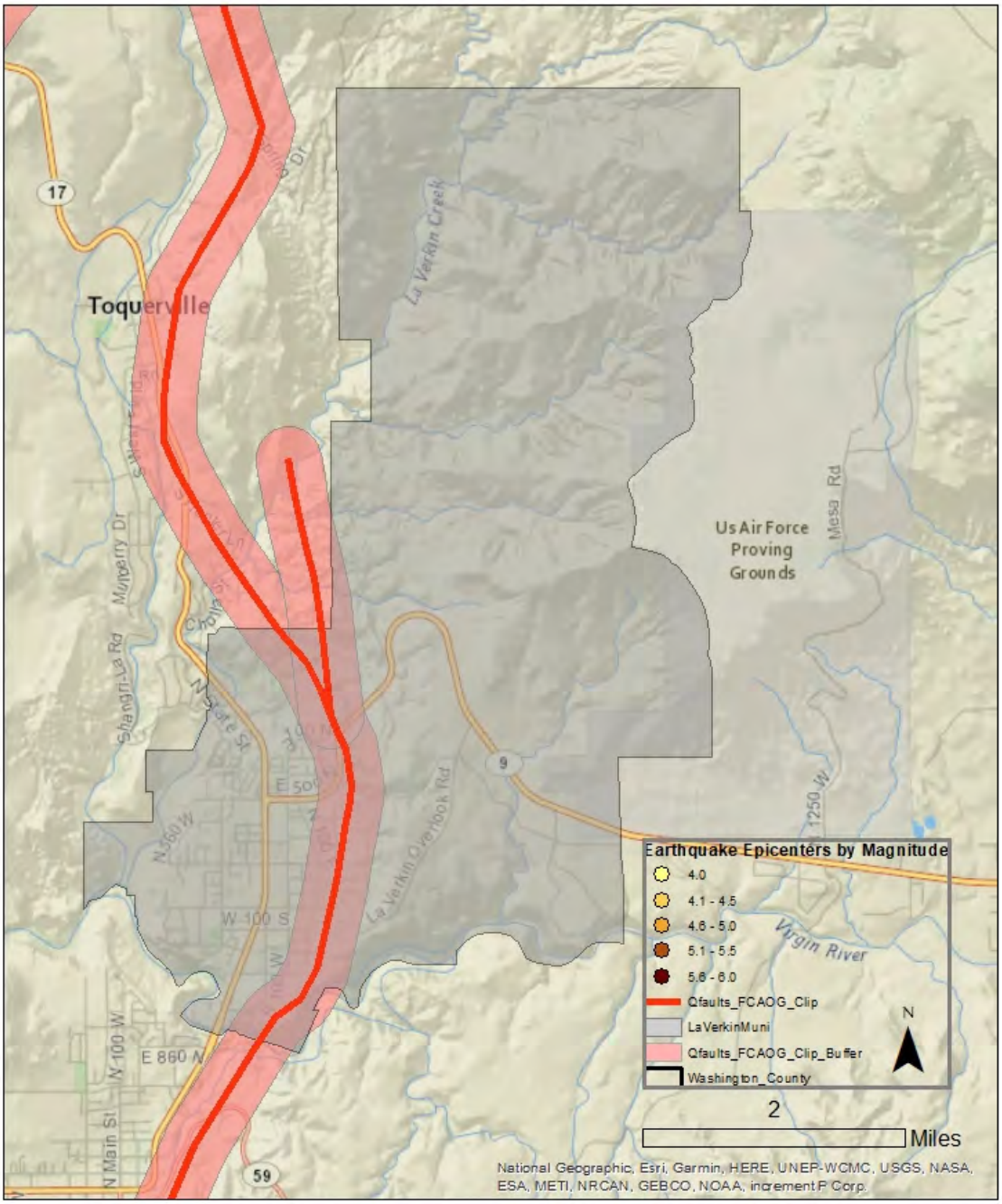


Figure 383: La Verkin Exposure to Quaternary Fault and Earthquake Epicenters

Source: Utah Geologic Survey, 2020

Five County assessed the community assets that may be most at risk to earthquake hazards, including ground shaking and liquefaction. Understanding that the fault is likely to be the source for strong shaking, the assessment documents the assets that fall within a quarter mile of the fault line. This can be observed in Figure 383 and summarized in Table 403. It is important to note that earthquakes can be felt and cause impacts to assets further than a quarter mile away.

Table 403: La Verkin Exposure within a Quarter Mile of Quaternary Fault

La Verkin Exposure within a quarter mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
40.0%	0.0%	20.3%	19.4%	1.9%	N/A	N/A

Source: Utah Geologic Survey, 2020; Washington County Assessor, 2020; UDOT, 2020. AGRC, 2020.

Five County analysis of community assets compared the locations that would fall within a quarter mile of a fault line, which shows that 40% of critical facilities and 20% of residential parcels are a quarter mile or less distance away from a quaternary fault. These highlight local vulnerabilities to earthquake hazards to address through mitigation. Assets elsewhere in La Verkin can also expect to experience impacts from a moderate to strong earthquake event but may not have as acute as those closer to the fault.

Another vulnerability to earthquakes in La Verkin is the number of structures built before 1975, when seismic codes were adopted in Utah. The Washington County assessor's data indicates that 12.8% of structures were built before 1975. These structures are often built using unreinforced masonry and can sustain greater damages during strong shaking events than structures using modern construction techniques. Damaged buildings from earthquake events can be unusable following an earthquake event, but unreinforced masonry can cause bricks to fall, causing damage to building contents, neighboring structures, or people in and outside of the structure.

Liquefaction

The Utah Geologic Survey has also published mapping of liquefaction hazards, which can occur because of strong ground shaking during an earthquake. Figure 384 shows that the very high liquefaction susceptibility can be observed along the Virgin River and La Verkin Creek surrounding the city. The base of the Hurricane cliffs also shows a high risk of liquefaction. In these zones, shaking events can cause the soil and rock to lose their integrity and become fluid.

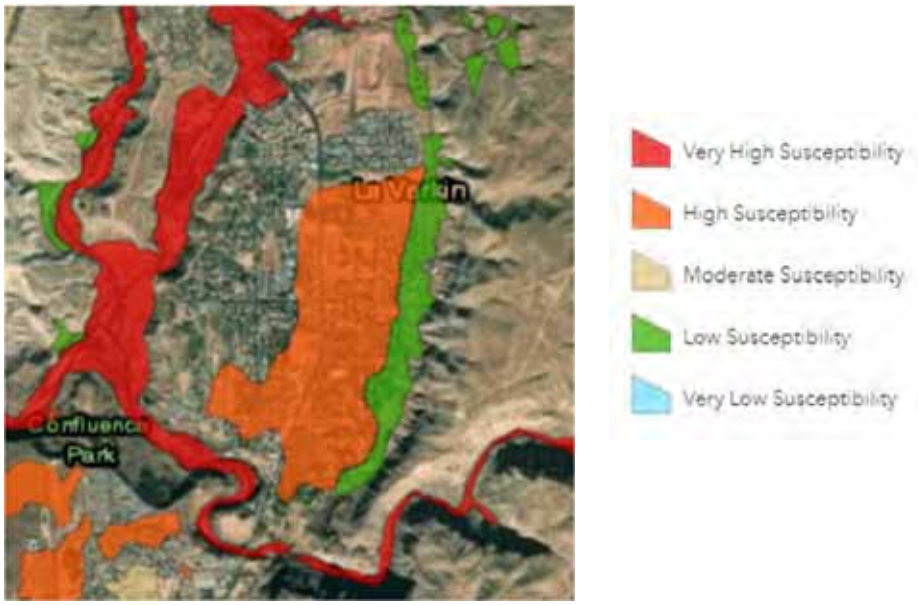


Figure 384: La Verkin Liquefaction Susceptibility

Although large earthquakes are infrequent in the area, La Verkin has a high risk to earthquake due to its proximity to a quaternary fault, associated liquefaction hazards, and relative exposure to a strong earthquake from the fault.

Landslide

According to Utah Geologic Survey mapping, La Verkin has a record of landslides south of the city, in undeveloped areas along the Virgin River. The community has also reported recent landslide events that have caused damages. In 2020 a landslide in a new development placed several homes at risk and led to the demolition of one home, as it was impacted directly by the slide. Due to the large cliffs and unique landscape, landslides and rockfall hazards are common in La Verkin.

The Utah Geologic Survey mapped landslide and rockfall hazard susceptible areas throughout the Five County region. Figure 385 illustrates the identified susceptible areas for La Verkin. According to this mapping, these hazards exist throughout La Verkin City, especially along rivers and creeks, mesas, and cliffsides.

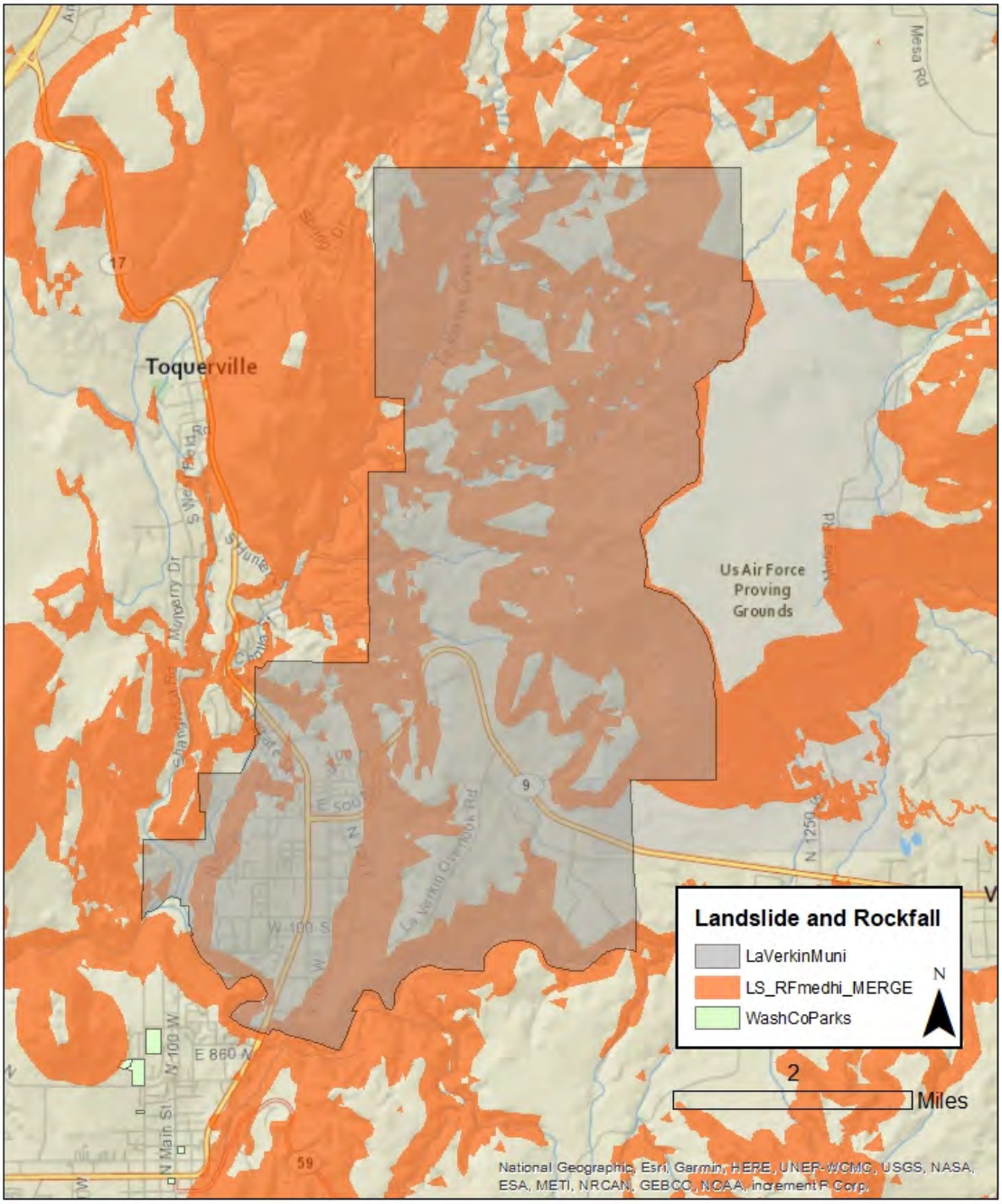


Figure 385: La Verkin Landslide Susceptibility

Source: Utah Geologic Survey; Washington County Assessor, 2020.

The Five County Association of Governments assessed community assets within these susceptible areas and identified that 48% of La Verkin Road miles are in landslide susceptible areas, as seen in Table 404: La Verkin Exposure to Landslide Susceptibility. Further, 25% of residential parcels are in a landslide or rockfall susceptible area. This hazard has moderate exposure to the community and presents vulnerabilities for transportation and residences in the community. Twenty percent of critical facilities

are in a landslide or rockfall susceptible area. This can place community gathering places or emergency response at risk to a landslide.

Table 404: La Verkin Exposure to Landslide Susceptibility

La Verkin Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
20.0%	11.3%	25.5%	24.9%	48.7%	N/A	N/A

Source: Utah Geologic Survey; Washington County Assessor, 2020; UDOT, 2020.

La Verkin landslide risk is moderate given the exposure and the recorded frequency of these hazards. It is probable that a landslide event will occur in future, especially as we consider the likelihood for wildfire, drought, earthquake, and severe weather in the area which can contribute to landslide, rockfall, and debris flow events.

Flood

The mapped floodplain in La Verkin is along the Virgin River, La Verkin Creek, and the base of the Hurricane Cliffs. While there is limited exposure to the floodplain, La Verkin does still have a risk to flooding. Most flooding events impacting the community are a result of rapid rainfall from severe storm events, which cause sheet or flash flooding events. The community also falls in the dam inundation area, which covers areas of the city near the Virgin River and La Verkin Creek. Figure 386 demonstrates the locations of the floodplain and dam inundation zones in La Verkin.

Figure 386: La Verkin Exposure to Floodplain and Dam Inundation Zones

Table 405: La Verkin Exposure to Floodplain and Dam Inundation Zone presents the number of parcels that are within the floodplain and dam inundation areas. La Verkin road miles have the greatest concern from flooding in these mapped zones, at 9.9% of road miles interacting with the mapped areas. No critical facilities and 1.0% of commercial and residential parcels are interact with the mapped floodplain and dam inundation zones. These mapped areas and associated impacts do not take into consideration the flooding potential elsewhere in the community because of stormwater.

Table 405: La Verkin Exposure to Floodplain and Dam Inundation Zone

La Verkin Exposure to Floodplain and Dam Inundation Zone						
Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	1.4%	1.0%	1.0%	9.9%	N/A	N/A

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1976. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

La Verkin participates in the NFIP with an initial FIRM developed in 1976. The current effective FIRM date is 2009. Table 406below describes the number of flood insurance policies, and dollar value insured and claimed since participation began. La Verkin does not have properties that have reported repetitive losses and the community does not participate in the Community Rating System (CRS).

Table 406: La Verkin NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$353	0	0	1	$280,000	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 407 describes the two flood events that have impacted La Verkin.

Table 407: La Verkin Reported Flood Events

Date	Damage/Injury	Description
10/21/2004	$15,000	A major storm system brought severe weather and damages statewide. In Southwestern Utah, La Verkin Creek damaged bridges in Toquerville and the Virgin River was reported to be flowing 25 feet higher than normal in St. George.
8/1/2007	$125,000	Five homes reported with water damage due to severe storm that caused flash flooding.

8/1/2012	One death	La Verkin Creek experienced flash flooding. A child living near the creek was reported missing during the event and had drowned.

As observed in the descriptions above, flooding events can damage homes, property, infrastructure, and cause local transportation delays. FEMA has several programs to mitigate and address flooding, including the National Flood Insurance Program, which can support participating home and property owners after a flood event to recover and repair.

Severe Weather

The Southwest frequently experiences hazardous severe weather conditions. Common events to the region and to La Verkin include thunderstorms, hail, strong winds, and severe heat. The NOAA Storm Events database indicates that there are five events that have had reported impacts on La Verkin. The events are described in Table 408.

Table 408: La Verkin Severe Weather Record

Date	Damage/Injury	Description
8/19/1984	None Reported	Thunderstorm Wind was recorded in La Verkin.
7/6/1985	None Reported	Thunderstorm Wind recorded in La Verkin with gusts of 60 MPH.
7/21/1988	None Reported	Thunderstorm Wind recorded with gusts of 60 MPH.
12/26/2005	$10,000	A severe winter storm affected much of the State of Utah. A La Verkin residence had a roof pulled from the building in the storm.
7/16/2012	$3,000	A thunderstorm with high winds caused tree limbs to be downed in La Verkin.

Source: NOAA Storm Events Database, 2020

Local recording describes recent damages from severe winds, predominantly to roofs of buildings and downed trees. A storm in the summer of 2020 resulted in $21,000 in damages to the La Verkin City building. The building needed roofing redone after the storm to prevent further damages to the structure and its contents. Thunderstorms and severe rain create potential for sheet flooding as stormwater drainage and detention rapidly achieves capacity in these types of storms, causing damages to residences and structures.

Summer and early fall are when severe heat is a significant risk throughout the southwest, including La Verkin. The relative exposure of people outside heightens these risks. Further the draw of outdoor enthusiasts to La Verkin and the surrounding area can pose challenges in relation to severe weather, including extreme heat events. Extreme temperatures impact those working outside. Under resourced communities within La Verkin may also see increased effects as they may be more exposed to extreme heat events and may not be able to find places to stay cool on hot days.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 387. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

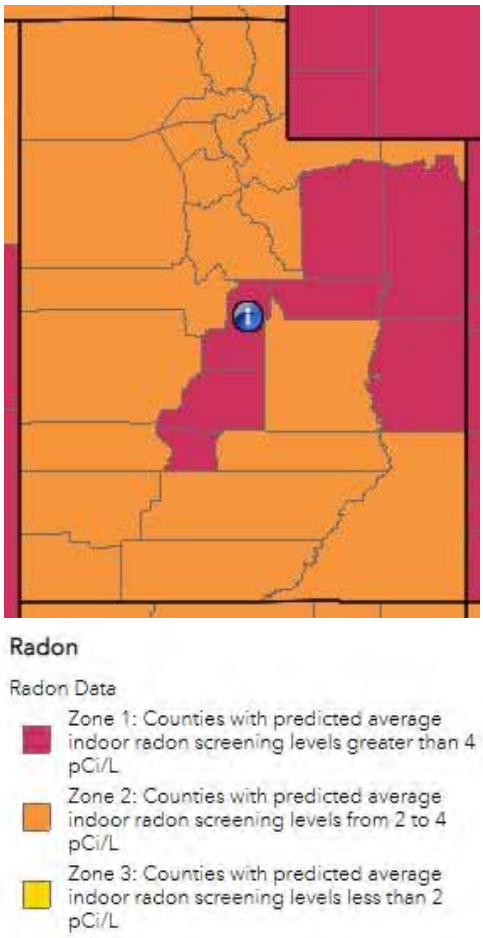


Figure 387: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 409: Washington County Short Term Radon Testing Reported describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 409: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Drought

The Five County Region has experienced seven periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe weather.

Monitoring drought generally occurs across several climate division. La Verkin lies in the Dixie division, which includes only southwestern Washington County. Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses can translate directly to local economies that rely on industries impacted by drought.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

La Verkin is at high risk to drought, which can challenge existing water sources, industry, and increase risks of other natural hazards. The community works with the Washington County Water Conservancy District to address water conservation in the community. The community code and general plan indicate that the city prefaces waterwise practices in the community and is pursuing activities with the WCWCD to address identified water conservation challenges, including protecting the supply.

Problem Soils

Problem soils are a problem for construction and development throughout La Verkin City. The community is exposed to expansive, collapsible, gypsum, and piping susceptible soils, with highest susceptible areas located in the southeast section of the city. The City has opted to address problem

soils using geologic studies pre-construction to prevent adverse effects on properties. While problem soils will exist throughout the city despite the studies, this gives the developer the responsibility to protect the structure, residents, and contents through mitigation measures.

La Verkin is included in an updated mapping project by the Utah Geologic Survey, which describes in depth the susceptibility of the community to problem soils. These layers unfortunately were not available in a shape file format for Five County assessment; however, the maps (Figure 388-Figure 393) indicate that problem soils are pervasive in the southwest and that most of the city is at risk of some problem soil hazard.

Wind-Blown Sand Susceptibility

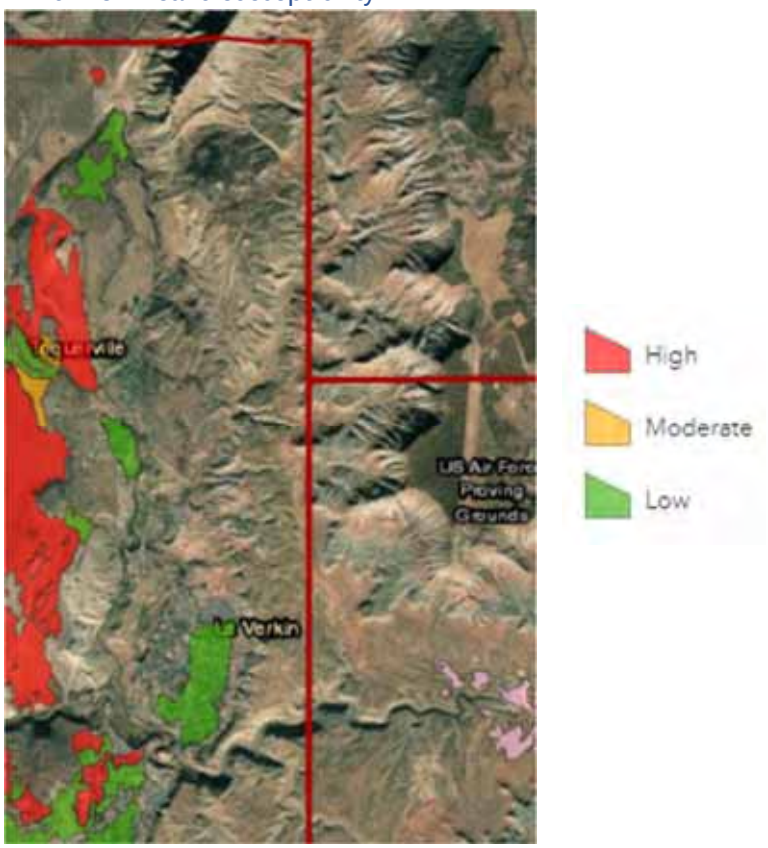


Figure 388: La Verkin Wind Blown Sand Susceptibility

Soluble Soils Susceptibility

Figure 389: La Verkin Soluble Soils

Shallow Bedrock Susceptibility

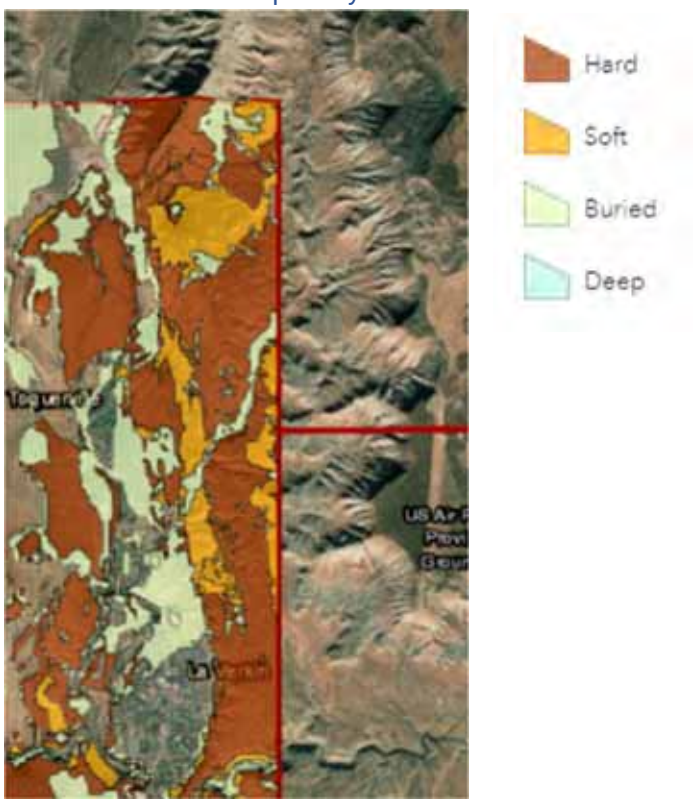


Figure 390: La Verkin Shallow Bedrock Susceptibility

Piping and Erosion Susceptibility

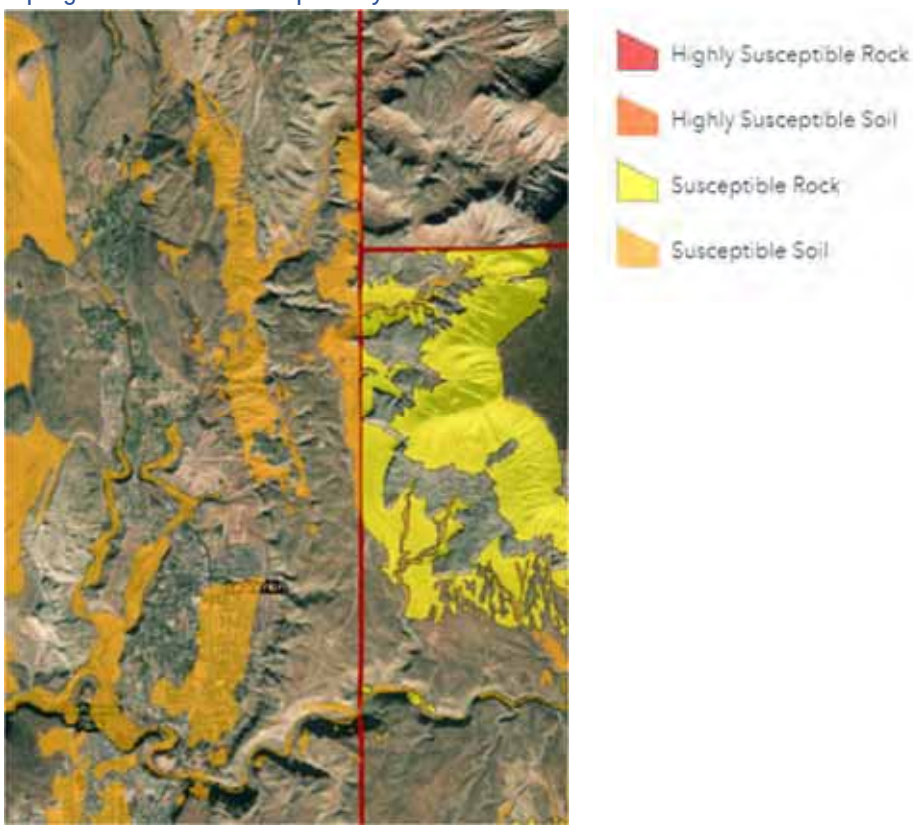


Figure 391: La Verkin Piping and Erosion Susceptibility

Expansive Soil and Rock Susceptibility

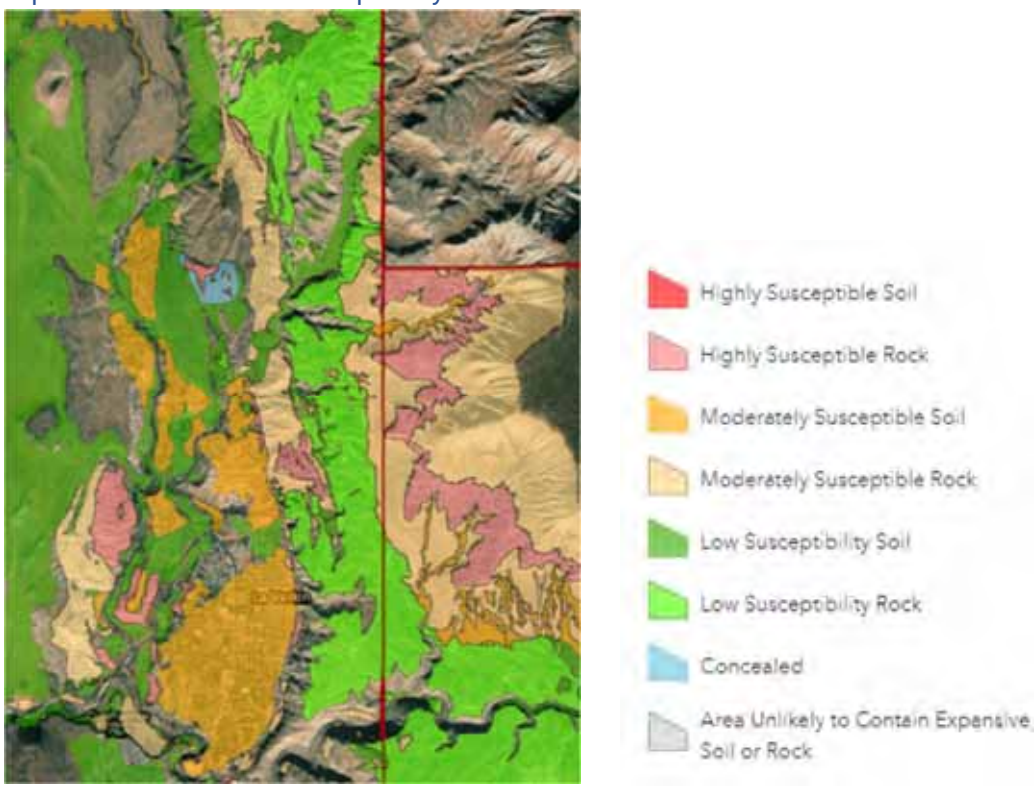


Figure 392: La Verkin Expansive Soils and Rock Susceptibility

Collapsible Soil and Rock Susceptibility

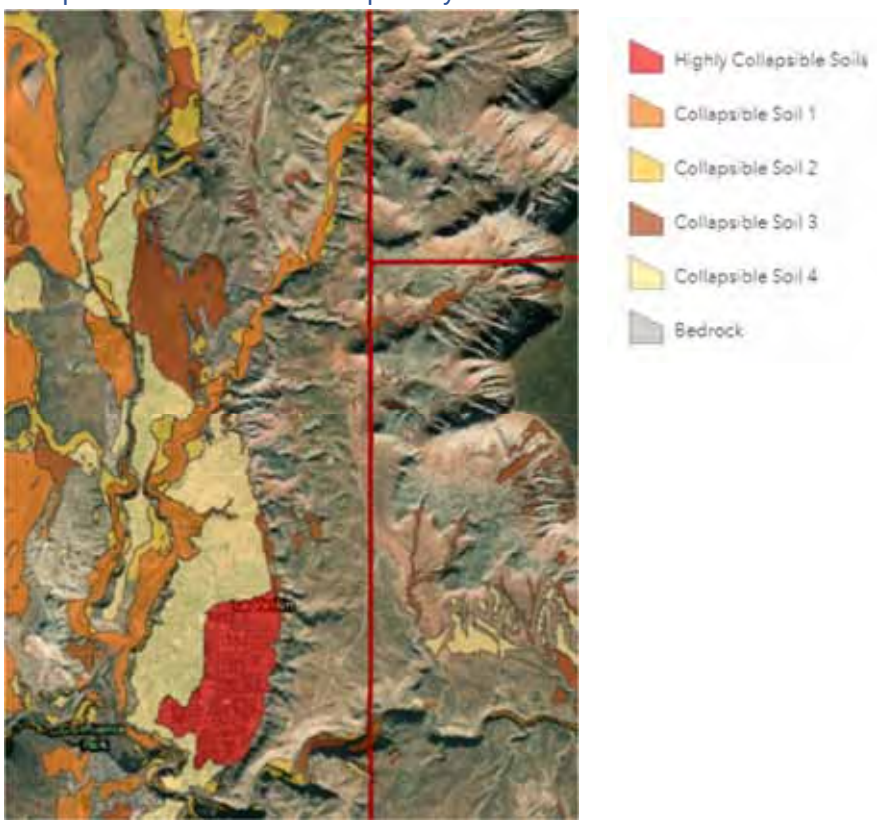


Figure 393: La Verkin Collapsible Soil and Rock Susceptibility

According to the mapping, the developed areas of La Verkin City have moderate to high susceptibility to collapsible soils and rock, expansive soils, and piping and erosion. The bedrock is also documented to have significant limestone and gypsum, which are at risk to solubility. La Verkin City requires a geologic study for all new development, to assess the soil quality below a subdivision or plot before construction commences. At the conclusion of the study, the developer or property owner must engage in mitigation activities to address the problem soils on the site before construction. Risk from problem soil is low, given this preconstruction requirement and the limited documented impacts from this natural hazard on the community.

Mitigation Strategy

La Verkin participated in the 2016 iteration of the Five County Natural Hazard Mitigation Plan and developed a community mitigation strategy. Table 410 lists the identified actions and includes an update on the progress made in implementing the action. La Verkin City has not yet completed and adopted a stormwater master plan, but the city continues to see this as an important step to identifying future flood and severe weather mitigation activities.

Table 410: 2016 Mitigation Strategy Progress

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Prevent rainwater and snowmelt that causes flooding and erosion in developed areas.	Prepare and adopt an updated community-wide stormwater management master plan.	1 Year	City Operating Budget	Incomplete; still needed

Source: Five County Association of Governments Multijurisdictional Natural Hazard Mitigation Plan, 2016

La Verkin used the risk assessment and description of impacts following natural hazard events to develop a mitigation strategy to reduce potential future impacts and risks to the identified hazards in this plan. In a series of meetings, La Verkin identified actions to build their mitigation strategy, described in Table 411. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 394.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 394: Regional Plan Goals

Table 411: La Verkin 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2	Identify areas in need of stormwater infrastructure improvements.	Prepare and adopt an updated community-wide stormwater management master plan.	M	1 year	M	City Operating Budget	La Verkin City
Wildfire #1	6	Identify public and critical facilities vulnerable to wildfire. Implement	Assessment and fuels reduction at critical facilities and schools identified in	M	3 years	M	City Operating Budget	La Verkin City, Hurricane Valley Fire Dept.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		defensible space tactics.	wildfire risk areas.					
Wildfire #2	2, 5	Identify public and critical facilities vulnerable to wildfire.	Retrofit critical facilities at risk to wildfire with noncombustible building materials.	M	5 years	M	City Operating Budget	La Verkin City
Earthquake #1	2	Protect public structures from ground shaking impacts.	Assess and inventory critical facilities, schools, and historic structures for seismic safety. Implement retrofits to community structures identified on the inventory.	M	3 years	M	City Operating Budget, Preservation Utah, State and Federal Tax Credit	La Verkin City
Landslide #1	1, 2, 6	Collect data and plan to reduce risk.	Assess existing steep slope ordinance and additional needs to address landslide areas that could be included in a Geologic Hazard Ordinance.	H	1 year	L	City Operating Budget	La Verkin City, Utah Geological Survey
Problem Soils #1	1, 2, 6	Collect data and plan to reduce risk.	Assess existing construction standards requiring geological study for problem soils, landslides and rockfall, and faults. Consider where a Geologic Hazard Ordinance could fill additional needs.	H	1 year	L	City Operating Budget	La Verkin City, Utah Geological Survey
Drought #1	2	Improve water infrastructure for conservation and longevity.	Replace secondary water system.	L	5 years	H	City Operating Budget	La Verkin City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #2	3	Conserve Municipal water resources.	Public outreach about water conservation and drought risks through water billings and on city social media/website. .	H	Ongoing, annually	L	City Operating Budget	La Verkin City
Severe Weather #1	1, 4	Improve energy efficiency, especially of LMI homes.	Engage in local weatherization programs for aging residential properties.	H	5 years	L	City Operating Budget	La Verkin City
Radon #1	3	Inform residents of radon hazard, testing, and mitigation.	Public outreach about the importance of Radon testing and mitigation. To be distributed by City at offices and on website/social media.	H	Ongoing	L	City Operating Budget	La Verkin City
Radon #2	2	Reduce radon risks in public facilities.	Conduct radon testing at La Verkin Elementary School. Retrofit radon mitigation systems if results indicate high concentrations.	M	1 year	M	City Operating Budget	La Verkin City, Washington County, Washington County School District

Source: Local Planning Team

Leeds

Leeds Town is a rural community on the I-15 Corridor through Southwestern Washington County, bordered to the east by Toquerville. This community is to the North of Quail Creek State Park and a portion of the Red Cliffs Desert Reserve is in the town boundaries. Leeds has a strong interest in preserving historically prevalent property in the community, as described in the general plan, many of which date back to the late 1800s.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

Demographics

As of the 2018 American Community Survey, Leeds has a population of 785 people, described in Figure 395. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

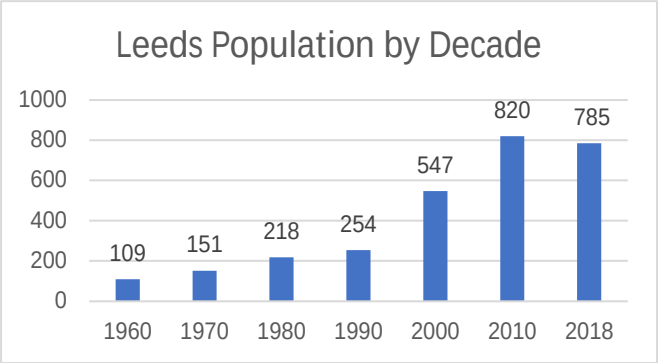


Figure 395: Leeds Population by Decade

Source: US Census Bureau

Leeds population has been increasing with time, with the most rapid changes observed in 2000. Since then, the population has slowed and decline estimated by 2018, as observed in Figure 396.

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Leeds, the community could see 2,928 people living in the community in the next 45-years[23]. Although, if declining populations continue for the area, it is likely that the population will be less than the 45-year estimate.

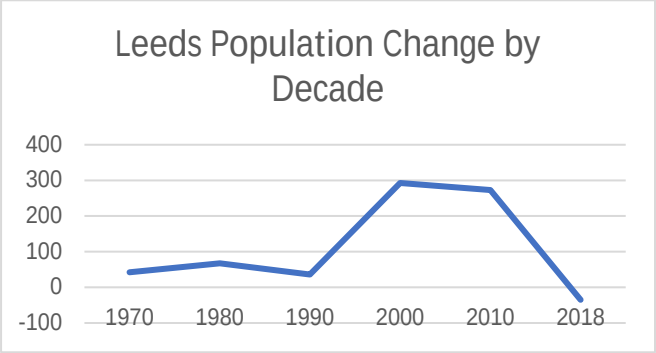


Figure 396: Leeds Population Change

Source: US Census Bureau

Economy

Leeds has historically participated in agricultural and mining industries as staples of the local economy (General Plan). As mining was eventually phased out, the local community shifted to a focus on agriculture and local commercial development. Today, local businesses can be found near the Main Street of the community.

The US Census Bureau OnTheMap tool depicts Leeds current prominent industries by the number of jobs supported in the community, illustrated in Figure 397. Healthcare and Social Assistance industry and retail trade industries are prominent employers in the community. Retail trade employment points

[23] This estimate is created using the 2015 ACS population estimate for Leeds, which was 890, and adding 229% of this population estimate to the population for that year.

to the local commercial in the community. Agriculture industries still occupy approximately 4% of jobs in the community.

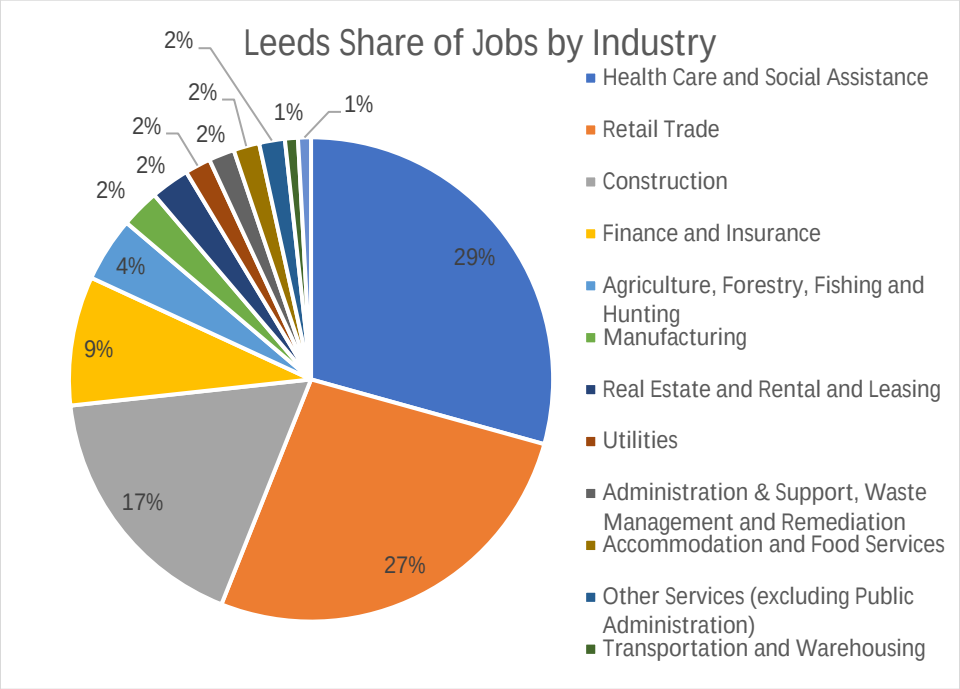


Figure 397: Leeds share of Private Primary Jobs by Industry

Development

The most prominent land use in Leeds as of 2010 is undeveloped private property, making up 82% of the community's land, according to the General Plan. The community has prioritized a rural feel to the community, with larger lot residential development and low density throughout the community. There has been no significant development in the past several years, although one new subdivision is under consideration at the time of this writing.

Community Capabilities

Leeds is governed by a mayor and city council, who engage in legislative activities for the community. A planning commission also supports specialized review and recommendation of planning and zoning activities in the community to the council.

Ivins staff include a clerk/recorder, treasurer, and public works personnel. Public safety is provided through a MOU with Washington County for law enforcement and with the Hurricane Valley Fire Special Service District for fire protection.

Plans and Policies

Leeds has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Leed's plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Leeds ordinances describe conditions under which development is subject to special review in areas where natural hazards may be present, through a hillside ordinance. Development will not be allowed on slopes 30% or greater. Slopes with less grade may require special consideration from the planning commission and town council.

The code also describes situations where restoration of buildings may take place when the structure is damaged, including by natural hazards.

General Plan

The town of Leeds is engaging in an update of their general plan which will be complete in 2022. The existing plan was used to meet the needs of this planning process. Leeds General Plan (2010) describes the vision for the community, referencing the history, current and planned land use, need for services, and conservation. Several of the policies and goals for the community address natural hazard mitigation, including:

- protecting steep slopes and waterways.
- Establish a sensitive lands ordinance including buffers for steep slopes and water courses.
- Grading limits for cut roads.
- Develop criteria and standards to protect steep slopes and hillsides and water quality.
- Continued progress in Leeds's fire staff[24], facilities, and emergency services.
- Continue to participate in the state cooperator wildland program.
- Pursue additional opportunities to increase wildland fire safety.
- Pursue funding to expand existing fire station.
- Work with property owners to minimize stormwater runoff and containment of waterways.
- Develop programs and incentives for wise water management, including encouraging native, drought tolerant landscaping.

Risk Assessment

Leeds is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 412 describes the relative risks of hazards in the community.

Table 412: Leeds Hazard Risk

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High

[24] Since the drafting of the General plan in 2010, the town has signed an MOU with the Hurricane Valley Fire Special Service District, which now supports fire suppression activities for the town.

WILDFIRE	3. High
FLOOD	4. Moderate
LANDSLIDE	5. Moderate
EARTHQUAKE	6. Moderate
RADON	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Leeds can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Leeds include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Leeds is a city in southern Washington County, which is bounded by I-15 and is surrounded by unincorporated County and open space. I-15 is a significant asset to the region which runs through the center of town. Figure 398 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Leeds that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

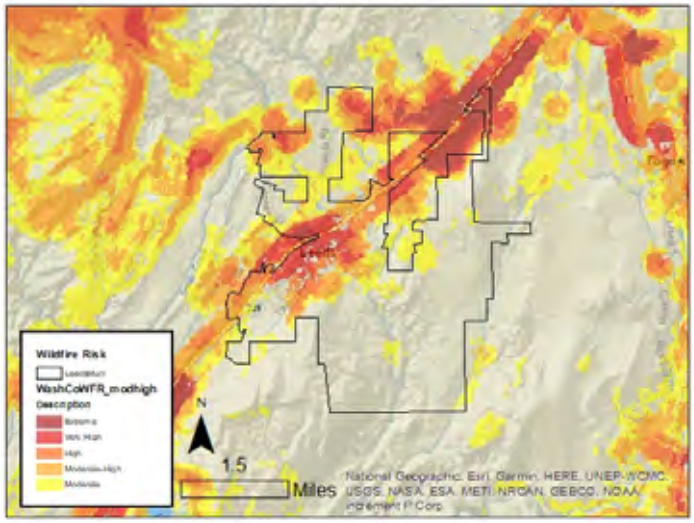


Figure 398: Leeds Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 413 further describes Leeds Town's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Leeds, which could damage property, impact public health and safety, or impact local economies. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods. Critical Facilities impacted by wildfire can have challenges providing services during emergencies.

Table 413: Leeds Wildfire Risk

Leeds Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	100.0%	91.7%	92.0%	37.6%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. Table 414 describes the fire event which has impacted Leeds Town.

Table 414: Leeds Wildfire Record

Leeds Fire History			
Fire Name	Year	Acres Burned	Description
Cottonwood Trail	2020	1,600	Fire caused by a blown tire on a motor vehicle. Led to delays and detours from I-15 and damage to nearby trailheads.

Source: Utah Fire Info, accessed 2020; (Blowers, Few losses, no casualties reported while battling 4 fires thanks to coordinated firefighting efforts, 2020)

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Leeds, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 399 shows the mapped earthquake epicenters and fault lines in Leeds.

No earthquakes have been identified with an epicenter in the Leeds municipal boundary.

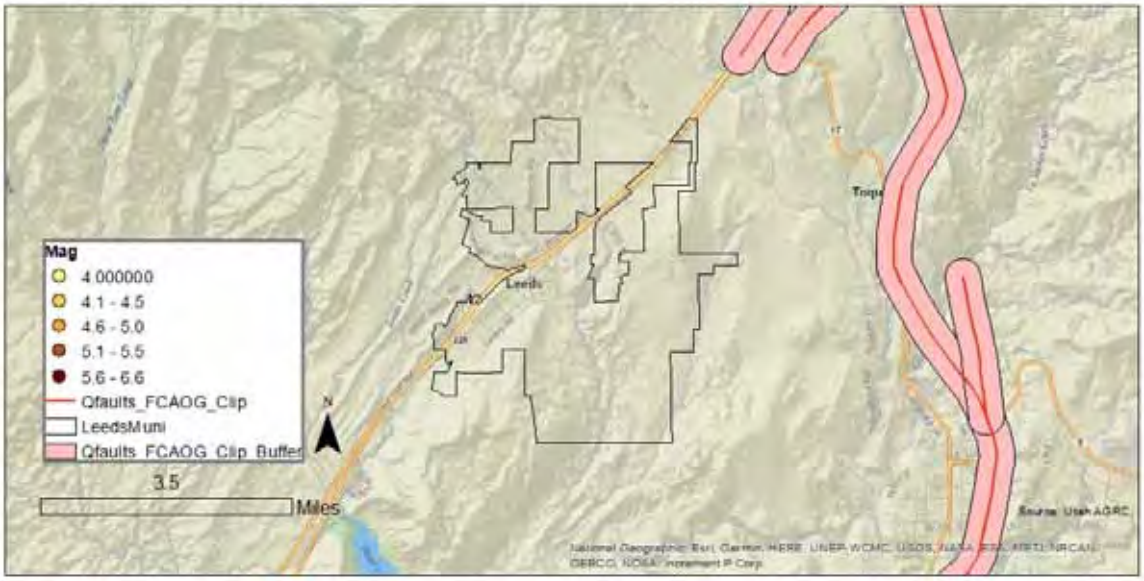


Figure 399: Leeds Earthquake Epicenter and Quaternary Faults

Source: UGS, Washington County Assessor, AGRC

There are no faults in the municipal boundary, with the closest mapped as a segment of the Hurricane Fault Zone approximately one mile northeast of the city boundary.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 69 structures were built before the adoption of seismic code requirements, approximately 19.1% of the total structures in the city boundaries. No critical facilities have been identified as being built before the 1970s. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Leeds Town, described in Figure 400. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid. The map indicates that some areas of Leeds may experience low to high susceptibility to liquefaction hazards.

Figure 400: Leeds Liquefaction Susceptibility

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters of 4.0 magnitude or greater have been reported in Leeds Town as of 2020. The nearest earthquake to Leeds was the Washington City earthquake which occurred approximately 13 miles southwest of the Leeds Municipal Boundary.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 401 depicts the flood and dam inundation exposure in Leeds. Dam inundation is observed to the south and east of the community, outside of the municipal boundary, along La Verkin Creek and in the Virgin River. The 100-year floodplain has been identified through the community, crossing I-15 and Main Street at multiple points through the community.

Figure 401: Leeds Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 415 describes the Leeds community assets exposed to dam inundation and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Residential parcels see the most exposure to potential flood areas, placing residents and personal property at risk. Damages can take significant time and cost to repair following a flood.

Table 415: Leeds Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	8.3%	11.5%	11.4%	5.8%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Leeds property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 416: Leeds NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$2,816	0	0	5	$1,550,000	1	$13,591

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Leeds participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 416 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. One claim has been submitted, and there are no repetitive losses recorded for the community. Leeds does not participate in the Community Rating System (CRS). The community received a Community Assistance Visit in 2009.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 417 describes the flooding events which have impacted Leeds and the surrounding area.

Table 417: Leeds Reported Flood Events

Date	Damage/Injury	Description
8/12/2005	None Reported	Heavy rain caused flooding in Leeds and the surrounding area. Street flooding and some basement flooding was reported, as well as flooding of campgrounds near Quail Creek and required that campers be evacuated.
8/6/2008	None Reported	Heavy rainfall was estimated as high as 2.9 inches, which caused flash flooding in Quail Creek.
7/16/2012	None Reported	Thunderstorm caused flooding of drainages near Hurricane, Utah.
9/8/2014	None Reported	Flash flooding was reported near Quail Creek Reservoir in Gould's Wash.

Source: NOAA Storm Database

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk to humans when events interact with the built environment and recreation opportunities. Figure 402 maps the landslide susceptible areas in Leeds, which are observed throughout the community.

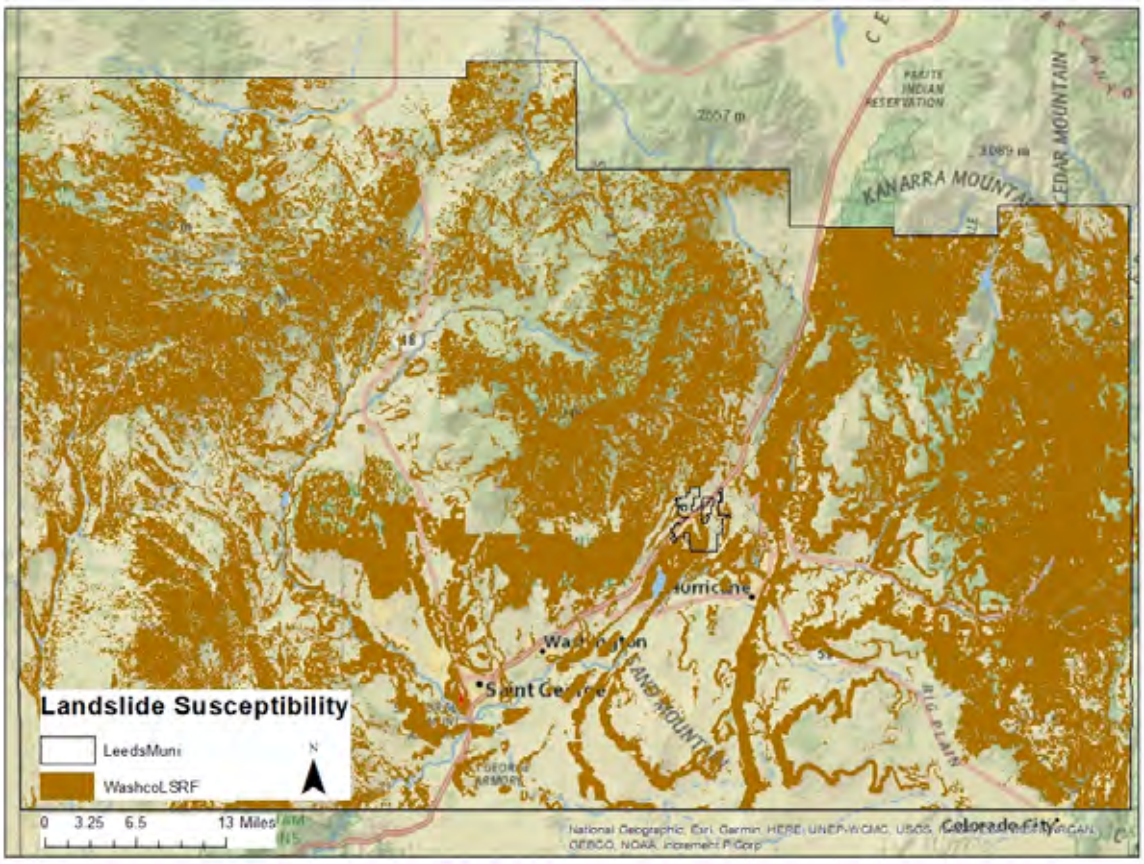


Figure 402: Leeds Landslide Susceptibility

Source: Utah Geological Survey

Leeds is exposed to landslide susceptible areas throughout the community. In these areas, the community is bounded by cliffs and hillsides. Table 418 describes the exposure of community assets to landslide susceptible areas. Exposed assets in the community include critical facilities, commercial and residential parcels, and road miles. People and property are vulnerable to landslides, which can damage homes, vehicles, and cause injury or death. On roadways, landslides can place debris on or cause damage to roadways. Such damages can block traffic and make access to the community a challenge. Future growth in the community could place new construction in susceptible areas without proper planning.

Table 418: Leeds Landslide Susceptibility Exposure

Leeds Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	50.0%	19.8%	20.8%	7.2%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Landslides that interact with humans and property can have financial, health, life and public

safety impacts. While landslides have been documented throughout the County, none have been reported for Leeds Town to date.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 403: Estimated Indoor Radon Level Zones- Utah. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

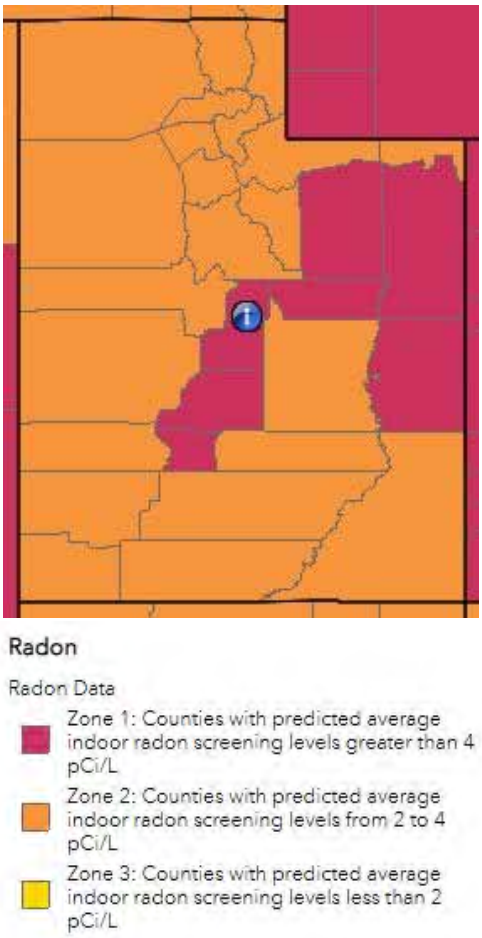


Figure 403: Estimated Indoor Radon Level Zones- Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 419 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 419: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Hurricane, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Leeds sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Leeds has four reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 420. While the deaths reported during the 2013 events did not occur in Leeds, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers are vulnerable to these extreme temperatures.

Table 420: Leeds Severe Weather Record

Date	Damage/Injury	Description
2/3/2008	None Reported	Heavy snow dropped 6 inches of snow in less than 12-hours in Leeds.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures contributed to the death of a hiker in Kane County.
5/10/2014	None Reported	White Reef RAWS reported maximum wind gusts of 65 MPH.
8/6/2015	None Reported	White Reef RAWS reported maximum wind gusts of 60 MPH.
6/5/2020	None Reported	White Reef wind sensor reported maximum wind gusts of 58 MPH.

Source: NOAA Storm Database

High winds are a frequently observed hazard in Leeds. Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. Figure 404 illustrates where the Utah Geological Survey has mapped problem soils in and surrounding Leeds. Expansive soils appear to be prevalent in the southern portion of the community.

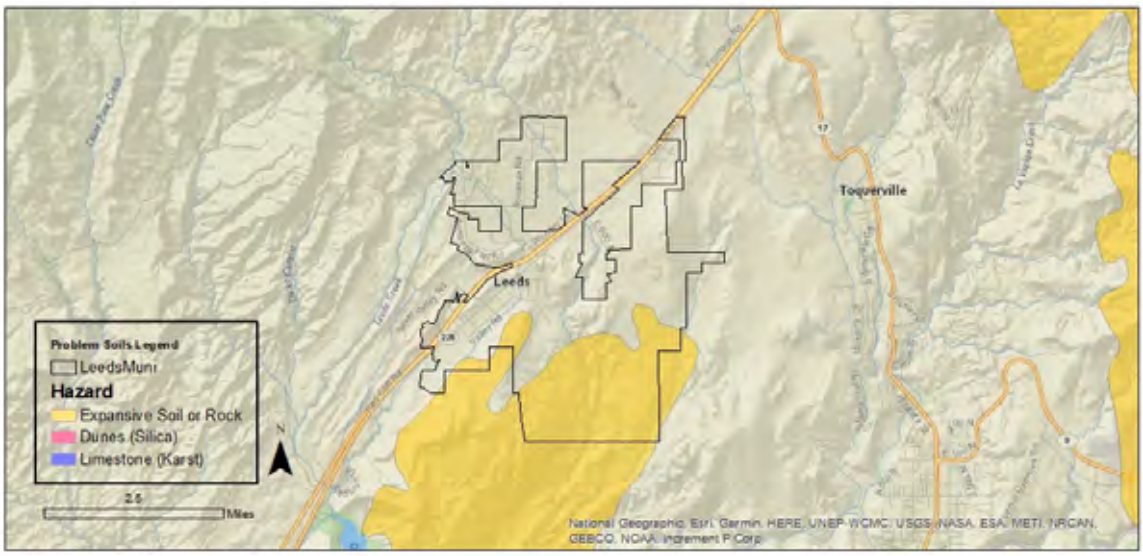


Figure 404: Leeds Problem Soils Map

Source: UGS, AGRC

Community assets, infrastructure, and property are exposed to problem soils, with the greatest exposure being in critical facilities. Problem soils are often challenging to structures and infrastructure, as when the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure. In Leeds, road miles appear to be exposed to expansive soil or rock, as described by Table 421: Leeds Problem Soil Exposure.

Table 421: Leeds Problem Soil Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	0.0%	0.0%	0.0%	10.2%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, UDOT

UGS has developed new mapping for other communities in the region, which provides more detail to mapped problem soils. Leeds is included in this mapping study area. Maps for Leeds show a greater extent of problem soils throughout the community and that more types of problem soils are prevalent.

This section includes a summary of the soil type, but greater detail can be found in the Hazard Identification chapter describing problem soils.

Caliche

Figure 405: Leeds Caliche Susceptibility

Collapsible Soil

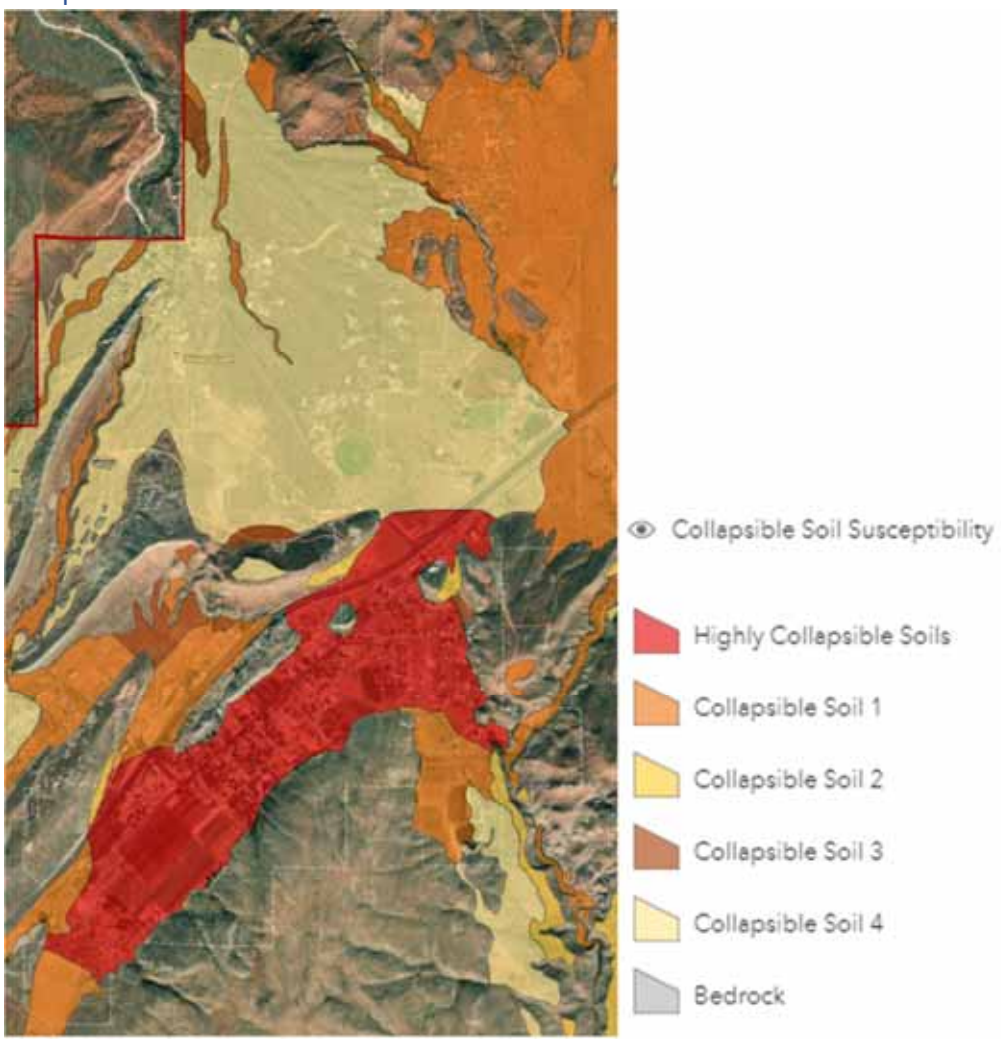


Figure 406: Leeds Collapsible Soil Susceptibility

Expansive Soil

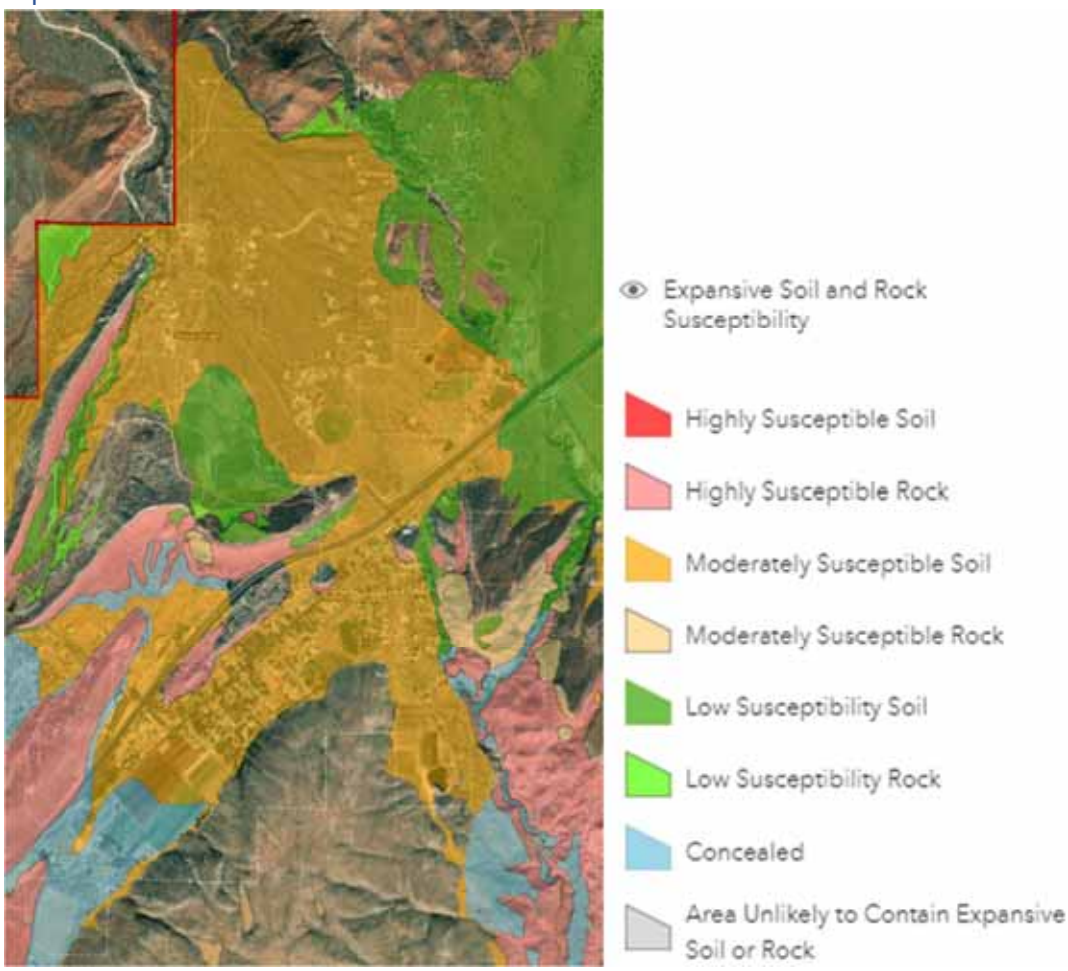


Figure 407: Leeds Expansive Soil and Rock Susceptibility

Piping and Erosion

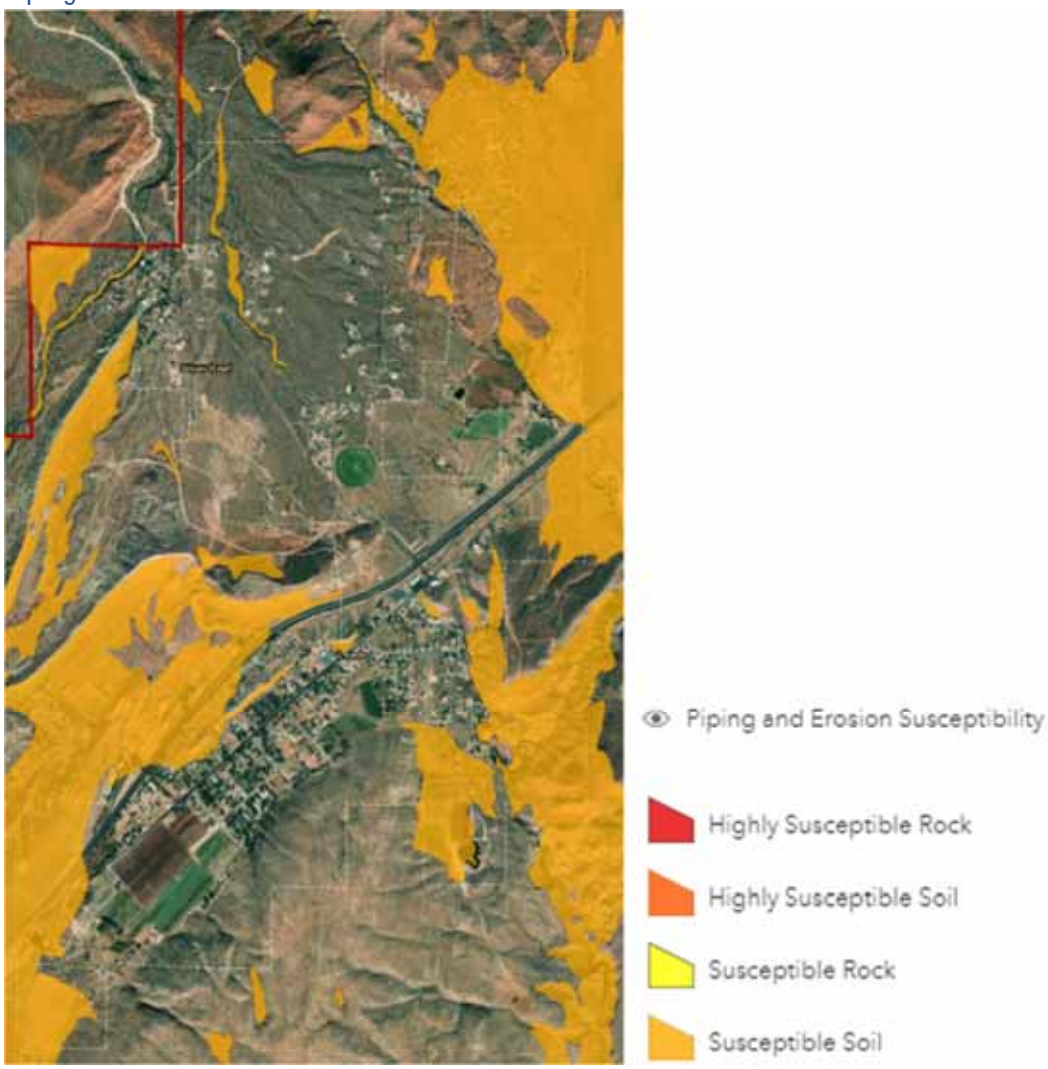


Figure 408: Leeds Piping and Erosion Susceptibility

Shallow Bedrock

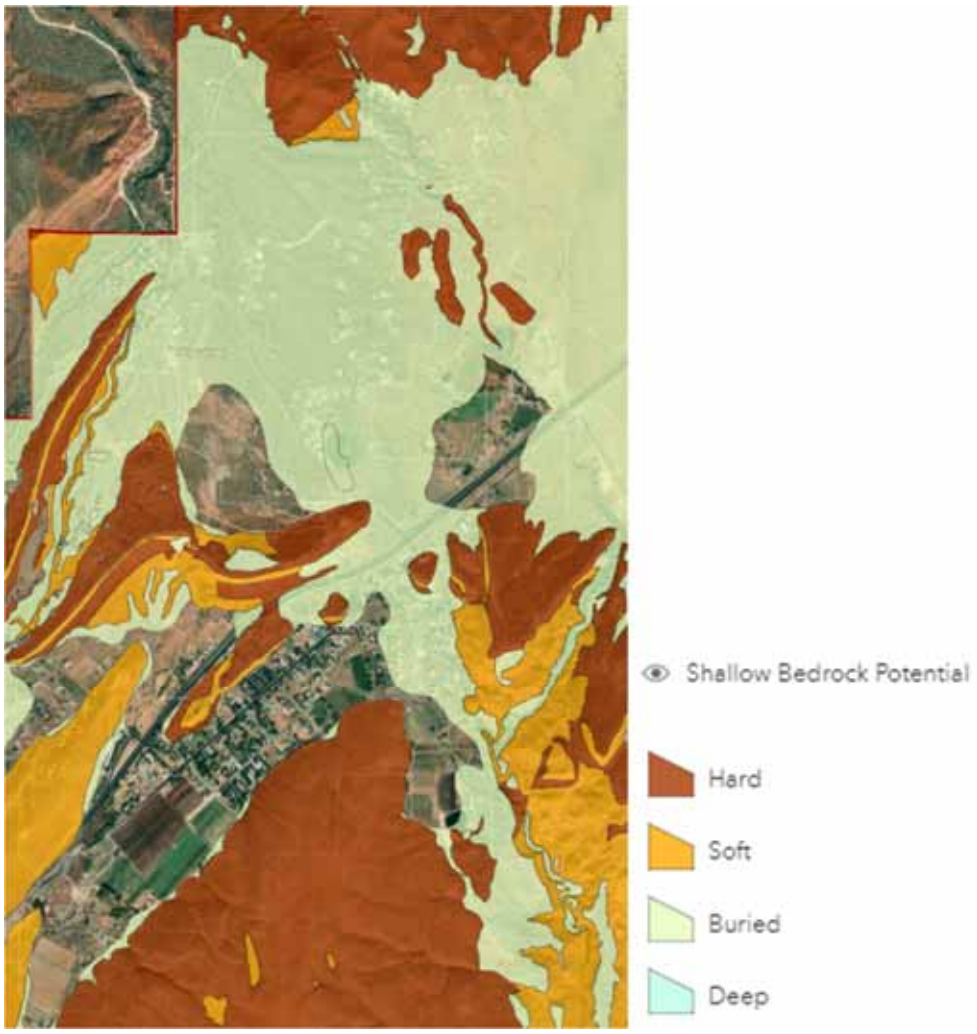


Figure 409: Leeds Shallow Bedrock Potential

Soluble Soil and Rock

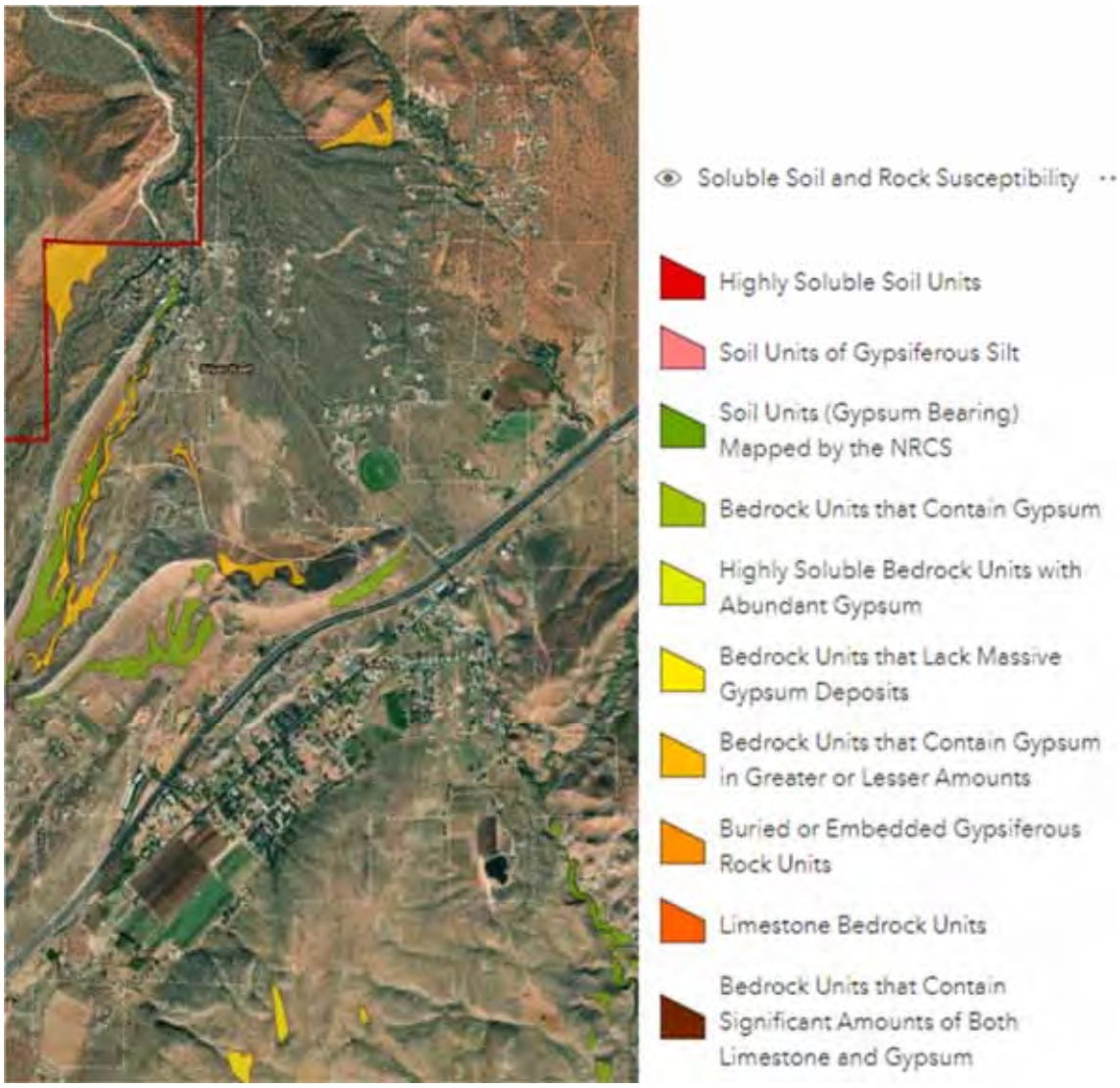


Figure 410: Leeds Soluble Soil and Rock Susceptibility

Wind-Blown Sand

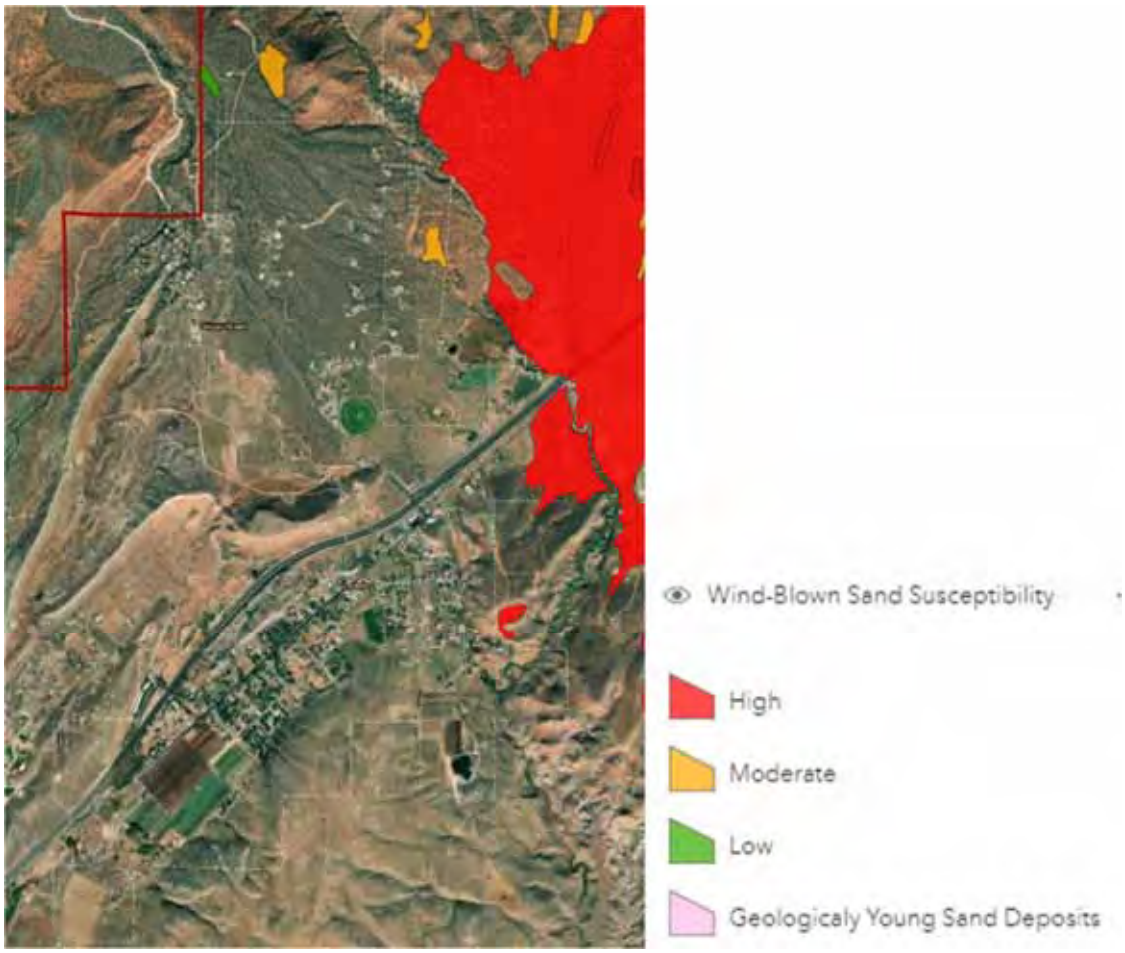


Figure 411: Leeds Wind-blown Sand Susceptibility

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Leeds is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. Critical facilities in Leeds are exposed to wildfire susceptible areas per the maps in this plan, which can impact the facility's ability to respond to emergencies or events if impacted by hazard. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Leeds has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 422 describes progress made on the Leeds mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 422: 2016 Leeds Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	(Main Street Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Replace ditch on north side of Main Street with curb and gutter. Storm drain catch basins along Main Street at intersections. Storm drain outlet to discharge into Harrisburg Wash.	5 Years	Leeds, CIB, CDBG, FEMA	In progress.
Flood #2	(Silver Reef Area Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Re-grade swales. Clear debris from washes and waterways. Place rip rap along points of erosion (turns, steep slopes, and culvert inlets and outlets)	5 Years	Leeds, CIB, CDBG, FEMA	Still needed
Flood #3	(Silver Meadows and Mesa View Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Re-grade swales. Clear debris from washes and waterways. Place rip rap along points of erosion (turns, steep slopes, and culvert inlets and outlets). Install underground storm drainpipe.	5 Years	Leeds, CIB, CDBG, FEMA	Still needed
Flood #4	(Leeds Valley Road Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Construct concrete swales with catch basins and underground piping. Direct underground piping to convey water to discharge into Harrisburg Wash.	5 Years	Leeds, CIB, CDBG, FEMA	In progress.
Flood #5	Town Storm Water Maintenance Program) Reduce community and residential flooding through storm drainage improvements.	Develop a Storm Water Maintenance and Management Plan to manage sediment build up and removal. Plan will outline costs for such maintenance and planning for future improvements. GIS mapping of project with portable management device.	6 Years	Leeds, CIB, CDBG, FEMA	In progress.

Source: 2017 Five County Association of Governments NHMP

The Leeds Town planning team identified actions to include in the community mitigation strategy. Each action in Table 423 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 412.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 412: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, Leeds has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 423, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions. The town elected to not include a problem soils action due to the low risk observed by the community.

Table 423: Leeds 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Reduce radon exposure to residents.	Provide radon risk, testing, and mitigation information to residents.	H	1-year	L	Leeds Town	Leeds Town
Radon #2	4	Reduce radon exposure to residents.	Test k-12 public schools for radon hazard.	M	2-years	L	Washington County, Washington County	Leeds Town, Washington County,

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
							School District	School District
Radon #3	1	Reduce radon exposure to residents.	Adopt a geologic hazard ordinance which sets requirements for construction to mitigate radon hazards.	H	1-years	L	Leeds Town	Leeds Town
Drought #1	4	Ensure water resources are conserved and protected.	Work with private water company for public education and securing water resources.	H	3-years	L	Water company, Leeds Town	Water Company, Leeds Town
Drought #2	1, 2	Ensure water resources are conserved and protected.	Work with water company to plan for redundancy and ensure that pipes are resilient to geologic hazards.	M	5-years	M	Water company, Leeds Town	Water Company, Leeds Town
Earthquake #1	2	Protect town facilities and users from natural hazards.	Assess and implement structural and nonstructural retrofits to the Town Hall.	L	5-years	M	Leeds Town	Leeds Town
Wildfire #1	1, 4	Reduce fuel loads in and near the town to address severe wildfire risks.	Coordinate BLM on with ongoing fuels abatement near town.	M	2-years, ongoing	L	Leeds Town, BLM	Leeds Town, BLM
Wildfire #2	1, 4, 5	Coordinate with other entities for natural hazard preparedness, response, and recovery efforts.	Coordinate with the community and county on an evacuation route for the community.	M	5-years	M	Leeds Town	Leeds Town, Washington County, UDOT, Private property owners.
Wildfire #3	1, 4	Reduce fuel loads in and near the town to address	Coordinate with Hurricane Valley	H	2-years, ongoing	L	Leeds Town,	Leeds Town,

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		severe wildfire risks.	SSD for fuels abatement.				Hurricane Valley SSD	Hurricane Valley SSD
Flood #1	2	(Main Street Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Replace ditch on north side of Main Street with curb and gutter. Storm drain catch basins along Main Street at intersections. Storm drain outlet to discharge into Harrisburg Wash.	M	5 Years	H	Leeds, CIB, CDBG, FEMA	Leeds Town
Flood #2	2	(Silver Reef Area Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Re-grade swales. Clear debris from washes and waterways. Place rip rap along points of erosion (turns, steep slopes, and culvert inlets and outlets)	M	5 Years	H	Leeds, CIB, CDBG, FEMA	Leeds Town
Flood #3	2	(Silver Meadows and Mesa View Storm Drain Improvements) Reduce community and residential flooding through storm drainage improvements.	Re-grade swales. Clear debris from washes and waterways. Place rip rap along points of erosion (turns, steep slopes, and culvert inlets and outlets). Install underground storm drainpipe.	M	5 Years	H	Leeds, CIB, CDBG, FEMA	Leeds Town
Flood #4	2	(Leeds Valley Road Storm Drain Improvements) Reduce community and residential flooding through	Construct concrete swales with catch basins and underground piping. Direct underground piping to convey water to	M	5 Years	H	Leeds, CIB, CDBG, FEMA	Leeds Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		storm drainage improvements.	discharge into Harrisburg Wash.					
Flood #5	2	Town Storm Water Maintenance Program) Reduce community and residential flooding through storm drainage improvements.	Develop a Storm Water Maintenance and Management Plan to manage sediment build up and removal. Plan will outline costs for such maintenance and planning for future improvements. GIS mapping of project with portable management device.	M	6 Years	M	Leeds, CIB, CDBG, FEMA	Leeds Town
Severe Weather #1	2	Protect town facilities and users from natural hazards.	Installing and maintaining surge protection on critical electronic equipment.	H	1-year	L	Leeds Town	Leeds Town
Severe Weather #2	1, 4	Coordinate with other entities for natural hazard preparedness, response, and recovery efforts.	Coordinate with entities with large facilities (like the local church or fire department) to act as shelters during power outages.	M	2-years	L	Leeds, Fire SSD, Local Churches, business owners.	Leeds, Fire SSD, Local Churches, business owners.
Landslide #1	2	Protect town facilities and users from natural hazards.	Plan for reseeding and revegetation of town owned slopes following wildfire events.	L	2-years	M	Leeds, Fire SSD	Leeds, Fire SSD
Landslide #2	2	Plan for future growth in potential hazard areas.	Review and include landslide and steep slope requirements in annexation plans for the town.	H	3-years	L	Leeds	Leeds

Source: Local Planning Team

Refer to the Plan Maintenance Chapter of the Hazard Plan to review the schedule for updating this plan and opportunities for region wide planning group meetings between updates.

New Harmony

Located in northern Washington County, New Harmony Town is bordered by the Pine Valley Mountains and Kolob Canyon. This picturesque valley is set a short drive from I-15, roughly between St. George and Cedar City. The community was settled in 1852 as an agricultural community. A historic flooding event in 1862 displaced residents of then Fort Harmony, which is documented as bringing residents to the valley.

Demographics

As of the 2018 American Community Survey, New Harmony has a population of 180 people, described in Figure 413. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

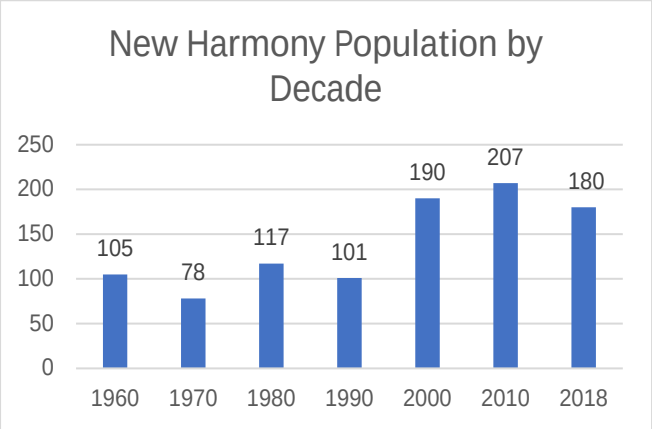


Figure 413: New Harmony Population by Decade

Source: US Census Bureau

New Harmony population has been increasing with time, with the most rapid changes observed in 2000, as seen in Figure 414. The 2010 census illustrated an 8.9% increase to the population, although with the 2018 estimate, population in the community is declining. Since 1960, the average population change is 15% each decade.

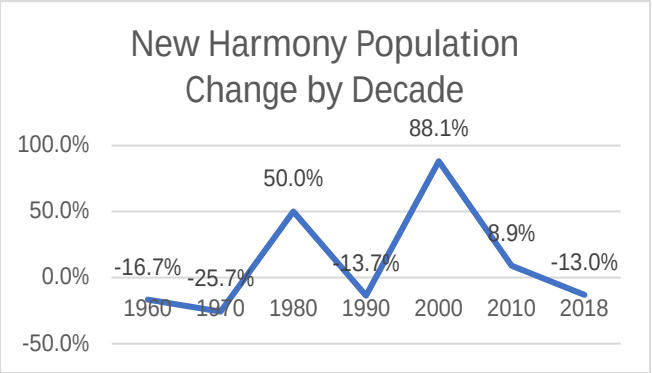


Figure 414: New Harmony Population Change

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to New Harmony, the community could see 630 people living in the community in the next 45-years[25].

Economy

New Harmony was an agricultural settlement in Northern Washington County, supporting the population moving from nearby Fort Harmony, which flooded and displaced the pioneers. Since that history, New Harmony has maintained a local economy with a focus on agriculture, forestry, fishing, and hunting according to the US Census Bureau, and described in Figure 415. It is likely that some residents in New Harmony are employed in other neighboring communities, like Cedar City and St. George.

[25] This estimate is created using the 2015 ACS population estimate for New Harmony, which was 192, and adding 229% of this population estimate to the population for that year.

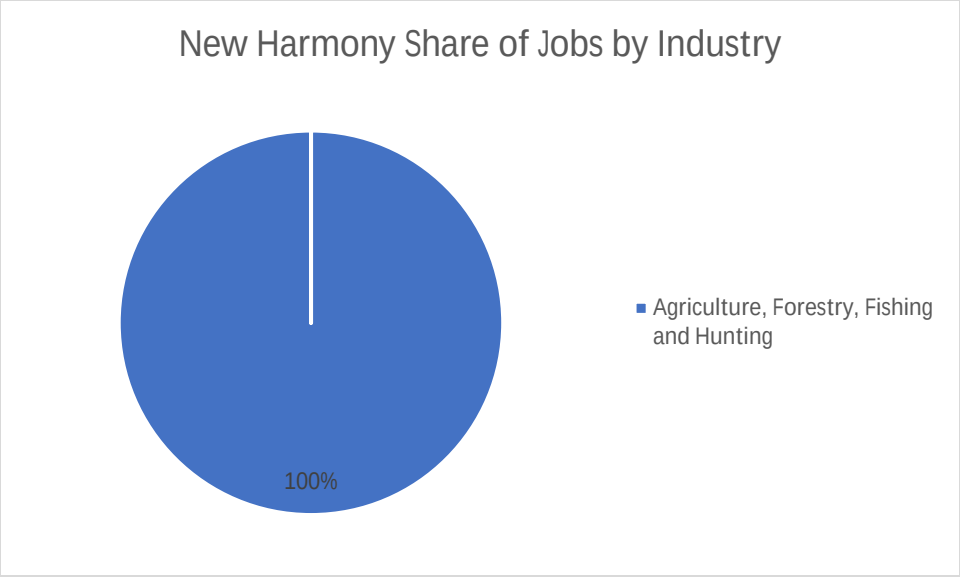


Figure 415: New Harmony share of Private Primary Jobs by Industry

The New Harmony local economy includes local businesses and agricultural resources. There are two local parks: Town park and Comance Park which have trails and open space for the enjoyment of residents and visitors.

Community Capabilities

New Harmony is governed by a mayor and a five-person town council. Council members are the acting heads of various municipal departments, including water, roads and streets, and cemeteries and parks. The community has a five-person Planning commission which engages the community in economic development and planning activities. (New Harmony Town , 2020)

The community has agreements with Washington County for law enforcement and the Harmony Valley Fire Special Service District (SSD), which supports the valley with fire suppression. (New Harmony Town , 2020) The Harmony Valley Fire SSD is a volunteer organization which responds to incidents in a 51-mile range. (New Harmony Fire , 2020)

New Harmony provides services for water, roads and streets. In addition to these services, there are several local utility providers in the community:

- Rocky Mountain Power, Dominion Energy, AmeriGas, and CenturyLink.
- Washington County provides trash removal services for the community.

Development

Washington County has identified that development is trending in New Harmony and is expected to continue, according to the New Harmony Valley General Plan. As of 2019, there is a proposal for a commercial development outside of the city, near the entrance to Kolob Canyon and Zion National Park. While this development is outside of the city boundaries, it would be serviced by the volunteer Harmony Valley Fire SSD.

A handful of homes have been built within the town limits. Other development within town has not been observed.

Plans and Policies

New Harmony is an incorporated community that adopts local ordinances and plans to govern and set standards for development in the town. Five County staff reviewed these local plans and policies to understand potential existing Mitigation projects, goals, or policies that address natural hazards. A summary of the local language in the general plan and local zoning code that describe natural hazards can be found below.

General Plan

The New Harmony General Plan Addendum (2011) was drafted by Washington County to identify the goals and objectives for the community. This plan describes the community's interest to protect hillsides as open space and public land. Further, one of the policies described in the plan describes a severe weather and flooding mitigation action on Old Highway 91, to protect from runoff from the Black Ridge Reservoir during a storm event. The policy describes the need to work with state and local partners to address this concern, including the Utah Department of Transportation and an irrigation company which controls the reservoir water rights.

Ordinances

The local ordinances call for documentation of the safety of a site for construction at the request of the planning commission to show whether the site has suitable soil or lies in a flood or earthquake hazard area. This documentation is the responsibility of the developer or applicant.

New Harmony has also identified a restricted development overlay zone and an open space zone to dictate what is constructed in the community and how, to limit construction in the flood, erosion, steep slope, and rockfall areas. In the restricted development overlay zone, a conditional use permit may be granted if an applicant shows the measures that will be taken to mitigate flood and flash flood dangers. Mitigation measures must be developed by an engineer, planner, or architect to meet the requirements of the code. The New Harmony Zoning Map (adopted 2020) does not reflect that properties in the municipal boundary fall in this restricted development or open space overlay zone.

Risk Assessment

New Harmony Town experiences and is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. This area experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with New Harmony to prioritize the highest risk hazards based on probability, frequency, and local exposure of the hazard. A description of the risk assessment metrics is included in the hazard description for New Harmony. Table 424 displays the relative risks of hazards in New Harmony Town.

Table 424: New Harmony Town Hazard Risk

HAZARD	RISK
WILDFIRE	High
SEVERE WEATHER	High
FLOODING	High
EARTHQUAKE	Moderate

DROUGHT	Moderate
RADON	Low
PROBLEM SOILS	Low
LANDSLIDES	Low

Five County assessments for New Harmony include reviewing the exposure that residential parcels, parks, and roads have to the natural hazards that impact the area. A detailed description and mapping of each of the natural hazards that impact New Harmony can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in lowering the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Comance Nature Park and the Town Park were not included in a state database of local parks. Five County will be working to include these parks in the analysis, but notes that as of this writing, they have not been included in mapping analysis and the parks metric is marked as “unknown”.

Wildfire

Wildfire is a natural phenomenon which becomes a risk when it interacts or comes near human settlements, resources, or assets. The Utah Wildfire Risk Assessment Portal indicates that New Harmony is at risk to wildfire. The Five County assessment shows that a significant portion of the community’s parcels and roads are exposed to wildfire risk. This risk represents the possibility of loss or harm and is based on several factors, including fuel types, development, water and infrastructure assets, and the likelihood of an area burning. Figure 416 illustrates the that the relative risk of wildfire to New Harmony is at least moderate through most of the community, but is highest in the north, west, and central portions of the community.

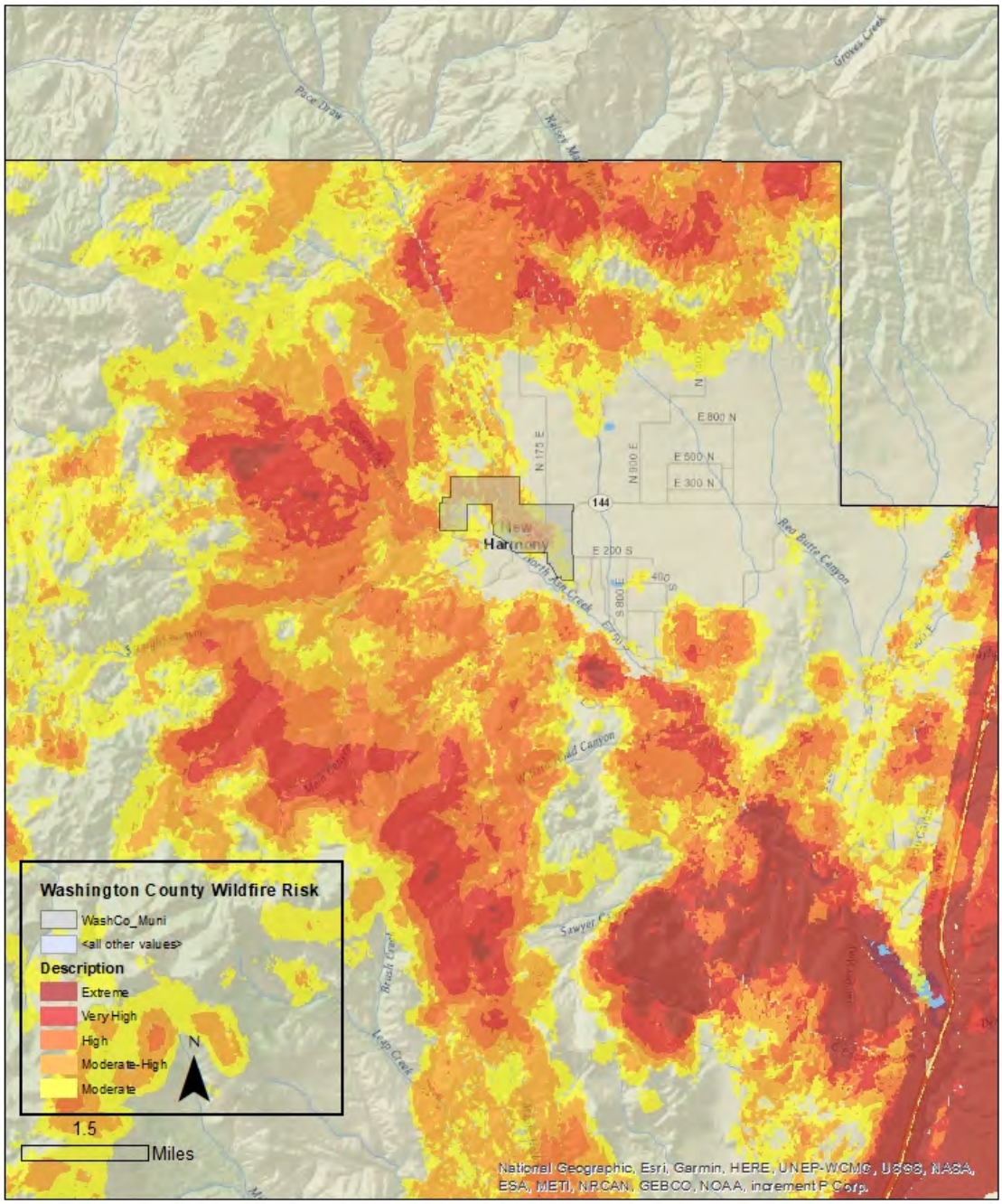


Figure 416: New Harmony Wildfire Risk

Source: Oregon Department of Forestry, 2020

Five County's analysis included assessing which community assets and resources could be impacted by wildfires. This assessment included understanding which residential, commercial parcels, roads, park infrastructure were impacted. Table 425 describes the interaction of community assets and people with the wildfire risk areas. Parcels and road miles have at least a 90% risk to wildfire hazards.

Table 425: New Harmony Wildfire Exposure

New Harmony Exposure to Wildfire					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
100.0%	98.2%	98.3%	90.7%	N/A	N/A

Source: Oregon Department of Forestry, 2020; Washington County Assessor, 2020

Hazard History

New Harmony is a higher elevation community in Washington County with hillsides and the Pine Valley Mountains to the west of the community. The area has experienced many instances of wildfire over the years, several of which have threatened the town. Past instances of wildfire are described in Table 426. Descriptions of these fires were accessed by reviewing BLM, Forest Service, Utah Fire Info website, and local news sources.

Table 426: New Harmony Wildfire Record

Fire Name	Year	Acres Burned	Other Impacts
West Valley	2018	11,716	Fire caused by an abandoned campfire. The fire was within 3-miles of the town limits.
New Harmony Fire	2012	2,000	Fire caused the evacuation of Bumblebee and New Harmony and closed i-15. The fire burned several structures.
Utah Mill Flat Fire (FM-2831-UT)	2009	12,600	Destruction and damage to homes and mandatory evacuations of 170 residents.
Utah Blue Springs Fire (FM-2564-UT)	2005	12,000	Impacted the Harmony Heights community, outside of New Harmony town limits. The fire caused the closure of Interstate 15 Southbound lanes. 375 homes were threatened, and 1,200 people were evacuated. Three outbuildings and 14 power poles were burned, causing some power outages. Cost of the fire is estimated at $3.3 million.

Source: FEMA Region 8 Fire Management Assistance Grant (FMAG), Salt Lake Tribune "Sudden wind shift forces evacuation of New Harmony", Salt Lake Tribune "Mill Flat Fire roaring out of control", KSL "Blue Springs Fire Contained", and The Spectrum "Officials don't expect West Valley Fire to force evacuations".

Earthquake

The closest Faultline to New Harmony is the Cedar City segment of the Hurricane Fault at 5.5 miles away. Five County's assessment considers the community assets within a quarter mile of a Faultline, which does not apply to New Harmony.

The fault is typically where a large earthquake would be caused, from the shifting of the two sides of the fault. Earthquake epicenters can be recorded miles away from an earthquake, as is observed throughout Washington County in Figure 417. Further, amplification of earthquake waves can send strong shaking away from an epicenter, leading other locations to feel the shaking event and potentially see related impacts to infrastructure. New Harmony is still located in earthquake country and has some risk to earthquakes at the documented distance from a fault line.

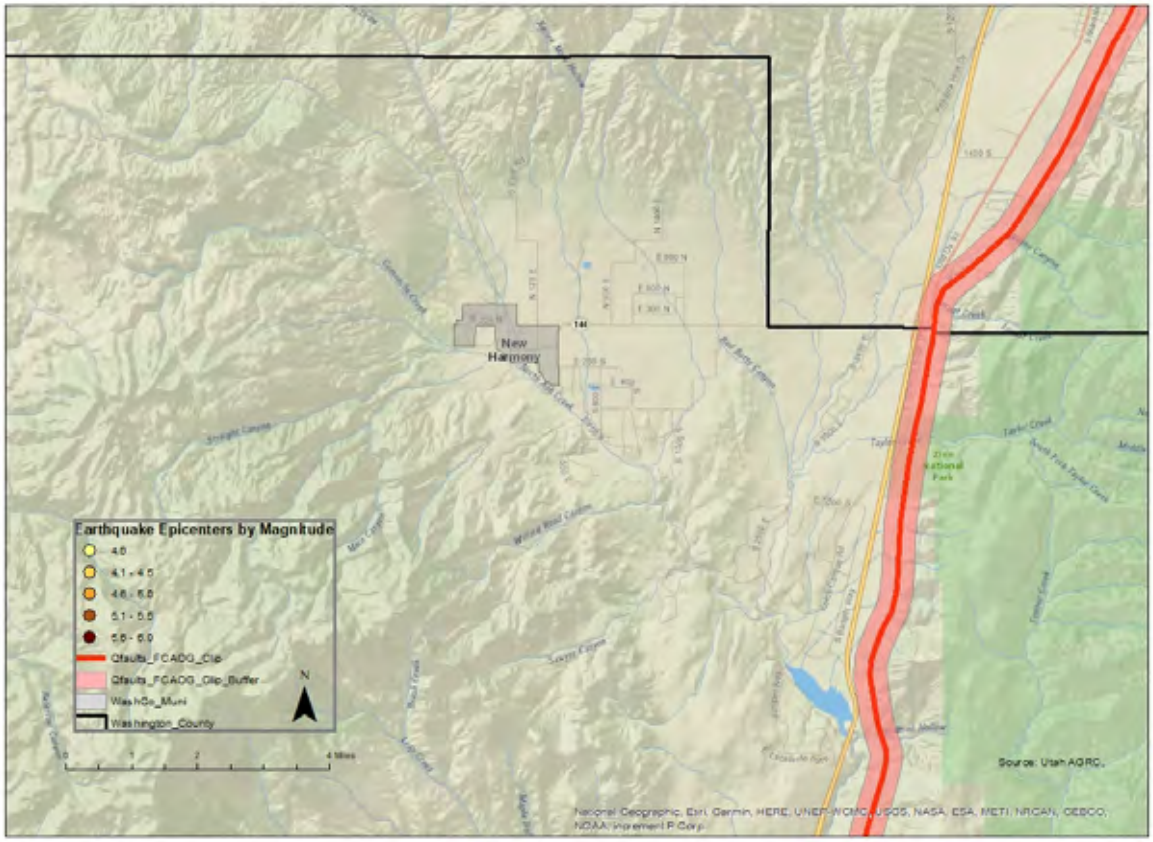


Figure 417: New Harmony proximity to epicenters and quaternary faults

Source: Utah Geologic Survey; University of Utah Department of Geology.

Another consideration to keep in mind is that 37.4% of parcels in New Harmony had structures built before 1975. 1975 is when seismic code was adopted and enforced in the State of Utah. Buildings constructed before that time sometimes include unreinforced masonry, which can perform more poorly in a shaking event than wood frame or steel or concrete reinforced structures. Not only is there the potential for these structures to be damaged, users or bystanders can be at risk from falling debris from the structure.

Flood

Flooding in southwestern Utah rarely occurs because of overtopping rivers or lakes. It is more frequently associated with intense rain and winter storms that trigger flash flooding in communities. In 2010, the New Harmony area experienced a severe storm that caused flooding outside of the town limits. A bridge was threatened and lead to volunteer evacuation orders of a subdivision. (KSL.com, 2010) While the 2010 event caused impacts outside of the town boundaries, similar events mark the community's history. A geological survey conducted by the Department of the Interior describes a 1904 event that drove residents from their homes, damaging roadways and homes. (Woolley, 1946)

Figure 418 illustrates where in New Harmony the Floodplain and dam inundation zones lie. Table 427 describes the impact that these zones may have on community assets. Nearly one-third of roadways and more than one-quarter of residential parcels are in these zones.

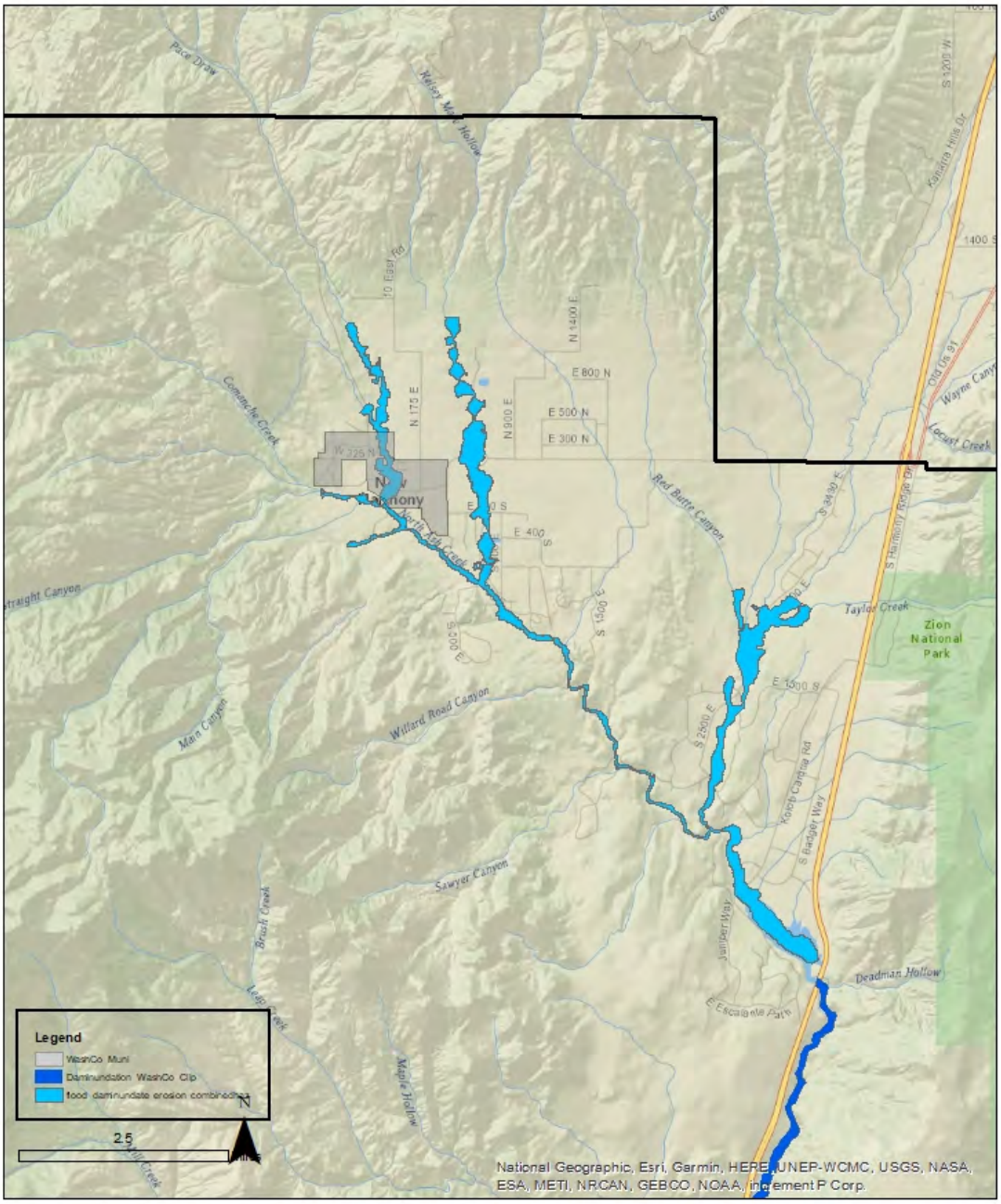


Figure 418: New Harmony Flood and Dam Inundation Zones

Source: Digital flood insurance rate maps (DFIRMS), 2017.

Table 427: New Harmony Exposure to Flood and Dam Inundation Zones

New Harmony Exposure to Floodplain and Dam Inundation Zone					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
100.0%	26.3%	27.0%	32.1%	N/A	Unknown

Source: Digital flood insurance rate maps (DFIRMS), 2017; Washington County Assessor, 2020.

National Flood Insurance Program (NFIP)

The New Harmony community and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program, approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

New Harmony has participated in the NFIP since 2009, when the first Flood Insurance Rate Maps were developed for the community. Table 428 below describes the number of flood insurance policies, and dollar value insured and claimed since participation began. New Harmony does not have properties that have reported repetitive losses and the community does not participate in the Community Rating System (CRS).

Table 428: New Harmony NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$5,373	0	3	3	$497,700	1	$10,292

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Landslide

Landslides are the flow of dirt, mud, and debris which can be triggered by ground shaking, rain, wildfire, or human causes. Landslides most frequently happen on steep slopes, areas that have little or removed vegetation, and locations of past landslides. The Utah Geological Survey mapped landslide susceptibility for the southwest and Five County used this data to understand the interaction of communities and these susceptible areas. According to this data, New Harmony has a low susceptibility with very little interaction with community assets. Figure 419 and Table 429 demonstrate the extent of landslide susceptibility in the community. There is no documented record of landslide events impacting New Harmony Town.

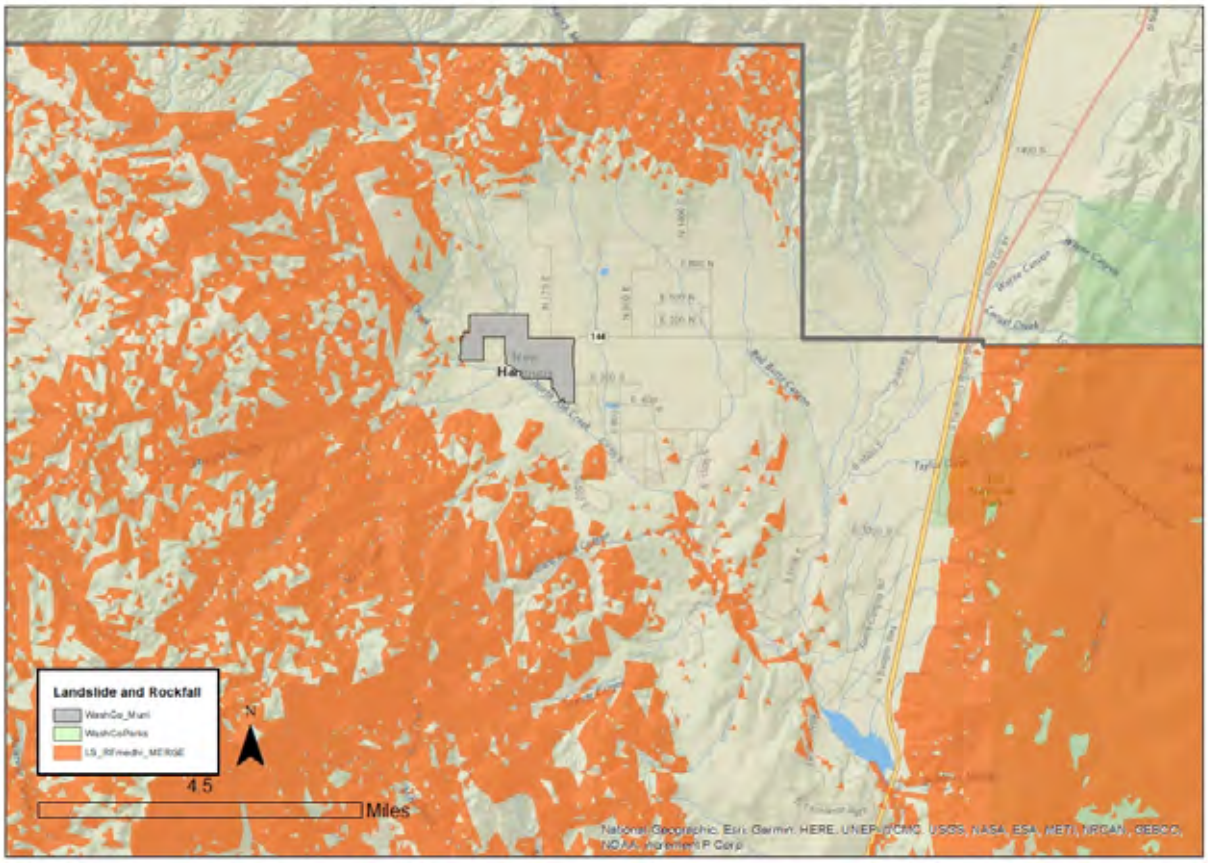


Figure 419: New Harmony Landslide Susceptibility Exposure

Source: Utah Geologic Survey

Table 429: New Harmony Landslide Susceptibility

New Harmony Landslide Susceptibility					
Parcels			Road Miles	Rail Miles	Local Parks
Commercial	Residential	Total			
0.0%	1.8%	1.7%	3.1%	N/A	Unknown

Source: Utah Geologic Survey; Washington County Assessor, 2020

While present community assets have minimal exposure to landslide susceptible areas, growth in New Harmony has the potential to place residents and new development in at risk areas to landslide hazards.

Drought

The Five County Region has experienced 7 periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite.

Monitoring drought generally occurs across several climate division. New Harmony lies in the Southcentral division, which includes much of southern Utah. Drought, given its regional scope will impact residents, facilities, infrastructure, businesses, and property in the community.

Agricultural assets can be susceptible to drought impacts. Hot and dry conditions, especially in summers can lead to lost or damaged crops and increased risks of wildfire. Drought can compound preexisting water supply, quality, or delivery concerns. Decreases in water supply can trigger water quality impacts, as can wildfire smoke, ash, and run-off.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact New Harmony, however our analysis assumes that severe weather events will impact the whole of New Harmony residents, facilities, infrastructure, businesses, and property.

New Harmony is in the northern area of Washington County, and has a different climate than the arid, lower elevation communities to the south. New Harmony has distinct seasons with snowfall common in the winter. The area experiences hot and dry summers that are common in the southwest, marked by thunderstorms and monsoon rains. These rapid downfalls of rain can trigger flash flooding in the communities. The NOAA storm and weather history database documents four events that impacted the New Harmony community.

- A spring 2020 event brought 1.83 inches of rain to New Harmony.
- October 2004 rain and snowstorm event brought river and basement flooding to New Harmony. Statewide, $50,000 in damages were reported relating to this storm.
- August 2008 event reported rainfall between 4 and 7 inches in New Harmony with flash flooding reported.
- July 2010 rainfall on the Mill Flat burn scar sent flash flooding and debris flow into town.

Severe weather will continue to impact New Harmony, as weather events are regularly occurring in this region. While the average weather event may not have significant impacts, severe weather events including winter storms, wind, heavy rain, thunder, and hailstorms can cause damages and impact community members. These events are predicted to become more frequent or extreme in the future, which will likely cause impacts on communities like New Harmony, which see impacts from weather related hazards. For further information about severe weather hazards in southwestern Utah, please see the hazard identification chapter of this plan.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is described as the natural hazards that kills most people in Utah. Despite this statistic, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation is affordable, especially when completed in pre-construction phases.

Problem Soils

New Harmony is outside of the mapped area for the Utah Geological Survey's most recent problem soil mapping, which describes collapsible, corrosive, karst, and expansive soil types which may pose a risk to new and existing development if not mitigated. Based on the data that is available for New Harmony, this community does not have any mapped expansive soils, dunes, or limestone karst features, described in Figure 420. Further data is needed to understand the types and extent that problem soils may affect New Harmony. Considering the occurrence of problem soils in Washington County and nearby Cedar City, it is possible that problem soils impact New Harmony despite the limited available data.

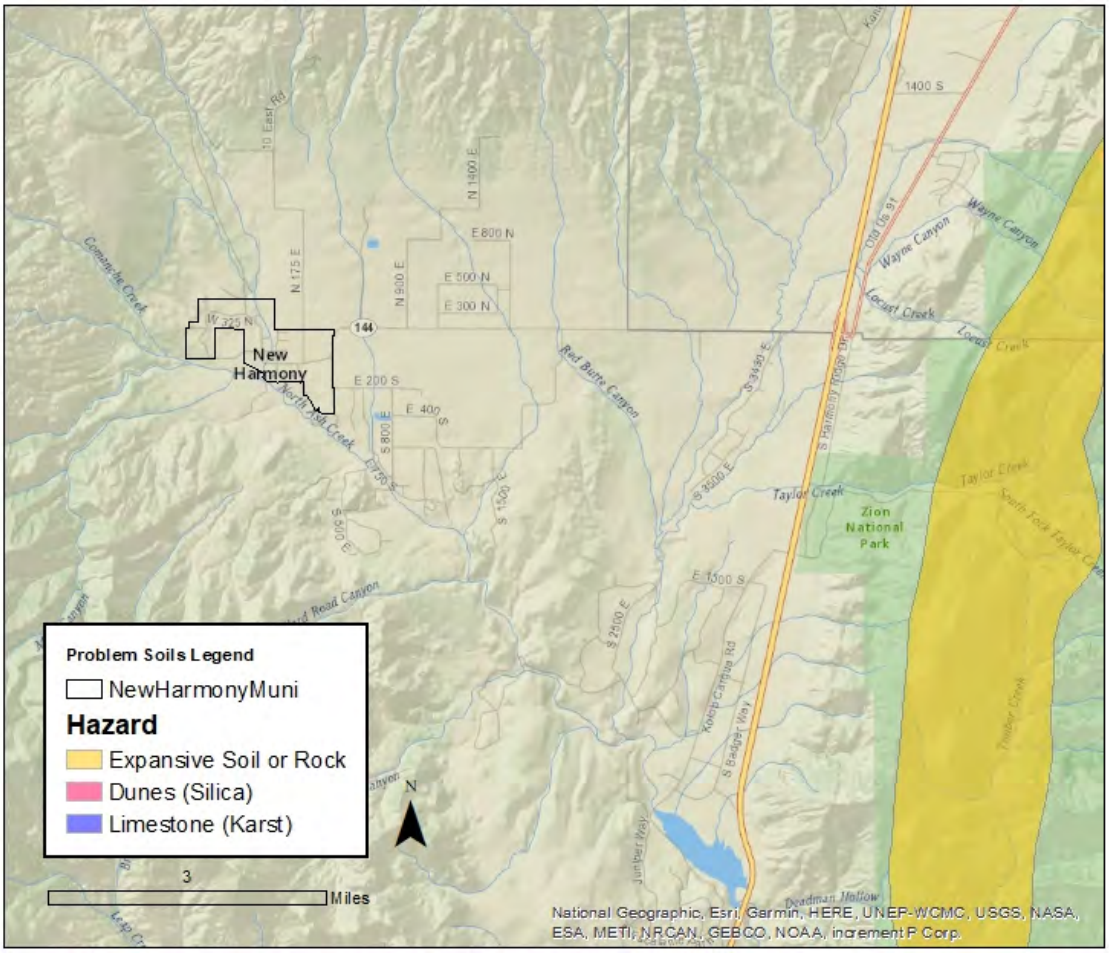


Figure 420: New Harmony Problem Soil Exposure

New Harmony requires geological study of problem soils at the request of the Planning Commission as a requirement for building permits from Washington County.

Mitigation Strategy

The Mitigation Strategy is a community's blueprint to address risks and avoid potential losses from the hazards identified in the Risk Assessment. Each community's strategy describes the need for the action, priority, timeline, funding source, estimated cost, and responsible parties for the action. The objective of this plan is that the actions will be implemented and incorporated into the community policies, plans, and procedures when applicable.

Mitigation actions can fall into four types: plans and regulations, structure and infrastructure projects, natural systems protection, and education or awareness programs. Incorporating a variety of these types into the mitigation strategy can create a robust and diverse method to address the local natural hazard risks.

Previous Mitigation Strategy

New Harmony participated in the 2016 Natural Hazard Mitigation Plan update and provided two flood mitigation actions. Table 430 shows the actions developed by the community for the plan.

Table 430: New Harmony 2017 Mitigation Strategy

Action Number	Objective	Action	Timeline	Funding Source	
Flood #1	Minimize structural damage from floods.	A structural alternative would be to construct a levee along Pace Draw creek through town, a levee distance of about 5,000 feet.	Unknown	Local government operating budget; State and Federal flood grant programs	No levee has cleared the creek bed.
Flood #2	Provide Flood protective features along Ash Creek in and near New Harmony.	Provide flood protective features along Ash Creek to prevent flooding to residences in area subdivisions.	Unknown	Local government operating budget; State and Federal flood grant programs	Excess vegetation and debris were removed.

The New Harmony planning team identified actions to include in the community mitigation strategy. Each action in Table 431 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are summarized in Figure 421.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 421: Regional Plan Goals

Table 431: New Harmony 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire/ Flood #1	1, 3, 4, 5	Improve access and evacuation options for the community during hazardous events.	Coordinate with Washington County and local property owners to identify a secondary access road to the community to improve community access during emergency situations. Inform residents of hazards and evacuation protocols annually.	H	5-years	M	Washington County, UDOT	New Harmony, local property owners, Washington County, UDOT.

Source: Local Planning Team

Rockville

The town of Rockville incorporated in June of 1987. The community sits in a canyon carved by the Virgin River, with cliffs on either side of the community. Now, the Virgin River parallels SR-9, the major thoroughfare through the community, which connects Rockville to St. George and Springdale.

Rockville is steeped with local history, being settled by pioneers in 1862 as an agricultural settlement. The Rockville municipal boundary now includes the town of Grafton, a ghost town that also was once settled for agricultural purposes. The community has proudly remained a small, rural community connected to their pioneer roots.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

Demographics

As of the 2020 Census, Rockville has a population of 226 people, described in Figure 422. Rockville population has been increasing with time, with the most rapid changes observed in 2000. The 2010 census illustrated a 2% decline in the population, although with the 2018 estimate, population in the community is seeing growth rebound, as described in Figure 423.

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Rockville, the community could see 1,300 people living in the community in the next 45-years[26]. A more modest projection which may be more reflective of the trends in the

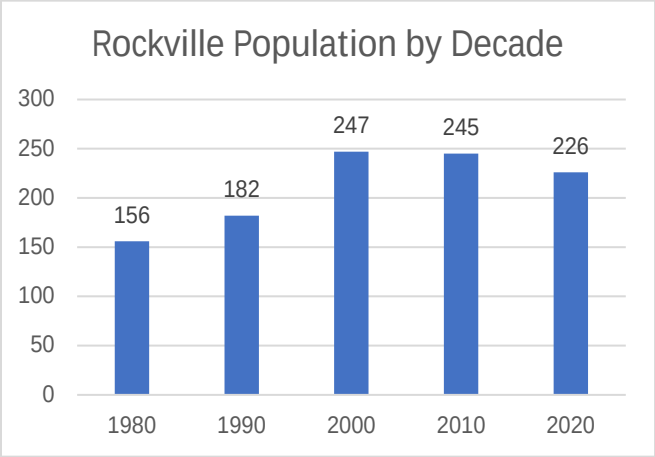


Figure 422: Rockville Population by Decade
Source: US Census Bureau, 2018 ACS.

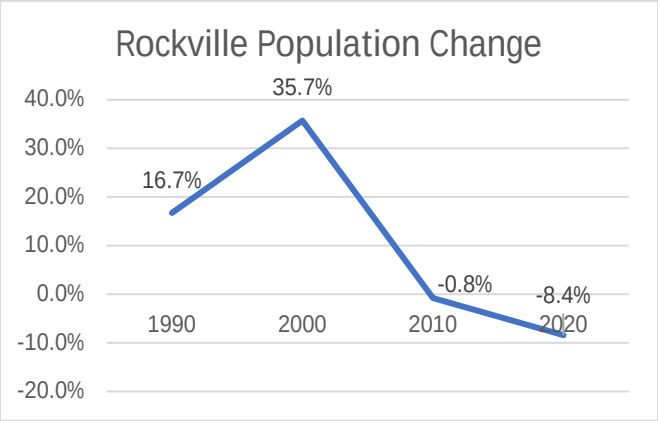


Figure 423: Rockville Population Change
Source: US Census Bureau, 2018 ACS.

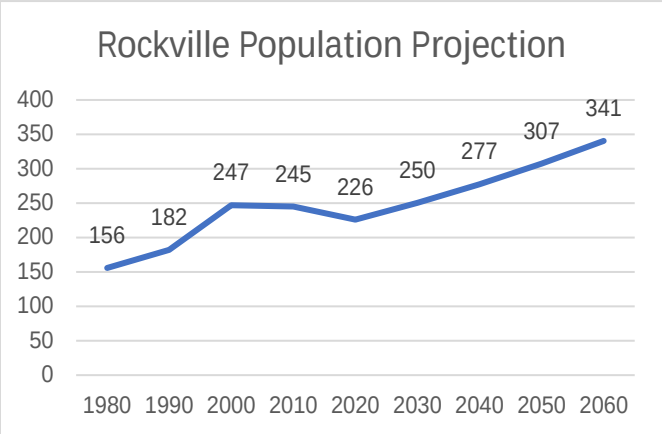


Figure 424: Rockville Linear Population Projection
Source: US Census Bureau

[26] This estimate is created using the 2015 ACS population estimate for Rockville, which was 395, and adding 229% of this population estimate to the population for that year.

community relates to the average growth in the community. Since 1990, the average growth each decade has been 10.8%. Figure 420 presents a projected population of 341 people estimated by 2060 in the community.

Economy

Rockville was settled as one of the pioneer agriculture colonies, as described by the Grafton Historical Society. Since that history, Rockville has kept local commercial uses small scale, with ordinances that set local businesses as operable from in the home only.

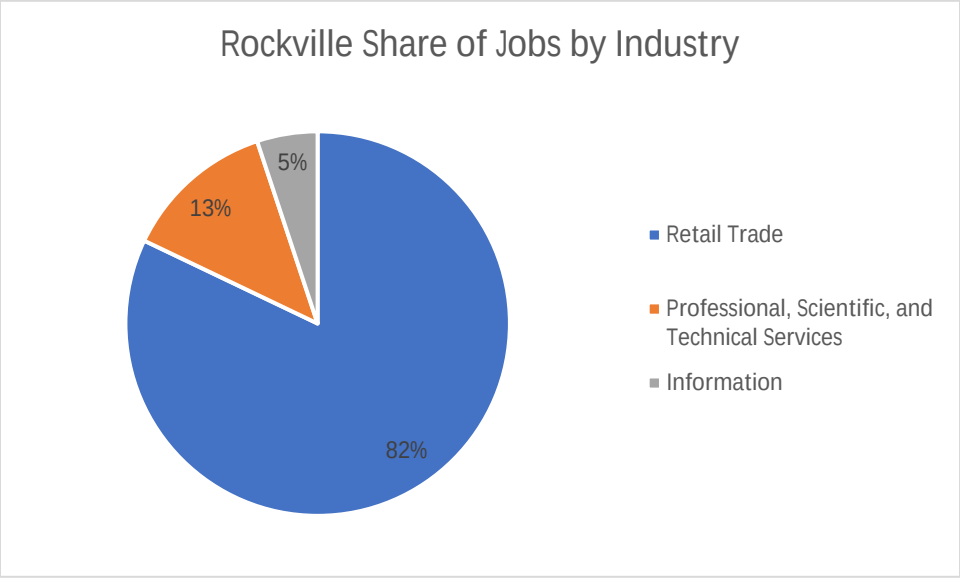


Figure 425: Rockville share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts Rockville prominent industries by the number of jobs supported in the community, illustrated in Figure 425. The assessment describes characteristics of workers working in the town boundaries. Retail trade provides the most jobs locally in Rockville. Other industries in the area, including professional, scientific services and information industries are likely small businesses, or remote employees who live in Rockville.

Some businesses not captured in the assessment by the US Census Bureau include 5 bed and breakfasts, short-term rentals, dog care facility and the gravel pit. These may be mischaracterized in the data as the incorrect industry type or may have been missed in the assessment. This is unfortunately a shortcoming of this data.

Development

Development in Rockville town is centered near the Main Corridor along SR-9. The Town recently adopted a short-term rental zone which has been in operation for 3-years in the community, which allows four short term rentals. There have recently been applications for subdivisions, but with no new development on the parcels to date. Recent subdivision has created nine parcels since 2019 which may see future development. The city also describes six to seven parcels which may see new homes built on them in coming years.

Over the past five-years an average of one home per year has been built in the town. All businesses in the community are home-based businesses, so there are no large commercial corridors in the community.

Community Capabilities

Rockville is governed by a mayor and city council, who engage in legislative activities for the community. A planning commission also supports specialized review and recommendation of planning and zoning activities in the community to the council. Rockville staff include a clerk and deputy clerk.

The Hurricane Valley Fire Special Service District provides fire protection services from their station in Springdale. The Community Emergency Response Team (CERT) is a volunteer group who is trained and organized to assist communities and residents in the service district boundaries respond to hazards, including natural events.

Utilities are provided by several organizations. Two companies provide irrigation water in Rockville, The Rockville Ditch Company provides irrigation water north of the Virgin River and Hall and Grafton Irrigation Company provide south of the Virgin River. The Rockville Pipeline Company supports culinary water to residents. The community works with Springdale for sewer service. Trash provided by Washington County.

Critical infrastructure in the community includes the Rockville Pipeline Company Wells and Holding tanks which provide water to most residents, and the sewer pipelines and treatment ponds which serve most of the community.

Plans and Policies

Rockville has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Rockville's plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

The Rockville Codes and Ordinances seek to protect resident's welfare and health and natural and cultural resources through local policy. Throughout the ordinances document, policy describes actions to take and situations to avoid, which protect the community from hazards. Some actions include, but are not limited to, subdivisions and development requiring drainage, use of current building standards, mitigation where natural hazards are a risk, and providing studies and plans to avoid hazards on a development site.

The zoning regulation seek to set uses in the community which can in part protect residents and visitors from natural hazards. Rockville open space zones provide a buffer from the built environment and potential natural hazard risk areas. Zoning ordinance also describe that "construction of permanent structures shall not be permitted, established, erected, or performed in such a manner as to place real or personal property and/or individuals at unreasonable risk of harm or injury from natural, geographic, or topographic hazards, such as landslides, rockfalls, flood, or excessive soil erosion."

General Plan

The Rockville General Plan (2020) describes the vision for the community, referencing the history, current and planned land use, need for services, and conservation. Several of the policies and goals for the community address natural hazard mitigation, including:

- The protection of vistas, water supply, and unstable soils through development controls
- Establishing a sensitive lands ordinance
- Maintaining capital improvements including evaluation of bridges and preservation of historic structures. Rockville has an agreement with the Town of Springdale to manage the waste water system.
- Adhering to the Uniform Building Code
- Protection of hillsides, hilltops, benches, mesas, and mountains
- Protection of floodplains, drainages, riparian zones, water courses, and washes.
- Use of riparian zones, floodplains, and washes for flood control, agricultural, and recreation purposes.
- Working with the privately owned culinary water system to ensure it is maintained.
- Require studies, including geotechnical soils studies for proposed development at the request of the town.

Risk Assessment

Rockville is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Rockville planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 432 describes the relative risks of hazards in the community.

Table 432: Rockville Hazard Risk

HAZARD	RISK
DROUGHT	1. High
LANDSLIDE	2. High
FLOOD	3. High
WILDFIRE	4. High
SEVERE WEATHER	5. Moderate
EARTHQUAKE	6. Moderate
RADON	7. Low

PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Rockville can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Rockville include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Rockville is a rural town in southern Washington County, which is bounded by cliff sides on the north and south portion of the community, with SR-9 connecting Rockville to neighboring communities. The area is dominantly residential and agricultural, with significant open space surrounding the community. A town resident and fire fighter described the town as landscaped with green or fire-resistant vegetation and rock, with fuels divided by built and natural features, like irrigation ditches, sidewalks, the Virgin River, and roads. The surrounding landscape includes rocky slopes and sagebrush and Pinyon-Juniper Forest.

The community has participated in mitigation activities with partner organizations in the past. The Utah Department of Natural Resources is currently removing Russian olive from Virgin River and have previously mitigated Tamarisk in the area. These are two invasive species that contribute to fuel loads in the areas. The Hurricane Valley Fire District has also provided clean ups and fire mitigation in the past.

Figure 426 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Rockville that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

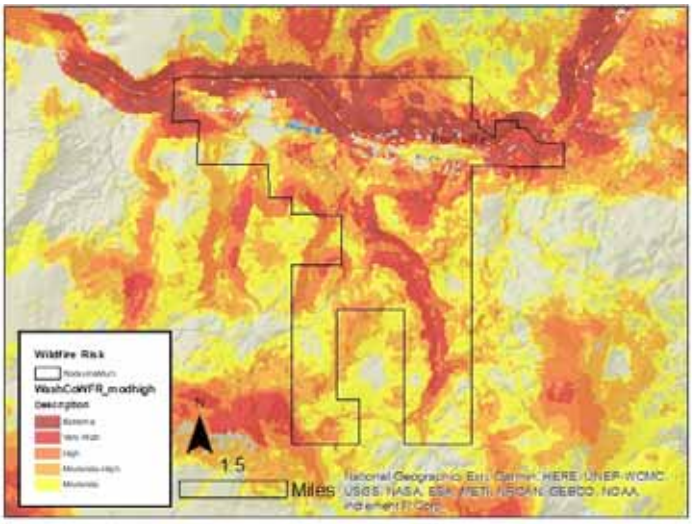


Figure 426: Rockville Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 433 further describes Rockville's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical parcels, and miles of roadway in Rockville, which could damage property, impact public health and safety, or impact local economies. Almost all residential and commercial parcels are exposed to wildfire risk areas in Rockville. Wildfire risk on roadways can result in challenges to response and recovery and the travel of people and goods.

Table 433: Rockville Wildfire Risk

Rockville Exposure to Wildfire Risk				
Critical Facilities	Parcels	Road Miles	Rail Miles	Parks

	Commercial	Residential	Total			
N/A	87.5%	97.2%	96.8%	67.1%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present, fires designated under Fire Mitigation Assistance Grant program from FEMA, and news sources. There have been no large wildfires reported for Rockville on these sources.

The town does describe fires which had the potential to impact the community if they had not been suppressed. In the mid-2000s a fire which occurred west of Coal Pits Wash on the mesa had the potential to move across SR-9 and impact the river. Had this fire reached the river water quality would have been a concern for the community and communities downstream.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Rockville, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 427 shows the mapped earthquake epicenters and fault lines in Rockville.

No earthquakes have been identified with an epicenter in the Rockville municipal boundary.

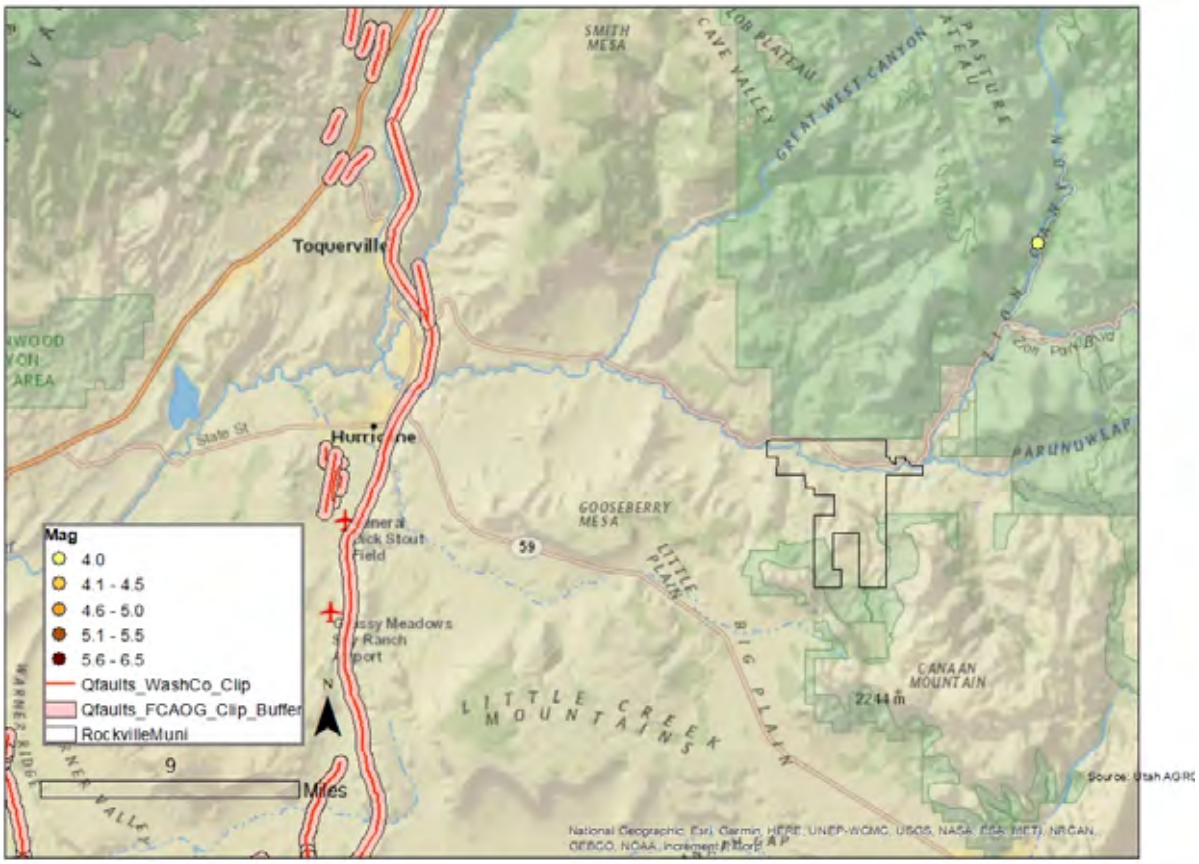


Figure 427: Rockville Earthquake Epicenter and Quaternary Faults

Source: UGS, Washington County Assessor, AGRC

There are no faults in the municipal boundary, with the closest mapped as a segment of the Hurricane Fault Zone approximately 13 miles west of the town.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 73 structures were built before the adoption of seismic code requirements, approximately 39.2% of the total structures in the city boundaries. No critical facilities have been identified as being built before the

1970s. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Rockville Town. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid. Figure 428 indicates that some areas of Rockville may experience low to high susceptibility to liquefaction hazards.

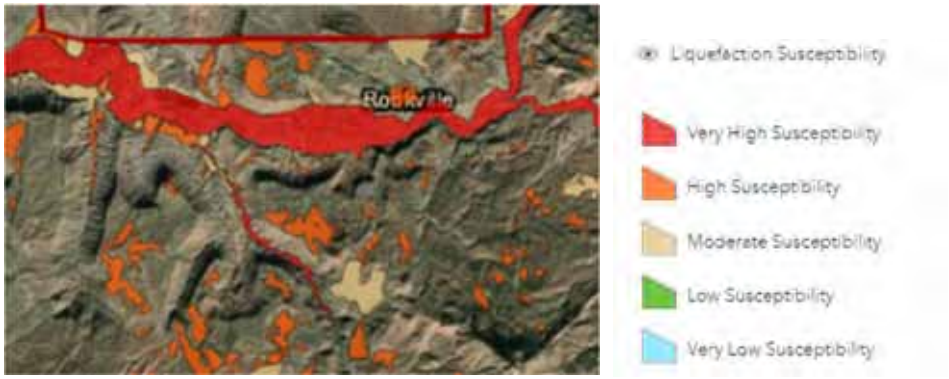


Figure 428: Rockville Liquefaction Susceptibility

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters of 4.0 magnitude or greater have been reported in Rockville as of 2020. The nearest earthquake was in Zion National Park, approximately 9 miles northeast of the Rockville municipal boundary.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid. A concern locally is that earthquakes will cause rockfall and landslide events, like a 1992 earthquake, which triggered rockfall throughout canyon.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 429 depicts the flood and dam inundation exposure in Rockville. Dam inundation and the 100-year floodplain is observed parallel to Main Street, along the Virgin River.

Figure 429: Rockville Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 434 describes the Rockville community assets exposed to dam inundation and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Residential and commercial parcels see the most exposure to potential flood areas, placing residents and personal property at risk. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood.

Table 434: Rockville Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
N/A	37.5%	41.0%	40.9%	7.2%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Rockville property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 435: Rockville NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$4,033	0	2	4	$792,000	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Rockville participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 435 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. No claims have been made for Rockville.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 436 describes the flooding events which have impacted Rockville and the surrounding area.

Table 436: Rockville Reported Flood Events

Date	Damage/Injury	Description
8/10/1997	$100,000	Flash flooding caused the Virgin River to rise 8-feet in Rockville and Springdale. 10 horses had to be rescued from flood waters in stables in Rockville.
1/10/2005	$300,000 (countywide)	Flooding impacted Washington County. During the event, the Virgin River reached a 25-year high.
12/21/2010	None Reported	Severe flooding in southwestern Utah raised concerns of the potential failure of a privately owned Dam on the Virgin River. Rockville, immediately down stream from the dam, was evacuated. The river was reported to have widened during the initial flooding. Engineers ultimately declared the dam safe.
2010?		The Virgin River had high and fast flow, which contributed to erosion of the riverbanks.
9/9/2011	None Reported	UDOT reported flash flooding in Rockville with water flowing on SR-9.
9/16/2011	None Reported	Drainages flowing from Zion National Park to Rockville flooded during large floods in the park.
7/30/2012	None Reported	Heavy rain caused flash flooding near Rockville, which flowed into the Virgin River.
9/22/2016	None Reported	Heavy rain caused the Virgin River to rise. In Virgin the increase was recorded as 100 cfs to 3300 cfs and in Zion National Park, the increase was 50 cfs to 2100 cfs.

Source: NOAA Storm Database; (The Associated Press, 2010)

It is probable that other flood events also impacted Rockville, although they either were not reported to NOAA, or they did not describe the impacts to Rockville in the report. Neighboring communities or the County record can provide additional context to the potential for flooding and impacts in Rockville.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events interact with the built environment and human activity. Future growth in the community could place new construction in susceptible areas without proper planning.

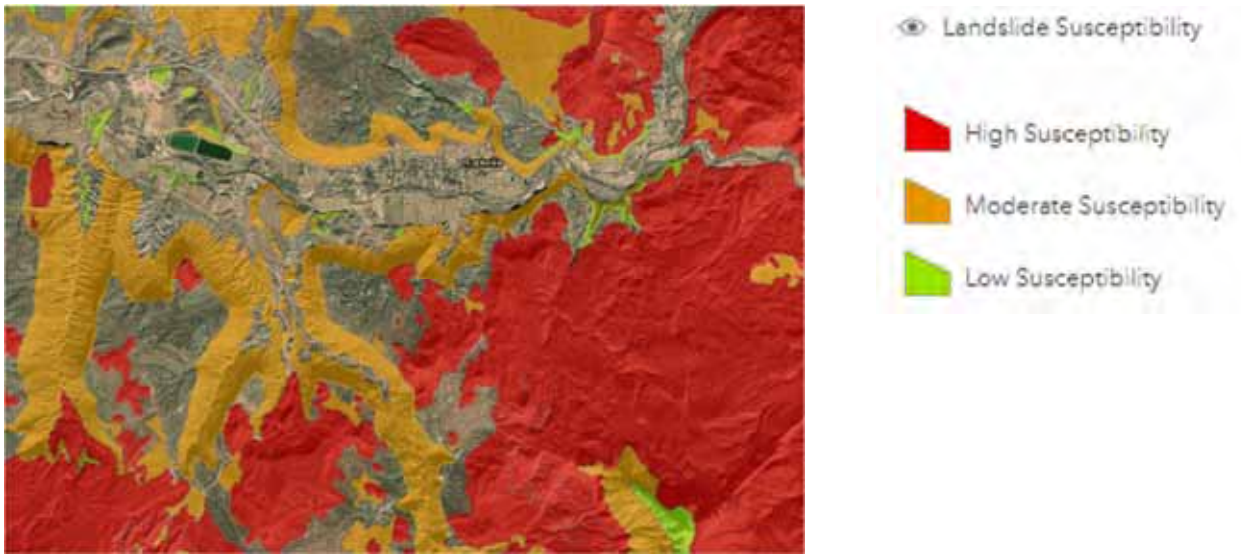


Figure 430: Rockville Landslide Susceptibility

Source: Utah Geological Survey, GEOLOGIC HAZARDS OF THE STATE ROUTE 9 CORRIDOR, LA VERKIN CITY TO TOWN OF SPRINGDALE, WASHINGTON COUNTY, UTAH 2013, and 2018 landslide records

Figure 430 illustrates that the landslide susceptibility in Rockville also aligns with the steep slopes and cliff sides in the community, with high susceptibility noted in the south end of the community, where large mesas are found. Landslides can include rockfall, but they often include the sliding or flow of dirt and debris down a slope.

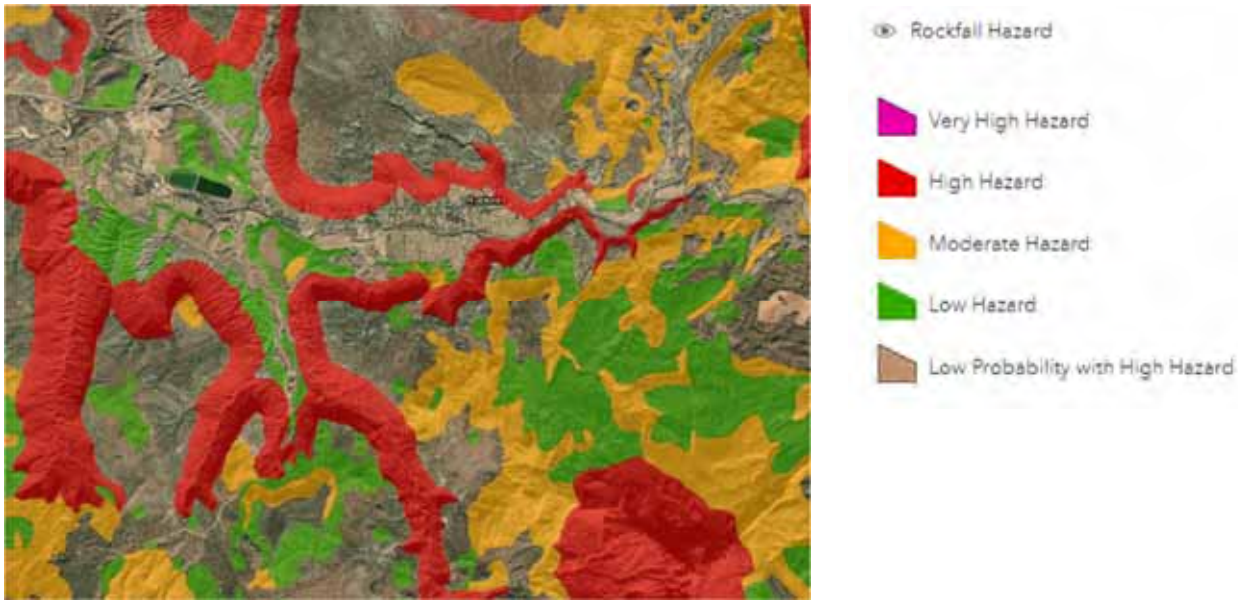
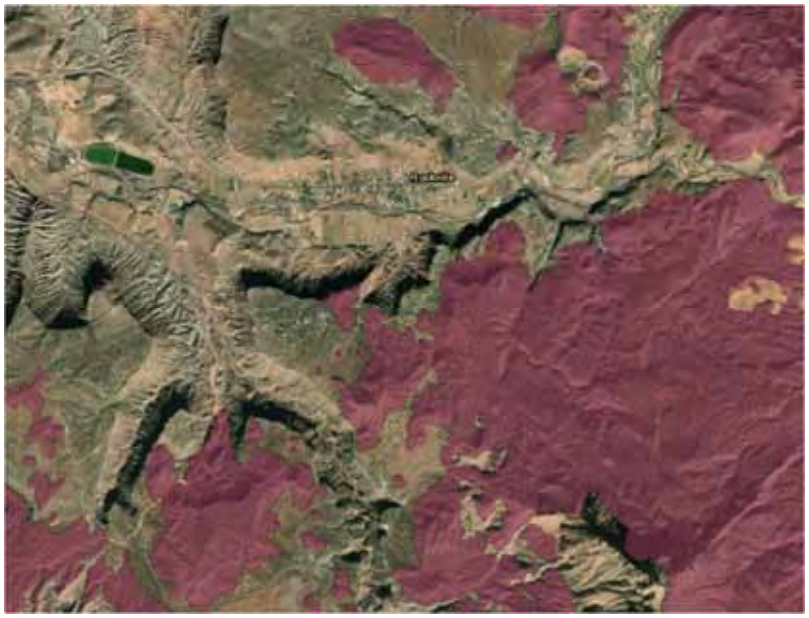


Figure 431: Rockville Rockfall Susceptibility

Source: Utah Geological Survey

Rockville has high rockfall hazard, especially in the areas near cliffsides in the community, illustrated by Figure 431. On the north end of the city, development is very close and in some of the rockfall hazard area. The 2013 Utah geological Survey report on a rockfall event in the community describes that several other structures are also in a rockfall risk area on this side of town. Rockfall will continue to occur into the future in this area.



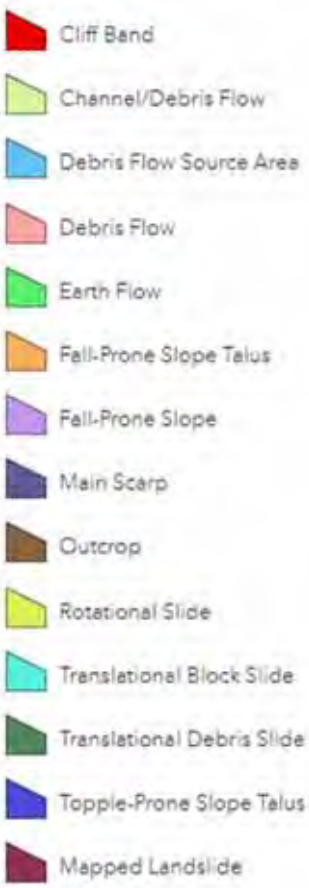


Figure 432: Rockville Mapped Landslides

Source: Utah Geological Survey

Mapped landslides, seen in Figure 432, are identified in the southern portion of the community, on the far side of the Virgin River from the community. Other occurrences appear to be on top of the cliffside north of the town. The extent of impacts to the town from these mapped landslides.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Rockfall occurs on occasion in the community and can impact roads and personal property. A past event on Mesa Road and Eagle Crags Road led to crushed irrigation lines. Table 437 describes the record of landslide and rockfall events in Rockville.

Table 437: Rockville Landslide Record

Incident Date	Location	Description
1953	Grafton, Washington County	Debris flow near Grafton.
1955	Rockville, Washington County	Debris flow near Rockville.
2001	Rockville, Washington County	A house was severely damaged by rockfall.
2010	Rockville, Washington County	A rock weighing approximately 450 tons rolled downslope, shattering into smaller rocks, damaging outbuildings, 2 vehicles, and a home.
2013	Rockville, Washington County	A large rock fell from the cliff and rolled downslope, hitting a home, garage, and vehicle. Two residents were killed.

Source: Utah Geological Survey, (Castleton, 2009)

The Utah Geological Survey has studied the area in Rockville to assess the rockfall risks to homes and property in the community. The UGS identified that the 2013 Rockfall event occurred within a mapped high rock-fall hazard area and that other structures and residences in the town are within the mapped

hazard area. Assessment by the Utah Department of Transportation found that options for residents in Rockville are to either remain in the structure knowing the risk of rockfall or relocate.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

In Rockville, watering has been encouraged during evening hours and to limit landscape watering during summer months. The Town and the Rockville Pipeline Company set an agreement to supplement the wells with river water during the ongoing drought situation from the months of April to October. Normally the river water is primarily an irrigation use.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 433. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

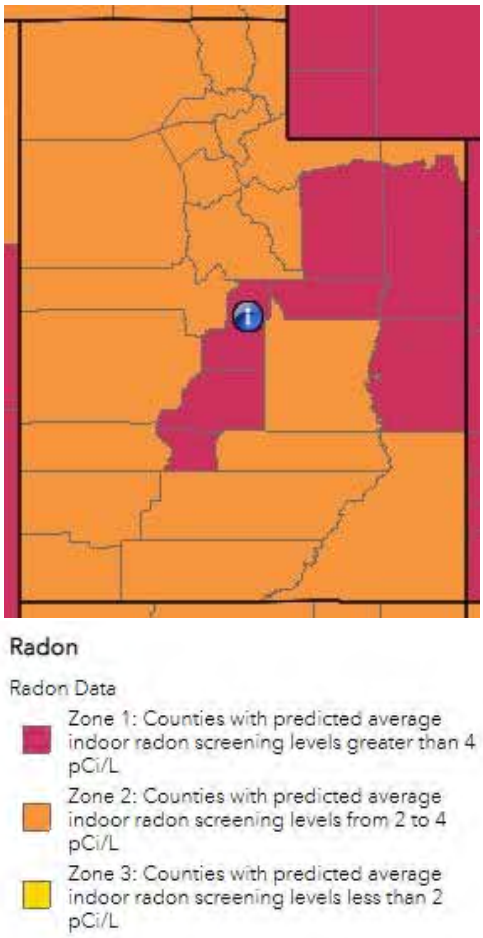


Figure 433: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality (DEQ) describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 438 describes the reported findings from short term radon testing across Washington County and for the Rockville zip code. The countywide average test result is 2.2 pCi/L of air. Rockville by comparison has a higher average, at a level where mitigation is normally needed to reduce risks from exposure. Rockville also has much fewer tests reported to the DEQ. The takeaway from this data is that radon gas has been identified in structures in the community and that testing, and information is necessary to understand and reduce risk.

Table 438: Washington County Short Term Radon Testing Reported

Community	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
Washington County	88.3%	11.7%	31.9	2.2 pCi/L	797
Rockville (Zip Code 84763)	50.0%	50.0%	10.4 pCi/L	5.8 pCi/L	4

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Rockville, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Rockville sees summers marked by heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Rockville has one reported severe weather event which has impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 439. While the deaths reported during the 2013 events did not occur in Rockville, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers are vulnerable to these extreme temperatures.

Table 439: Rockville Severe Weather Record

Date	Damage/Injury	Description
9/25/1997	None Reported	Heavy rains and high winds impacted southwestern Utah. In Rockville, minor flooding was reported on SR-9 following this event.
4/3/1999	$100,000 (Countywide)	Extreme cold temperatures led to crop damages across Washington County.
7/4/2013	3 deaths (Regional)	A widespread heatwave was recorded across the state of Utah. Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death (Regional)	Hot temperatures were recorded across southern Utah contributed to the heat related death of a hiker in Kane County.

Source: NOAA Storm Database

Wind events which have toppled trees and branches. Occasional occurrence.

Heavy rain has impacted Rockville, causing floods and debris flows as documented in this section and the Flood section. Some events may have impacted Rockville but were not documented with NOAA or did not include the impacts caused to Rockville in the event description. Referencing the flood section for neighboring communities or Washington County can provide some additional context to the flood history for Rockville.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. As the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure.

The Utah Geological Survey has developed updated mapping for some communities in the region, which provides greater detail to mapped problem soils and the types prevalent to the region. Rockville is included in this mapping study area for collapsible soils and rock, expansive soils, piping and erosion susceptible soil, soluble soil and rock, and windblown sand, described in Figure 434 to Figure 437.

Collapsible Soil

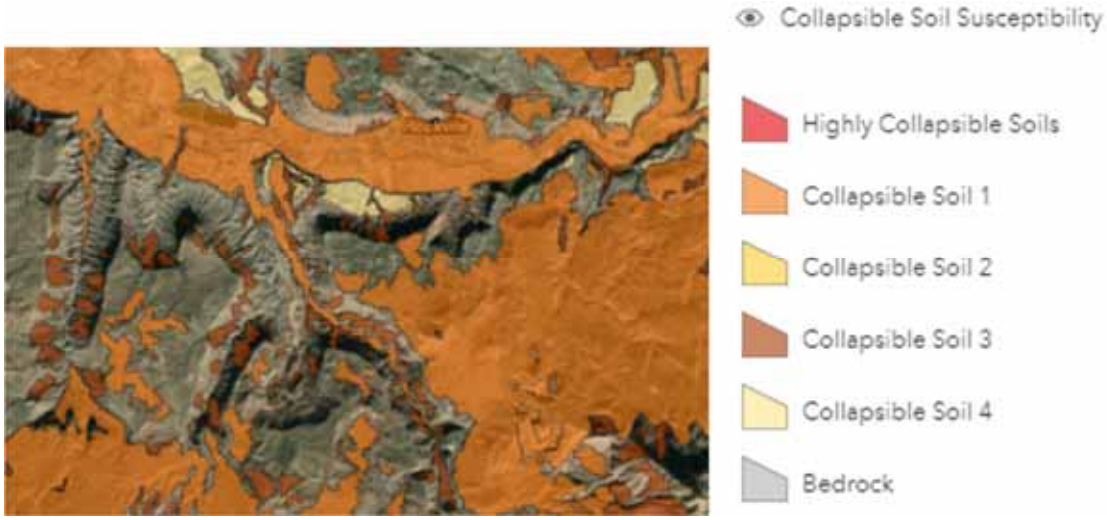


Figure 434: Rockville Collapsible Soil Susceptibility

Source: Utah Geological Survey

Collapsible soils are present throughout Rockville Town. These soils are a risk to the community, as they have the potential to settle when moisture is introduced.

Expansive Soil and Rock

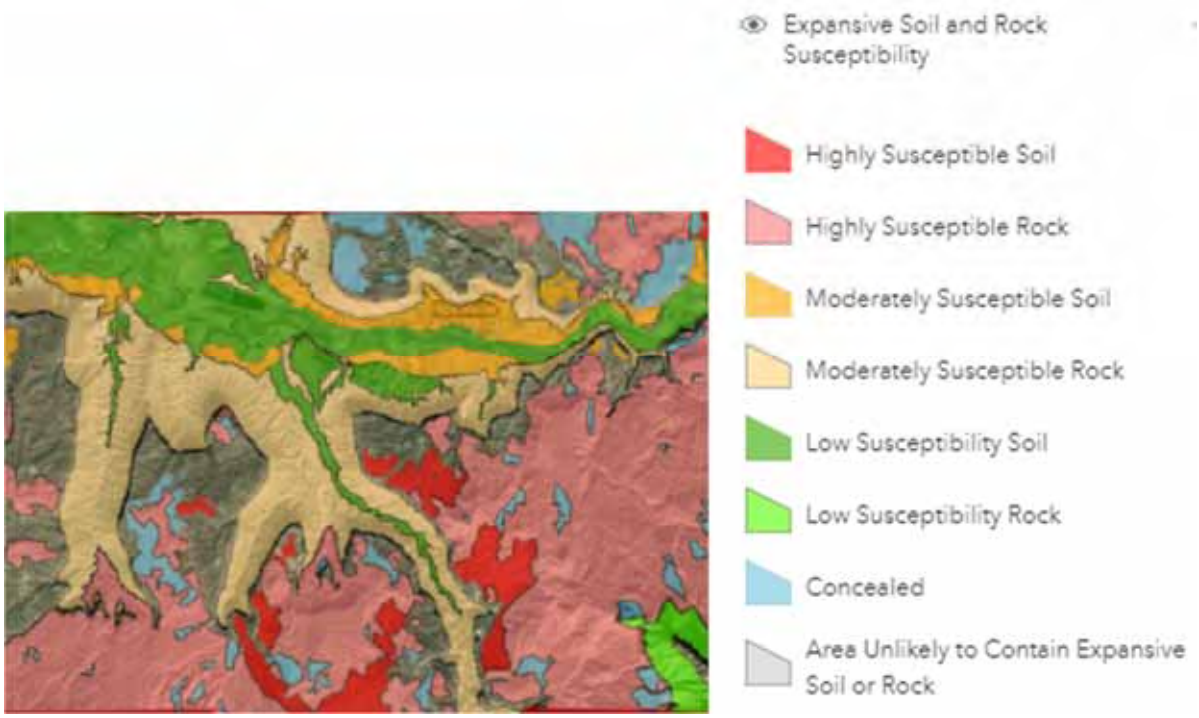


Figure 435: Rockville Expansive Soil and Rock Susceptibility

Source: Utah Geological Survey

Expansive Soils have a high clay content, which swells when wet and shrinks when dry. This soil type is a challenge for structures and infrastructure if not mitigated, as the shrink and swelling actions can disturb development. Rockville requires geotechnical report of soil for the issuance of building permits for new developments or subdivisions in at risk areas of the community.

Piping and Erosion

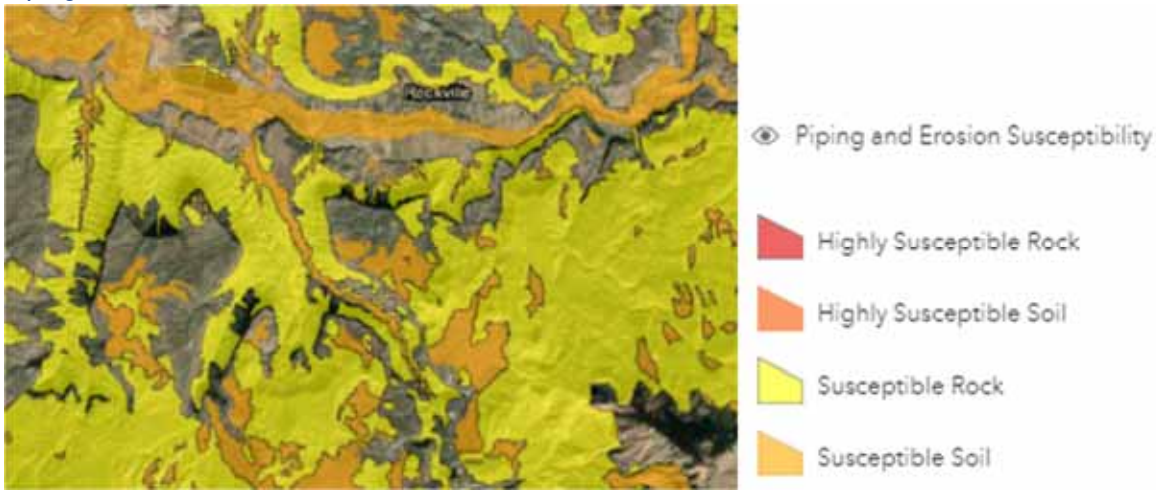


Figure 436: Rockville Piping and Erosion Susceptibility

Source: Utah Geological Survey

Piping and erosion are underground erosion of rock, which can lead to collapse of the soil above the surface.

Soluble Soil and Rock

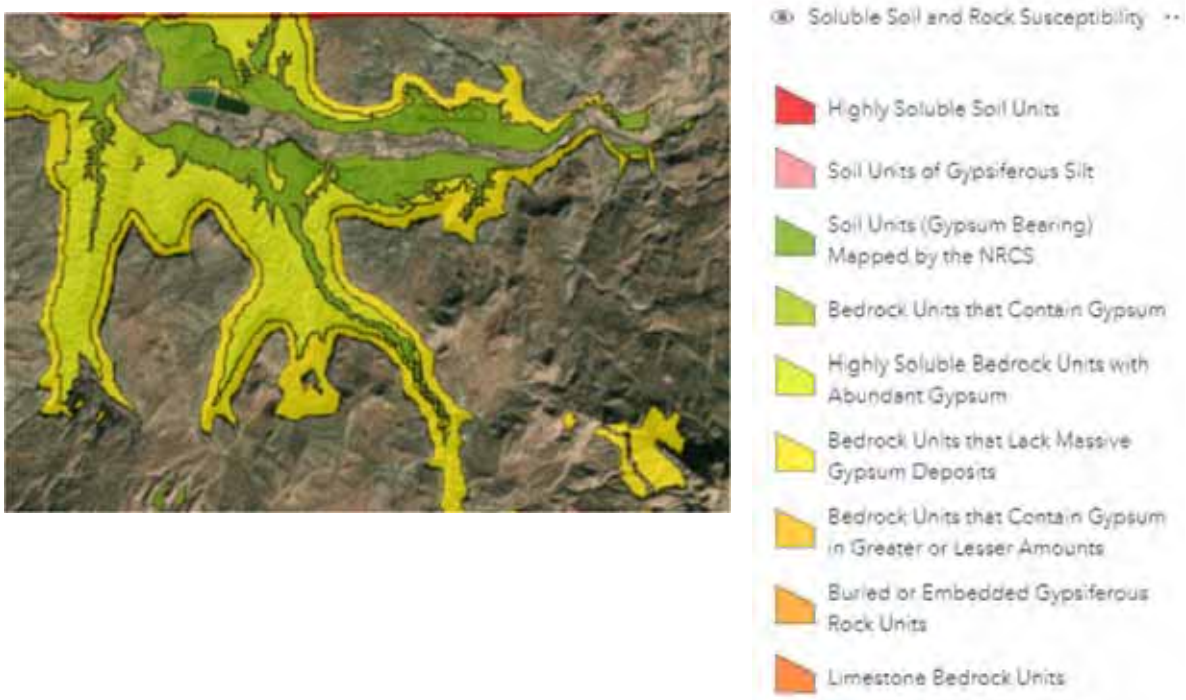


Figure 437: Rockville Soluble Soil and Rock Susceptibility

Source: Utah Geological Survey

Soluble soils and rock are soils and rock types which can be dissolved by water, impacting the soil or rock's stability.

Hazard History

The community does not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

Rockville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. Rockville does not have critical facilities in the town boundary, however, impacts to roadways during a natural hazard event can further impact the community if emergency responders cannot access the community because of flooding, landslide, wildfire, earthquake, or another natural hazard. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

The Mitigation Strategy is a community's blueprint to address risks and avoid potential losses from the hazards identified in the Risk Assessment. Each community's strategy describes the need for the action, priority, timeline, funding source, estimated cost, and responsible parties for the action. The objective of this plan is that the actions will be implemented and incorporated into the community policies, plans, and procedures when applicable.

Mitigation actions can fall into four types: plans and regulations, structure and infrastructure projects, natural systems protection, and education or awareness programs. Incorporating a variety of these types into the mitigation strategy can create a robust and diverse method to address the local natural hazard risks.

2016 Mitigation Strategy

Rockville has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 440: 2016 Rockville Mitigation Strategy describes progress made on Rockville's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 440: 2016 Rockville Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Landslide #1	Stabilize or limit the potential for damage from rock fall	Protect or relocate structures located in the high rock fall hazard area north of SR-9 in Rockville, Utah.	This is a long-term strategy with undetermined timelines.	Local funding, state and federal grant funds as available.	Action is ongoing and still needed.
Flood #1	(Wash east of Cos Rd. and North of Hwy 9 Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches, and prolong the life of roadways through erosion management.	Obtain easements for new wash route. Wash redesign and new construction for wash north of Highway 9. Install rip rap along areas of erosion.	5 Years	Rockville, CIB, CDBG, FEMA	The wash has been cleaned of brush and tree growth every other year. Rip Rap was installed on the wash.

Flood #2	(Dennett Lane Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches, and prolong the life of roadways through erosion management.	Re-grade and widen wash. Install culverts to ensure adequate flow. Place rip rap along points of erosion (Turns, steep slopes, and culvert inlets and outlets). Clear Debris from wash and culverts along Dennett Lane.	5 Years	Rockville, CIB, CDBG, FEMA	Wash is cleared every other year. No other progress has been made. The action is ongoing and still needed.
Flood #3	(De Mille Rd. Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches and prolong the life of roadways through erosion management.	Re-grade swale to collect and divert water to drainage washes. Install soil erosion mechanisms along lower part of mesa to minimize amount of sediment during storm events. Install culvert under roadways to route water to natural drainage channels.	5 Years	Rockville, CIB, CDBG, FEMA	Action is ongoing with regular maintenance and grading. Culverts are cleaned annually.
Flood #4	(Town Storm Water Drainage Plan) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches and prolong the life of roadways through erosion management.	Develop a storm water drainage and management plan. Plan will outline costs for such maintenance and planning for future improvements. GIS Mapping of Projects with portable management device.	5 Years	Rockville, CIB, CDBG, FEMA	No progress to date. Action still needed. Town is considering purchasing GIS software.

Source: 2017 Five County Association of Governments NHMP

2022 Mitigation Strategy

To address the risks and vulnerabilities identified in this chapter, Rockville has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 441. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 438Figure 412.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 438: Regional Plan Goals

Table 441: Rockville 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	3, 4	Conserve water resources locally.	Encourage the Rockville Pipeline Company to inform users on water efficiency and conservation methods.	H	Ongoing, annually	L	Rockville Town & Rockville Pipeline Company	Rockville Town & Rockville Pipeline Company
Drought #2	2	Conserve water resources locally.	Replace unused turf and grass with native vegetation on Town owned Property.	H	3 years	M	Rockville Town	Rockville Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #3	6	Preserve natural features of the landscape.	Remove invasive species growing along the Virgin River bottom.	M	5 years	M	Rockville Town & Utah DNR	Rockville Town & Utah DNR
Severe Weather #1	3	Inform residents of mitigation on their property.	Educate residents on keeping trees trimmed to prevent limb breakage.	H	Ongoing, annually	L	Rockville Town	Rockville Town & Town Arborist
Wildfire #1	3	Inform residents of mitigation on their property.	Educate residents on keeping removing dried debris and participating in tree trimming.	H	Ongoing, yearly	L	Rockville Town	Rockville Town & Town Arborist
Wildfire #2	2, 4, 5, 6	Facilitate partnerships with other entities to address natural hazards.	Coordinate with the Hurricane Valley Fire District and DNR on fuels treatment and mitigation activities.	M	5-years	M	Rockville Town, Hurricane Valley Fire District, & Utah DNR	Rockville Town, Hurricane Valley Fire District, & Utah DNR
Wildfire #3	4	Facilitate partnerships with other entities to address natural hazards.	Coordinate with local arborist to assist on properties to remove tree limbs, fallen trees, and other fuels.	M	Ongoing, annually	M	Rockville Town, residents.	Rockville Town & Town Arborist
Flood #1	2, 6	Engage in designs and construction to address natural hazards.	Obtain easements for new wash route. Wash redesign and new construction for wash north of Highway 9. Install rip rap along areas of erosion.	M	5-years	H	Rockville, CIB, CDBG, FEMA	Rockville Town, UDOT, Washington County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #2	2, 6	Engage in designs and construction to address natural hazards.	Re-grade and widen wash. Install culverts to ensure adequate flow. Place rip rap along points of erosion (Turns, steep slopes, and culvert inlets and outlets). Clear Debris from wash and culverts along Dennett Lane.	M	5-years	H	Rockville, CIB, CDBG, FEMA	Rockville Town, UDOT, Washington County
Flood #3	2, 6	Engage in designs and construction to address natural hazards.	Re-grade swale to collect and divert water to drainage washes. Install soil erosion mechanisms along lower part of mesa to minimize amount of sediment during storm events. Install culvert under roadways to route water to natural drainage channels.	M	5-years	H	Rockville, CIB, CDBG, FEMA	Rockville Town, UDOT, Washington County
Flood #4	2	Update local codes and policies to protect residents from hazards.	Develop a storm water drainage and management plan. Plan will outline costs for such maintenance and planning for future improvements. GIS Mapping of Projects with	M	5-years	M	Rockville, CIB, CDBG, FEMA	Rockville Town, Washington County

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			portable management device.					
Landslide #1	1, 2	Stabilize or limit the potential for damage from rock fall	Protect or relocate structures located in the high rock fall hazard area north of SR-9 in Rockville, Utah.	M	Ongoing, long-term strategy	H	FEMA Hazard Mitigation Grant Program	Rockville Town, Utah Department of Public Safety, Washington County
Radon #1	3	Inform residents of mitigation on their property.	Provide public education about radon.	H	Ongoing, yearly	L	Utah Department of Environmental Quality, Rockville Town	Rockville Town
Radon #2	1	Update local codes and policies to protect residents from hazards.	Consider land use code change to address radon hazard in new development.	L	5 years	L	Rockville Town	Rockville Town
Earthquake #1	2	Protect existing Town facilities from natural hazards.	Retrofit of town owned buildings (no roof mounted equipment, chimneys, or) as needed.	L	5 years	H	Rockville Town, Preservation Utah	Rockville Town
Earthquake #2	3	Inform residents of mitigation on their property.	Share information about earthquake preparedness.	H	Ongoing, yearly	L	Rockville Town, Utah Seismic Safety Commission	Rockville Town
Problem Soil #1	1, 2	Update local codes and policies to protect residents from hazards.	Review current land use code for applicable problem soils and geologic hazard ordinances.	M	5 years	L	Rockville Town	Rockville Town

Source: Local Planning Team

St. George

St. George was settled by pioneers as part of the Cotton Mission, making the city a center for agriculture in the region. In 1863, the city was designated as the Washington County seat.

I-15 runs through St. George City, with the Mojave Desert to the southwest, Pine Valley Mountains to the North, and Zion National Park visible to the southeast. The Virgin River runs through the southern portion of the community parallel to I-15. The community lies in an arid desert which receives very little annual rainfall and sees several days annually which surpass 100 degrees Fahrenheit.

St. George is home to a state university and a community college. These institutions bolster the local population with students. While these institutions attract many local students for education, students from throughout the State of Utah and elsewhere move to St. George to attend these institutions.

The southern Washington County area, including St. George have become a hub for tourism and special events, which brings thousands of people through the area annually.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

Demographics

As of the 2018 American Community Survey, St. George has a population of 82,194 people, described in Figure 439. The city is the largest community in the southwest and the 8th largest city in Utah. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

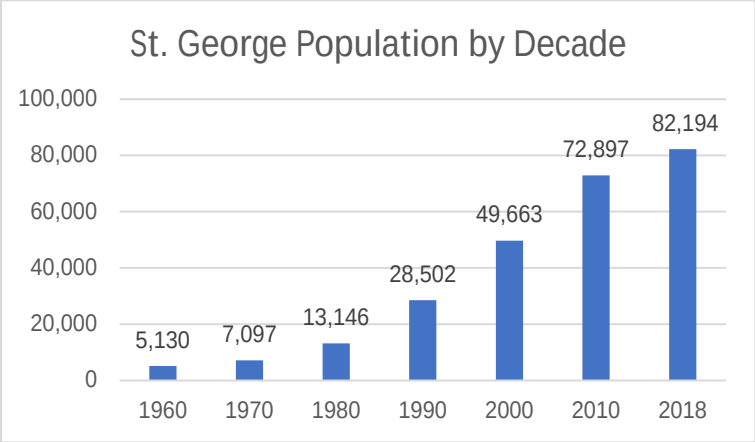
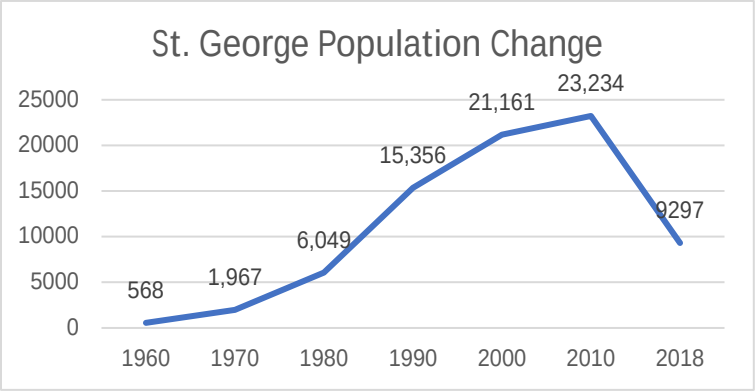


Figure 439: St. George Population by Decade

Source: US Census Bureau

The St. George population has seen booming growth in recent decades, with the most growth seen in the 1990s. Since that time, growth has slowed, but remained positive. The community is one of the fastest growing in the United States as of the 2010 census. Population change, described in Figure 440, over the past several years shows that populations have been increasing by an average of 62% between 1960 and 2010.



Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see

an 229% increase in population between 2015 and 2065. If applied to St. George, the community could see 250,000 people living in the community in the next 45-years[27].

Economy

St. George was settled in the late 1800s for agricultural purposes. 300 families moved to the area to support the cotton mission. Since this time, St. George has grown to be a large metropolitan area with businesses, restaurants, and manufacturing in the city. The community is also a hub for outdoor recreation and tourism in the area, attracting visitors to state and national parks and local events.

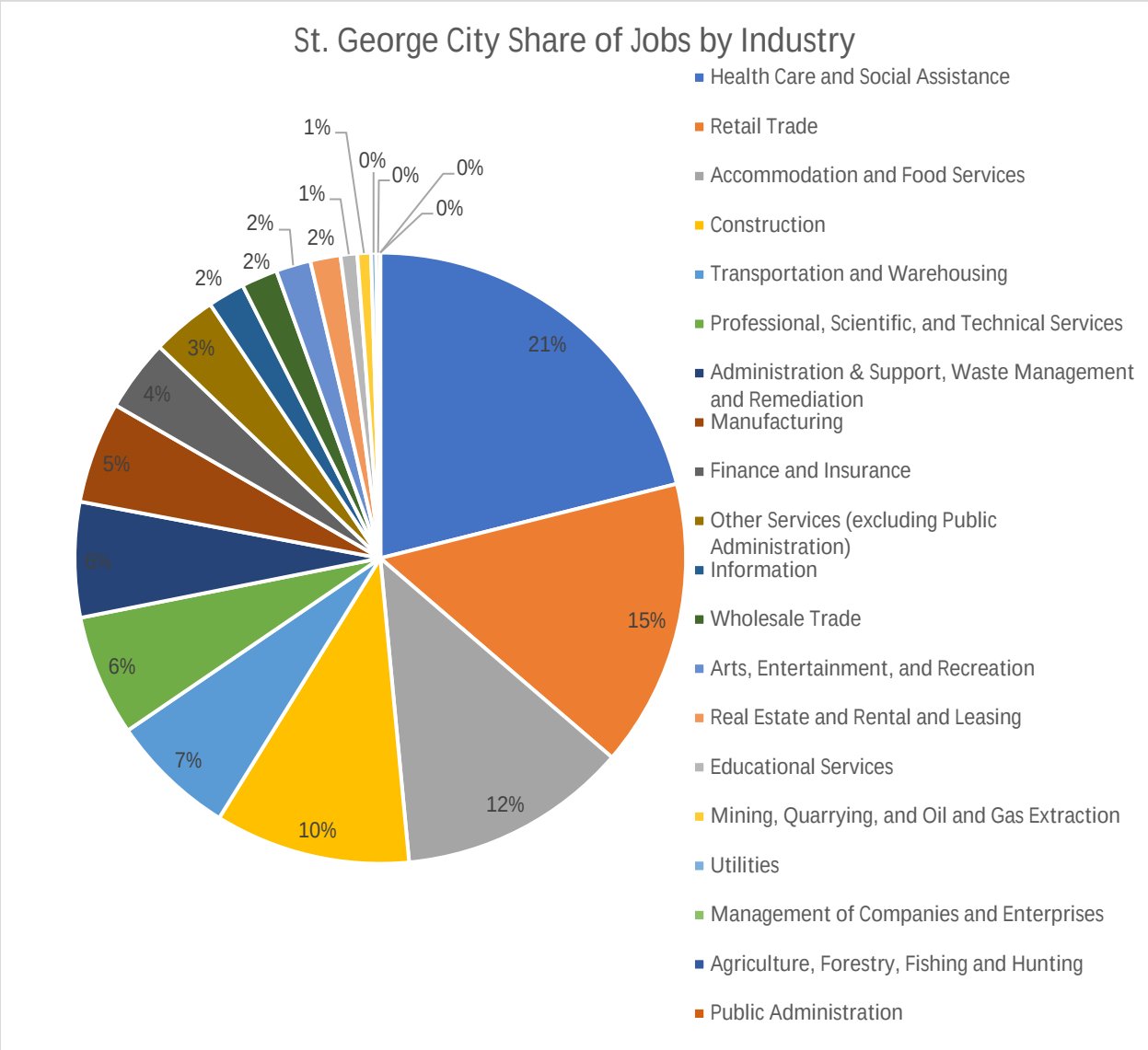


Figure 441: St. George share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts St. George prominent industries by the number of jobs supported in the community, illustrated in Figure 441. Health care, retail trade, and accommodation and

[27] This estimate is created using the 2015 ACS population estimate for St. George, which was 76,915, and adding 229% of this population estimate to the population for that year.

food services industries provide the most jobs locally in St. George. The St George Regional Hospital and services for aging residents likely contributes to the bulk of health care jobs. The amount of food service and accommodation jobs support the prominent tourism seen in the community.

Development

St. George has experienced significant growth and development in recent years throughout the community, of both commercial and residential properties. The municipality is geographically constrained by slopes, rivers, streams, drainages, problem soils, and other geological hazards. As new development enters the community and building moves outside of the currently developed city, exposure to certain natural hazards will increase.

Community Capabilities

St. George is governed by a mayor and city council, who engage in executive and legislative activities for the community, respectively. These positions are elected by registered voters every four years.

Several boards and commissions advise council on specialized topics, some of which can make decisions and set requirements within the scope of their board. A planning commission also supports specialized review and recommendation of planning and zoning activities in the community to the council. Other boards and commissions include:

- Arts Commission
- Southwest Utah Stormwater Coalition
- Washington County Flood Control Authority
- St. George Hillside Development Board

St. George City provides public safety for the community, which includes dispatch, police, and fire services. The fire department covers approximately 75 square miles surrounding St. George City and includes seven stations. They respond to fire, emergency medical, hazardous material, and other types of calls in the area. The St. George fire department is staffed with a full time chief and staff of firefighters. The police department serves the area inside St. George with law enforcement. While the department is staffed, there are volunteer opportunities for community members for programs like the Community Emergency Response Team (CERT).

Electric, water, and sewer utilities are provided by St. George City. Natural Gas is provided through Dominion Energy and Waste removal is provided to residents through Washington County Solid Waste Removal.

Plans and Policies

St. George City has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of St. George City's plans and policies as they relate to natural hazards. Additional plans may exist which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

The St. George Codes and Ordinances seek to protect resident's welfare and health and natural and cultural resources through local policy. Throughout the ordinances document, policy describes actions to take and situations to avoid, which protect the community from hazards. Actions include completion of geologic hazard testing preconstruction, regulating development in mapped floodplains, restrictions for redirecting the flow of drainage or floodplains, set landscaping standards for slope, water use, and drought tolerant vegetation.

General Plan

The St. George City General Plan (2016) describes the vision for the community, referencing the history, current and planned land use, need for services, and conservation. Several of the policies and goals for the community address natural hazard mitigation, including:

- Preserving and restoring historic buildings in the City.
- Adaptive re-use of historic structures so long as their historic qualities can be preserved.
- Address landslides by managing development, requiring mitigation, evaluate impacts from development on hillsides/cliff tops, and recommending setbacks for mesa top development.
- Minimizing flood losses by preserving natural floodplain, washes, and drainages, discouraging development within 100-year floodplain, enforcing floodplain regulations, provide zoning incentives to transfer residential development out of floodplain, and providing floodplain and erosion protection in new development plans.
- Preserving significant wetlands from impacts from land use proposals and working with engineers to prevent wetland encroachment.

Parks, Recreation, Arts, and Trails Master Plan

The Parks Recreation, Arts, and Trails Master Plan (2019) envisions the open spaces in the St. George area, describing priorities for acquiring open space, setting standards for trail development through sensitive landscapes, preservation of environmental features including steep slopes, and water conservation on outdoor sports fields.

Active Transportation Plan

The St. George City Active Transportation Plan (2017) prioritizes and visions improvements to the active transportation infrastructure in St. George City, including pedestrians, cyclists, and other modes of transportation which are not dependent on motorized vehicles. Items described in this plan that relate to natural hazards primarily describe concerns with drainage and stormwater impacting active transportation infrastructure, including inundation on bike lanes, placement of stormwater inlets to not cause harm to cyclists or pedestrians, and improvements for flood control on Halfway Wash Trail.

Since the completion of the active transportation plan, the city adopted a complete streets policy, which is a strategy where streets are designed for multiple modes of transportation, including pedestrians, bicycles, drivers, and public transportation.

Risk Assessment

St. George is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the St. George planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 442 describes the relative risks of hazards in the community.

Table 442: St. George Risk Assessment

HAZARD	RISK
DROUGHT	1. High
SEVERE WEATHER	2. High
RIVERINE EROSION	3. High
FLOOD	4. High
EARTHQUAKE	5. Moderate
WILDFIRE	6. Moderate
LANDSLIDE	7. Moderate
RADON	8. Low
PROBLEM SOIL	9. Low

A detailed description and mapping of each of the natural hazards that impact St. George can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hurricane include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

St. George is an urban community surrounded by open space, with the Mojave Desert to the southwest and the Pine valley mountains to the North. The community is a hub for infrastructure, shopping, and tourism in the southwest, connecting areas like Las Vegas and Phoenix to Salt Lake City. These community assets reveal potential vulnerabilities in the event of a wildfire impacting the community, which can affect traffic, travel of good, visitors and residents, and natural systems in the area. Much of St. George City is presently developed and a significant interface area identified by the planning team is along the riparian areas and drainages, where invasive fuels may be present in high loads. Development near these riparian areas may be vulnerable to wildfire.

Figure 442 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding St. George that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

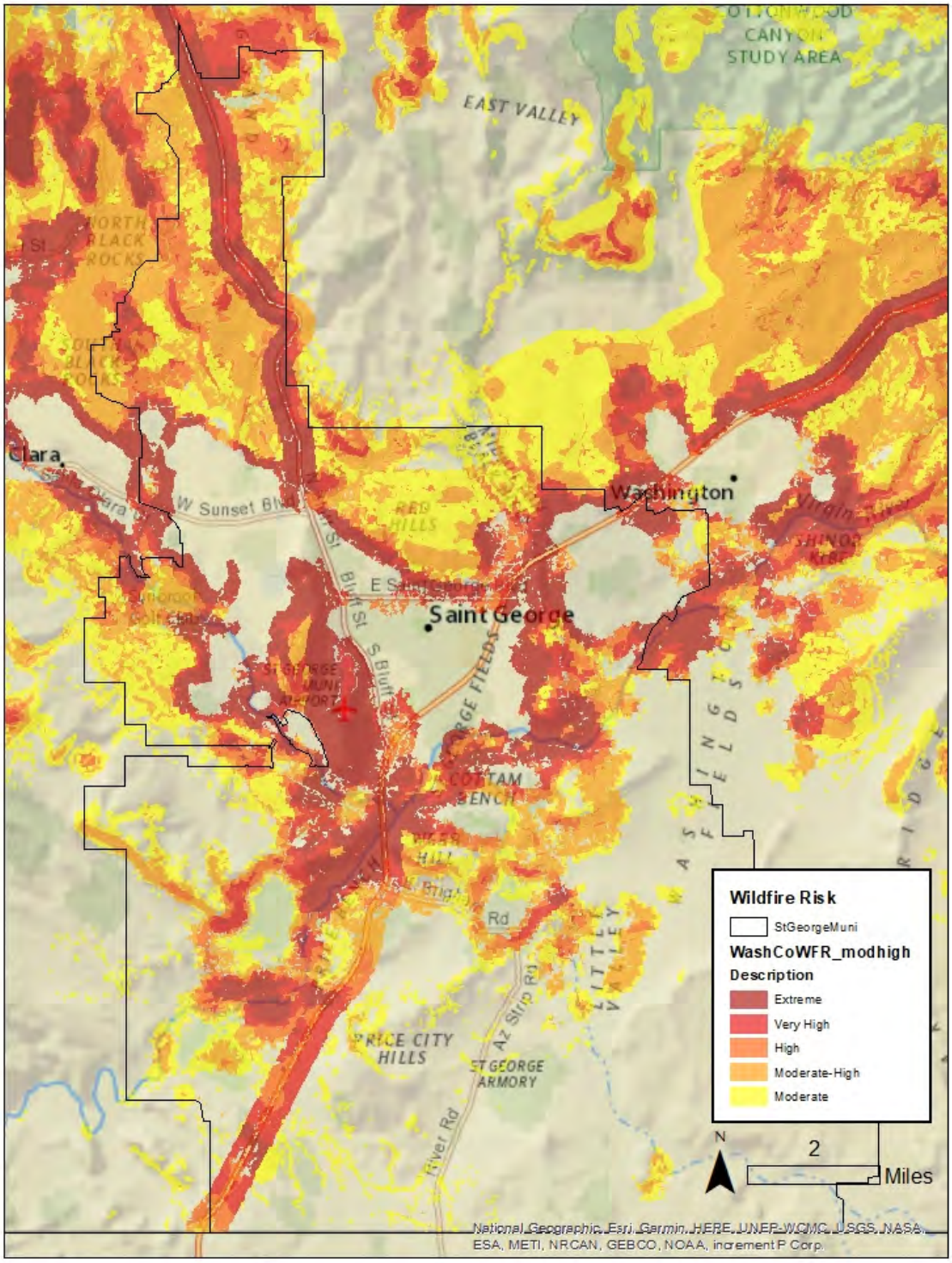


Figure 442: St. George Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 443 further describes St. George's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parks, parcels, and miles of roadway in St. George, which could damage property, impact public health and safety, or impact local economies. Almost all 50% of commercial parcels are exposed to wildfire risk areas in St. George, which can have an impact on local economies and access to goods and services for residents. One third of the road miles in the community are at moderate to extreme wildfire risk, which can challenge response and recovery and the travel of people and goods.

Table 443: St. George Wildfire Risk

St. George Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
28.8%	49.9%	38.2%	39.0%	34.1%%	N/A	80.0%

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. Table 444 describes the wildfire events which have impacted St. George City.

Table 444: St. George Wildfire History

Fire Name	Year	Acres Burned	Description
Turkey Farm Road	2020	11,993	Human caused by fireworks west of Washington City. Suppression costs exceeded $2.5 million. Impacts in St. George included several trail closures and closures of secondary roads north of St. George.
Jarvis Fire	2006	50,697	A human caused fire which exceeded $1 million to fight. The fire burned west of St. George and came close to the community of Bloomington.

Source: Utah Wildfire Info, (Deseret News , 2006)

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-

term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to St. George, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large

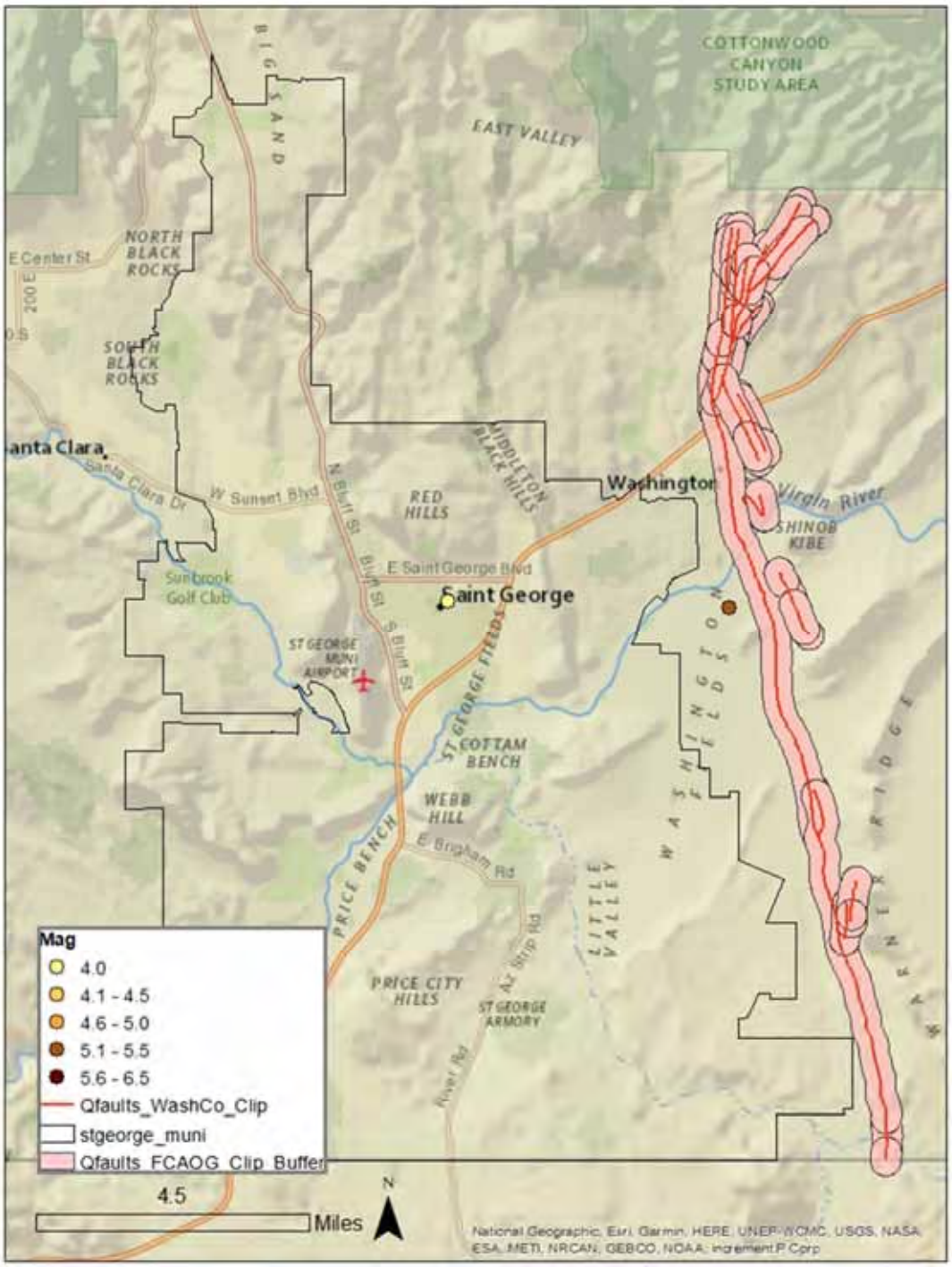


Figure 443: St. George Earthquake Epicenter and Quaternary Fault Exposure

earthquakes which cause impacts. Figure 443 shows the mapped earthquake epicenters and fault lines in St. George.

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 2477 structures were built before the adoption of seismic code requirements, approximately 6.4% of the total structures in the city boundaries. Approximately 6.8% of the community's critical facilities have been identified as being built before the 1975. The low proportion of total pre 1975 structures is a result of the significant growth the community has seen since the 1980s, with the population nearly doubling in the decades following.

A recently completed report inventories public k-12 schools throughout the State of Utah with suspected URM construction on campus. Dixie High School and Snow Canyon Middle School are identified in the report as schools in St. George City which may be vulnerable to earthquakes due to buildings on their campus.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes St. George City. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid. Figure 444 indicates that some areas of St. George may experience low to high susceptibility to liquefaction hazards. Several areas in St. George city have shallow groundwater or high water tables and will have higher liquefaction potential during an earthquake event.

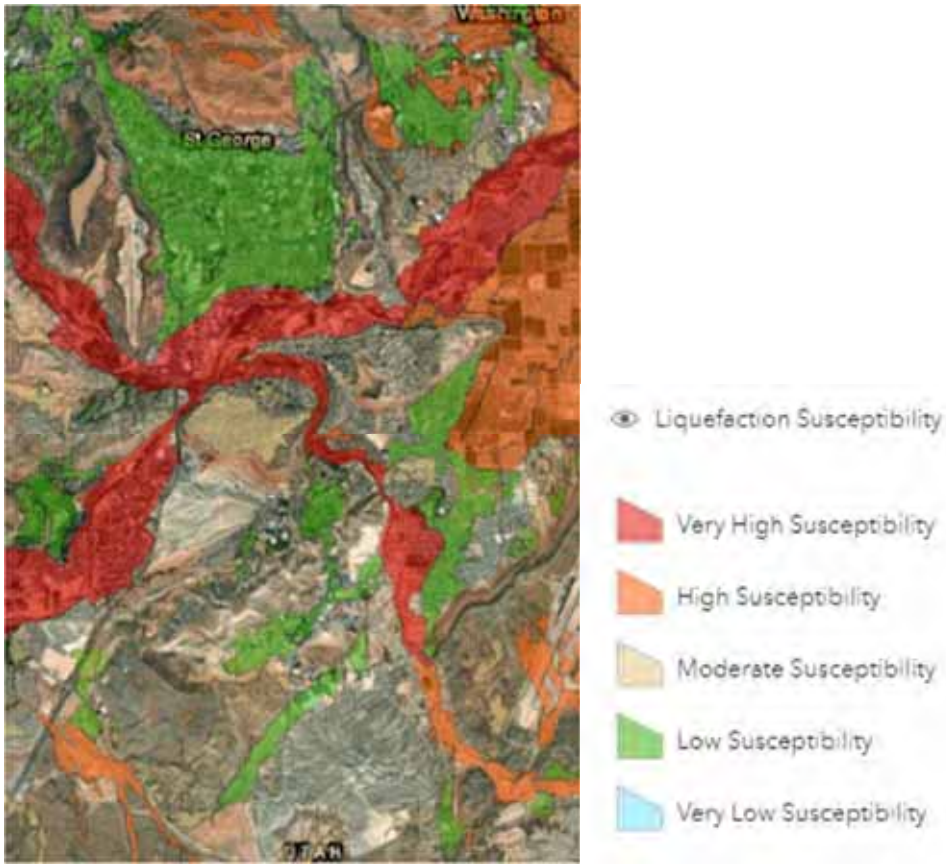


Figure 444: St. George Liquefaction Susceptibility

Source: Utah Geological Survey, 2021

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement. Table 445 documents the earthquakes with epicenters in St. George City.

Table 445: St. George Earthquake Epicenter Record

Incident Date	Location	Magnitude
1891	St. George	4.81
1903	St. George	4.05
1920	St. George	4.05

Three earthquake epicenters have been recorded in the St. George Municipal Boundaries, all in 1920 or earlier. Since that time, earthquakes elsewhere in the county have caused impacts and damages in St. George. One is the 1992 5.8 magnitude earthquake with an epicenter in Washington City, which caused impacts from Flagstaff, AZ to Richfield, Utah and from Las Vegas, NV to Escalante, UT. (Peterson) In St.

George, impacts included damages to building walls as the shaking loosened plaster and caused cracks, while Springdale town experienced a landslide event and localized damages due to the shaking.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire. Liquefaction is also a potential outcome of large earthquakes or ground shaking events, where strong shaking causes the soil to become fluid.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 445 depicts the mapped 100-year floodplain, dam inundation, and riverine erosion exposure in St. George. The Santa Clara and Virgin Rivers seem to be primary corridors for all three mapped flood areas.

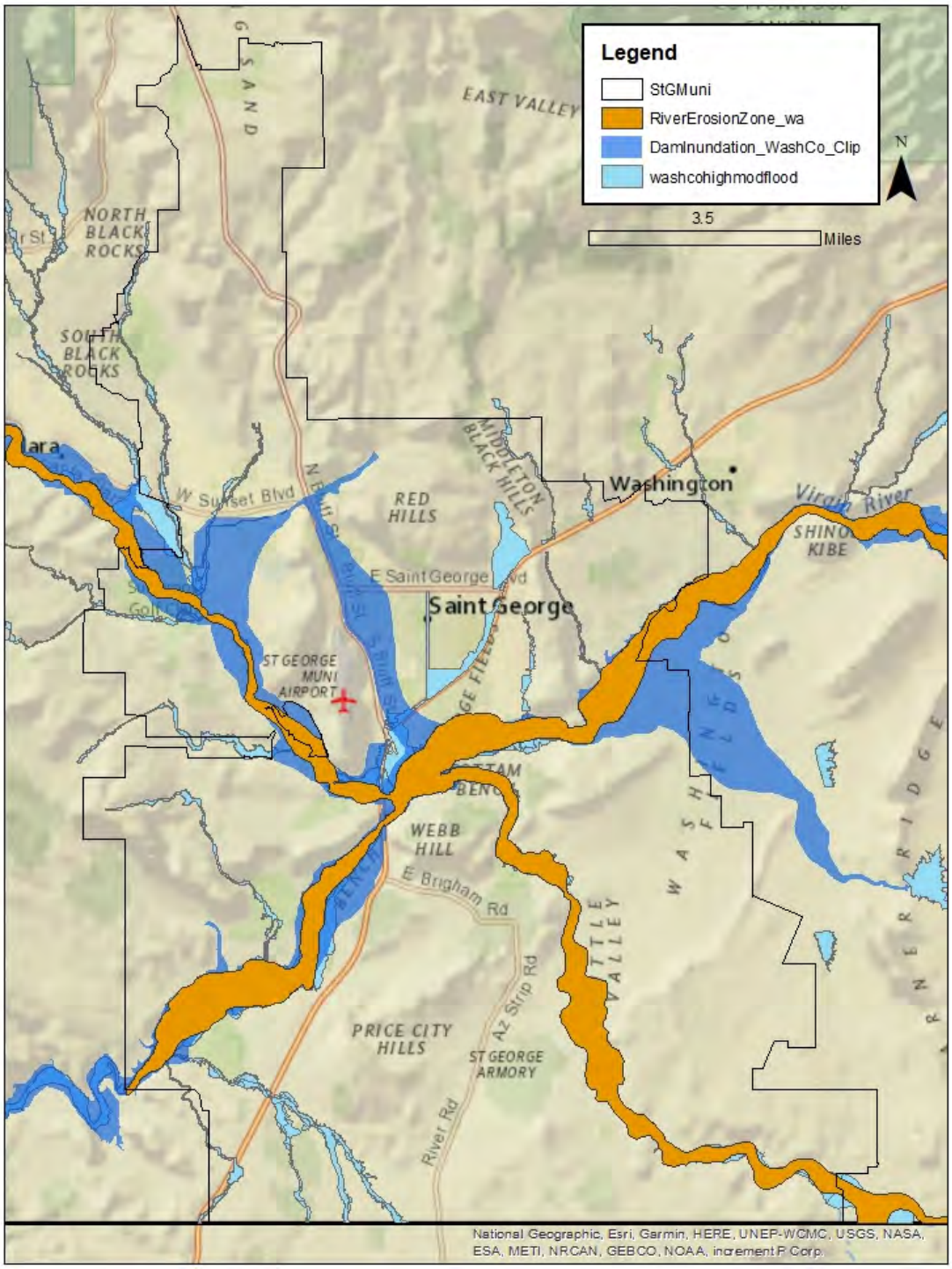


Figure 445: St. George Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Several debris basins and reservoirs which have been mapped locally, which describe potential impacts of flooding. These drainages are identified in the below figures x-x. This local mapping is not included on the data set for dam inundation above. The City Creek Debris Basin could have direct impacts on the more developed and urban area of St. George City, impacting the area from Bluff Street to Valley View Drive. Likewise, the Navajo Debris Basin, located in the Bloomington Hills neighborhood of St. George City, could have impacts on residential properties and trails infrastructure should the debris basin fail or experience damage.

Other drainages identified here include the Warner Draw, Gypsum Wash, and Stucki debris basins which are all located in and operated by neighboring Washington City. These drainages have the potential to impact development on the St. George and Washington City boundary, as indicated in figures x-x.

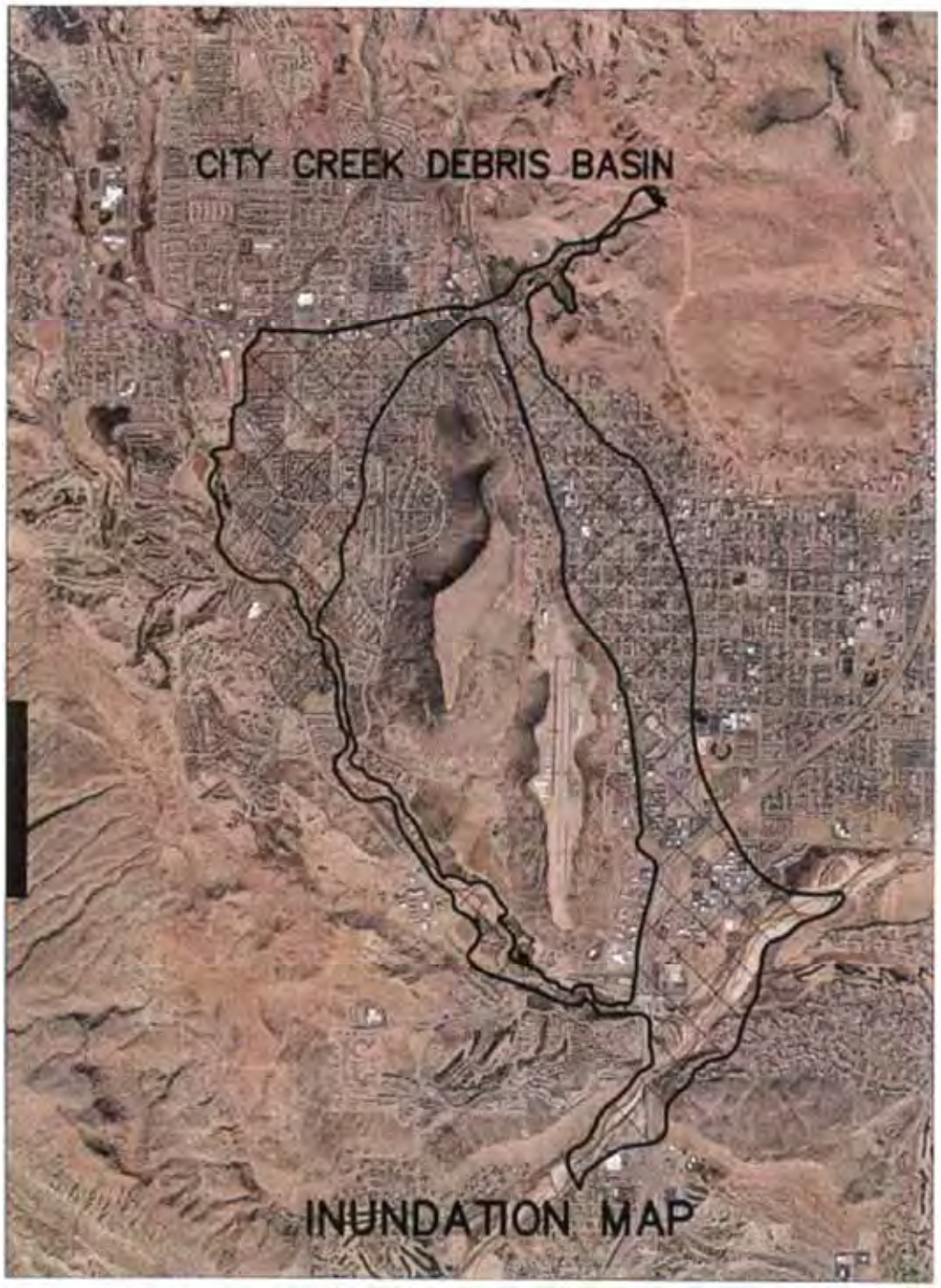


Figure 446: City Creek Debris Basin

Source: St. George City

Figure 447: Navajo Debris Basin

Source: St. George City

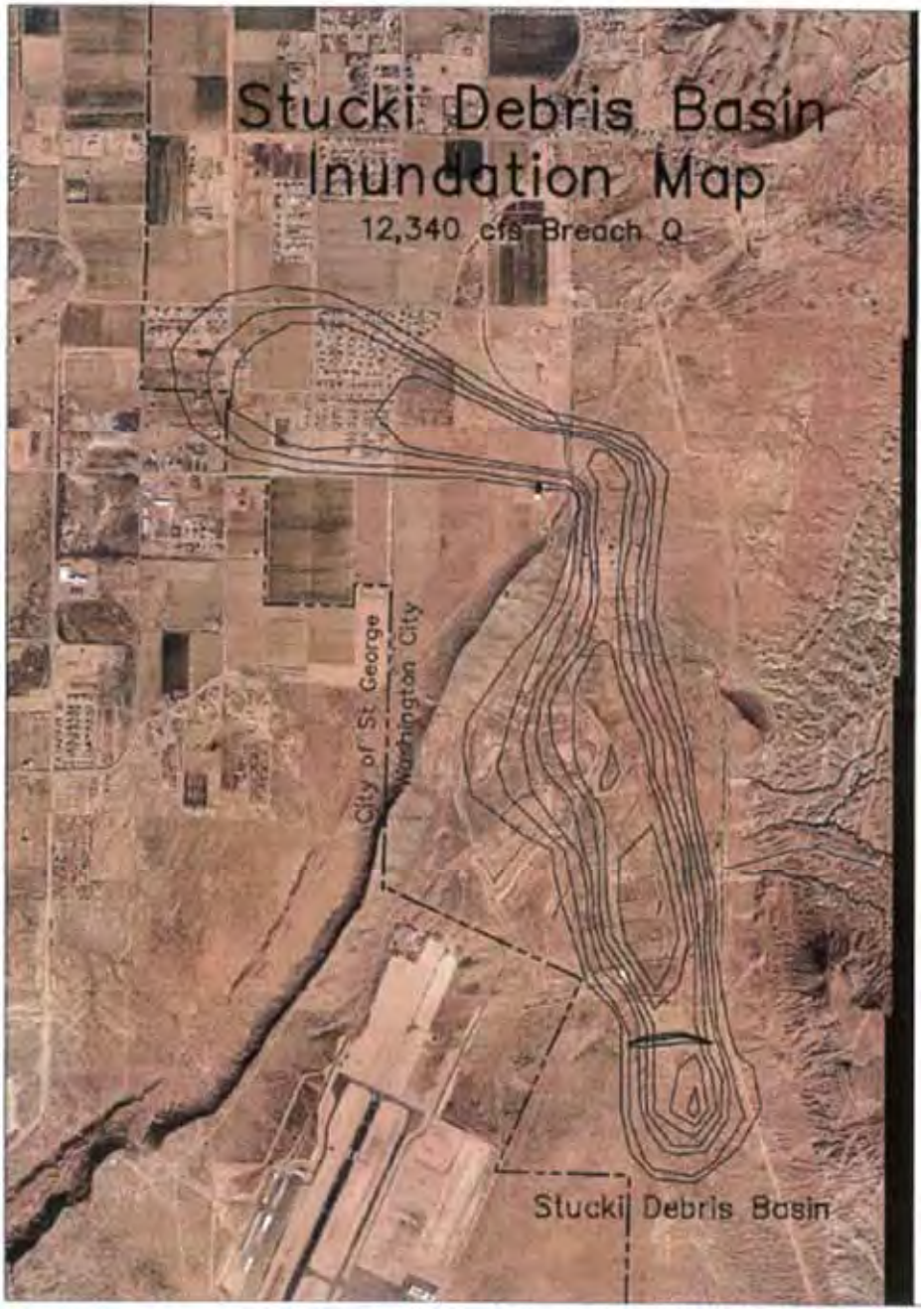


Figure 448: Stucki Debris Basin

Source: St. George City

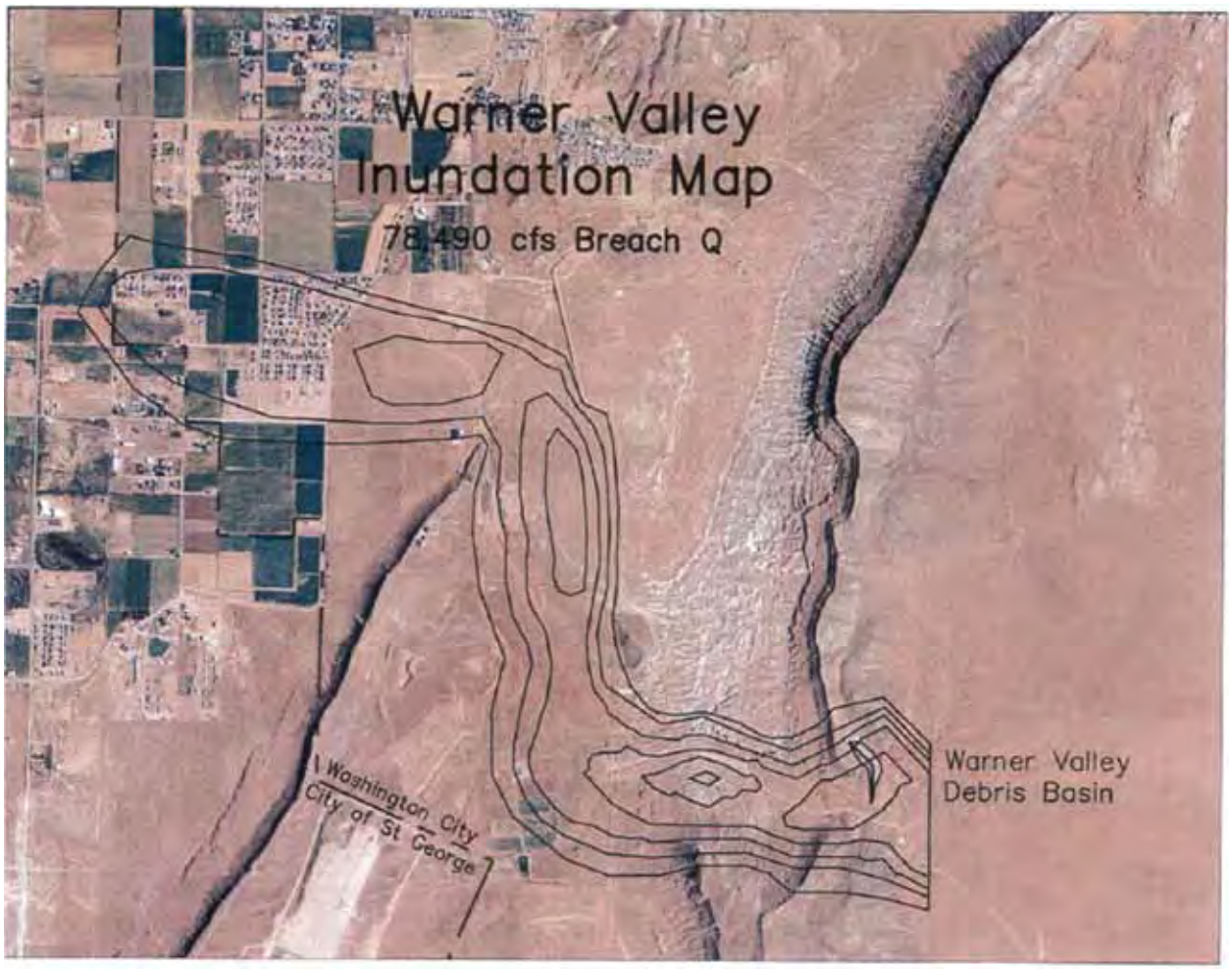


Figure 449: Warner Valley Debris Basin

Source: St. George City

Figure 450: Gypsum Wash Debris Basin

Source: St. George City

Table 446 describes the St. George community assets exposed to riverine erosion, dam inundation, and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Parks see the most exposure to potential flooding and impacts, which can expose park visitors and cause damages to park infrastructure, however these open spaces can act as a buffer to residential and commercial properties. Commercial parcels and critical facilities are also identified in flood risk areas. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood. Critical facilities impacted by flood may result in delays in service, damage, or loss of equipment, among other potential outcomes.

Table 446: St. George Exposure to Flooding, Dam Inundation, and Riverine Erosion

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
23.7%	36.1%	19.3%	20.5%	17.0%	N/A	80.0%

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

St. George property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 447: St. George NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$112,804	0	17	198	$67,327,900	23	$173,607

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

St. George participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. The Floodplain Administrator enforces flood ordinances and reviews applications which may be vulnerable to flooding, ensuring city actions comply with NFIP standards. Table 447 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. There have been 23 claims made for flood damages from property in the St. George Municipal boundary, none of these are considered repetitive losses. There have been a Community Assistance Contact and a Community Assistance Visit in 2020 and 2015 respectively.

The community does participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 448 describes the flooding events which have impacted St. George and the surrounding area.

Table 448: St. George Reported Flood Events

Date	Damage/Injury	Description
11/21/1996	$5,000,000 2 Injuries	Heavy rains caused significant flooding in Washington County. St. George saw 1.84 inches of rain and streets and basements flooded.
1/3/1997	$5,000,000 11 Injuries	Streets and Basements in St. George and Bloomington flooded after 2.38 inches of rain fell in St. George.
8/15/2003	None Reported	Thunderstorm led to flash flooding near St. George, causing water to run over bridges and closed roads.
8/22/2003	$5,000	Water flowed over the Fort Pierce Bridge in St. George during a flash flood.
10/20/2004	None Reported	A severe storm caused statewide snow and rain fall. In St. George, the Virgin River was 25 to 30 feet higher than average.

1/10/2005	$300,000,000 1 Death 6 Injuries	During a severe storm the Virgin River water level reached a 25-year high and the Santa Clara River was higher than previously recorded. Damages and injuries were reported throughout the St. George area.
8/11/2006	None Reported	The Virgin River in St. George Rose from 41 CFS to 1221 within two hours.
9/7/2006	None Reported	St. George Boulevard and nearby roads in Downtown St. George were inundated during a flood.
7/30/2007	None Reported	St. George saw flash flooding during a storm event.
8/5/2010	None Reported	Heavy rain caused flash flooding in the Fort Pearce Wash, which traveled to St George over 6 hours, impacting a St. George golf course.
12/19/2010	$19,700,000	A severe storm caused heavy flooding across Washington County. Impacts in St. George include: Road flooding, flooding in residences and on golf courses, which caused erosion and damaged a foot bridge.
7/15/2012	$500,000	St. George experienced flash flooding which overwhelmed storm drains in the city. Water was recorded at three to four feet deep on some streets, stranding vehicles and occupants. Damage was reported at 100 homes and some businesses. Landslides and debris flows were reported associated with this flood.
7/28/2013	None Reported	Flash flooding reported on Fort Pearce Wash, with a peak rate of 4146 CFS near St. George.
9/9/2014	$350,000	Washington County experienced flooding. Impacts in St. George homes and the Southgate Golf Course were flooded.
9/27/2014	$350,000 1 death	Washington County experienced severe flooding which killed a hiker in Zion National Park. In St. George, damages from flooding were most severe at the Southgate Golf Course, where the majority of holes were reported to be under water.
7/18/2015	$50,000	Flash flooding caused the virgin river to rise from Zion to St. George. In St. George, several roads were flooded during the event.
8/23/2020	$1,000,000 to $1,500,000	A significant thunderstorm produced two inches of rain which led to flash flooding. Impacts include flooding of homes and roads, sewer lift stations backed up, and sink holes in the community.

Source: NOAA Storm Database

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events interact with the built environment and human activity. The City does not permit development in areas identified to have severe rock fall risk by the Utah Geologic Survey. Figure 451 maps the landslide and rockfall susceptible areas are observed throughout St. George.

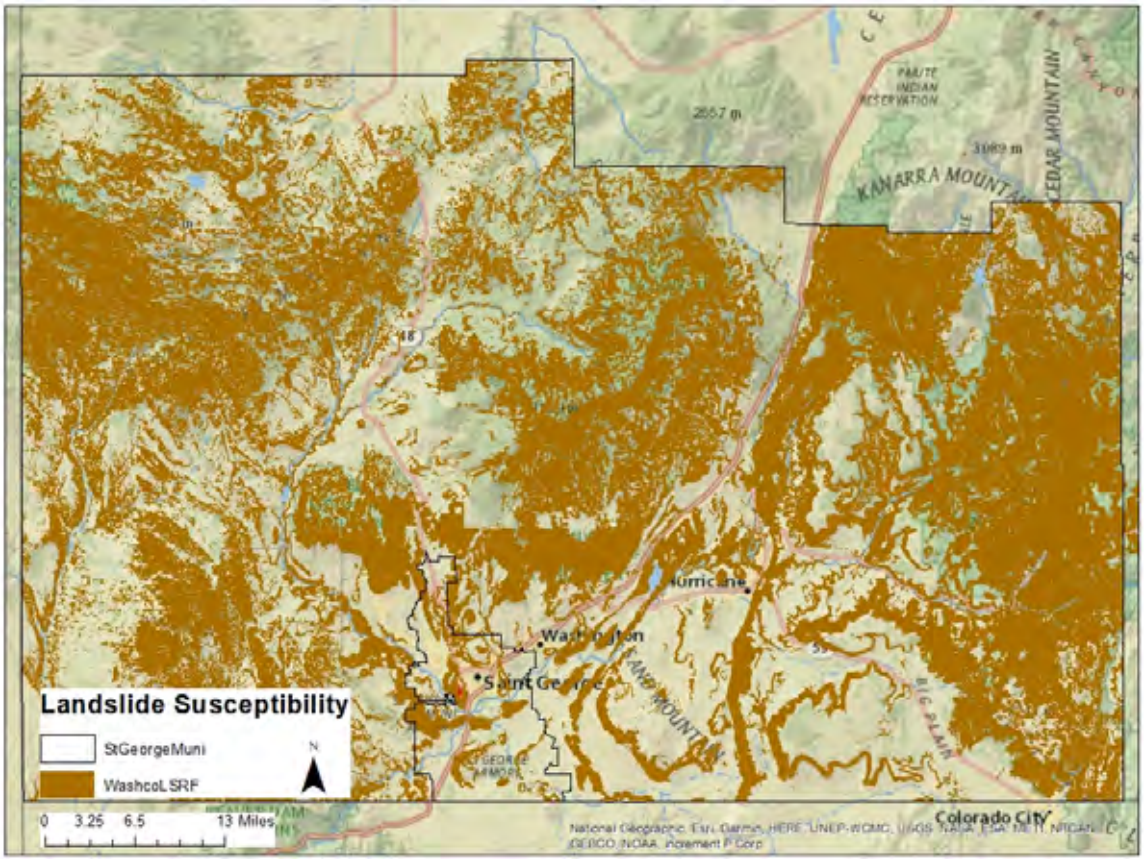


Figure 451: St. George Landslide Susceptibility

Source: Utah Geological Survey

Rockville is exposed to landslide susceptible areas throughout the community, given the local landscape, Table 449 describes the exposure of community assets to landslide susceptible areas. Parks see the highest exposure to landslide and rockfall areas in St. George. While landslides at a park can threaten the visitors and infrastructure, parks can buffer residents, property, and local businesses from potential landslide and rockfall. Parcels and road miles are also exposed to landslide and rockfall susceptible areas, which can impact life, property, and essential infrastructure. Landslides can block or damage roadways, causing delays and access challenges within a community. Without proper planning, future growth could place development in landslide risk areas, increasing risk of landslide impacts.

Table 449: St. George Landslide Susceptibility Exposure

St. George Exposure to Landslide Susceptible Areas

Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
5.1%	17.1%	13.3%	13.6%	13.7%%	N/A	20.0%

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. St. George has experienced landslide and rockfall events which have impacted personal property and public safety. Table 450 describes the record of landslide and rockfall events in St. George.

Table 450: St. George Landslide Record

Incident Date	Location	Description
1915	St. George, Washington County	Human caused landslide in St. George and Cottonwood Canal.
2014	St. George	A landslide following heavy rain caused the failure of a retaining wall. Several residents of a mobile home park were evacuated.

Source: (Blowers, Evacuations follow landslide caused by heavy rains, 2017)

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

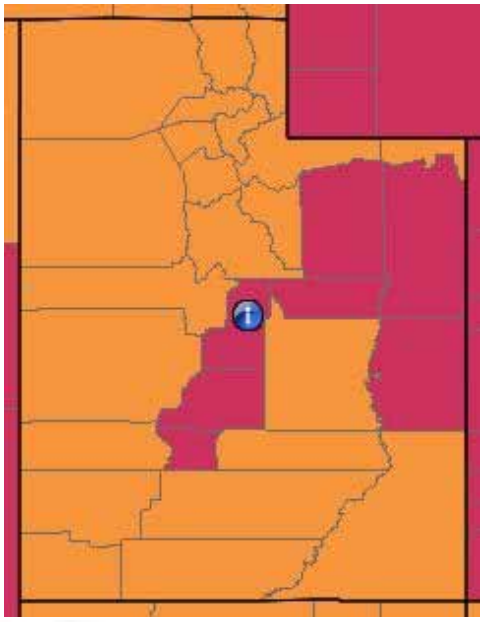
Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

St. George City and the Washington County Water Conservancy District have been moving public education on the importance of water conservation, especially during years with severe drought. A recent St. George City ordinance restricts water use by car washes locally and there has been discussion to reduce the allowable amount of turf in new developments and reductions to city water use.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 452. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.



Radon

Radon Data

- Zone 1: Counties with predicted average indoor radon screening levels greater than 4 pCi/L
- Zone 2: Counties with predicted average indoor radon screening levels from 2 to 4 pCi/L
- Zone 3: Counties with predicted average indoor radon screening levels less than 2 pCi/L

Figure 452: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 451 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been

identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 451: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact St. George, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

St. George sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. St. George has several reported severe weather event which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 452. While the deaths reported during the 2013 events did not occur in St. George, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers are vulnerable to these extreme temperatures.

Table 452: St. George Severe Weather Record

Date	Damage/Injury	Description
7/18/1994	None Reported	A severe storm produced 0.80 inches of rain in St. George in 40 minutes, causing flooding in residences and on streets.
4/12/1996	None Reported	High Winds were recorded in St. George, with speeds of 76 MPH during a thunderstorm.
4/23/1997	$40,000	High winds of 60 MPH were recorded in St. George during a storm that impacted the state of Utah.
11/26/1997	$10,000	Strong winds blew out a large plate-glass window in a St. George shop. Wind gusts during the event were recorded at 75 MPH at the St. George Airport.

12/7/1997	None Reported	High winds with gusts of 58 MPH were reported in St. George.
4/8/1999	None Reported	A storm produced April snow in St. George for the first time in 72 years. Winds of 67 MPH were recorded at the St. George airport.
10/6/1999	None Reported	Strong winds were reported in St. George, with gusts of 66 MPH.
3/13/2002	$35,000	66 MPH winds at the St. George Airport closed the airport following a wind gust causing landing gear to collapse on a taxiing plane. Damage included a blown off roof, broken window at Dixie College, and blowing a sign down. Storm caused $35,000 in crop damage
4/15/2002	None Reported	67 MPH wind gusts were reported in St. George.
3/1/2003	None Reported	A winter storm produced 1 inch of snow in St. George.
7/24/2003	$3,000	A thunderstorm produced wind gusts of 57 MPH in St. George.
12/26/2005	$10,000	A cold front brought damaging thunderstorms to St. George. Ten phone poles were snapped in St. George.
3/9/2006	None Reported	A heavy snowstorm produced snow in St. George, causing vehicle accidents on the slick roads.
4/23/2007	None Reported	St. George airport recorded wind gusts of up to 53 MPH.
7/27/2007	None Reported	A thunderstorm dropped one to two inches of rain in St. George, which led to street flooding.
7/30/2007	None Reported	Heavy thunderstorms caused flash flooding in St. George.
12/21/2007	None Reported	A thunderstorm produced wind gusts over 61 MPH.
1/28/2008	None Reported	74 MPH wind gusts were recorded associated with a thunderstorm.
4/30/2008	None Reported	Strong wind gusts were recorded, with the peak gust of 60 MPH in St. George.
9/16/2008	None Reported	59 MPH wind gusts were recorded associated with a thunderstorm.
6/25/2009	None Reported	Strong winds were recorded in St. George with a peak gust of 59 MPH.
3/13/2010	None Reported	Peak wind gusts were between 58 and 59 MPH in St. George during a thunderstorm.
6/16/2010	None Reported	Peak wind gusts were 60 MPH in St. George.
10/5/2010	2 injuries	Two teenagers were struck by lightning while seeking shelter from rain under a tree during a thunderstorm.
11/21/2010	None Reported	St. George recorded a max wind gust at 58 MPH.
1/3/2011	None Reported	A snowstorm produced up to three inches of snow in St. George.
4/7/2011	None Reported	A windstorm had sustained winds above 40MPH, with gusts recorded between 50 and 55 MPH. The wind caused visibility limitations of a quarter mile at the airport due to blowing dust.
7/24/2012	None Reported	St. George recorded maximum wind gusts of 62 MPH.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures contributed to the death of a hiker in Kane County.
10/28/2013	$1,000	St. George had a peak wind gust of 53 MPH during a storm which blew over a tree on the Dixie State University Campus.
12/3/2013	$2,000	St. George recorded 2 inches of snow during a storm, which caused 30 vehicle accidents and at least one injury across Washington County.
12/7/2013	None Reported	Six inches of snow fell in St. George during a snowstorm. The storm caused travel delays and the closure of I-15, leaving 300

		people stranded on the highway. The St. George airport was also closed during the event.
2/27/2014	$10,000	A tree was knocked over in high winds with peak gusts at 49 MPH. The tree fell on a home, damaging the roof.
3/26/2014	None Reported	High winds produced a peak wind gust of 68 MPH in St. George.
2/23/2015	None Reported	Up to three inches of snow fell in St. George during a snow event.
3/28/2016	None Reported	Strong winds with gusts of 60 MPH were recorded in St. George.
7/28/2016	None Reported	The St. George Airport recorded a wind gust of 61 MPH.
8/1/2016	None Reported	The St. George Airport recorded a wind gust of 59 MPH.
8/10/2016	None Reported	A thunderstorm produced nickel sized hail in St. George.
3/30/2017	$10,000	High winds knocked down utility poles, causing power outages and traffic problems. A peak wind gust was recorded at 62 MPH.
7/8/2017	None Reported	A tornado was reported east of St. George.
8/13/2017	$1,000	A thunderstorm with high winds caused damage near Red Cliff's Mall, uprooting several trees.
4/7/2018	$400,000	Lightning strike ignited and destroyed a St. George home.
2/20/2019	None Reported	A storm produced four inches of snow in St. George.
6/5/2020	None Reported	A windstorm produced a peak wind gust of 58 MPH recorded at the St. George airport.
6/28/2020	None Reported	A windstorm produced a peak wind gust of 59 MPH recorded at the St. George airport.
8/23/2020	$1,000,000 to $1,500,000	Two inches of rain fell in St. George during a significant thunderstorm which led to widespread flash flooding in the community.

Source: NOAA Storm Database

High winds, thunderstorms, and snowstorms cause damages and injury in the St. George area. Snowstorms cause impacts to traffic flow through the community and can cause vehicle accidents and injury. Winds often do not have reported impacts associated with them, but can cause property damage, impact infrastructure, and affect the welfare of residents and visitors to St. George when winds break windows, damage roofs, or knock down trees and tall structures.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. Figure 453 illustrates where the Utah Geological Survey has mapped problem soils in, and surrounding St. George. Expansive soils are mapped in the southern and western portions of the city.

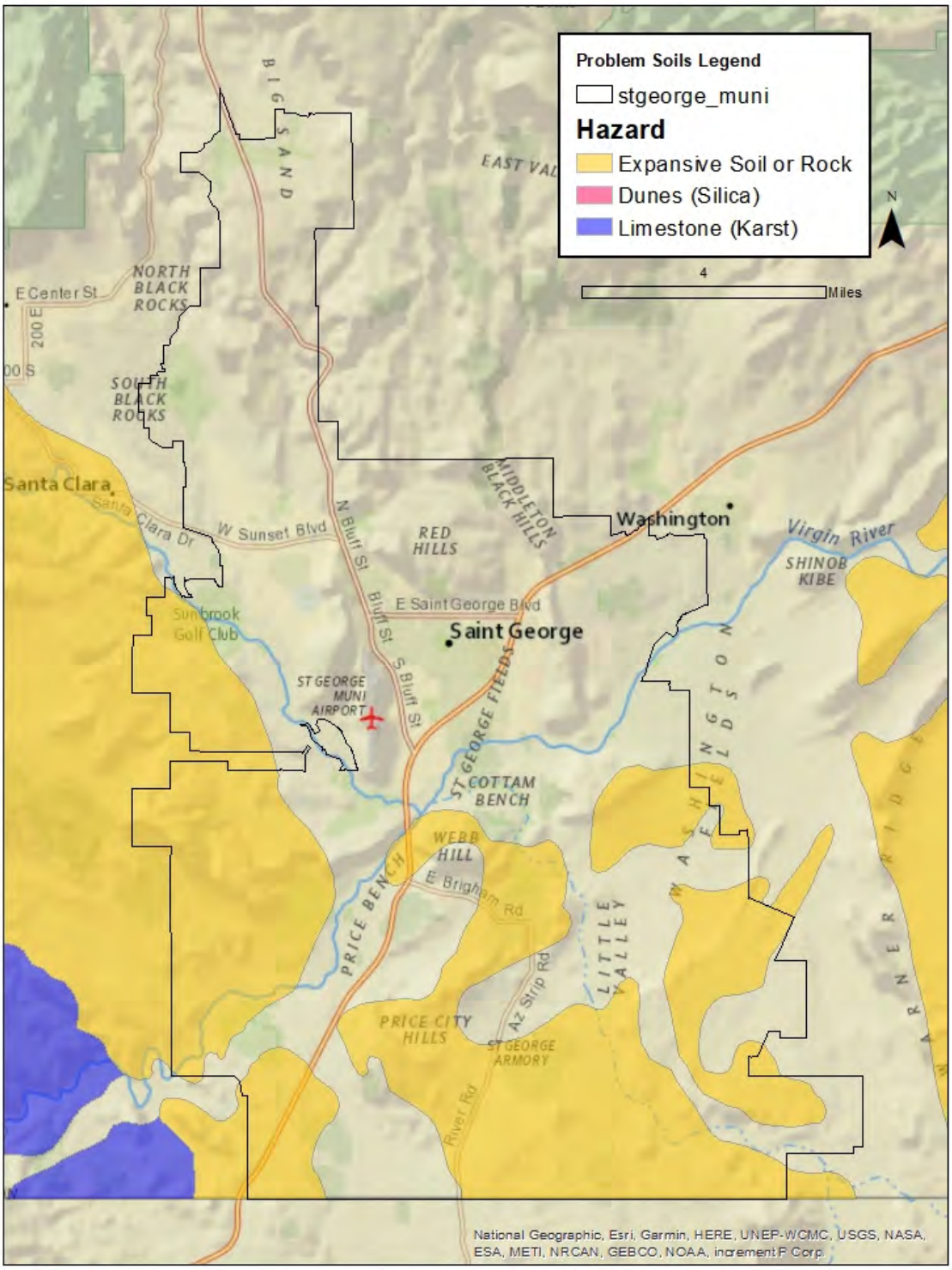


Figure 453: St. George Problem Soils Map

Source: UGS, AGRC

Community assets, infrastructure, and property are exposed to problem soils, with the greatest exposure being in critical facilities. Problem soils are often challenging to structures and infrastructure,

as when the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure.

Table 453: St. George Problem Soils Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
5.1%	6.2%	22.7%	21.6%	23.4%	N/A	0.0%

Source: Utah Geological Survey, Washington County Assessor, UDOT

UGS has developed updated mapping for some communities in the region, which provides greater detail about the susceptibility and potential for problem soils and the types prevalent to the region. St. George is included in this mapping study area for caliche, collapsible soils, expansive soils and rock, piping and erosion susceptible soil, shallow bedrock, soluble soil and rock, and windblown sand. The updated mapping is available in an online format only and was not used for GIS analysis, Table 453 does not refer to the updated mapping. Figure 454 to Figure 460 map each of the susceptible problem soils identified by the Utah Geological Survey.

Caliche

Figure 454: St. George Caliche Susceptibility

Collapsible Soil

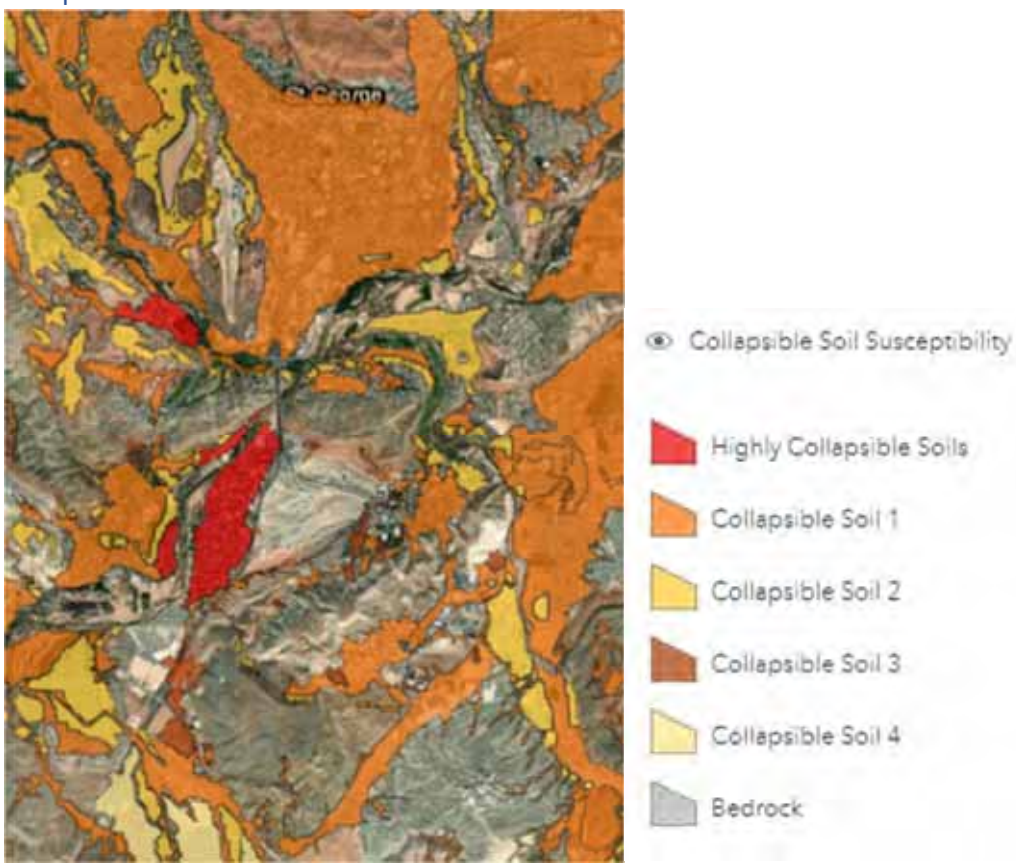


Figure 455: St. George Collapsible Soil Susceptibility

Expansive Soil and Rock

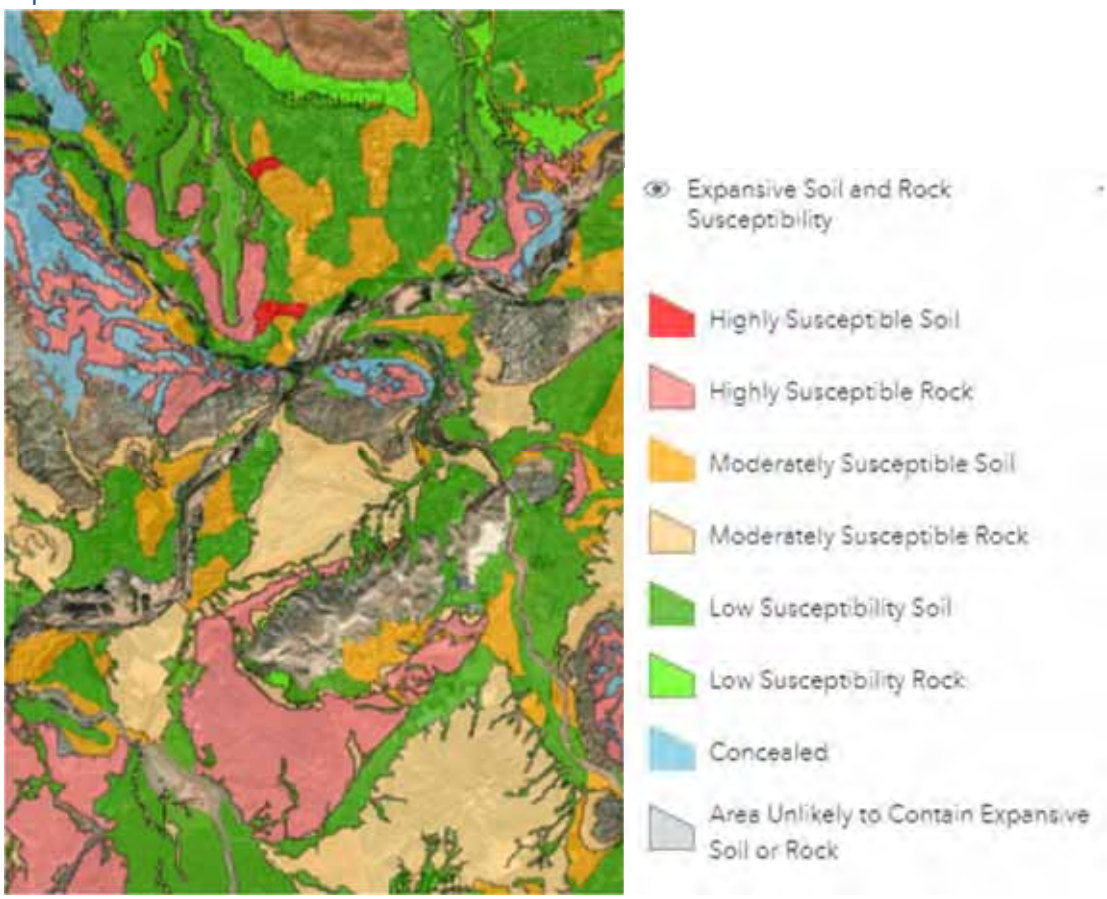


Figure 456: St. George Expansive Soil and Rock Susceptibility

Piping and Erosion

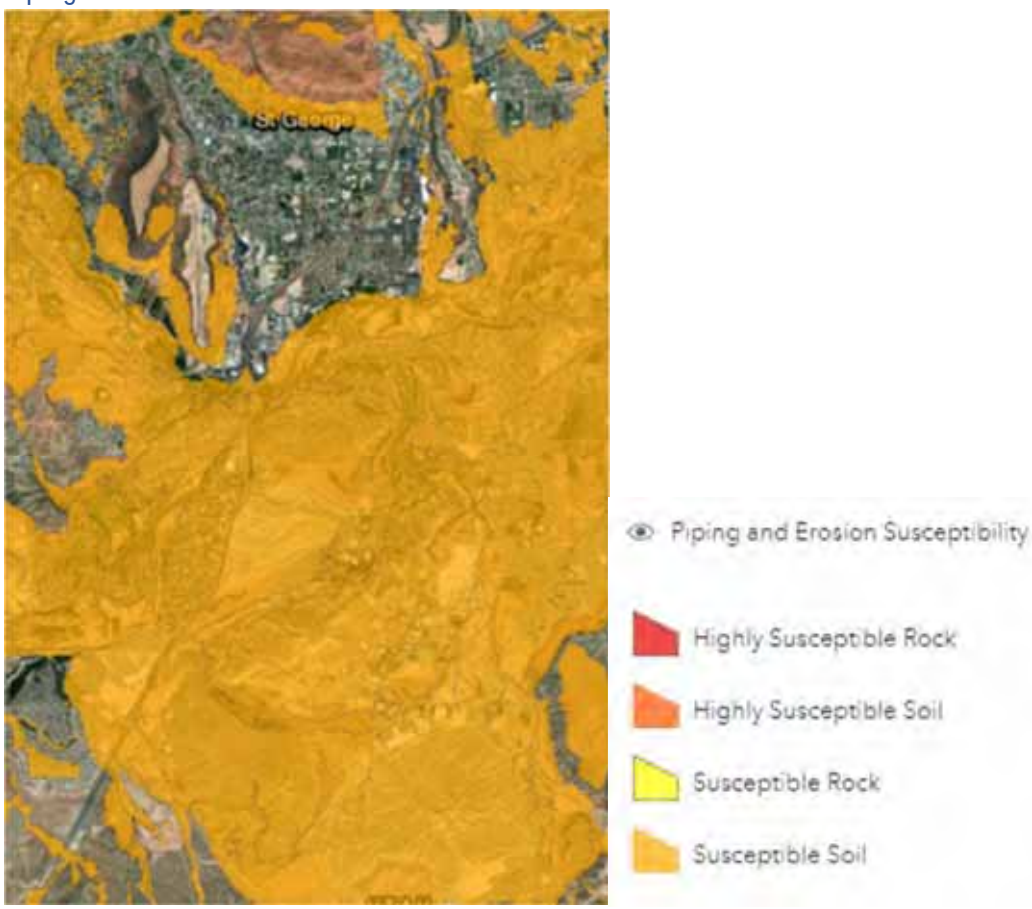


Figure 457: St. George Piping and Erosion Susceptibility

Shallow Bedrock

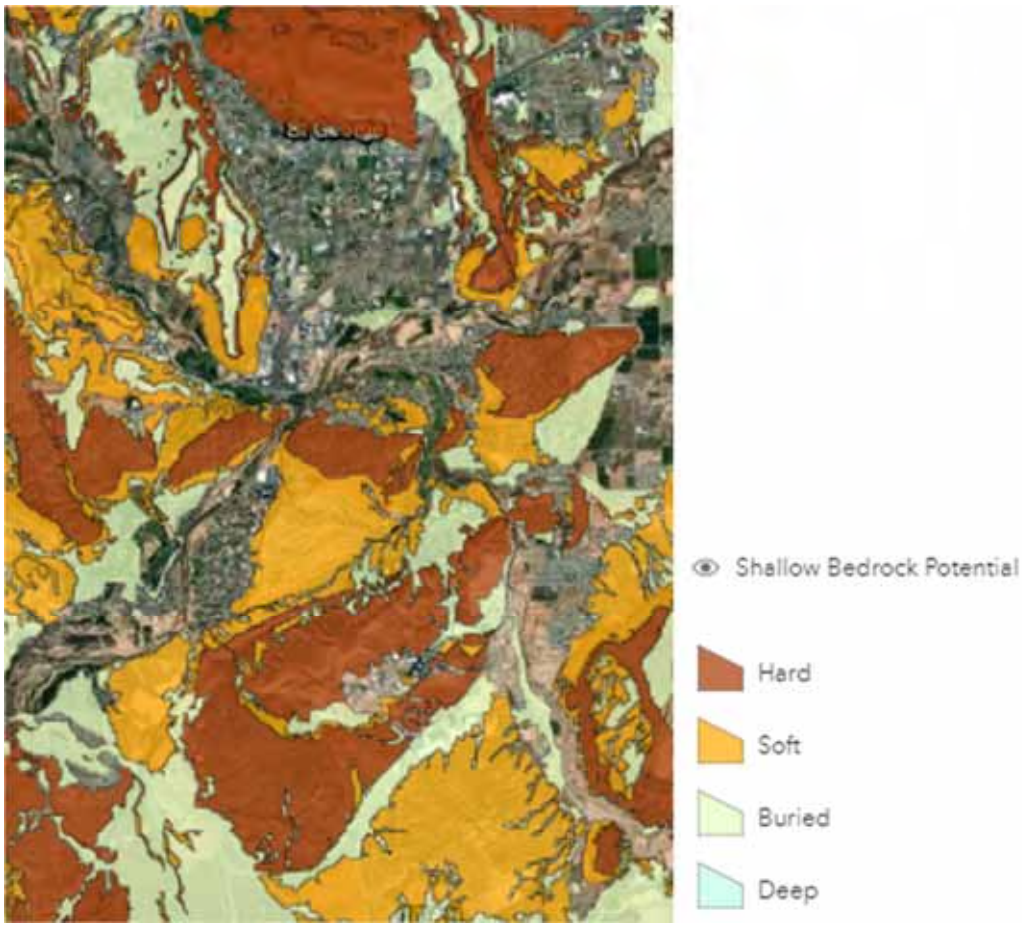


Figure 458: St. George Shallow Bedrock Potential

Soluble Soil and Rock

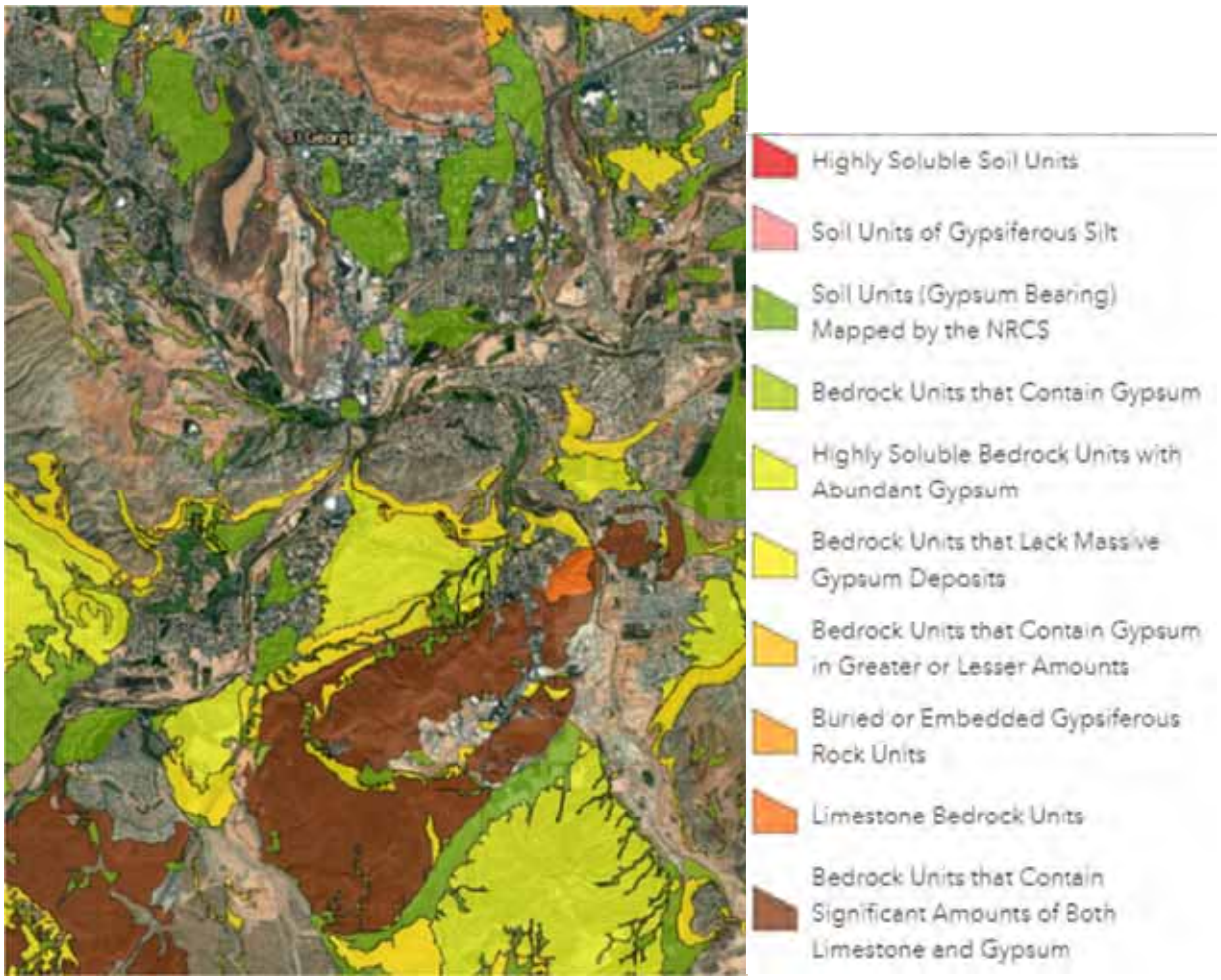


Figure 459: St. George Soluble Soil and Rock

Wind-Blown Sand

Figure 460: St. George Wind-Blown Sand Susceptibility

The community and the county do not have a record of problem soil impacts, although building permits should include a description of where studies were required, indicating whether problem soils have been discovered on a site and what types of mitigation were completed.

Summary

St. George is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. St. George critical facilities are vulnerable to severe weather, problem soils, landslide, flood, earthquakes, and wildfires. Impacts from these natural hazards can impact a facility's capacity to respond to an emergency event. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

St. George has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 454 describes progress made on St. George's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 454: 2016 St. George Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Provide for erosion protection for Millcreek Power Generation station in St. George.	Provide for erosion protection for Millcreek Power Generation station in St. George.	Unknown	Local government operating budget; State and Federal flood grant programs	complete
Flood #2	Stabilize Santa Clara River for future flood events.	Provide grade stabilization to limit scouring near Dixie Drive Bridge and through Santa Clara City. (Washington County, St. George, and Santa Clara City).	Unknown	Local government operating budget; State and Federal flood grant programs	complete
Flood #3	Stabilize Santa Clara River for future flood events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Santa Clara River. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	This is a long-term strategy with undetermined times lines.	Local funding, state, and federal grant funds as available.	ongoing

Source: 2017 Five County Association of Governments NHMP

The St. George City planning team identified actions to include in the community mitigation strategy. Each action in Table 455 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 303.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action.
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 461: Regional Plan Goals

Table 455: St. George City 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	6	Conserve municipal water resources.	Replace city owned unused turf with xeriscape landscaping.	H	Ongoing	M	St. George City, State of Utah	St. George City
Drought #2	1	Conserve municipal water resources.	Inform residents of water conservation measures through postings to City notice boards, social media, and websites in partnership with Washington County Water Conservancy District.	H	Ongoing	L	St. George City, Washington County Water Conservancy District	St. George City, Washington County Water Conservancy District

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2, 6	Stabilize Santa Clara River for future flood events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Santa Clara River. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	M	Ongoing	M	Washington County Flood Control Authority, St. George City.	Washington County Flood Control Authority, St. George City.
Flood #2	2, 6	Stabilize Virgin River for future flood events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Virgin River. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	M	Ongoing	M	Washington County Flood Control Authority, St. George City.	Washington County Flood Control Authority, St. George City.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #3	2, 6	Stabilize Sand Hollow Wash for future flood events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Sand Hollow Wash. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	M	Ongoing	M	Washington County Flood Control Authority, St. George City.	Washington County Flood Control Authority, St. George City.
Flood #4	2, 6	Stabilize Fort Pierce Wash for future flood events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Fort Pierce Wash. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	M	Ongoing	M	Washington County Flood Control Authority, St. George City.	Washington County Flood Control Authority, St. George City.
Flood #5	3	Inform residents, property owners, businesses, and other partners of local flood risks.	Public education and outreach. notify property owners in and adjacent to floodplain. Notify business owners and work with realtors, engineering firms, about flood risk.	H	Annually ongoing	L	St. George City	St. George City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #1	2	Align mitigation with existing city plans and processes.	Complete stormwater infrastructure actions identified in Capital Facilities master plan.	M	Ongoing	M	St. George City	St. George City
Landslide #1	1, 2	Align landslide mitigation with existing city plans and processes.	Continue to enforce the development in adverse geological hazard areas ordinance.	H	Ongoing	L	St. George City	St. George City
Landslide #2	1, 2	Align landslide mitigation with existing city plans and processes.	Follow up on recommendations from hillside review board and professional engineering studies for all new development. Enforce and monitor recommendations and requirements over time.	H	Ongoing	L	St. George City	St. George City
Wildfire #1	6	Remove significant fuels loads in vulnerable drainages, especially those near development.	Assessment and removal of vegetation in the Santa Clara River, Virgin River, Sand Hollow Wash, and Fort Pierce Wash.	H	Ongoing	M	Washington County Flood Control Authority, St. George City, Fire Department.	Washington County Flood Control Authority, St. George City, Fire Department.
Earthquake #1	3	Inform residents of earthquake risks and mitigation.	Engage in a public education campaign to inform residents and property owners of unreinforced masonry risks and earthquake safety. To be shared on city website and social media.	H	Ongoing annually	L	St. George City	St. George City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of radon risks and mitigation.	Develop a public education campaign to inform residents of radon risks, testing, and mitigation. To be shared on city website and social media.	H	Ongoing annually	L	St. George City	St. George City
Multi-Hazard #1	2	Ensure power reliability and continued service to critical facilities and infrastructure within service area.	Consider acquisition of a backup battery to be housed and operated at the city power plant.	L	Dependent on available funding	H	Department of Energy, Build Back Better Infrastructure funding, FEMA.	St. George City

Source: Local Planning Team

Santa Clara

Santa Clara City was settled in 1854 and incorporated as a city in 1915. Settled by Mormon pioneers, many of which were of Swiss origin. The community was an agricultural hub for the area. Fruits and produce were traditionally an attraction to the area.

The city is located northwest of St. George, the largest metropolitan area in the region. The community sits in the shadow of Snow Canyon State Park and the Red Cliffs National Conservation Area, which lie directly north of the community. Old highway 91 runs through the community and connects Santa Clara to neighboring communities. The community also has the Santa Clara River running through the community, parallel to highway 91.

The city is growing, but is largely suburban, with many residents working in neighboring St. George.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

Demographics

Santa Clara is part of the St. George Metropolitan area, which is considered one of the fastest growing areas in the nation. As of the 2020 census, Santa Clara has a population of 7,553, described in Figure 462, although City staff indicate that their local population estimate is 8,500 people and continuing to grow rapidly.

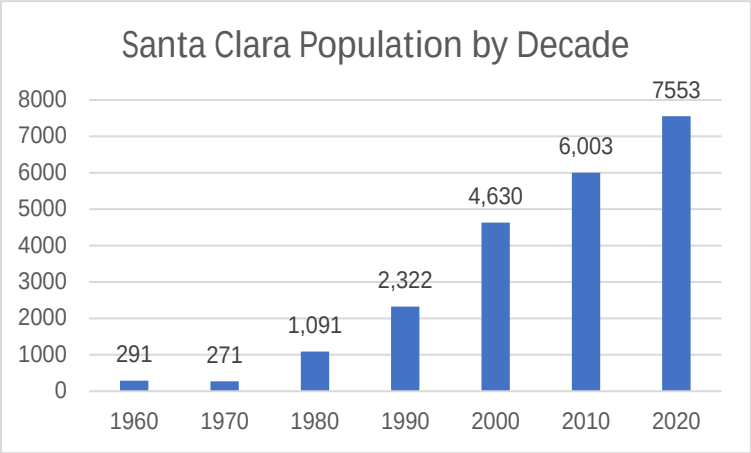
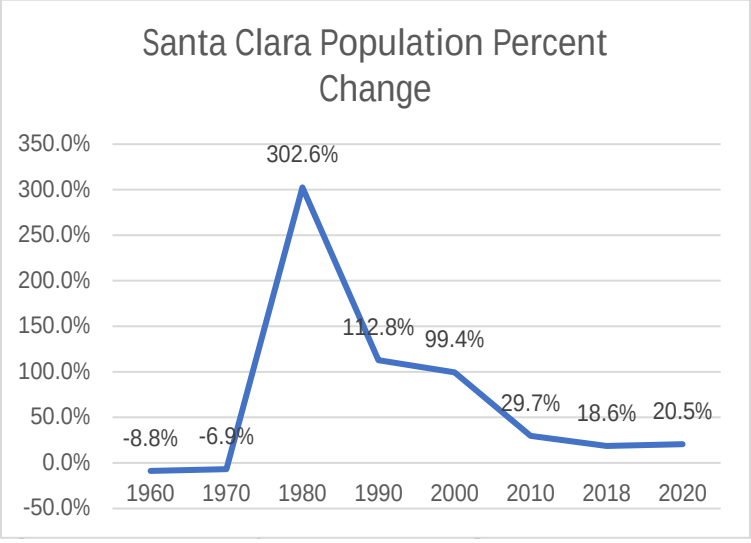


Figure 462: Santa Clara Population by Decade

Source: US Census Bureau

Santa Clara City's population growth has grown significantly, like the other nearby communities in Washington County. The greatest growth was recorded in 1980, where Santa Clara saw 302% growth, as shown in Figure 463. The rate of growth remained high until the 2010 census, where population growth became more consistent, ranging between 20% and 30% in 2010 and 2020. Population changes over the past several decades shows that the populations increased by an average of 88% each decade between 1960 and 2010.



Population projections for Washington County have been completed by the Kem C. Gardner Institute and describe that the County is expected to see an

229% increase in population between 2015 and 2065. Using a step-down analysis, applying the estimated County rate of growth to Santa Clara, the community could see up to 21,550 people living in the community in the next 45-years[28].

Development

The city has recently approved several new projects which have brought new residential and commercial development to the community. These projects have been approved and many have phases under construction or near completion at the time of this writing.

Residential Development

Heritage Point Townhomes is a Planned Development Residential, PD-R zoned project is being developed on former State Trust Land (SITLA) along Santa Clara Drive at the east entrance to the city. Heritage Point includes 55 two-story townhome units with limited commercial space on seven acres of property. Construction is expected to be completed in 2022.

In July 2019, the City Council approved a Concept Plan and General Plan Amendment for the Black Desert project of which 298 acres are located within Santa Clara, and another 300 acres are within Ivins City and St George City. This project is in the northeastern portion of Santa Clara City and the Concept Plan and General Plan amendment allow for a total of 1,937 dwelling units, much of which will be clustered in compact development to encourage project affordability. Phase I includes 199-units on approximately 19 acres of land owned by Regal Homes of Utah. The proposed rental housing project is intended to provide housing within the price range of the local Washington County workforce. The project is expected to proceed in 2022.

The Desert Edge project is a townhome and apartment development proposed on approximately 21 acres, which will include 119 owner-occupied townhomes and 120 apartment units for rent, some of which include rents for individuals between 30% to 80% of AMI.

Desert Village is a Planned Development Residential zoned area for 185 townhome units near the heart of the city. This project is currently in progress, with Phase I (64-units) nearing completion, Phase II (53-units) is under construction, and Phase III (68-units) to start in 2022.

Commercial Development

Santa Clara City has experienced growth in the north portion of the city, near Rachel Drive and Pioneer Parkway with the development of the Harmon's Shopping Center. The center includes a large grocery store with several retail and restaurants on the site, including Café Rio, Capriotti's, Mo Bettah's, Swig, and Tag N Go Carwash. Other new developments located near the intersection of Rachel Drive and Pioneer Parkway include a hardware store, several restaurants, and retail spaces.

Community Capabilities

Santa Clara is governed by a mayor and city council, who engage in executive and legislative activities for the community, respectively. Elections for these positions are every four years. Administrative staff include a city manager, treasurer, recorder, and finance officer who support the implementation of

[28] This estimate is created using the 2015 ACS population estimate for Santa Clara, which was 6,550, and adding 229% of this population estimate to the population for that year.

legislative actions. The community also has a building, planning, and zoning, parks and recreation, public works, power, and stormwater departments.

Several boards and commissions advise the city council on specialized topics, some of which can make decisions and set requirements within the scope of their board. A city planning commission also supports specialized review and recommendation of planning and zoning activities in the community to the city council. Other boards and commissions include:

- Economic Development Commission
- Heritage & Parks Committee
- Shade Tree Committee
- Technical Review Committee
- Hillside Committee

Public safety is provided by an interlocal agency, the Santa Clara-Ivins Public Safety Department, which provides police, fire, and emergency medical services to residents of both communities.

Electric, water, and sewer utilities are provided by Santa Clara City. Natural Gas is provided through Dominion Energy and Waste removal is provided to residents through Washington County Solid Waste Removal.

Plans and Policies

Santa Clara City has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Santa Clara City's plans and policies as they relate to natural hazards.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

The Santa Clara Codes and Ordinances seek to protect resident's health, safety, and welfare and natural and cultural resources through local policy. Throughout city code, ordinances describe requirements for constructions and methods to avoid hazard situations, which protect the community from impacts of a natural hazard event.

The following chapters in the city ordinances describe natural hazards:

8.28- Weeds and Deleterious Objects

Describes noxious weeds and their potential for fire hazard.

15.20- Fire Code

Adoption of the international fire code sections and appendices for Santa Clara City.

15.36- Flood Damage Prevention

This chapter sets standards for development to protect the City, its residents, and assets from flood risk through regulation, restrictions, and requirements for development activities.

Identifies areas of special flood hazard from Flood Insurance Rate Maps dated 2009 and describes the role of the Floodplain Administrator.

Describes an erosion hazard zone and the standards for development in the overlay area.

17.48- Construction Subject to Natural Hazards

Describes requirements for geologic reports to understand risks to development and mitigation of those identified hazards before construction.

17.80- HP Hillside Protection Overlay Zone

The overlay zone sets standards for development and grading on hillsides and slopes for proposed development. The ordinance establishes a hillside review board to recommend to the planning commission and city council on hillside developments in this zone. Required submissions and requirements for review by the review board are detailed in the full text of the chapter.

17.90- Landscape Standards

Sets a standard for landscaping, noting that landscaping addresses heat, reduces noise, and removes pollutants. The standards require that all new developments or remodeling developments consider water efficiency, erosion control, plant adaptation to the environment, drought tolerance, and other requirements.

17.92- Water Efficient Landscaping & Conservation Standards

Sets standards to conserve the public's water resources and to promote water efficient construction and landscaping to protect and enhance the community's environmental, economic, recreational, and aesthetic resources by promoting efficient use of water in our community's buildings and landscapes, reduces water waste, and establishes a structure for designing, installing, and maintaining water efficient buildings and landscapes throughout the city.

General Plan

The Santa Clara City General Plan, adopted in 2014, describes the vision for the community, referencing the history, current and planned land use, need for services, and conservation. Several of the policies for the community address natural hazard mitigation in the regional cooperation, parks trails, and open space, infrastructure, and subareas sections of the plan.

Chapter 4 describes subareas within Santa Clara City and their dominant land uses. In this section, one policy describes flood hazards to the downtown core area.

> "Policy 4.2: To avoid flooding hazards in the Historic Downtown Core, clustering new development is encouraged to preserve the floodplain for agriculture, river access, and emergency management."

Chapter 8 of the Santa Clara General plan illustrates infrastructure systems throughout the city, including transportation, street scape, utilities, and public services. A section of this chapter describes flooding response in the city and surrounding area, including the establishment of the Washington County Flood Control Authority and the development of plans.

"Policy 8.11: Santa Clara endorses the principles described in the Santa Clara River Master Plan to reduce the risk of flooding and erosion damage within the community. The City also supports the efforts of the Washington County Flood Control Authority to maintain critical flood control infrastructure within the region.

Policy 8.12: The City is dedicated to protecting public health and safety by maintaining the capacity of floodplains and floodways and keeping our waterways clean and healthy by preventing storm water pollution."

Chapter 9 of this plan details Parks, Trails, and Open Space in Santa Clara City, with a specific section dedicated to preserving sensitive lands and habitats. These lands tend to be lava fields, bluffs, foothills, areas with expansive soils, floodplains, and dry washes, which protect the community. Policies from this chapter related to natural hazards include:

"Policy 9.5: New development will avoid or mitigate impacts on sensitive lands.

Policy 9.7: Santa Clara endorses the Santa Clara River Management Plan and will aid in its implementation.

Policy 9.8: Dry washes are to be protected in a natural state for floodways, wildlife habitat, and passive recreation (hiking trails).

Policy 9.9: The City requires careful engineering, design, and mitigation in areas of expansive clay soils. In these areas, clustered and attached dwelling units will also be encouraged to reduce the per-dwelling-unit cost of mitigation.

Policy 9.10: Development will mitigate the impact on hillsides through placement, articulation, and aesthetic controls."

Chapter 10 of the Santa Clara General plan describes regional cooperation, including coordination with the Bureau of Land Management with is the land manager for much of the open space near the community. One policy describes coordination efforts to act on natural hazards.

"Policy 10.1 The City supports disposal of BLM land in the South Hills area with conditions that:

a. Protect sensitive habitats.

b. Minimize and mitigate grading that would scar visible hillsides.

c. Provide multiple means of access.

d. Suitably avoid construction on expansive clay soils."

River Master Plan

The Santa Clara River Master Plan (2005) was commissioned in Fall of 2005 following significant flood events on the Santa Clara and Virgin Rivers in January of 2005, which cost millions in damage and losses to homes and infrastructure. The flood event impacted several communities in Washington County. The River Master plan assesses the event and engineering strategies to respond and recover from the event on the Santa Clara River. The plan also provides a list of actions and maintenance to reduce damage from future floods. Reduce risk of damage and losses due to bank erosion.

River Stability Study for Santa Clara and Virgin Rivers

The River Stability Study was developed in 2005 to provide added context to the Santa Clara River Master Plan, which described the impacts of severe flooding from earlier that year in several Washington County communities. The River Stability Study provides a Geomorphic evaluation of the rivers to understand channelization and the potential for erosion along the rivers and led to the development of an erosion hazard map for the area (JE Fuller Hydrology and Geomorphology, Inc., 2005). Recommendations for hazard mitigation in this plan include adopting ordinances for appropriate use in erosion hazard areas, preserving natural river systems in policies, and protection of bank structures.

Santa Clara City Construction Design Standards

The Santa Clara City Construction Design Standards were adopted in 2016. The standards provide general conditions and instructions for all development in Santa Clara. A number of these standards describe situations which avoid natural hazards, including flood control design aligned with the Washington County Flood Control Authority Storm Drainage Systems Design and Management Manual; requirements for various permitting, planning, and reporting to address grading, drainage, soils, and geologic hazards; and specifying placement of pipelines on lot lines to avoid flood damage.

Risk Assessment

Santa Clara is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. In addition to common hazards prevalent throughout the region, the community added two hazards to address in this section: Riverine Erosion and Shallow Groundwater. These hazards have been well documented in the community and pose risks to the public, property, and safety.

Five County has worked with the Santa Clara planning team to develop a ranking of the highest risk hazards based on probability, and local exposure of the hazard. Table 456 describes the relative risks of hazards in the community.

Table 456: Santa Clara Risk Assessment

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. High
SEVERE WEATHER	3. High
RIVERINE EROSION	4. High
PROBLEM SOIL	5. High
LANDSLIDE	6. Moderate
WILDFIRE	7. Moderate
EARTHQUAKE	8. Moderate
RADON	9. Moderate
SHALLOW GROUNDWATER	10. Low

A detailed description and mapping of each of the natural hazards that impact Santa Clara can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Santa Clara include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Santa Clara is an urban community surrounded by open space, with the Mojave Desert to the southwest and the Pine valley mountains to the North. The community is one of the cities comprising the St. George Metropolitan area, a hub for infrastructure, shopping, and tourism in the southwest, connecting areas like Las Vegas and Phoenix to Salt Lake City. Santa Clara has historic and cultural assets which the community values. These community assets reveal potential vulnerabilities in the event of a wildfire impacting the community, which can affect traffic, travel of necessary goods, visitors and residents, and natural systems in the area.

Figure 464 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal, which uses wildland fire risk assessment data (2013) compiled for the West Wide Wildfire Risk Assessment (WWA). Mapping completed by the Five County AOG describes those areas in and surrounding Santa Clara that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

The community described that since this dataset was developed, significant commercial and residential development have occurred near the north-western portion of the municipal boundary, where the map indicates a high to extreme risk of wildfire exists. The data presented for wildfire may not reflect the exact risk in this area following this development. Given that wildlands are present outside of the new developments, wildfire risk may still exist in and surrounding the development. There is a need for updated data from the state to improve assessment of wildfire risks and vulnerabilities to communities and their interface areas.

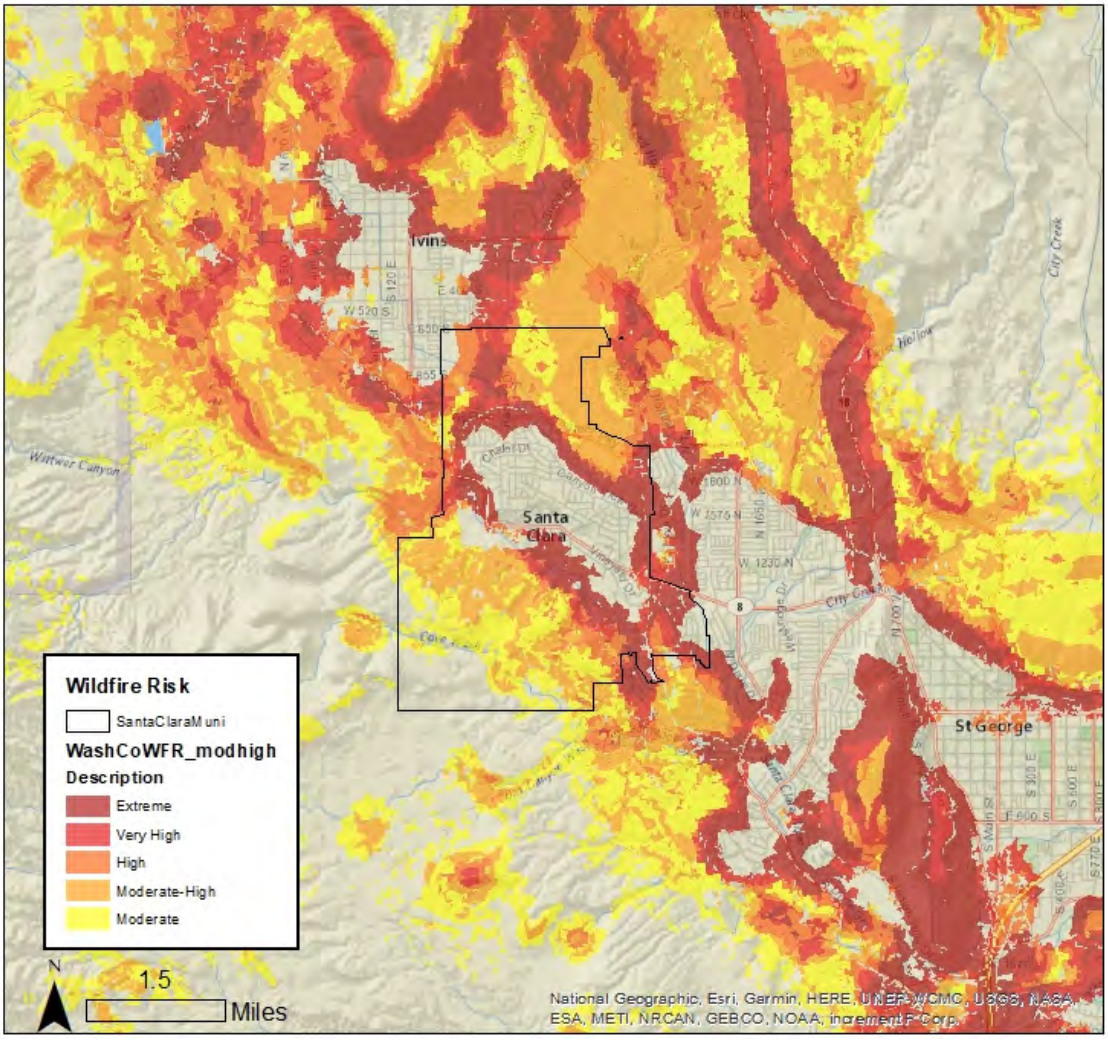


Figure 464: Santa Clara Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 457 further describes Santa Clara's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parks, parcels, and miles of roadway in Santa Clara, which could damage property, impact public health and safety, or impact local economies. Over half of the commercial parcels in the community are exposed to moderate or greater risk to wildfires. Forty-four percent of the road miles in the community are at moderate to extreme wildfire risk, which can challenge response and recovery and the travel of people and goods.

Table 457: Santa Clara Wildfire Risk

Santa Clara Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
33.3%	56.9%	48.1%	48.2%	44.2%	N/A	100.0%

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. No fires documented on either source have impacted Santa Clara as of July 2020. Smaller fires may have occurred that impacted the area that are not recorded on either source. Local records of fires describe minor wildfires near the river and in drainage ditches and washes that have high fuel loads. One such event occurred near a substation, having the potential to impact local utilities in the area. Fires of this type are often started on accident from controlled burning or by children.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to existing infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Santa Clara wildfire events in 2004 and 2005 impacted the flood flow following severe storms and bank topping events, leading to increased sediment deposits. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Santa Clara, and it is essential to be aware of the interrelated nature of these identified hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may be perceptible to residents. Several faults in the state have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 465 shows the mapped earthquake epicenters and fault lines in Washington County. There are no faults or earthquake epicenters documented in Santa Clara.

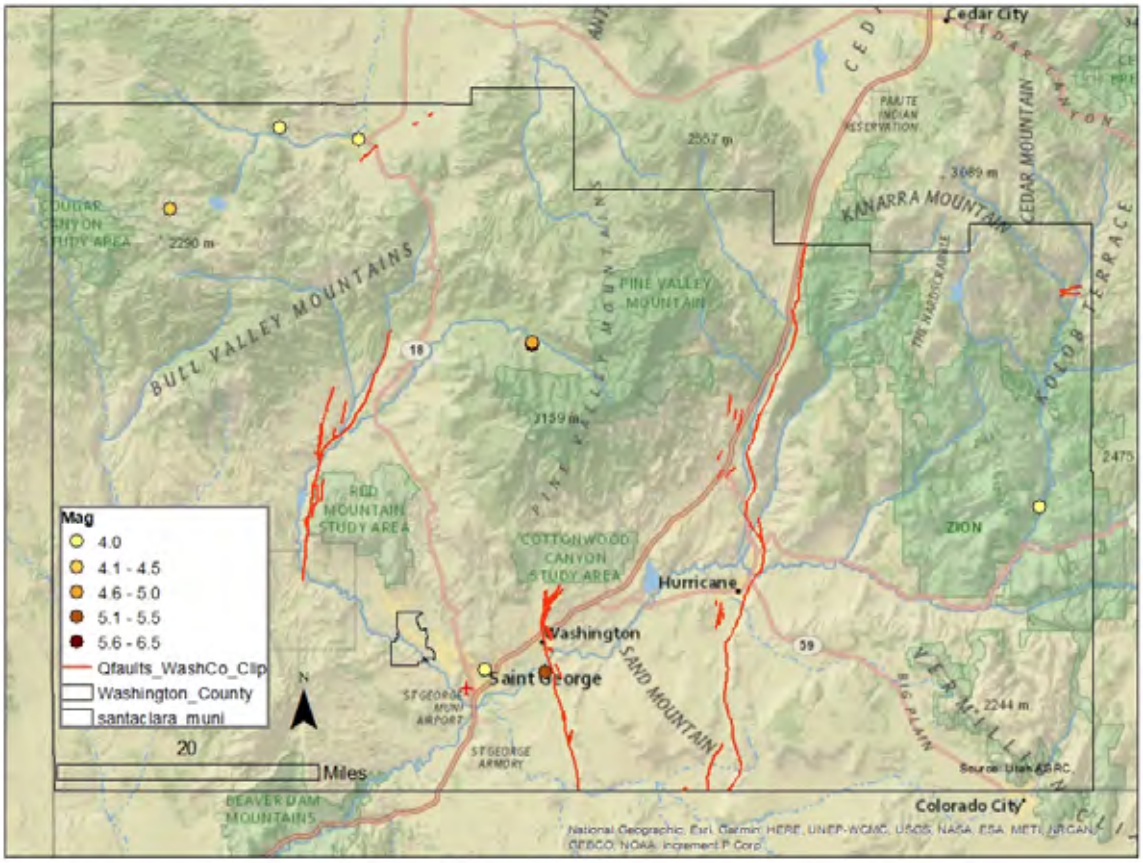


Figure 465: Santa Clara Earthquake Epicenter and Quaternary Faults

Source: Utah Geological Survey

Given that there are no faults identified in Santa Clara, there is no risk of surface-fault-rupture in the community, however, Santa Clara could experience strong ground shaking and liquefaction following a significant earthquake event.

An identified vulnerability to earthquake ground shaking events in the region include structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, Santa Clara has 164 structures which were built before the adoption of seismic code requirements, making up approximately 5.7% of the total structures in the city boundaries. None of the community's

critical facilities have been identified as being built before the 1975. The low proportion of total pre 1975 structures is a result of the significant growth the community has seen since the 1980s, with the population nearly doubling in the decades following. Southern Utah has pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Santa Clara City. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid. Susceptible soil is close to the surface, loose, water saturated, and sandy soil.

Figure indicates that Santa Clara has areas of high to very high susceptibility to liquefaction hazards. The very high susceptibility generally follows the Santa Clara River, but some of the built environment in the community has been idenfied in susceptible zones. Liquefaction can impact structures, infrastructure, and critical assets as soil loses integrity.

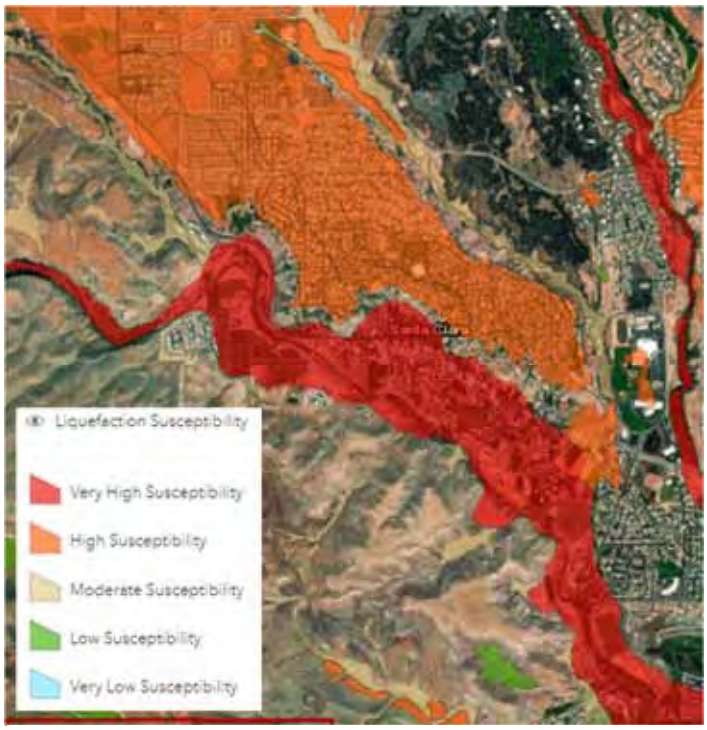


Figure 466: Santa Clara Liquefaction Susceptibility

Source: Utah Geological Survey

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters with a 4.0 magnitude or greater have been reported in Santa Clara as of 2020.Earthquakes elsewhere in the county may have caused impacts to Santa Clara, including the 1992 5.8 magnitude earthquake with an epicenter in Washington City. This earthquake caused impacts from Flagstaff, AZ to Richfield, UT and from Las Vegas, NV to Escalante, UT. (Peterson) In the St. George metropolitan area, impacts included damages to building walls as the shaking loosened plaster and caused cracks. Santa Clara City's planning team indicate that while the 1992 earthquake was felt in the community, no significant damages were documented.

Damages and impacts due to liquefaction have not been documented in Santa Clara. Liquefaction is a risk throughout the southwest, and liquefaction events have been reported in the region, including in nearby St. George City.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can however be triggered by earthquakes, including flooding, rockfall, landslide, and wildfire.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazards as failure could inundate an area downslope. Figure 467 depicts the mapped 100-year floodplain, dam inundation, and riverine erosion exposure in Santa Clara.

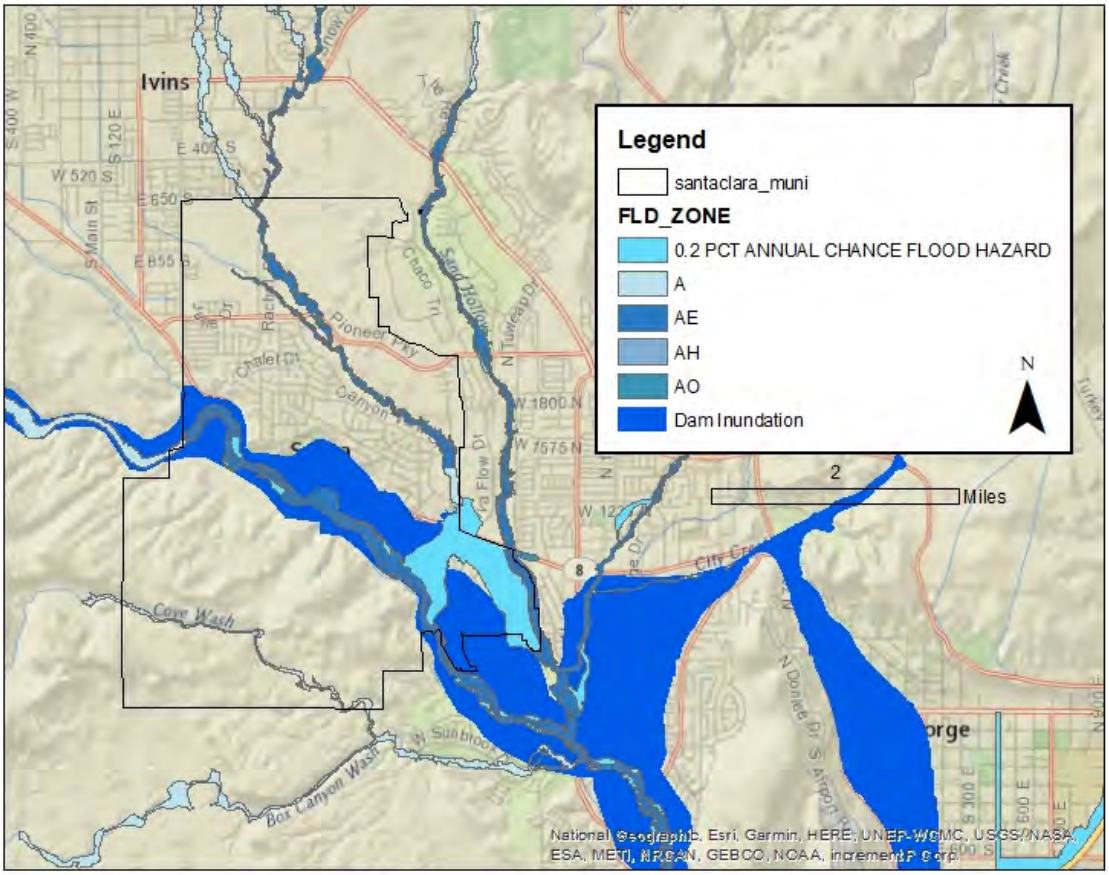


Figure 467: Santa Clara Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 458 describes the Santa Clara community assets exposed to riverine erosion, dam inundation, and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Local parks see the most exposure to potential flooding and impacts, which can expose park visitors and cause damages to park infrastructure, however these open spaces can act as a buffer to residential and commercial properties. Commercial parcels and critical facilities are also identified in flood risk areas. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood. Critical facilities impacted by flood may result in delays in service, damage, or loss of equipment, among other potential outcomes.

Table 458: Santa Clara Exposure to Flooding and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
33.3%	84.5%	25.8%	27.0%	29.9%	N/A	100.0%

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Santa Clara property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

The Santa Clara City Floodplain Manager complies with the NFIP by enforcing the city floodplain ordinance and adopted Flood Insurance Rate Maps, updated in 2009. In this role, the Floodplain manager identifies areas of flood hazard risk in the city and reviews documentation for new construction or improvements in areas of risk. New or improved residential structures in special flood hazard areas must submit an elevation certificate from a registered engineer, architect, or land surveyor. Commercial, industrial, or other nonresidential structures must be elevated at least one-foot above the base flood elevation. A floodplain development permit is required for new development within the floodplain to assess its feasibility, impacts to the floodplain, and impacts to neighboring properties. (Santa Clara City Floodplain Manager, 2022) The city participates in the Community Rating System (CRS) by engaging in floodplain management practices which surpass NFIP requirements. The CRS program is a FEMA program which provides incentives to communities which surpass the requirements of NFIP participation. CRS participation can result in a reduction in flood insurance rates in a community.

Table 459: Santa Clara NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$5,665	0	2	15	$4,835,000	2	$1,194

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Table 459 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. There have been 2 claims made for flood damages from property in the Santa Clara municipal boundary, none of these are considered repetitive losses. There have been a Community Assistance Contact and a Community Assistance Visit from the Federal Emergency Management Agency (FEMA) in 2019. These meetings are an opportunity for FEMA to review floodplain management and provide technical assistance to a community.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which

bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 460 describes the flooding events which have impacted Santa Clara and the surrounding area.

Table 460: Santa Clara Reported Flood Events

Date	Damage/Injury (countywide)	Description
1/10/2005	$300,000,000 6 Injuries 1 Death	During a severe storm the Virgin River water level reached a 25-year high, and the Santa Clara River was higher than previously recorded. Damages and injuries were reported throughout the St. George area.
7/30/2010	$100,000	A thunderstorm caused flash flooding in Ivins and Santa Clara. In Santa Clara, flood waters were reported at 1 foot deep and 40 feet. Homes and basements reported flooding in the city.
9/11/2012	$7,500,000	Heavy rain and flooding lead to the failure of the Laub Dike in Santa Clara, which flooded 63 homes and 16 businesses, in addition to damaging infrastructure.
9/27/2014	$350,000	Flooding was reported after a severe storm in Washington County, leading to reports across many cities. Nearby Ivins, Utah was impacted during this event and drainages in Santa Clara were filled during this event. No known damages were attributed in Santa Clara during the event.

Source: NOAA Storm Database

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can experience landslides and rockfall hazards over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events impact the built environment and human activity. Figure 468 to Figure 470 map landslide and rockfall susceptible areas and documented landslides in Santa Clara.

Rockfall Susceptibility

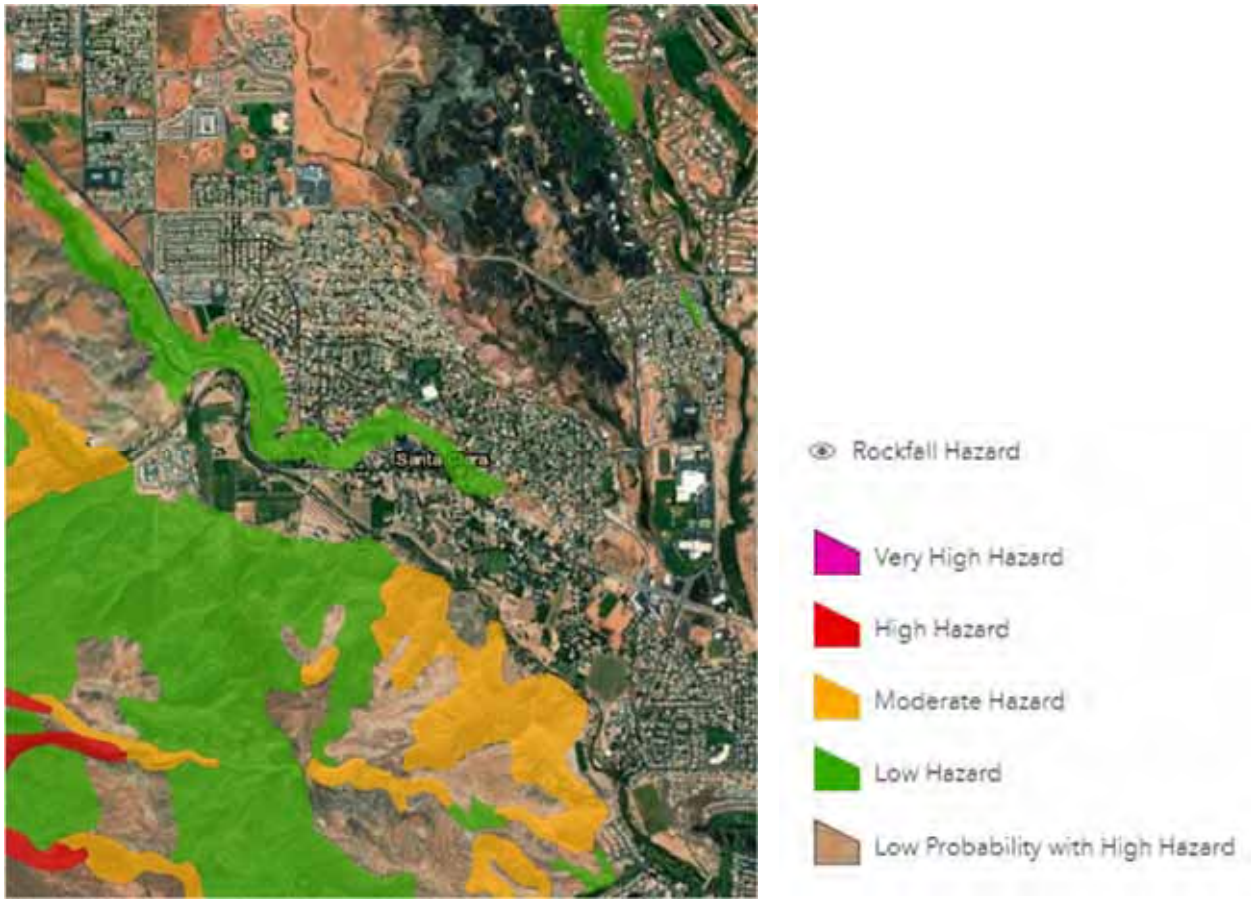


Figure 468: Santa Clara Rockfall Hazard Susceptibility

Source: Utah Geological Survey

Rockfall is a landslide hazard where rocks shift or fall from cliffs or hillsides. Susceptibility is observed on either side of the Santa Clara River, where cliffsides and steep slopes are present in the community. The highest hazard is outside of Santa Clara City, in the unincorporated county.

Landslide Susceptibility

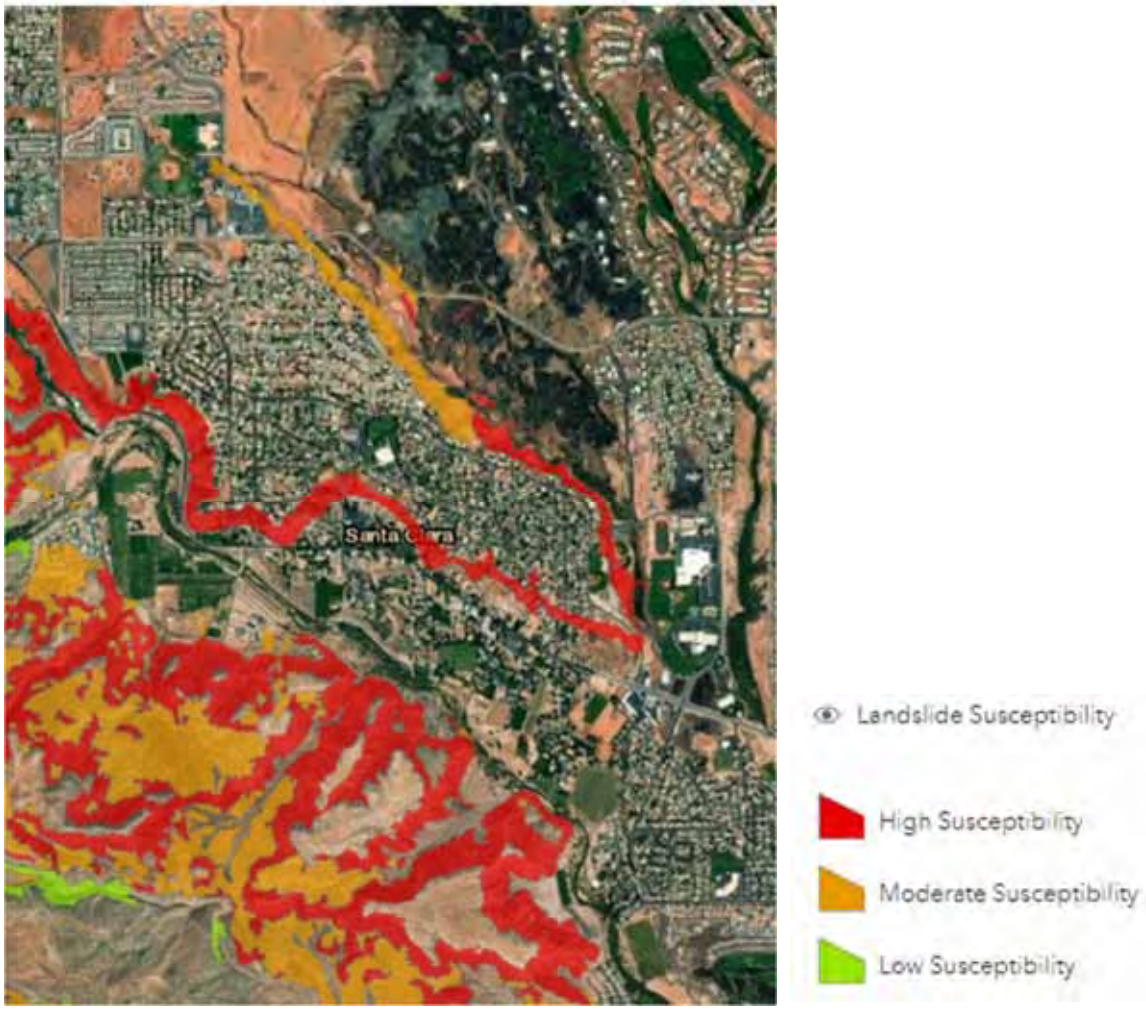


Figure 469: Santa Clara Landslide Susceptibility

Source: Utah Geological Survey

Landslide susceptibility in Santa Clara is also observed in the areas near the steeper slopes in the community. Landslide susceptibility is considered high in these areas of the community. Significant susceptible area is observed to the southwest of the community in the Santa Clara River Reserve area, which is open space near the community.

Identified Landslides

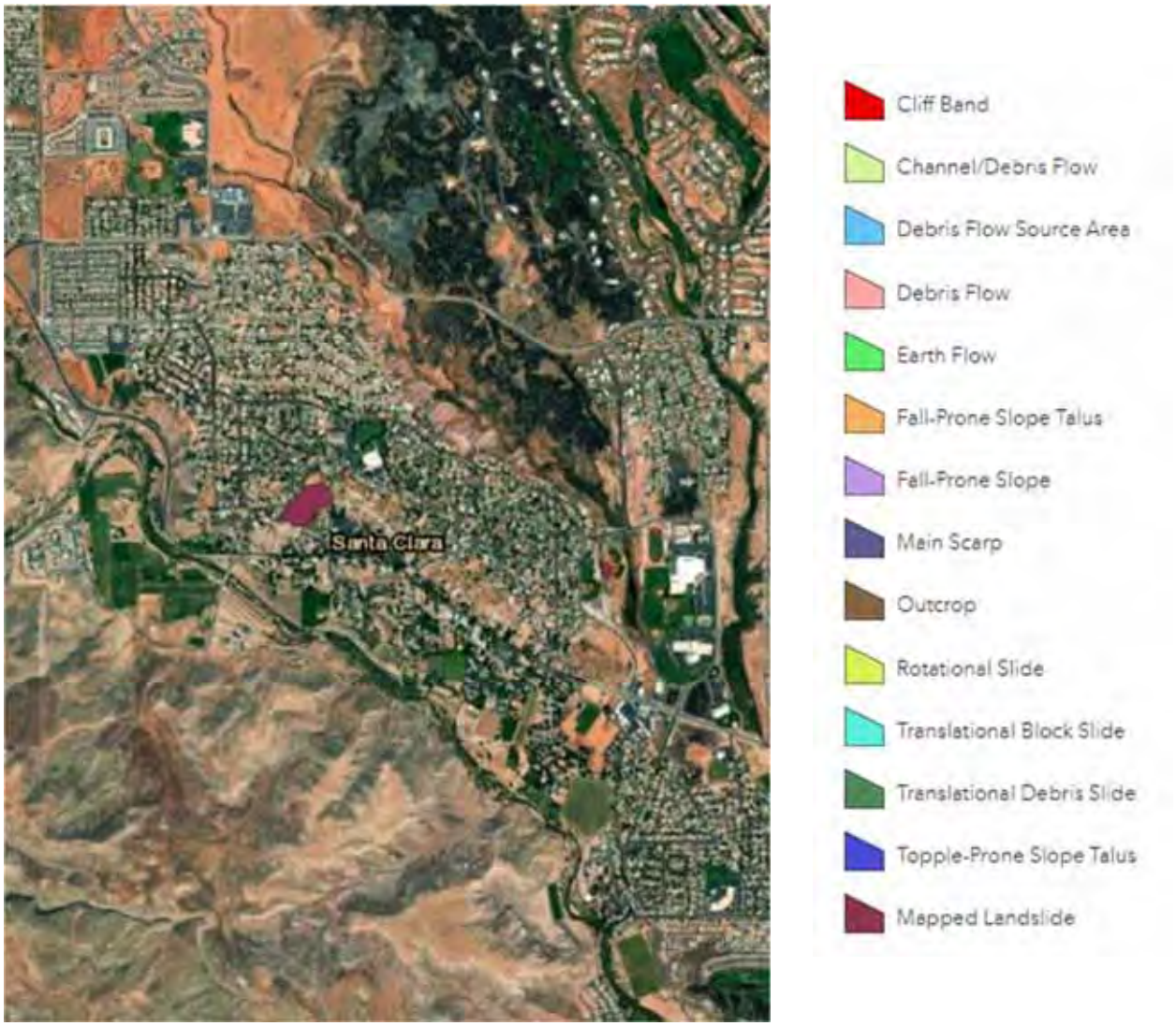


Figure 470: Santa Clara Identified Landslides

Source: Utah Geological Survey

The mapped landslides in Santa Clara include a landslide near the center of the city and a landslide to the east of the city. Both landslides are near built areas and have the potential to damage personal property or cause injury.

Santa Clara is exposed to landslide susceptible areas throughout the community, given the local landscape, Table 461 describes the exposure of community assets to landslide susceptible areas. Parks see the highest exposure to landslide and rockfall areas in Santa Clara. While landslides at a park can threaten the visitors and infrastructure, parks can buffer residents, property, and local businesses from potential landslide and rockfall. Parcels and road miles are also exposed to landslide and rockfall susceptible areas, which can impact life, property, and essential infrastructure. Landslides can block or damage roadways, causing delays and access challenges within a community. Without proper planning, future growth could place development in landslide risk areas, increasing risk of landslide impacts.

Table 461: Santa Clara Landslide Susceptibility Exposure

Santa Clara Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
16.7%	8.6%	6.7%	6.7%	12.0%	N/A	0.0%

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Santa Clara has experienced landslide events which have impacted personal property and public safety. Table 462 describes the record of landslide events in Santa Clara.

Table 462: Santa Clara Landslide Record

Incident Date	Location	Property Damage	Injuries / Fatalities	Description
1992	Santa Clara, Washington County	Unknown	Unknown	A landslide destroyed a portion of Truman Drive and flowed to nearby homes.
1994	Santa Clara, Washington County	Unknown	Unknown	Landslides west of Truman drive impacted the Santa Clara Field and Canal Company Canal.
2000	Santa Clara, Washington County	Unknown	None reported	A landslide occurred east of the Haskell Substation near Canyon View Park. The city installed a groundwater drain to stabilize the slope at a cost of $10,000.
2002	Santa Clara, Washington County	Unknown	None Reported	A landslide near Truman Drive caused two homes to be vacated and were ultimately purchased by the city. The city ultimately purchased 4 homes and 2 vacant properties impacted by the slide.

Source: St. George News, "City offers to purchase 3 homes affected by landslide", St. George News "Santa Clara Heights Landslide: 30 years of problems, no solution in sight"

A particular challenge from landslides has been in the Santa Clara Heights development, which has been monitored since the 1980s. The event is a slow-moving landslide on Truman Drive, which impacted residences on top and below the hillside. (Morgan, 2016) In 2016, six properties in danger of serious damage associated with this slide were acquired by the City through a FEMA funded mitigation project. (Bolerjack, 2016) The acquisition included four homes and two vacant lots at the cost of $1,562,000. Impacts from the landslide are seen in Figure 471 and Figure 472.

Figure 471: Truman Landslide photo

Source: Santa Clara City

Figure 472: Truman Landslide Photo

Source: Santa Clara City

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and Washington County section of this plan, as drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, and 2021 conditions requiring significant water conservation efforts on behalf of cities throughout the state, there are implications from this natural hazard on the regional economy and people in the area.

Water is a concern throughout the region. Santa Clara City works with the Washington County Water Conservancy District (WCWCD) to manage water resources. While Santa Clara City maintains their own sources of water, they have signed a regional supply agreement with the WCWCD and neighboring cities to share supply of the water. The district regularly has efforts to develop new water sources and conserve water in residential, commercial, and agricultural settings.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash have the potential to impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 473. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

The St. George Metropolitan area, including Santa Clara, is among a few communities in the Five county region, which have more detailed susceptibility data for radon. The Utah Geological Survey prepared a public information series titled "Radon-Hazard potential in the St. George Area, Washington County, Utah." The map from this series has been included as figure 9. In this figure we see that Santa Clara includes areas of low to moderate radon-hazard potential, which factors the geologic conditions which create the greatest potential for radon. While Figure 474 shares high level radon hazard potential data, the best way to understand risk of radon at a particular site is to conduct testing and mitigation, as many factors influence exposure.

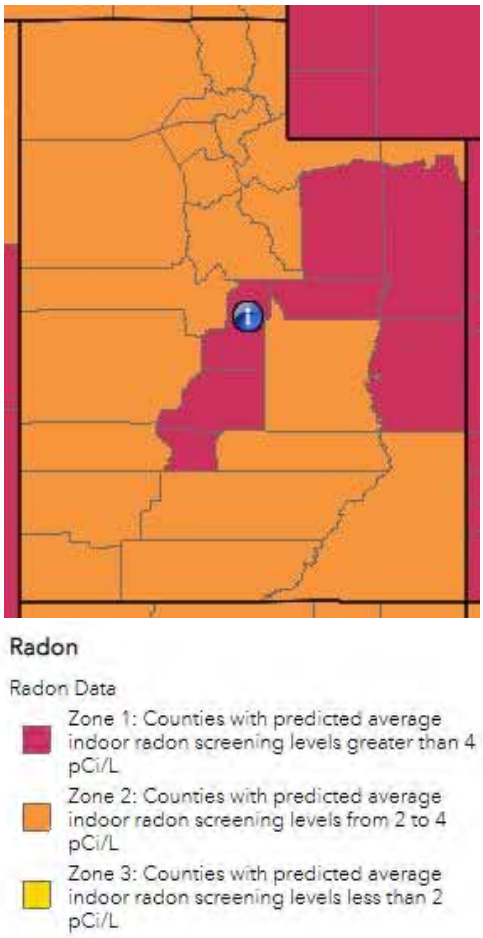


Figure 473: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on factors like the soil uranium content, soil permeability to allow radon movement, structures foundation, air pressure inside a structure. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter buildings, become trapped and concentrating. Outdoor spaces are not a risk as the airflow dilutes radon.

The focus on homes in radon testing is often because those are spaces where people spend significant amount of time. Negative effects of radon are observed in high quantities of the gas over time. Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

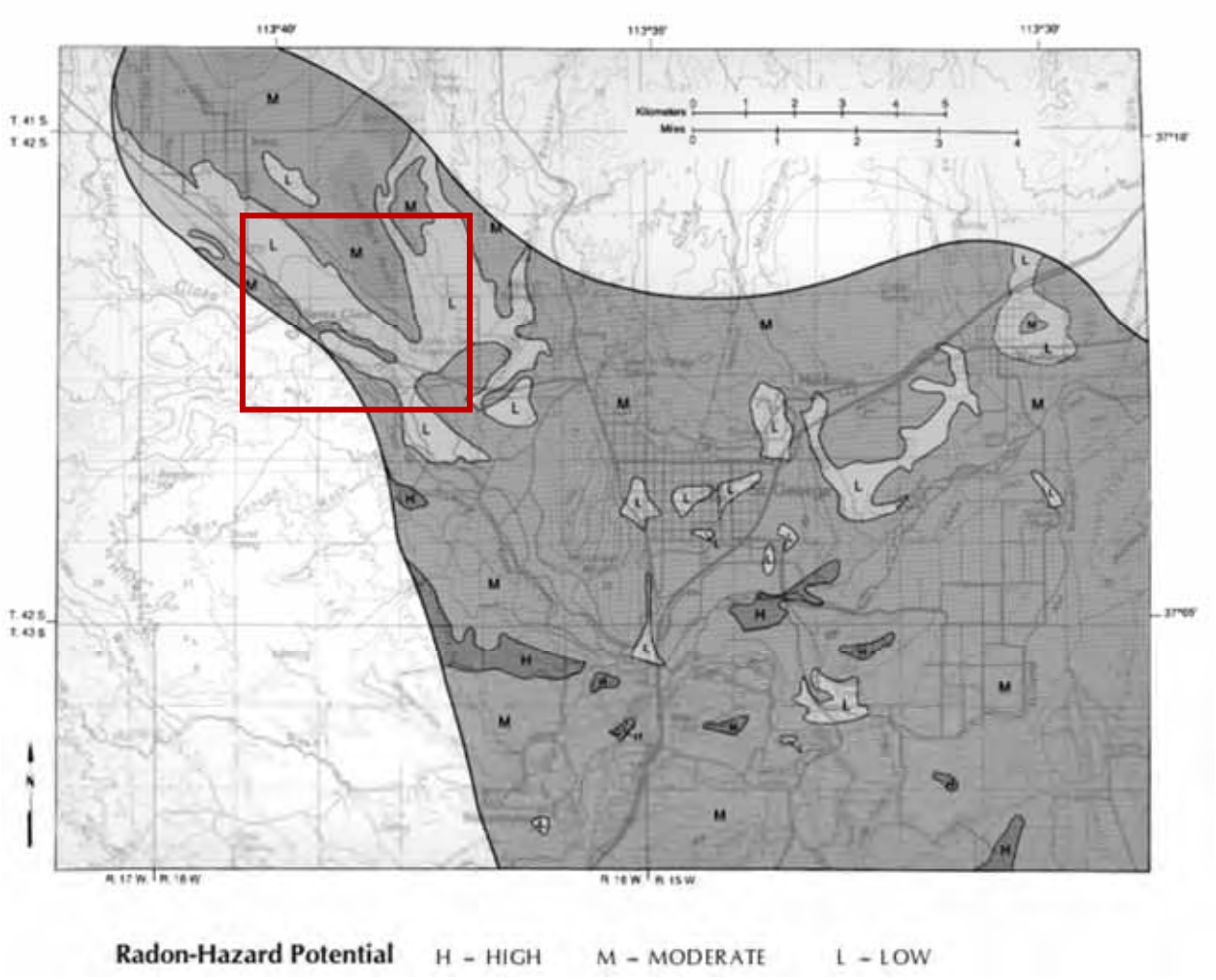


Figure 474: St. George Area Radon-Hazard Potential

Source: Utah Geological Survey

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 463 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 463: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the city level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Sant Clara, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Santa Clara sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Santa Clara has several reported severe weather events which have impacted the community. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest. Two such events are described in Table 464. While the deaths reported during the 2013 events did not occur in Santa Clara, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers are vulnerable to these extreme temperatures.

Table 464: Santa Clara Severe Weather Record

Date	Damage/Injury	Description
7/18/1994	None Reported	A thunderstorm produced high winds knocked down trees and a quarter inch of rain fell in ten minutes.
9/1/1998	$10,000	A thunderstorm caused regional flooding and a lightning strike which resulted in a housefire in Santa Clara.
8/24/1999	$1,000	High winds blew dust and knocked down power lines in Santa Clara.
3/20/2000	$110,000	Strong thunderstorm winds near 80 MPH blew over tree, road signs, and fences and sheds in Santa Clara.
9/9/2006	None Reported	Hail fell on Santa Clara which was the size of ping pong balls.
7/30/2010	$30,000	Hail one inch in diameter fell in Santa Clara during a thunderstorm. Powerlines were knocked over during the event.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures contributed to the death of a hiker in Kane County.
4/7/2018	$400,000	Lightning struck and caused a fire, destroying a home in St. George.

Source: NOAA Storm Database

High winds, thunderstorms, and hail events have caused damages in Santa Clara. Wind events have damaged infrastructure, property and knocked down trees. Two lightning events in the area resulted in damage to residences, placing lives at risk. It is likely that such events will continue to impact Santa Clara in the future.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area,

which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section.

UGS has developed updated mapping for some communities in the region, which provides greater detail about the susceptibility and potential for problem soils and the types prevalent to the region. Santa Clara is included in this mapping study area for collapsible soils, expansive soils and rock, piping and erosion susceptible soil, soluble soils and rock, and windblown sand. The updated mapping is available in an online format only and was not used for GIS analysis. The local planning team identified three primary types of problem soils prevalent in the community: collapsible soils, expansive soils, and windblown sand. Figure 475 through Figure 477 describe each of the hazard's prevalence in the community. Expansive soils, even if not present at the surface, are described by the planning team as having a significant impact in the community on existing and future construction and infrastructure, where these materials are present within 20-feet of the surface.

Collapsible Soil

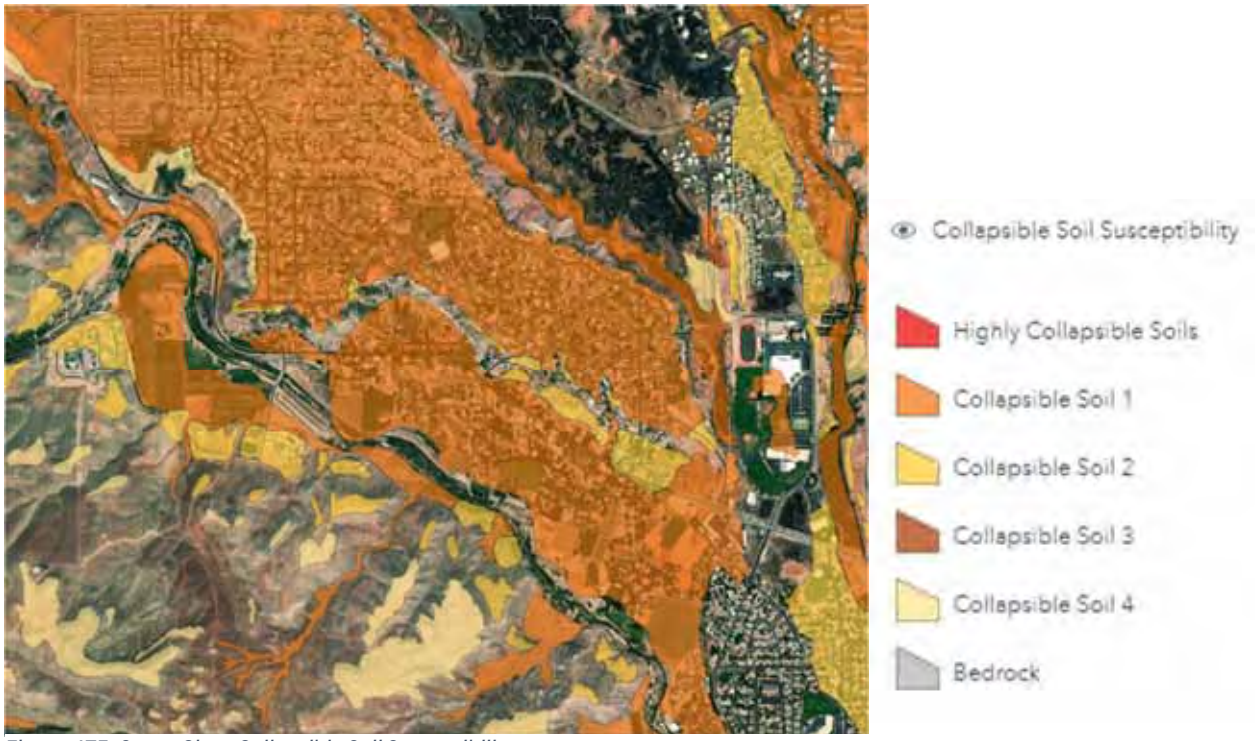


Figure 475: Santa Clara Collapsible Soil Susceptibility

Collapsible soils are present throughout Santa Clara City. These soils are a risk to the community, as they have the potential to settle when moisture is introduced.

Expansive Soil and Rock

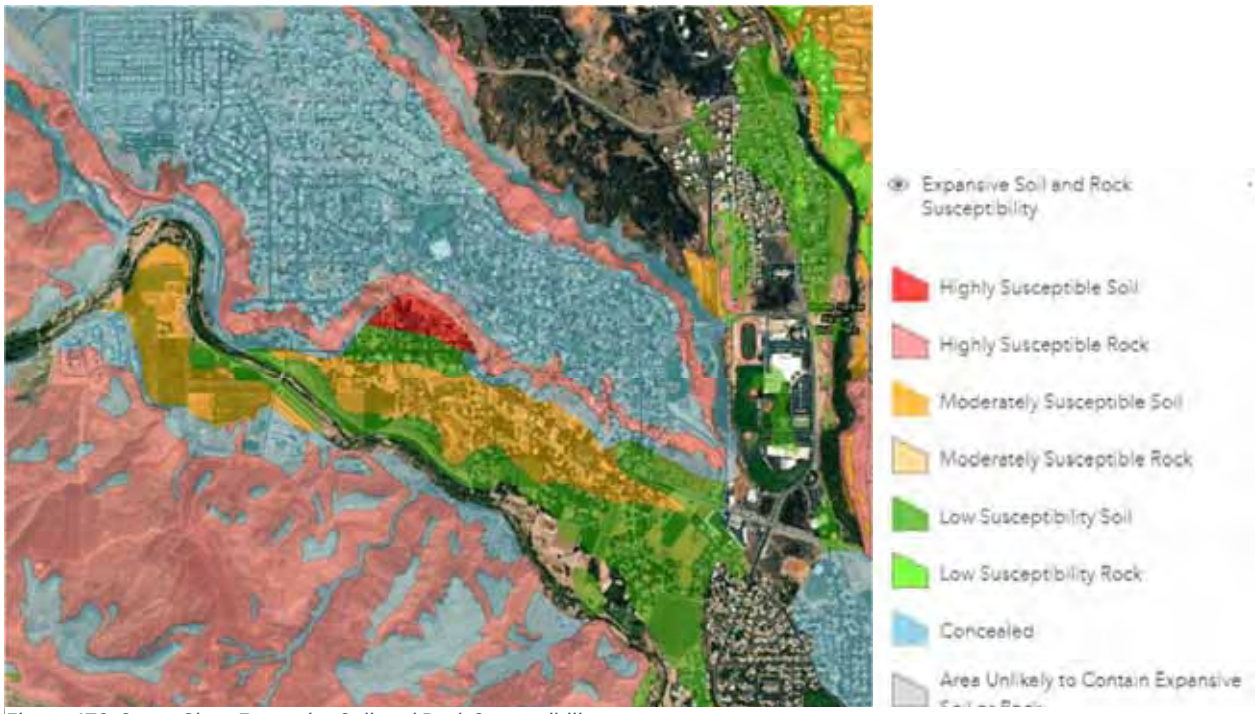


Figure 476: Santa Clara Expansive Soil and Rock Susceptibility

Expansive Soils have a high clay content, which swells when wet and shrinks when dry. This soil type is a challenge for structures and infrastructure if not mitigated, as the shrink and swelling actions can disturb development. Figure 477 presents an image of a cracked brick façade which is attributed to expansive soil damages.

Windblown Sand

Figure 477: Santa Clara Wind-Blown Sand Susceptibility

Windblown sand is a concern in much of the southwest as the sand can impact visibility and infrastructure in the community, like covering roads. Windblown sand has been identified in Santa Clara in an area which has dominantly been developed and covered with structures and landscaping. The planning team describes minimal impacts from windblown sand on this portion of the community.

Hazard History

Santa Clara does not have a detailed record of problem soil impacts, although building permits will identify where geological studies were required, whether problem soils have been discovered on a site, and what types of mitigation were completed.

Riverine Erosion

Erosion is a process of breakdown of natural material, including soils and rock. Riverine erosion is one method of erosion, which in the Southwest of Utah can cause significant damage to rivers and development surrounding the river. Erosion is notable during and after periods of higher-than-normal water flow or when vegetation has been damaged or removed. Eroded materials are deposited downstream, which can cause changes in the river flow, new erosion, or blockages, contributing to flooding (American Geosciences Institute, n.d.).

The Santa Clara River, which flows through Santa Clara City has experienced riverine erosion which caused damages to property during severe flooding. A River Masterplan and a River Stability study developed for the St. George Metropolitan area. As part of this study a riverine erosion layer was developed to identify areas which may be vulnerable to riverine erosion. Figure 478 illustrates the extent of the riverine erosion area from the 2005 studies in Santa Clara City. The erosion zone parallels old Highway 91, a main access to the city, along the Santa Clara River.

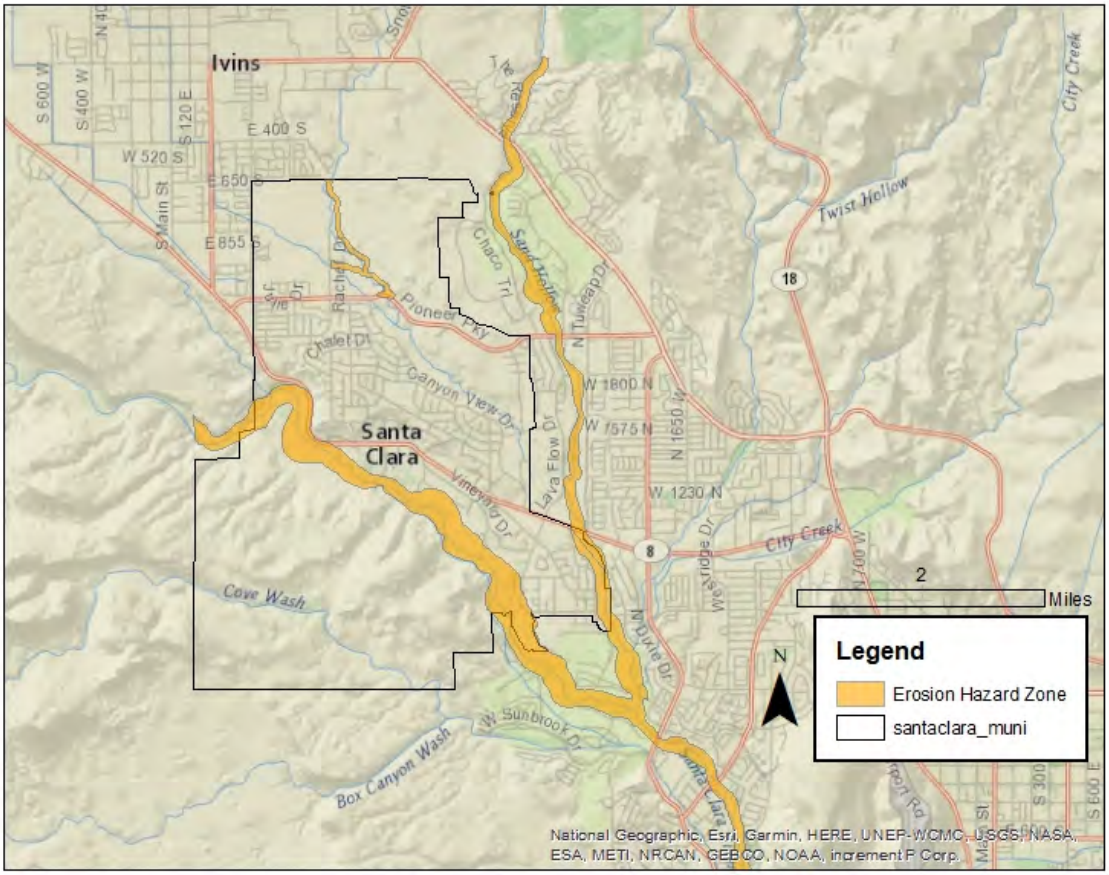


Figure 478: Santa Clara City Riverine Erosion

Riverine erosion has the potential to impact the health safety, and public welfare of residents in Santa Clara City. Table 465 describes the exposure of community assets and amenities to riverine erosion. Road miles and parcels experience some exposure to mapped erosion hazard areas. While much of the community is not exposed to the erosion area, an event like the 2005 flood would be significant and would have the potential to cause damage and harm to some properties in the community.

Table 465: Santa Clara City Riverine Erosion Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	1.7%%	4.3%	4.2%	7.9%	N/A	0.0%

Source: JE Fuller Erosion study, Washington County Assessor, UDOT, AGRC.

Hazard History

Riverine erosion was well documented during the 2005 flood, which caused damage across Washington County. The Santa Clara River Stability study describes earlier records of riverine erosion and channelization of the river, dating back to 1870. Figure 479 illustrates documented changes in the position of the river channel. The Santa Clara River has experienced river channelization over the years. Future changes in position may expose the built environment and residents to riverine erosion risks. The report describes that prior to 2005, erosion and channelization were primarily the result of the removal of vegetation and other human activities in the 1900s.

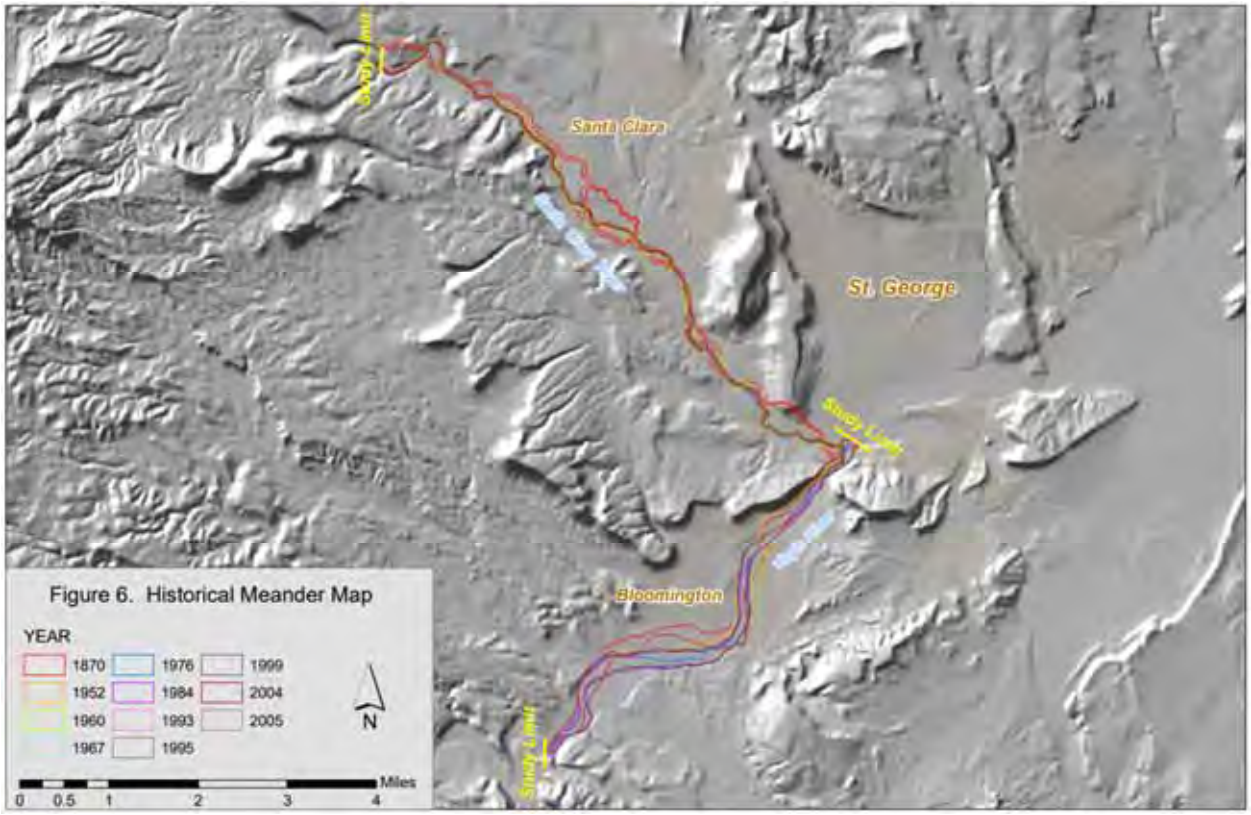


Figure 479: Santa Clara River Channel Position map

Table 466 documents the major riverine erosion events. These events were documented using local description, reports, historical records, and news sources. The damaging event in January 2005 caused significant damage and injury associated with rapidly flowing floodwaters on the Santa Clara and Virgin Rivers.

Table 466: Santa Clara City Riverine Erosion Hazard Record

Date	Damage/Injury	Description

Late 1800s	Unknown	Channel bed degradation over steepened some banks in the Santa Clara River.
January 2005	County wide $300,000,000 6 Injuries 1 Death	Flooding caused by severe rain and snow run off triggered riverine erosion along the Santa Clara River.

Source: NOAA, JE Fuller Hydrology and Geomorphology, Inc.

Riverine erosion is a greater risk during high volumes of water flow and where vegetation has been damaged or removed. Flood, drought, landslide, and wildfire all have the potential to trigger or worsen riverine erosion conditions. Likewise, erosion can increase flooding or landslide potential by damming rivers with debris. It is likely that changes in long term weather and climate can increase erosion as increased storm severity and aridity can impact the river system.

Shallow Groundwater

Groundwater is stored water below the ground's surface where it is less vulnerable to loss from evaporation. The underground water system includes a layer of porous rock and soil, a water table, or the upper surface of the underground water, an aquifer which is where most of the storage exists, and a layer of impermeable rock at the bottom, illustrated in Figure 480. The water table and aquifer can be exposed by wells and springs for use of groundwater as a water source.

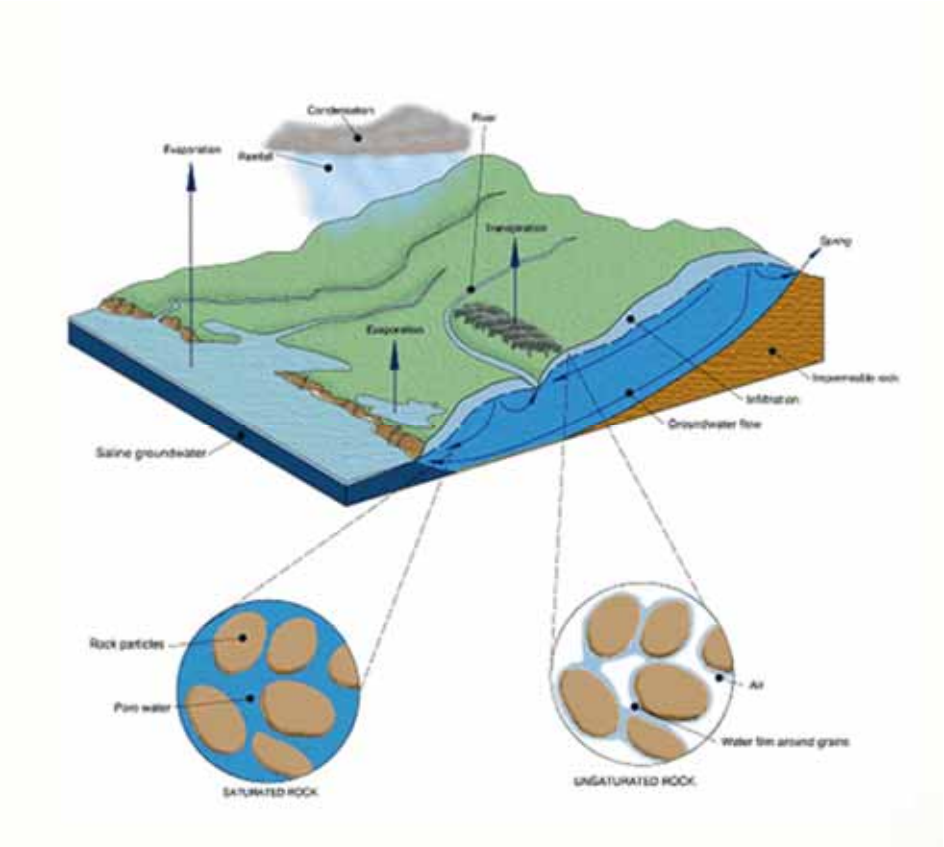


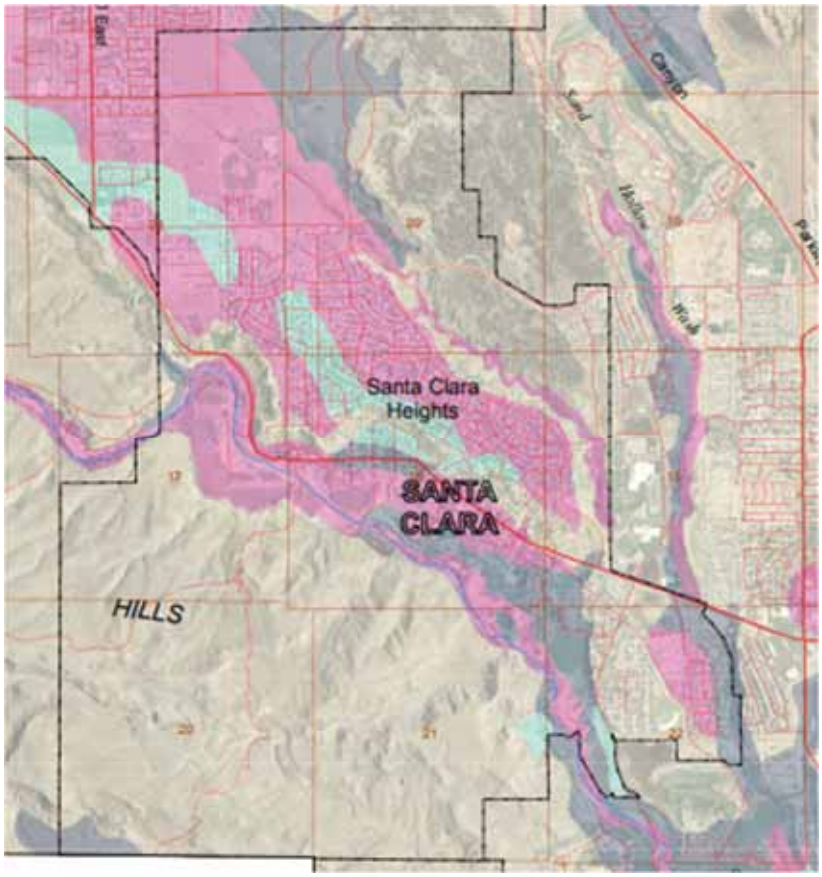
Figure 480: Groundwater System Diagram

Source: University of Nebraska-Lincoln School of Natural Resources
http://snr.unl.edu/data/water/groundwater/realtime/satuate.aspx

The Utah Geological Survey has defined shallow groundwater as a construction-related problem where groundwater is within ten feet of the surface (Lund W. R., Knudsen, Vice, & Shaw, 2008). Areas of shallow groundwater can have higher soil saturation and may be marked with wetland vegetation and pests attracted to standing water, like mosquitos (Muckel, United States Department of Agriculture, Natural Resources Conservation Service, & National Soil Survey Center, Lincoln, Nebraska, 2004). Shallow groundwater has been identified in Santa Clara, with a report from an engineer in the mid-1980s describing the impacts from shallow groundwater, including the

Mapping completed by the Utah Geological Survey illustrates soils which are likely to present shallow groundwater concerns. The pink areas describe soils likely saturated within 60 feet of the surface, are poorly drained, or regularly irrigated throughout Santa Clara City. These areas are likely to encounter shallow ground water at depths of 10 feet, impacting construction and underground utilities. Other

areas of Santa Clara may experience seasonal shallow groundwater following weather or irrigation, as illustrated by the map.



EXPLANATION

SGW1 — Naturally wet soils mapped by the Natural Resources Conservation Service (NRCS) (depth to groundwater ≤60 inches), and soils mapped by the NRCS as poorly drained or frequently irrigated where water-well or geotechnical information indicates a significant area of permanent shallow ground water (≤10 ft). Construction in these areas will likely encounter shallow ground water at depths ≤10 feet, and basements and other water-sensitive underground facilities are not recommended without adequate drainage or other protection. Following development, lawn watering and other sources of urban runoff may cause ground-water levels to rise even higher in these areas.

SGW2 — Poorly drained, generally fine-grained soils mapped by the NRCS that may develop shallow ground water locally when rates of water application exceed the soil's drainage capacity. Subsurface drains are frequently required to prevent these soils from becoming saturated. Because these soils naturally drain slowly, they may remain wet for most of the year, even though water is applied only during the growing season. Permanent shallow ground water is possible following urbanization.

SGW3 — Moderately to freely draining soils mapped by the NRCS that are commonly irrigated for agricultural purposes. Where high rates of water application occur, these soils may develop seasonally shallow ground water, but typically drain quickly once water application stops or is reduced below the soil's drainage capacity. Seasonal or transient shallow ground water is possible following urbanization.

Figure 481: Santa Clara City map of shallow groundwater hazard

Source: Utah Geological Survey

Shallow groundwater used as a water source is vulnerable to impacts from human activity. Contamination from natural processes, human activity, agriculture, and industrial land uses as minerals, pollutants, and other run off enters the groundwater system. Shallow groundwater is vulnerable to increased water temperatures, which has also been correlated with impacts to stream and river habitat

and associated higher temperatures in these systems (Hare, Helton, Johnson, Lane, & Briggs, 2021). The Utah Geological Survey (UGS) and the Natural Resources Conservation Service (NRCS) describe that shallow groundwater can have an impact on the built human environment, causing damage to basements, underground facilities and utilities, excavation, or construction sites, typically when groundwater is within ten feet of the surface. Waste collection like landfills and septic tanks are at risk to contaminating the groundwater in locations with shallow groundwater hazards, as shallow groundwater can infiltrate the landfill and septic infrastructure (Muckel, United States Department of Agriculture, Natural Resources Conservation Service, & National Soil Survey Center, Lincoln, Nebraska, 2004) (Lund W. R., Knudsen, Vice, & Shaw, 2008).

Hazard History

Several properties were identified as having underground water problems in a 1994 report about groundwater for Santa Clara City, although specific details about the extent of damage or descriptions of the events were not included. In this report it is suggested that a landslide north of Truman Drive is linked to the effects of shallow groundwater. City records will provide further detail about groundwater problems potential through the required geologic testing required on a site during preconstruction.

Santa Clara City requires geologic testing to assess for several hazards, including shallow groundwater at a site, which may provide a record of identified cases of shallow groundwater. This record will not indicate damages to homes or property or impacts on residents.

Risk Assessment Summary

Vulnerabilities identified potential economic impacts from supply chain delays, access, or traffic impacts following a natural hazard event. Residents are at risk to injury and property damage from several natural hazards. Santa Clara critical facilities are vulnerable to severe weather, problem soils, landslide, flood, earthquakes, and wildfires. Impacts from these natural hazards can impact a facility's capacity to respond to an emergency event. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires based on the risk assessment.

Mitigation Strategy and Actions

Santa Clara has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 467 describes progress made on Santa Clara's mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 467: 2016 Santa Clara Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Stabilize Santa Clara River for future flood events.	Provide grade stabilization to limit scouring near Dixie Drive Bridge and through Santa Clara City.	Unknown	Local government operating budget; State and Federal flood grant programs	Ongoing
Flood #2	Stabilize the Santa Clara River against future flooding events.	Stabilize riverbanks and hardened bank structure and infrastructure along the Santa Clara River. Limit development within the flood plain and relocate existing structures threatened by flooding. Clear debris and limit vegetation growth to reduce flood impacts. Provide early warning.	This is a long-term strategy with undetermined times lines.	Local funding, state and federal grant funds as available.	Ongoing

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Santa Clara has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 468. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 482.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 482: Regional Plan Goals

Table 468: Santa Clara 2022 NHMP Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	1, 2, 3	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Replace city owned unused turf with xeriscape landscaping.	H	2-3 years	H	Santa Clara City, State of Utah, Water Conservancy District	Santa Clara City
Drought #2	3, 4, 5	Conserve municipal water resources.	Develop Drought Contingency Plan in participation with	H	3-years	L	Water Conservancy District,	Santa Clara City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			the water conservancy district.				Santa Clara City	
Drought #3	2, 6	Collect data to inform mitigation needs and local decision making.	Monitor aquifer levels. If aquifer should fall below acceptable levels, implement emergency actions including pumping water and purchasing water from other sources.	H	ongoing	L	Santa Clara City	Santa Clara City
Drought #4	3	Conserve municipal water resources.	Inform residents of water conservation measures through postings to City notice boards, social media, and websites.	H	Annually	L	Santa Clara City, Water Conservancy District	Santa Clara City
Drought #5	2	Conserve municipal water resources.	Expand City secondary irrigation system.	H	ongoing	H	Santa Clara City, Water Conservancy District	Santa Clara City
Flood #1	1, 2, 6	Collect data to inform mitigation needs and local decision making.	Inventory property most vulnerable to flooding along washes and the Santa Clara River and plan for the city to purchase or rezone properties to mitigate flood risks.	M	2-years	L	Santa Clara City, Flood Control Authority, Utah Technical University	Santa Clara City
Flood #2	1, 2, 6	Conserve vulnerable areas and sensitive lands.	Acquire identified property most vulnerable to flooding along washes and the Santa Clara River.	M	Ongoing	H	Santa Clara City, Flood Control Authority	Santa Clara City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #3	1, 2	Collect data to inform mitigation needs and local decision making.	Update the Floodplain mapping completed for Santa Clara City.	L	5-years	H	Santa Clara City, FEMA, State of Utah	Santa Clara City
Flood #4	2, 4, 6	Minimize invasive species and debris in river.	Engage in vegetation removal along the Santa Clara River, including the removal of invasive species and debris.	H	Ongoing	M	Santa Clara City, Flood Control Authority	Santa Clara City
Flood #5	6	Collect data to inform mitigation needs.	Monitor existing vegetation and encroachments into the river channels.	H	Ongoing	L	Santa Clara City, Flood Control Authority	Santa Clara City
Severe Weather #1	2	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Upsize existing Tuacahn Wash Culvert at Pioneer Parkway.	H	3-years	H	Santa Clara City, FEMA BRIC	Santa Clara City
Severe Weather #2	2	Collect data to inform mitigation needs and local decision making.	Assessment of vulnerable power poles to identify damage, decay, or other need for replacement/repair.	M	Ongoing	L	Santa Clara City	Santa Clara City
Severe Weather #3	2	Protect identified vulnerable power infrastructure	Removal of hazardous trees and tree limbs which threaten power infrastructure.	M	Ongoing	L	Santa Clara City	Santa Clara City
Riverine Erosion #1	1, 2, 4, 6	Collect data to inform mitigation needs and local	Complete study/inventory of areas in the Sand Hollow Wash,	H	2-years	L	Santa Clara City, Flood Control	Santa Clara City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
		decision making.	Tuacahn Wash, and the Santa Clara River in need of erosion protection and bank stabilization				Authority, Utah Technical University	
Riverine Erosion #2	1, 2, 4, 6	Conserve and maintain essential community riparian and drainage areas.	On identified banks and slopes in the Sand Hollow Wash, Tuacahn Wash, and Santa Clara River, implement bank stabilization and erosion protection measures.	H	Ongoing	H	Santa Clara City, Flood Control Authority	Santa Clara City
Problem Soil #1	2	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Assess and repair City assets and infrastructure which are damaged by soils expansion and contraction.	M	Ongoing	H	Santa Clara City	Santa Clara City
Problem Soil #2	1, 2	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Assess the need for infrastructure, utility, and landscaping requirements in areas identified to have blue clay problem soils.	M	Ongoing	L	Santa Clara City	Santa Clara City
Problem Soil #3	1, 2	Assess need for problems soils mitigation and extent of hazard in the community.	Continue to enforce current problem soils ordinance.	H	Ongoing	L	Santa Clara City	Santa Clara City
Landslide #1	1, 2	Assess active landslides for future mitigation needs.	Monitoring of Truman drive landslide to ensure stability.	H	Ongoing	L	Santa Clara City	Santa Clara City
Landslide #2	1, 2	Collect data to inform mitigation needs and local decision making.	Inventory landslide vulnerable residential properties in need of additional mitigation.	H	Ongoing	L	Santa Clara City, Utah Technical University	Santa Clara City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #3	1, 2	Conserve vulnerable areas and sensitive lands.	Complete landslide mitigation or purchase of property on identified landslide vulnerable properties.	M	Ongoing	H	Santa Clara City, FEMA	Santa Clara City
Landslide #4	1	Prevent construction in identified hazard areas.	Include in hillside ordinance a third-party review for geologic study.	L	Ongoing	L	Santa Clara City	Santa Clara City
Landslide #5	1, 2, 5, 6	Conserve vulnerable areas and sensitive lands.	Plan for stabilization of unstable slopes.	H	Ongoing	H	Santa Clara City	Santa Clara City
Wildfire #1	1, 2, 4, 6	Reduce invasive species and fuel loads.	Participate in fuels reduction on the Santa Clara River.	H	Ongoing	L	Santa Clara City, Flood Control Authority	Santa Clara City
Wildfire #2	1, 2, 4, 6	Reduce fuel loads in Santa Clara City.	Inventory hillsides and washes in need of fuels mitigation in the community. Remove fuels in identified areas of need.	M	Ongoing	M	Santa Clara City	Santa Clara City
Wildfire #3	1, 2, 4, 6	Reduce fuel loads in Santa Clara City.	Inform residents of wildfire risks and activities/programs available for individual or neighborhood level mitigation like Firewise, on the City website and social media.	H	Annually	L	Santa Clara City	Santa Clara City
Earthquake #1	2, 5	Protect critical facilities from earthquake threats.	Assess the Circle Drive Fire Station for structural and nonstructural retrofit needs.	M	5-years	L	Santa Clara City, Fire Departme nt	Santa Clara City

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #2	2, 5	Protect critical facilities from earthquake threats.	Implement identified structural and nonstructural retrofit at the Circle Drive Fire Station.	M	5-years	H	Santa Clara City, Fire Departme nt	Santa Clara City
Earthquake #3	2	Protect critical facilities from earthquake threats.	Assess and secure critical equipment owned by the city for non-structural retrofit.	H	Ongoing	L	Santa Clara City	Santa Clara City
Earthquake #4	1, 2	Maintain and upgrade city infrastructure with hazard resilient materials and practices.	Upgrade City owned utility pipes to use flexible piping, as described in the Master Plan.	L	Ongoing	H	Santa Clara City	Santa Clara City
Radon #1	3	Inform residents of natural hazard risks and mitigation options available.	Inform the public of radon gas risks, testing, and mitigation techniques using City website and social media.	H	annually	L	Santa Clara City, Utah DEQ	Santa Clara City

Source: Local Planning Team

Springdale

The Town of Springdale that we know today was settled in the mid-1800s, as part of the cotton mission to southern Utah. Its placement in a riverine canyon bottom was ideal for agriculture. Prior to the pioneer settlement, the area sustained indigenous people, including the Southern Paiute, Pueblo, and Fremont peoples for millennia.

The Town of Springdale is a unique desert community for the Southwest and is the gateway to Zion National Park, Utah's first national park. Zion National Park was designated in 1919, having formerly been designated in 1909 as the Munkuntuweap National Monument. Following designation, the area saw increased visitation, supported by travel accessibility to the region and the completion of the Zion-Mt Carmel Highway.

Springdale Town has a relatively small population of full-time residents and sees annual visitation to the community and Zion National Park over 5 million. Many of the workforce is seasonal to support the park operations and local accommodations services.

Springdale in a canyon between two red rock cliff sides. The landscape of the community was historically shaped by natural events from erosion, landslides, flooding, and severe weather. The Virgin River, which run through the community, is the main source of water and has shaped much of the geology of the town.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

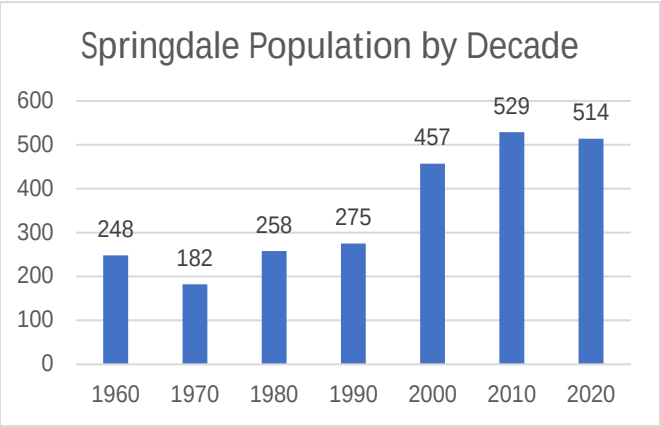


Figure 483: Springdale Population by Decade

Source: US Census Bureau

Demographics

As of the 2020 census, Springdale Town has recorded 514 residents, described in Figure 483. Springdale Town has expressed concern with the census, as the community has continued to develop and grow over the past several years. The community has reported significant development of residential properties over the past several years. Ninety-nine building permits were issued over the past 10-years, which allowed the construction of 157 new residential units. Given that the average family size in the community is estimated at 2.64 (US Census Bureau, 2019), the town may have seen an estimated increase

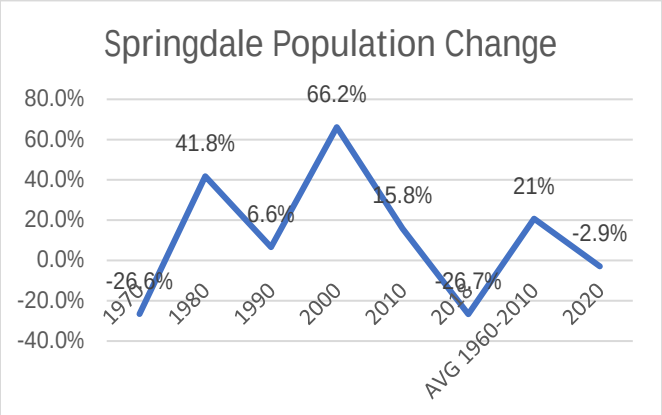


Figure 484: Springdale Population Change

Source: US Census Bureau

of 408 people in the past decade. The planning team estimates the current population to be near 600, reflective of the change in the previous decade from 2000 to 2010.

The Springdale population saw growth from 1970 to 2010, with a slight decline in 2020 according to the most recent census. Figure 484 shows the population change by decade in Springdale. Population changes, described in Figure 484 using US Census data, over the past several years shows that the population has been increasing by an average of 21% each decade between 1960 and 2010. Local population estimates, based on new development, would reflect growth in the last decade, not a decline of nearly 3%.

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Springdale, the community could see 1,460 people living in the community in the next 45-years[29].

Seasonal Population

Springdale lies at the south entrance of Zion National Park, which is one of the most visited national parks in the United States. The Park has seen increased visitation in recent years. In 2021, the visitation record was broken in November, with 5 million visitors anticipated by the end of the year (Williams, 2021). While visitors come to the park throughout the year, 70% of visits occur between the months of April and September (National Park Service, 2020). Visitors come from around the world to see Zion National Park and many inevitably pass-through Springdale Town.

Economy

Springdale was settled in the mid-1800s with an economy emphasizing agriculture. Since that time, the community has grown to include several local businesses, restaurants, and other commercial endeavors. The community is a gateway to Zion National Park, which draws millions of annual visitors and fuel outdoor recreation and accommodations industries. Springdale is also home to a local arts community, with galleries, and a nearby amphitheater.

[29] This estimate is created using the 2015 ACS population estimate for Springdale, which was 444, and adding 229% of this population estimate to the population for that year.

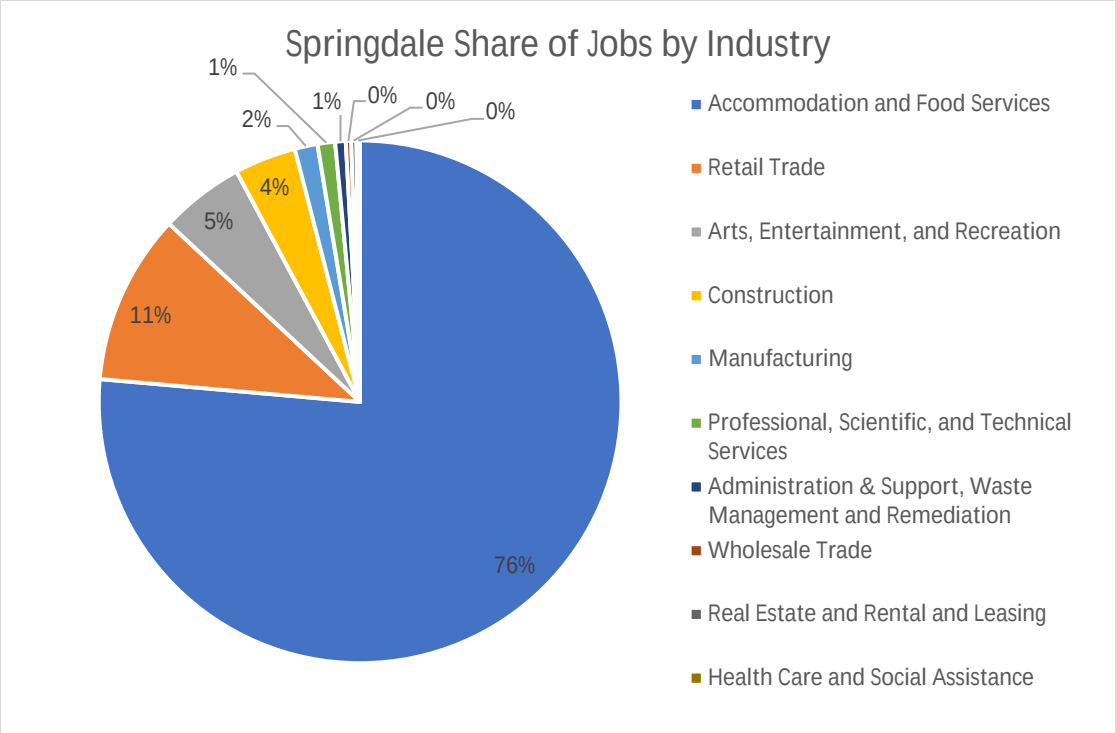


Figure 485: Springdale share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts Springdale prominent industries by the number of jobs supported in the community, illustrated in Figure 485. The influence of tourism in Springdale is prominent as jobs in accommodation and food services make up over 75% of the local jobs. The community otherwise has a mix of construction, manufacturing, and technical services, likely pointing to support services to provide infrastructure for other local industries.

Development

The Town of Springdale is currently experiencing a boom in new development. Over the last ten years the number of lodging units in the Town has doubled. The number of residential units has increased approximately 50%. Given continued high visitation to Zion National Park and a strong housing market, this development pressure is not likely to subside in the next five years. Due to its location in a geologically active river canyon, there is not much easily developable vacant land in Springdale. This means that anticipated future development will be placed on land that is more difficult to develop and more prone to natural hazard, particularly flood and landslide.

Community Capabilities

Springdale is governed by a mayor and town council, who engage in executive and legislative activities for the community. Administrative staff include a town manager, treasurer, clerk, deputy treasurer, and deputy clerk. The community departments include community development, public works, parks and recreation, and police department.

Several boards and commissions advise council on specialized topics, some of which can make decisions and set requirements within the scope of their board. A planning commission also supports specialized

review and recommendation of planning and zoning activities in the community to the council. Other boards and commissions include:

- Art Review Board
- Appeal Authority
- Springdale Historic Preservation Commission
- Zion Regional Collaborative (ZRC)

The town police department provides law enforcement to the community. Fire suppression service is offered through the Hurricane Valley Fire District, with a station in the community.

Culinary and secondary water and sewer utilities are provided by Springdale Town. Other utility providers in the area include Rocky Mountain Power for electric utilities, AmeriGas or B & L Propane for propane utilities, and CenturyLink or Infowest for internet Services. Two fiberoptics companies service the area along SR-9, including Springdale: South Central Communications and First Digital. Waste removal is provided to residents through Washington County Solid Waste Removal.

Plans and Policies

Springdale has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Springdale Town's plans and policies as they relate to natural hazards. Additional plans may exist, which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

The Springdale Codes and Ordinances seek to protect resident's welfare and health and natural and cultural resources through local policy. Throughout the code document, ordinances describe requirements for construction and methods to avoid hazard situations, which protect the community from impacts of a natural hazard event. Ordinances which describe natural hazards include:

- Acknowledgement of state uniform building code and uniform building code for dangerous building abatement, construction, remodeling, and other building activities.
- Requirements for excavation of filling on slopes, gradients, Chinle formation, drainage systems and other geologic hazards.
- Assignment of duties to the Public Works Streets Division for control of water flowing on streets, including the documentation of defects in streets and stormwater infrastructure.
- Description of noxious weed as a nuisance and impacts could include pollution of air or water or create a fire hazard.
- Establishes criteria for the Mayor to limit the use of water during times of water scarcity.
- A Geologic Hazard Ordinance and Erosion Hazard Ordinance to guide development in identified hazard areas.

General Plan

The Town of Springdale General Plan (2016) describes the vision for the community, referencing the history, current and planned land use, need for services, and conservation. The general plan is

undergoing an update as of this writing and is expected to be completed in 2022. New policies and goals will be included in this planned update are not reflected here. Several of the policies and goals for the community address natural hazard mitigation in the current plan include:

- Emergency preparedness and management
- Protection of views on cliffs, hills, and river corridors. Use of a Foothill residential zone
- Monitor grading and earth removal projects
- Protect pedestrians from potential hazards associated with the stone irrigation ditches, which was completed by placing stormwater pipes in the ditches and filling them.
- Reduce risk for wildfire on vegetated hillsides adjacent to street by removing weeds, litter, and debris.
- Construct stormwater improvements identified in the stormwater master plan. Maintain and update storm drainage in the community.
- Require developers to construct site specific stormwater drainage plans.
- Develop policies to mitigate water quality impacts of stormwater runoff entering the virgin river.
- Use drought tolerant vegetation in town and on town property and develop drought response plans.

Water Management and Conservation Plan

The 2017 Water Management and Conservation Plan describes the planning effort from the state of Utah to address water conservation to meet future water needs, save money, and preserve environment and natural resources available in the area. Throughout this plan, actions to limit indoor and outdoor water use are described, including fixing leaks, planting drought tolerant vegetation, and replacing lawns, among many other strategies.

Culinary Water Master Plan

The Culinary Water Master Plan Update (2015) assesses expected water demand and capacity of existing facilities and infrastructure. One facility assessed includes the treatment plant, which had several alternatives offered to address or upgrade the system. The alternative to upgrade the existing treatment plant, calls for a structural analysis on the building to bring it to seismic standard. A new plant was constructed and has been operational since July 1, 2019.

Stormwater Master Plan

The 2021 Stormwater Master Plan describes current conditions of stormwater facilities, land uses, development patterns, and drainages which all impact water flows following a storm. This plan uses hydrological modeling to identify the flows in drainage basins in the Town during certain storm events, with assumptions about future development. System improvements in this plan were generated comparing the modeling to the known capacities of the existing infrastructure. This plan highlights the need for natural drainage channel infrastructure and the inclusion of water quality management in the community's stormwater management, as runoff generally feeds into the Virgin River, the water source for the community.

Secondary Water Master Plan

The 2021 Secondary Water Master Plan describes the makeup of the irrigation system users. The plan does not project an increase in secondary water usage over time, even if the connections increase with development as the area is geographically constrained by cliffsides and the river, restricting the amount

of land available for irrigation. The plan describes the fees for use of the secondary water, types of users, and rates of use. Recommendations relate to metering and water rights.

Wastewater Master Plan

The Wastewater Master Plan (2021) describes community needs for improvements in the wastewater system to accommodate population growth and visitation to the community and adjacent Rockville and Zion National Park. The planning document makes considerations for both short- and long-term needs, as the communities grow. Sewer system capacity, treatment, and needed improvements are all described in this plan. This plan describes erosion protection of the discharge from the treatment facility to the river, addressing threat of river channelization and erosion impacting the treatment facility.

Following the development of the wastewater master plan, Springdale Town has begun a project to resolve Total Suspended Solid issues with wastewater discharge. The community is seeing algae suspended in the discharge water. Project will include erosion protection at the discharge point.

Virgin River Management Plan

The Virgin River Management Plan (2019) describes the value of the Virgin River flowing through the community, which is the town's primary water source for drinking and irrigation water. Several natural hazards or mitigation items are addressed in this plan by protecting the floodplain and native habitat, limiting development, and protecting the natural features of the river through technology around the Virgin River. Actions include enhancing habitat and environmental quality around the river, setting erosion setbacks for development, ensuring development does not impact river health, setting a planting density according to slope steepness, determining river channel bank conditions and setting appropriate stability techniques, provide area for function during flood events, and require green stormwater infrastructure on all properties in the town.

Risk Assessment

Springdale is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Springdale planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 469 describes the relative risks of hazards in the community.

Table 469: Springdale Risk Assessment

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. High
LANDSLIDE	3. High
WILDFIRE	4. Moderate
SEVERE WEATHER	5. Moderate

EARTHQUAKE	6. Moderate
PROBLEM SOIL	7. Low
RADON	8. Low

A detailed description and mapping of each of the natural hazards that impact Springdale can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Springdale include reviewing the exposure that critical facilities, residential and commercial parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, with Utah in an extended period of drought, with 2020 being the driest year on record and 2021 conditions requiring significant conservation measures statewide to ensure sufficient water storage for communities. The primary water source for the community is the Virgin River, although wells and springs also supplement the local water supply.

Drought hazards have implications on the regional economy and people in the area. Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Tourism and related industries are significant economic strongholds in Springdale Town, as described earlier in this chapter. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought. Low visitation could have significant impacts on a tourism-based economy.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality. Recent occurrence of Cyanobacteria or blue algae in the Virgin River have caused concerns regarding water quality on the Town's primary source. The community expressed that in the years that the bacteria flourished the community had seen lower than normal precipitation and river flows, which could contribute to the increased prevalence of the contaminant.

Ongoing efforts in the community to address drought include the longstanding practice of setting an irrigation schedule to limit daytime watering and an aggressive rate structure to encourage water conservation, where those who use more, pay more. The community also seeks to reintroduce native plant species and reduce invasive plant species which may not be drought tolerant like Tamarisk.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 486 depicts the mapped 100-year floodplain, dam inundation, and riverine erosion exposure in Springdale. The Virgin River seems to be primary corridors for flooding, based on flood plain and dam inundation data. The community describes the historic flood risk to be greater on side washes, which are normally dry and fill with water following severe storms.

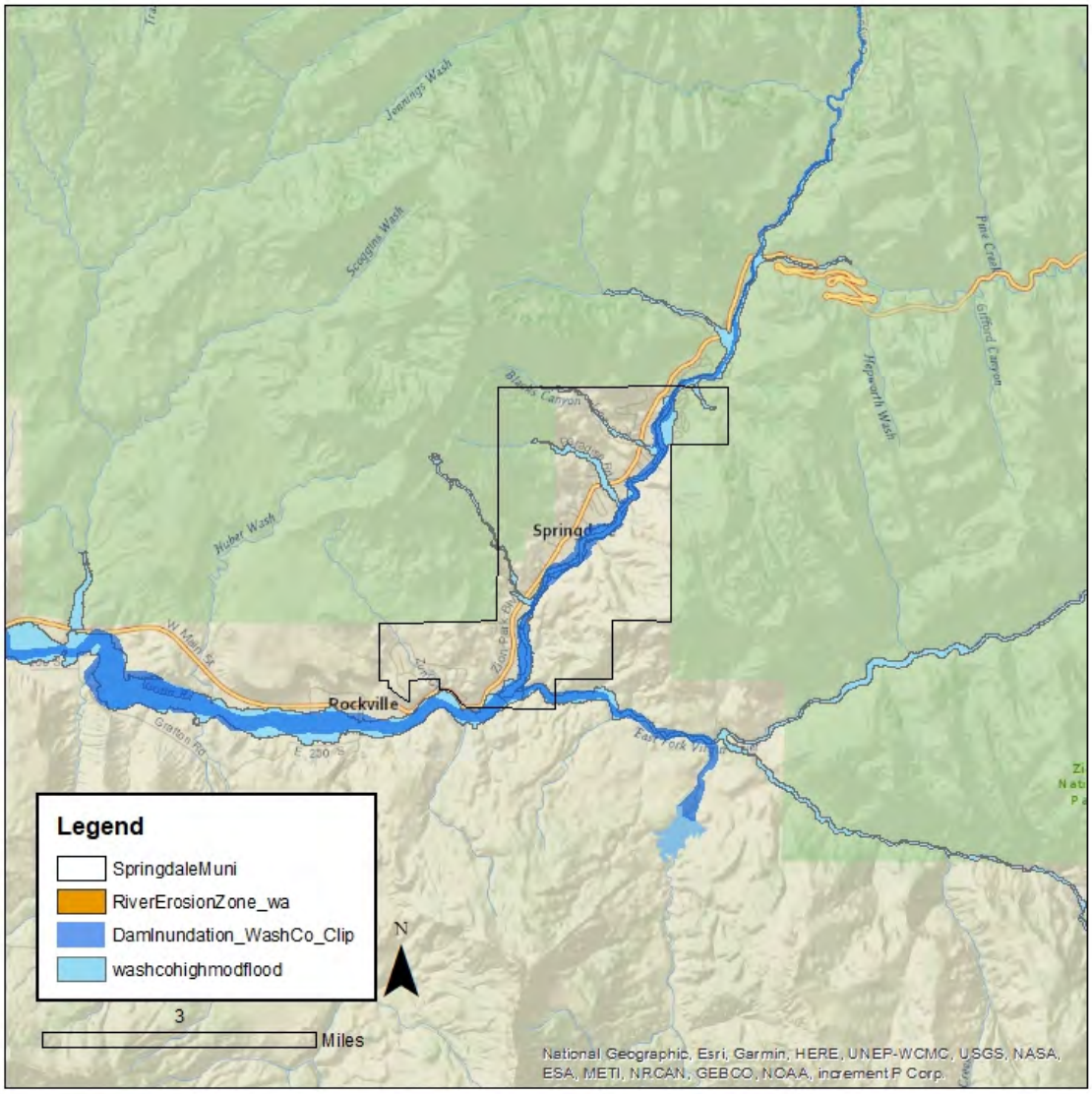


Figure 486: Springdale Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 470 describes the Springdale community assets exposed to dam inundation, and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Parks see the most exposure to potential flooding and impacts, which can expose park visitors and cause damages to park infrastructure, however these open spaces can act as a buffer to residential and

commercial properties. Commercial and residential parcels and critical facilities are also identified in flood risk areas. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood. Critical facilities impacted by flood may result in delays in service, damage, or loss of equipment, among other potential outcomes.

Table 470: Springdale Exposure to Floodplain and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
25.0%	46.0%	26.2%	30.1%	17.9%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

Riverine Erosion

Erosion is a process of breakdown of natural material, including soils and rock. Riverine erosion is one method of erosion, which in the Southwest of Utah can cause damage to rivers and development surrounding the river. Erosion is often recorded during and after periods of higher-than-normal water flow or when vegetation has been damaged or removed. Eroded materials are deposited downstream, which can cause changes in the river flow, new erosion, or blockages, which may contribute to flooding (American Geosciences Institute, n.d.).

The canyon in which Springdale lies is a product of riverine erosion from the flow of the Virgin River. In the Zion National Park, Virgin River Comprehensive Management Plan, the plan describes that sediment from erosion impacts water quality, and sediment likely comes from the “extreme rate of natural erosion in this watershed" (National Parks Service , 2013).

In 2020 the Town of Springdale worked with Rosenberg Associates to map high and moderate erosion hazard zones in the community. These zones border the floodplain in drainages and along the Virgin River throughout the community. Some of the identified hazard areas overlap with existing or planned development in the community.

Figure 487: Springdale Town Riverine Erosion Map

Source: Springdale Town

National Flood Insurance Program

Springdale property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 471: Springdale NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$6,105	0	5	8	$2,128,200	1	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020. NFIP HUDEX policy and loss data by geography, accessed 12/9/2021

Springdale participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 471 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. One claim has been made, but none paid through the NFIP. The claim made appears to be related to a 2021 flooding event which impacted the community. There are no repetitive losses identified. A Community Assistance Contact and a Community Assistance Visit were completed in 2019 and 2015.

Flood Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 472 describes the flooding events which have impacted Springdale and the surrounding area.

Table 472: Springdale Reported Flood Events 1997-2020

Date	Damage/Injury	Description
8/10/1997	$100,000	Flash flooding led to the closure of SR-9 from Zion National Park to Mount Carmel Junction as the roadway was eroded in some areas. Springdale saw the Virgin River to increase by 8 feet during the flooding.
9/11/1998	$220,000	A thunderstorm caused flooding countywide. In Zion National Park, the lodge was evacuated due to road damage from flooding. In Springdale, flooding destroyed a home. This event caused $20,000 in crop damage and $200,000 in property damage.
7/25/2003	None Reported	Flash flooding reported on the North Fork of the Virgin River, which rose 110 cubic feet per second.
7/15/2004	None Reported	Thunderstorms produced flash flooding on the North Fork of the Virgin River. Rising water was reported in Springdale and in the Zion Canyon Narrows.
1/10/2005	Unknown	A Countywide rainstorm caused snow to melt rapidly, leading to flash flooding throughout the County. In Springdale, impacts included flooding and closure of the city park.

12/19/2010	$19,700,000	Heavy rain caused rivers to rise throughout southern Washington County. SR-9 in Zion National Park was closed between the tunnel and Mt. Carmel Junction. The Park was also closed, and the lodge was evacuated due to landslide risks, as a historic landslide began moving due to rain waters. Residential flooding was reported in Springdale.
9/8/2013	None Reported	Flash flooding caused the North Fork of the Virgin River gauge near Springdale to rise from 0 CFS to 415 CFS.
9/9/2013	None Reported	Flash flooding caused the East Fork of the Virgin River gauge near Springdale to rise from 34 CFS to 140 CFS in one hour.
9/27/2014	$350,000 1 death	Flooding was reported Countywide, including Springdale, causing river flooding, rockfall, and mudslides. Flooding led to the closure of Zion National Park and the death of one hiker who was in the Narrows.
7/8/2015	None Reported	The Springdale gauge on the East fork of the Virgin River reported flow rates as high as 1140 CFS.
8/3/2017	None Reported	Rain caused flash flooding in Zion National Park. Springdale saw street flooding in town.
6/29/2021	No injuries reported Cost of damages unknown.	Heavy rain caused flash flooding in Zion National Park and Springdale Town. The Park closed several trails due to the flooding. The event led to the closure of SR-9, damages to several structures and infrastructure in the Springdale community.

Source: NOAA Storm Database

Several other flooding events are reported in Zion National Park, which do not describe specific impacts or observations for Springdale. Such events are documented in the Washington County and Kane County section of this plan. While events in the park may not always impact Springdale, they can impact the visitors to the park which may be visiting the community. The documented events which impact Springdale tend to occur during the summer monsoon season and coincide with increases in water levels on the Virgin River.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events interact with the built environment and human activity. Figure 488 through Figure 490 maps the landslide and rockfall susceptible areas are observed throughout Springdale. Given the placement in the bottom of a canyon, the greatest risk appears to be identified near the cliff walls.

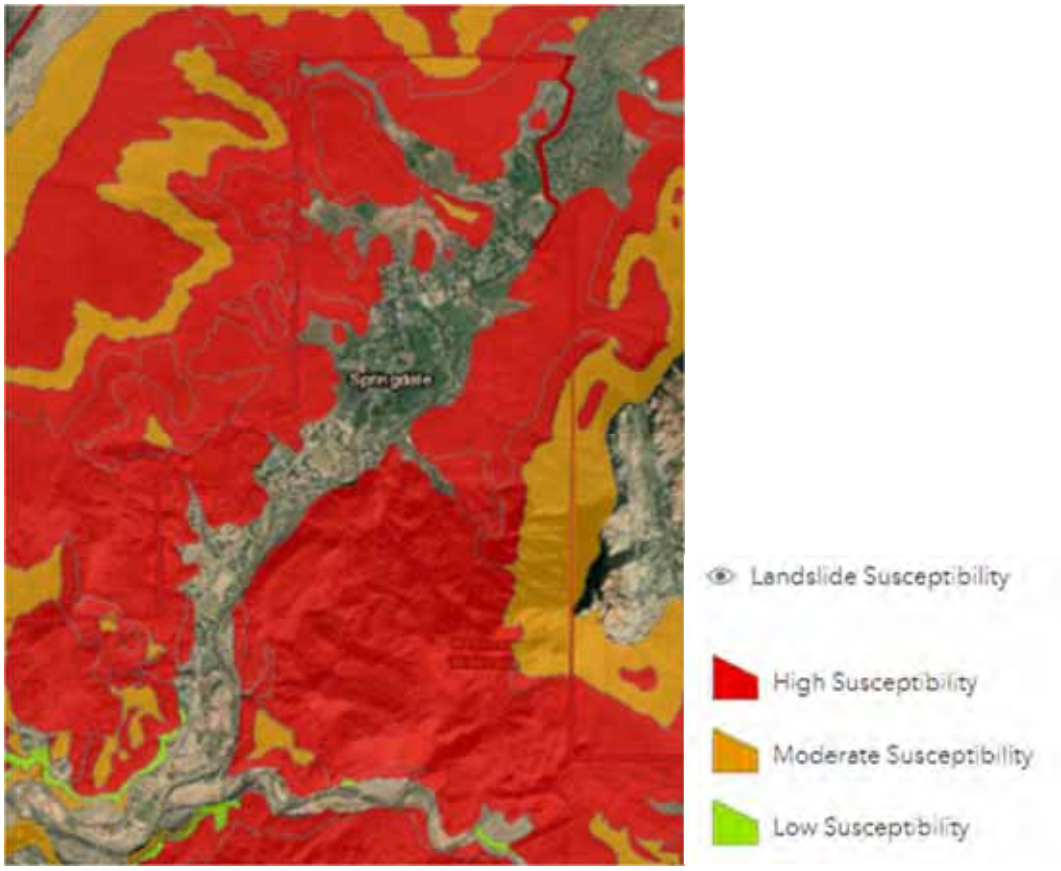


Figure 488: Springdale landslide susceptibility

Source: Utah Geological Survey

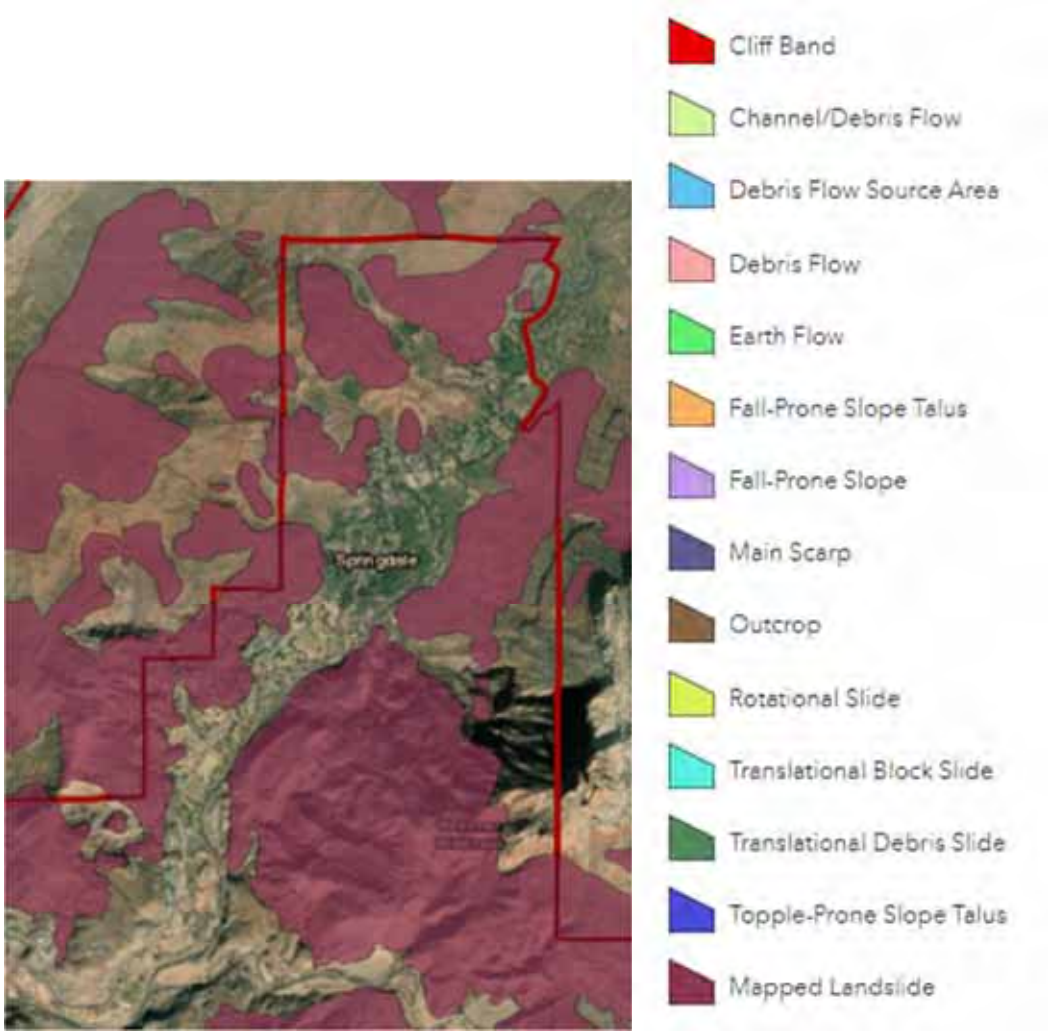


Figure 489: Springdale mapped landslides

Source: Utah Geological Survey

Zion Canyon and the area surrounding Springdale were formed in part by historic landslide events. The Utah Geological Survey has completed mapping of identified landslides in the community, seen in Figure 489. Landslides in Springdale appear to align with the risk susceptibility map, being located dominantly on and near the canyon wall in the community.

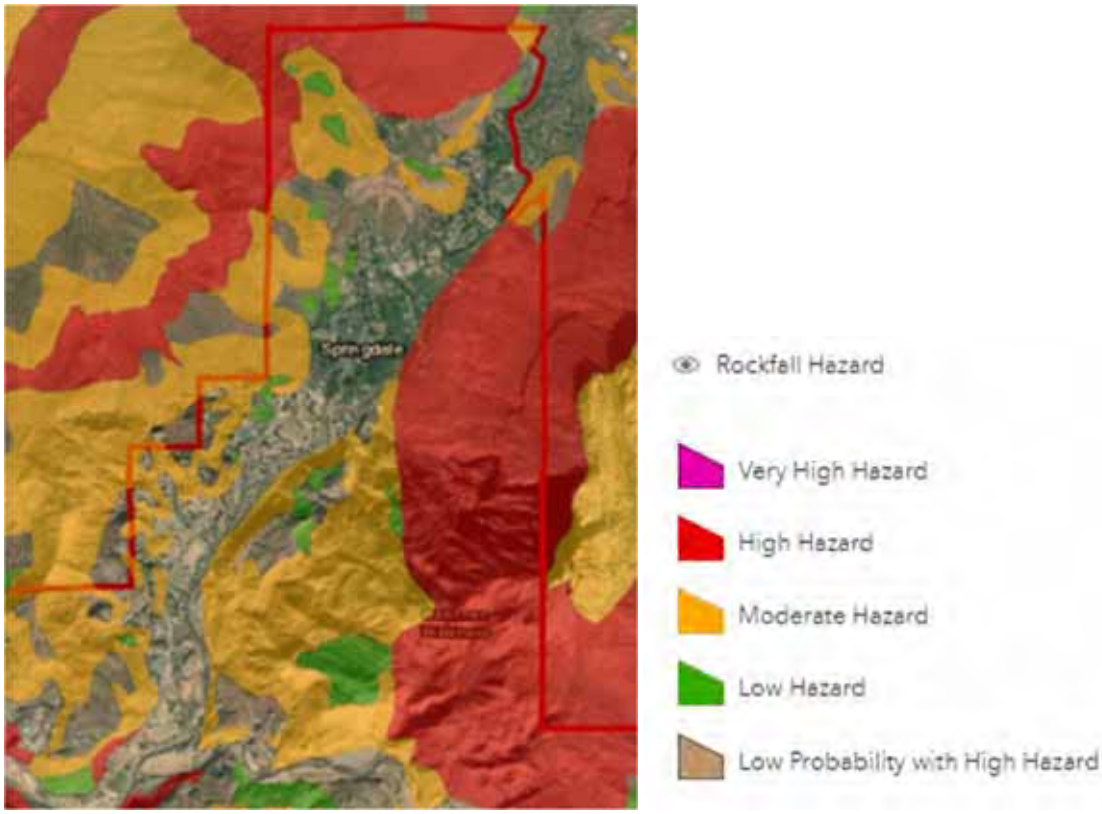


Figure 490: Springdale Rockfall Susceptibility

Source: Utah Geological Survey

Rockfall is a type of landslide where large boulders detach from a hill or cliffside and fall to the ground. As the rock falls, it can fragment into smaller rocks and boulders. Rockfall is a known risk in Springdale and the surrounding area, as several large rockfall events have been reported in the past several years.

Springdale is exposed to landslide susceptible areas throughout the community, given the local landscape, Table 473 describes the exposure of community assets to landslide susceptible areas. Parcels and road miles are most exposed to landslide susceptible areas. Critical facilities are also exposed to landslide susceptible areas, highlighting a community vulnerability which could impact response and recovery. Without proper planning, future growth could place development in landslide risk areas, increasing risk of landslide impacts.

Table 473: Springdale Landslide Susceptibility Exposure

Springdale Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
25.0%	51.7%	50.3%	50.6%	41.7%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

This table was developed using UGS data available in GIS format and does not reflect the above maps.

Landslide Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Springdale has experienced landslide and rockfall events which have impacted personal property and public safety. Table 474 describes the record of landslide and rockfall events in or near Springdale.

Table 474: Springdale Landslide Record

Incident Date	Location	Description
1920	Washington County	Debris flow at Zion National Park.
1930	Washington County	Debris flow at Andersen Ranch in Zion National Park.
1941	Washington County	Landslide at Zion National Park.
1992	Washington County	A landslide in Springdale was triggered by an earthquake in Washington City. The landslide destroyed two water tanks, three homes, and storage buildings, damaged above and below grounds utilities and covered SR-9 with debris.
2005	Washington County	A series of landslides in Zion National Park, with a slide covering a portion of Kolob Canyon Road at the North end of the park.
2019	Washington County	A rockfall event in Zion National Park dropped a 31,000-ton sandstone slab into the valley below. Three people were injured, equipment was damaged, and several trails remain closed.

Source: (Knox, 2021)

Some of the older landslide events have limited description associated with the event. Landslide events have been observed in and around Springdale and have impacted physical structures, access and transportation, and utilities. Following the 1992 landslide which caused severe damage to a subdivision and infrastructure, the town acquired more than half of properties in the Balanced Rock Subdivision and use it as permanent open space to mitigate landslide risk on the site. The community described an active landslide near a subdivision which is across the river from the community. This landslide has not caused impacts to residents or property, but increased development and activity in the area could create vulnerabilities. Given the geological history of the area, it is likely that landslides will continue to occur and impact the town, especially as tourist visitation increases and the community population increases.

The community sites that new development is beginning to encroach on identified landslide areas, part of the reasoning behind the use of the geologic hazard ordinance for the community. While severe landslides are infrequent, the hazard risk is prevalent in the community. Continued development and increased visitation in the community increases the potential of landslides which impact the human or built environment.

Several factors contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Wildfire

Springdale is a town marked by its access to outdoor recreation and open spaces. Zion National Park is located to the north of the community and the Virgin River, which is a water source to the region, runs through the community. Given the extent of visitors to the area, who may be on trails or in the back country, highlights a risk to wildfire.

Figure 491 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County Association of Governments describes those areas in and surrounding Springdale that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

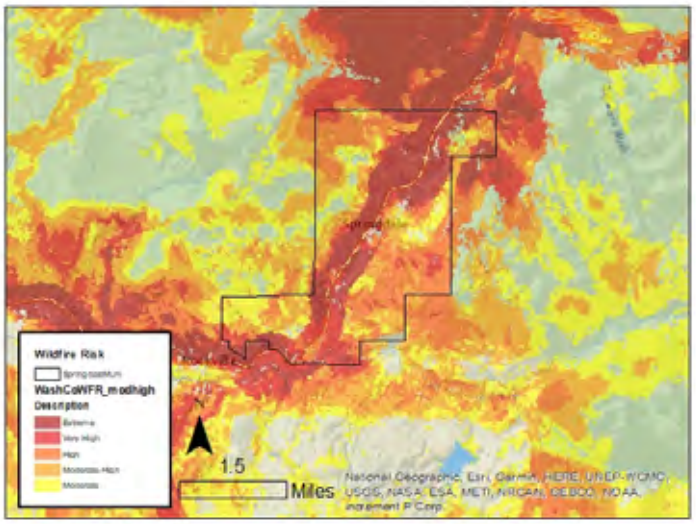


Figure 491: Springdale Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 475 further describes Springdale's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Springdale, which could damage property, impact public health and safety, or impact local economies. Almost all commercial and residential parcels are exposed to wildfire risk areas in Springdale, which can have an impact on local economies and access to goods and services for residents, in addition to endangering life and personal property. Two third of the road miles in the community are at moderate to extreme wildfire risk, which can challenge response and recovery and the travel of people and goods. All of Springdale's critical facilities are exposed to moderate or greater wildfire risk, which can impact response, equipment, and facilities essential for community function.

Table 475: Springdale Wildfire Risk

Springdale Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	97.7%	98.6%	98..4%	67.9%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Wildfire is an identified and well-known risk in the Springdale community. Efforts to reduce invasive plant species, promote native species throughout the community seek to address the wildfire risks. The Hurricane Valley Fire District supports local fire suppression in the community and engage in fuels management activities locally. The fire district has adopted Wildland Urban Interface ordinances which are reviewed in development locally.

Wildfire Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. In addition to these sources, this plan references previous documentation from the 2016 NHMP and news articles. One event, described in Table 476, occurred inside Zion National Park had secondary impacts on Springdale, as the fire burned electrical power poles. (The Associated Press, 2006)

Table 476: Springdale Wildfire Record

Fire Name	Year	Acres Burned	Description
Kolob	2006	17,632	The largest wildfire in Zion National Park in recorded history, burning 10,516 in the park and was human caused. The fire was a concern to Springdale Town but never reached the city limits. The fire caused indirect impacts, including the closure of SR-9, limiting access to the community.

Source: National Parks Service "ZNP fire management fire factsheet"

Several other fires are documented for Zion National Park, although it is unclear the extent to which these fires impacted Springdale Town. The Town regularly experiences small fires, which are generally suppressed quickly by the Hurricane Valley Fire District and cause minimal damage. The community continues to grow and the potential for wildfire is present throughout the community and the areas surrounding. While the history is limited, residents and visitors are exposed with the community growth and popularity of the national park. The community considers this a moderate-risk natural hazard.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Springdale, and it is essential to be aware of the interrelated nature of these hazards.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Springdale, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Springdale sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning. Winters in the high elevation areas can produce snow and rain fall.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Springdale has several reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 477. While the deaths reported during the 2013 events did not occur in Springdale, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers, are vulnerable to these extreme temperatures.

Table 477: Springdale Severe Weather Record

Date	Damage/Injury	Description
12/29/2010	None Reported	Two inches of snow reported in Springdale.
2/26/2011	None Reported	A winter storm produced five inches of snow in Springdale.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
12/3/2013	$2,000	A winter storm produced three inches of snow in Springdale. This storm caused damage across Washington County, including 30 vehicle accidents, fallen tree branches, and a fire hydrant hit by a vehicle.
12/7/2013	None Reported	A winter storm produced 13 inches of snow in Springdale.
8/10/2016	None Reported	Hail the size of ping pong balls fell in Springdale.
3/13/2020	None Reported	1.89 inches of rain was recorded in Zion National Park.

Source: NOAA Storm Database

Storm events which have described impacts for Springdale tend to be snow events. Washington County does not frequently receive snow in the valleys, but when it does, the impacts can include traffic delays, vehicle accidents, and damage to structures and utilities, as evidenced by the 2013 snow event. While damages were not reported for other events in Springdale, hail, rain, and snow may have impacted businesses, utilities, residences, or other assets in the community.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 492 shows the mapped earthquake epicenters and fault lines near Springdale. Based on the available data, faulting is not a concern in the community, but ground shaking, and subsequent liquefaction are risks.

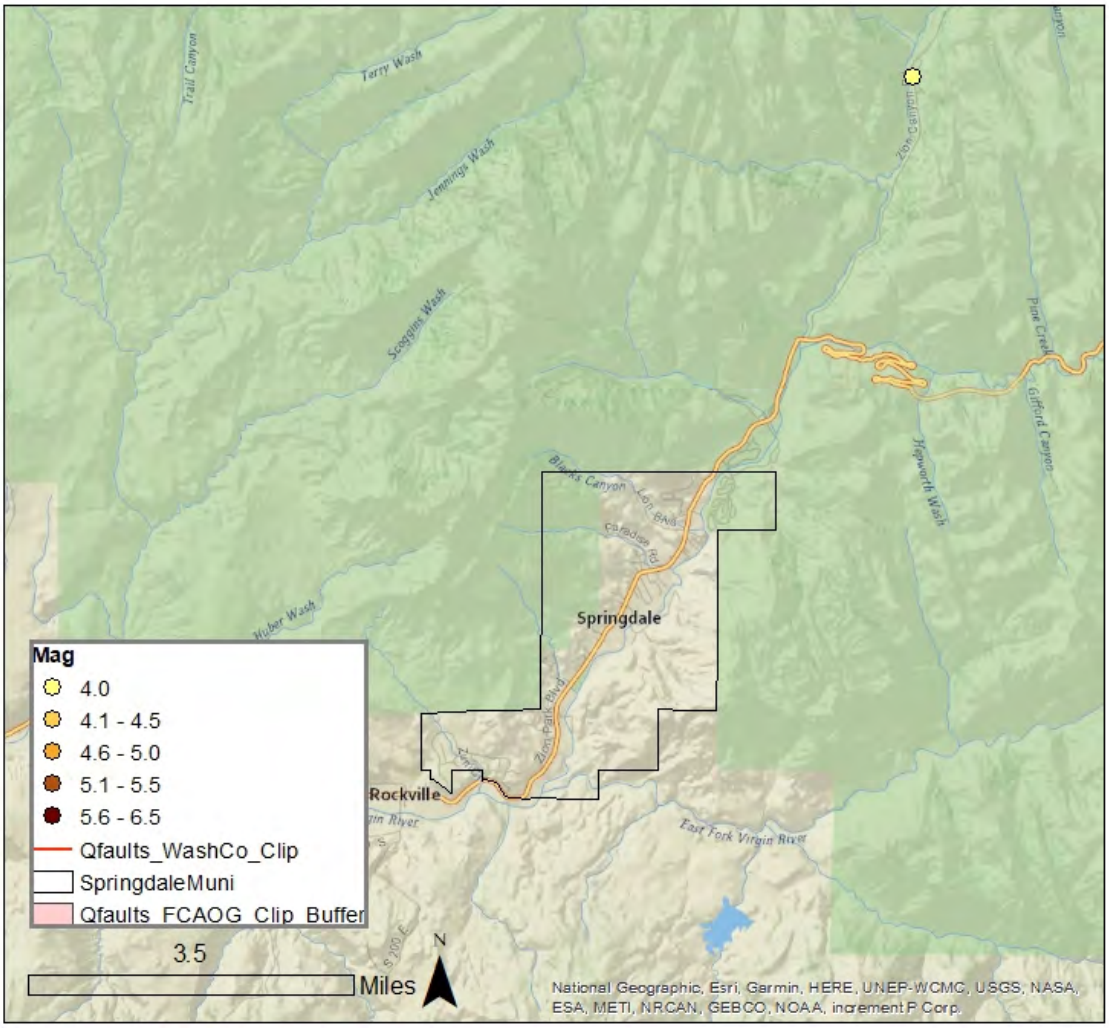


Figure 492: Springdale Earthquake Epicenter and Quaternary Faults

Source: Utah Geological Survey and University of Utah Seismology

Ground Shaking

An identified vulnerability to earthquakes in the region includes ground shaking, which can cause damages to structures and infrastructure, trigger other natural hazard events like landslide and liquefaction. Unreinforced masonry structures, typically built before 1975, before seismic code requirements were adopted by the State of Utah, are less protected during ground shaking events, exposing those inside and outside of the building to potential harm. These structures do not have steel

reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 82 Springdale structures were built before the adoption of seismic code requirements, approximately 18.3% of the total structures in the city boundaries. Southern Utah has a pride in the history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Springdale Town, identified in Figure 493. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid, which can be a risk to structures and property on susceptible soils. Figure 493 indicates that Springdale has areas of moderate to very high susceptibility to liquefaction hazards.

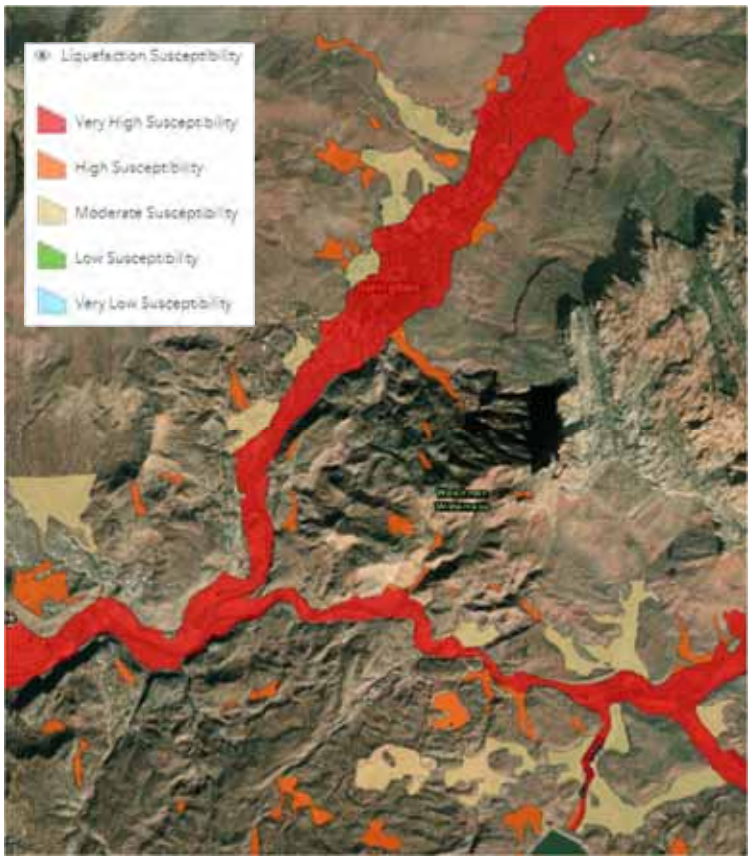


Figure 493: Springdale Liquefaction Susceptibility

Earthquake Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters or faults are identified in the municipal boundary, although an earthquake epicenter is identified in the Zion National Park, 4.5 miles from Springdale. Earthquakes elsewhere in the county may have been felt and caused impacts in Springdale, including the 1992 5.8 magnitude earthquake with an epicenter in Washington City. This earthquake caused impacts from Flagstaff, AZ to Richfield, Utah and from Las Vegas, NV to Escalante, UT. (Peterson) Impacts from this event included damages to building walls as the shaking loosened plaster and walls cracked. In Springdale and Zion

National Park, a landslide was triggered by the shaking from the 1992 earthquake, which caused extensive damage to a subdivision. This event is further covered in the landslide section of this plan.

Liquefaction has not been identified in the community hazard history.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which are reactive to moisture and other environmental factors cause the soil stability to change. Problem soils are often challenging to structures and infrastructure, as when the soils dissolve or expand, contract, or collapse, they can damage or impact structures that are on top of the changing soil structure.

UGS has developed updated mapping for some communities in the region, including Springdale, which provides greater detail about the susceptibility and potential for problem soils and the types prevalent to the region. The updated mapping is available in an online format only and was not used for GIS analysis. The mapped study area includes identification of collapsible soils and rock, expansive soils, piping and erosion susceptible soil, soluble soil and rock, and windblown sand susceptible areas.

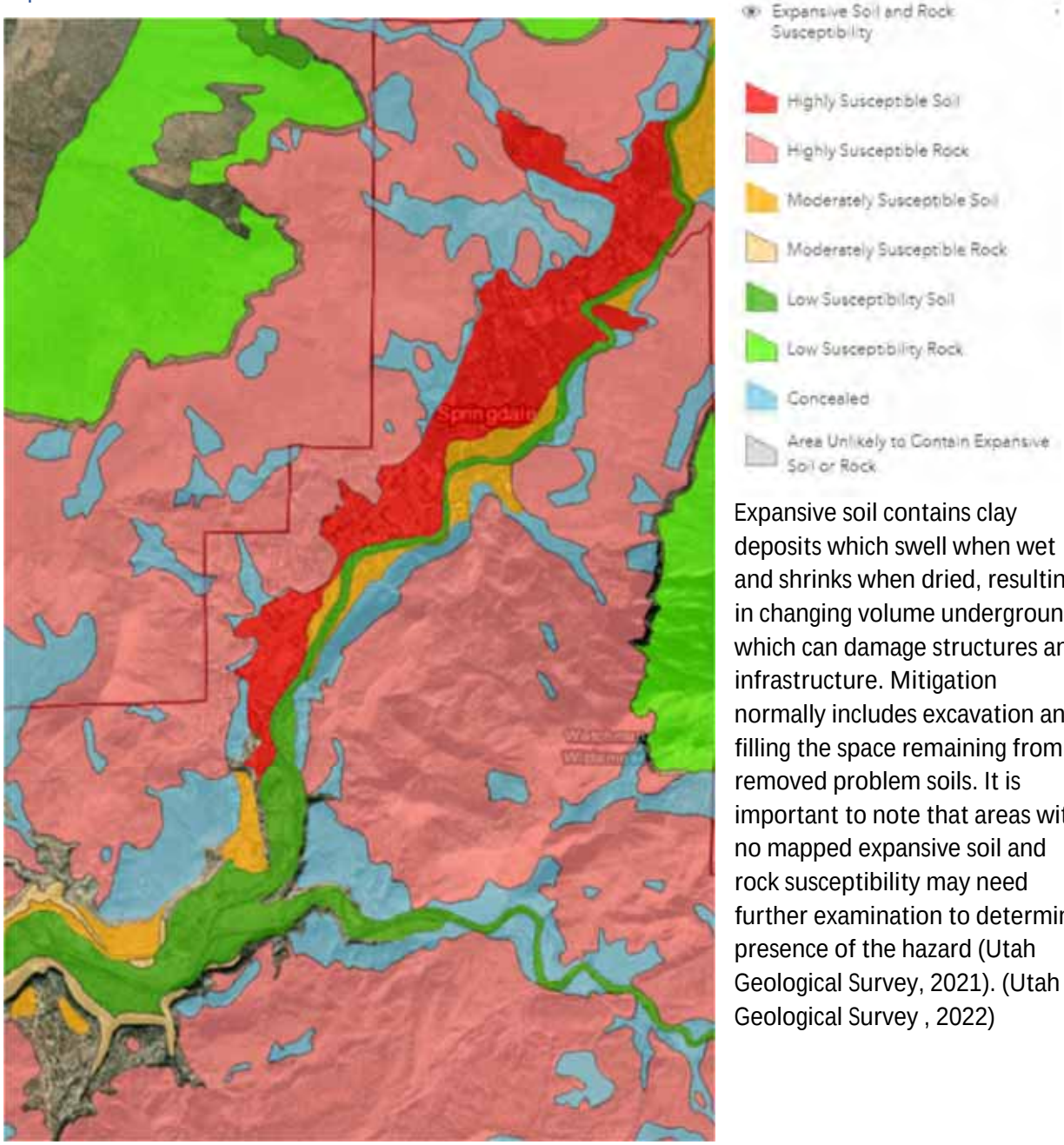
A known problem soil in the community is the prevalence of expansive soils, which are recorded regularly at development sites in geotechnical assessments as required by town ordinance. Mitigation in development phases has addressed the impacts from this type of soil.

Collapsible Soil

Collapsible soils are soils which become compact when wet. Water introduced to these soils allows air within the soil to escape, causing a collapse in the soil. The unstable soil can damage structures and infrastructure during the settling action of wet collapsible soils. Mitigation can include over excavating and recompacting or removing collapsible soils (Utah Geological Survey, 2021).

Figure 494: Springdale Collapsible Soil Susceptibility

Expansive Soil and Rock

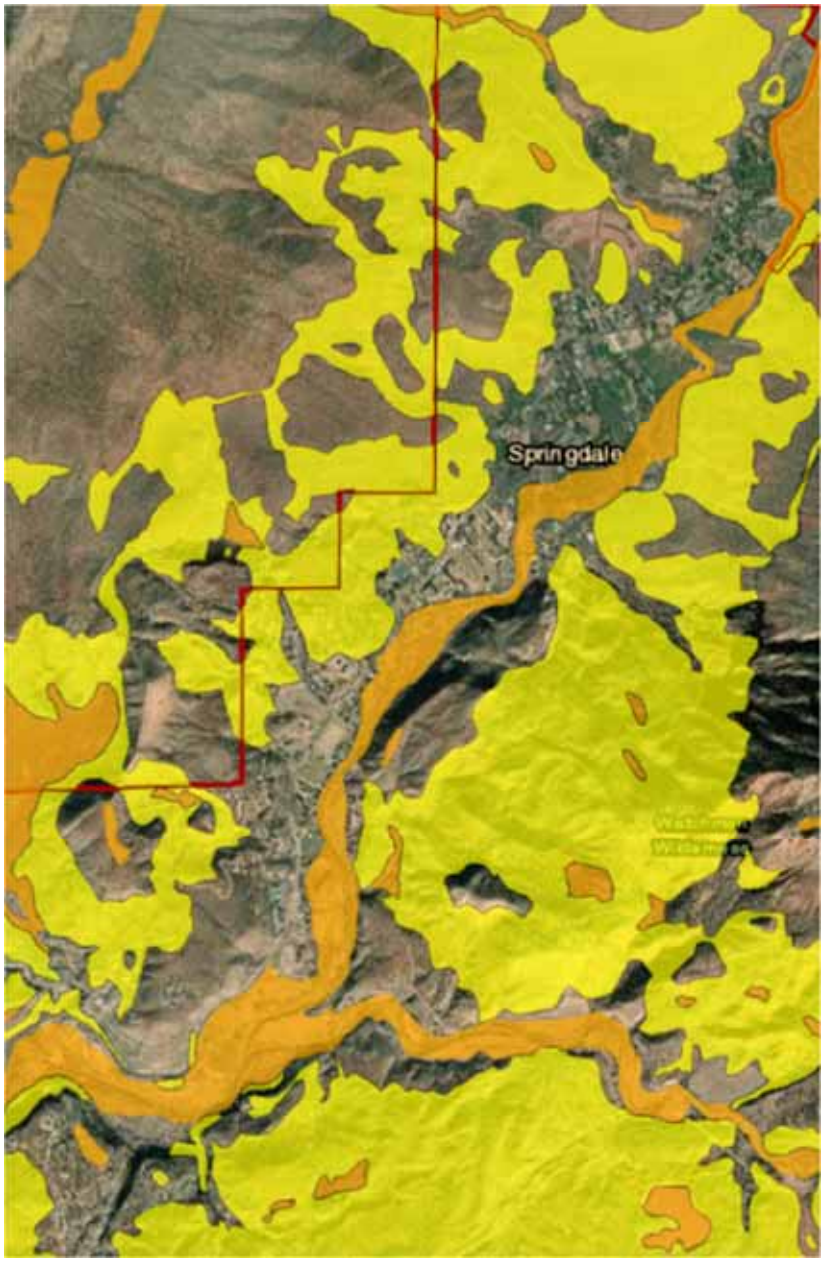


Expansive soil contains clay deposits which swell when wet and shrinks when dried, resulting in changing volume underground which can damage structures and infrastructure. Mitigation normally includes excavation and filling the space remaining from removed problem soils. It is important to note that areas with no mapped expansive soil and rock susceptibility may need further examination to determine presence of the hazard (Utah Geological Survey, 2021). (Utah Geological Survey , 2022)

Figure 495: Springdale Expansive Soil and Rock Susceptibility

Source: Utah Geological Survey

Piping and Erosion



Piping and Erosion Susceptibility

- Highly Susceptible Rock
- Highly Susceptible Soil
- Susceptible Rock
- Susceptible Soil

Piping is a form of underground erosion due to groundwater movement. It can damage infrastructure and structures above ground as sediment is removed by the water, which can cause collapse. Erosion is generally a challenge in southwestern Utah, especially during severe storms which cause flash flooding. Springdale has recorded flood occurrence of channelizing on the Virgin River, where flooding washes away portions of the riverbank (Utah Geological Survey, 2021).

Soluble soil and Rock and Windblown sand have minimal exposure in Springdale town and maps have not been included.

Figure 496: Springdale Piping and Erosion Susceptibility

The new mapping indicates that Springdale is highly susceptible to collapsible soils and expansive soils and rock. These soil types appear throughout the community and have regularly been documented in the community.

The community does not have a detailed record of problem soil impacts, although geologic testing is a requirement for building permits and tests which find problem soils will identify what type and the location of problem soils. Springdale has described that required testing and mitigation during development stages has reduced impacts from problem soils, although they remail prevalent throughout the community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by **Error! Reference source not found.**. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

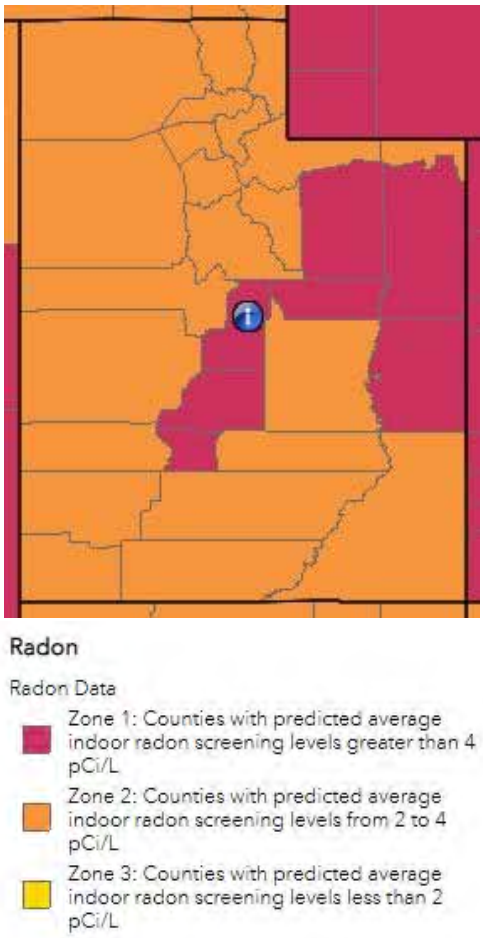


Figure 497: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases. In Springdale, the community has required that radon be addressed in new construction with basements by including a radon barrier in the construction. The geologic hazard ordinance in the community has included this contingency to protect users in new structures.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to generalize risk or determine where testing or mitigation is or is not needed.

Table 478 describes the reported findings from short term radon testing across Washington County and in the Springdale Town zip code. In Springdale only eight tests have been reported to the Utah Department of Environmental Quality. The countywide average test result is 2.2 pCi/L of air. Radon tests with high levels have been reported which, would require mitigation for human occupation of a space. Reported tests indicate that Springdale has some high levels of indoor radon documented, with a

maximum level at 4.7 pCi/L. Testing and information is necessary to understand and reduce risk at each property.

Table 478: Washington County Short Term Radon Testing Reported

Zip Code	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
84767 (Springdale Town)	62.5%	37.5%	4.7 pCi/L	3.2 pCi/L	8
Washington County Total	88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the community can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Risk Assessment Summary

Springdale is at risk to drought, flood, landslide, wildfire, severe weather, radon, and problem soil. Residents are at risk to injury and property damage from several natural hazards. Springdale critical facilities are vulnerable to severe weather, problem soils, landslide, flood, earthquakes, and wildfires according to mapping completed for this assessment and the known extent of hazards. Impacts from these natural hazards can impact a facility's capacity to respond to an emergency event.

Tourists and visitors are a prominent vulnerability in the community, with the Zion National Park bringing millions of people through the community each year. Visitors may not be aware of the natural hazard risks of being in the park and may not be prepared for events like severe weather, extreme heat, flash flooding, or landslides. Visitors to recreational areas in and near Springdale have been impacted by severe weather, flood, drought, and landslides.

Transportation routes have been impacted by historic natural hazard events and are exposed to several natural hazard susceptible or risk areas. State Route 9 is the primary access road to the community and impacts on this road can cause traffic delays locally, impact access to the community, and delay the transportation of goods, depending on the extent of the impacts.

Mitigation Strategy and Actions

Springdale has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 479 describes progress made on Springdale mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 479: 2016 Springdale Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	Minimize structural damage from floods.	Construct flood mitigation measures at Flannigan Diversion Structure (Springdale's Diversion) in Zion National Park. Measures may include increasing the height of the headwall, armoring above intake pipe to reduce scour effects, constructing new walls or changing weir roof material from aluminum to a heavier gauge steel.	Unknown	Local government operating budget; State and Federal flood grant programs	Zion installed a desanding structure in same area as Town's desanding structure, increased height of headwall.
Flood #2	Minimize structural damage from floods	Construct an erosion control/rip rap wall to protect the Canyon Springs Estates subdivision emergency access and Town water line from further erosion and damage.	Unknown	Local government operating budget; State and Federal flood grant programs	None, but action still needed

Flood #3	Minimize structural damage from floods	Construct an erosion control/rip rap wall at the South end of Springdale on the Dickman property to protect the Town sewer line and Rockville Canal irrigation pipe from further erosion and damage. Project currently under Corps of Engineers Section 14 review.	Unknown	Local government operating budget; State and Federal flood grant programs	None, but action still needed
Flood #4	Minimize structural damage from floods	Investigate erosion potential on bend of river near SR-9 south of Springdale Chevron and north of River Park.	Unknown	Local government operating budget; State and Federal flood grant programs	Applying for BRIC grant
Landslide #1	To reduce landslide risk as it relates to the built environment in Town of Springdale.	Adopt zoning regulations to prevent development of structures in identified rock fall or geologically unstable areas to minimize losses in the unincorporated areas of Washington County.	5 years	Private funds/ developer; Local government operating budget; Utah Geologic Survey operating budget.	A Geologic Hazards Ordinance has been presented to the Planning Commission.

Source: 2017 Five County Association of Governments NHMP

To address the risks and vulnerabilities identified in this chapter, Springdale has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 480. Each action includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 498.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 498: Regional Plan Goals

Although Problem soil is an identified hazard in the community, the community's current code and mitigation practices have proved effective at reducing damages and losses from problem soil hazards. The present risk to property and people from this hazard is minimal and addressed by the Town Code. No actions for problem soils have been included in this Hazard Plan.

Table 480: Springdale 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #1	2, 6	Use natural systems to mitigate hazards.	Update drought design guidelines for native and drought resistant landscaping.	H	1-year	L	Springdale Town	Springdale Town
Drought #2	2	Community planning to limit hazard exposure.	Drought response plan with itemized responses based	M	5-years	M	Springdale Town	Springdale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			on drought monitor status.					
Drought #3	2	Collect data for informed decision making.	Investigate water source redundancy for the community to address potential shortages from the Virgin River.	H	5-years	L	Springdale Town	Springdale Town
Drought #4	2, 6	Use natural systems to mitigate hazards.	Assessment of town assets for vegetation water use and install waterwise infrastructure and replace water intensive vegetation.	M	3-years	L	Springdale Town	Springdale Town
Flood #1	2, 6	Infrastructure improvement for public safety.	Construct an erosion control/rip rap wall to protect the Canyon Springs Estates subdivision emergency access and Town water line from further erosion and damage.	M	5-years	H	Springdale Town	Springdale Town
Flood #2	2, 6	Infrastructure improvement for public safety.	Construct an erosion control/rip rap wall at the South end of Springdale to protect the Town sewer line and Rockville Canal irrigation pipe from further erosion and damage.	M	5-years	H	Springdale Town, Washington County, NRCS	Springdale Town, Washington County, NRCS
Flood #3	2, 4	Collect data for informed decision making.	Review requirements and community needs to participate in the Community Ratings System (CRS) program.	H	1-year	L	Springdale Town	Springdale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #4	1, 2, 6	Community planning to limit hazard exposure.	Adopt an Erosion Hazard Ordinance for washes in Springdale Town.	H	1-year	L	Springdale Town	Springdale Town
Flood #5	2, 6	Infrastructure improvement for public safety.	Construct erosion control/rip rap wall on bend of river near SR-9 south of Springdale Chevron and North of River Park.	M	5-years	H	Springdale Town, UDOT, NRCS	Springdale Town, UDOT, NRCS
Flood #6	2, 6	Infrastructure improvement for public safety.	Construct and implement an erosion hazard structure at sewer discharge point.	M	5-years	L	Springdale Town	Springdale Town
Flood #7	1, 2	Infrastructure improvement for public safety.	Assess culverts and side washes for capacity, size, and maintenance to address debris. Coordinate with UDOT to address the culverts under SR-9.	L	5-years	M	Springdale Town, UDOT	Springdale Town, UDOT
Landslide #1	2, 6	Collect data for informed decision making.	Regularly monitor the landslide at balanced rock behind Town Hall.	M	ongoing	L	Springdale Town, UGS	Springdale Town, UGS
Landslide #2	2, 4, 6	Collect data for informed decision making.	Coordinate with Utah Geological Survey to assess active landslides for stability.	M	3-years	L	Springdale Town, UGS	Springdale Town, UGS
Landslide #3	1, 2	Community planning to limit hazard exposure.	Implement set back requirements for development near slopes of marginal stability.	H	2-years	L	Springdale Town	Springdale Town
Wildfire #1	2, 6	Use natural systems to mitigate hazards.	Create a vegetation restoration plan for use following fire events to stabilize soils.	L	3-years	M	Springdale Town	Springdale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #2	2, 4, 5, 6	Use natural systems to mitigate hazards.	Coordinate with HVFSSD for residential wildfire mitigation and fuels reduction in Springdale Town.	H	Ongoing	M	Springdale Town, Hurricane Valley Fire District	Hurricane Valley Fire District
Severe Weather #1	1, 2	Infrastructure improvement for public safety.	Develop heat shelters through shade structures and streetscape design.	H	5-years	M	Springdale Town	Springdale Town
Severe Weather #2	2, 5	Community planning to limit hazard exposure.	Develop a plan for power outage response and recovery.	H	3-years	M	Springdale Town, Rocky Mountain Power	Springdale Town, Rocky Mountain Power
Severe Weather #3	1, 2	Use natural systems to mitigate hazards.	Investigate development standards to encourage green infrastructure design in stormwater management.	M	3-years	L	Springdale Town	Springdale Town
Severe Weather #4	2, 5	Infrastructure improvement for public safety.	Purchase and install emergency generators at critical public facilities.	H	3-years	M	Springdale Town	Springdale Town
Severe Weather #5	1, 2, 3	Collect data for informed decision making.	Identify and map cooling centers locally to promote shelter from extreme heat events.	M	2-years; ongoing	L	Springdale Town	Springdale Town
Earthquake #1	1, 2, 3	Inform the community of hazard risks.	Inform owners of structures built before the adoption of seismic code of mitigation techniques to improve building safety during earthquakes.	H	Ongoing	L	Springdale Town	Springdale Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Earthquake #2	2	Infrastructure improvement for public safety.	Assess roof mounted equipment on town structures for security during a ground shaking event. Coordinate with critical facilities to stabilize and protect essential equipment from ground shaking.	H	2-years	M	Springdale Town	Springdale Town
Earthquake #3	2	Collect data for informed decision making.	Assessment of critical water infrastructure for seismic safety.	M	5-years	M	Springdale Town	Springdale Town
Radon #1	3	Inform the community of hazard risks.	Provide public information about residential radon testing.	M	Ongoing	L	Springdale Town, DEQ	Springdale Town
Radon #2	2, 4	Collect data for informed decision making.	Coordinate with Washington County School District to complete Radon testing in Springdale area schools.	M	2-years	L	Washington County, Washington County School District	Springdale Town, Springdale Elementary, Washington County, Washington County School District

Source: Local Planning Team

Toquerville

The City of Toquerville was settled by Mormon Pioneers in the mid-1800s, by Mormon pioneers. Its placement in a riverine canyon bottom made Toquerville a good location for agricultural endeavors in the area. The community is located south of Black Ridge and located on the stream called Ash creek, roughly 30 miles south of Cedar city and 20 miles north of St. George. The community has a small population of full-time residents and sees annual visitation to the community and Zion National Park over 3.5 million. Toquerville provides access from the North to Zion National Park from I-15, and sees people traveling Highway 17, which runs through the center of town.

The community may receive snow during the winter, which often melts during the heat of the day. Summer tends to produce high heat and monsoon thunderstorms, which drops rainfall, hail, and lightning across the region. Annual precipitation is sparce and the city regularly receives strong winds.

Demographics

Toquerville is a rural community in southwestern Utah. As of the 2018 American Community Survey, the community has a population of 2,031 people, described in Figure 499. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

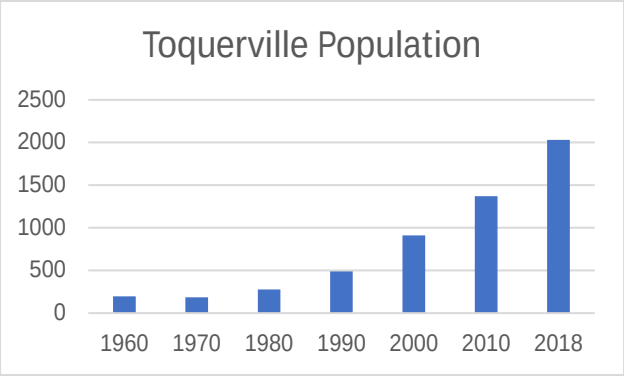


Figure 499: Toquerville Population by Decade

The Toquerville population saw growth from 1970 to 2010, although the 2018 estimated population indicates a decline in population. Population changes over the past several years, described in Figure 500, shows that the population has been increasing by an average of 41% each decade between 1960 and 2010, with peak change observed in 2000 at 86.5%.

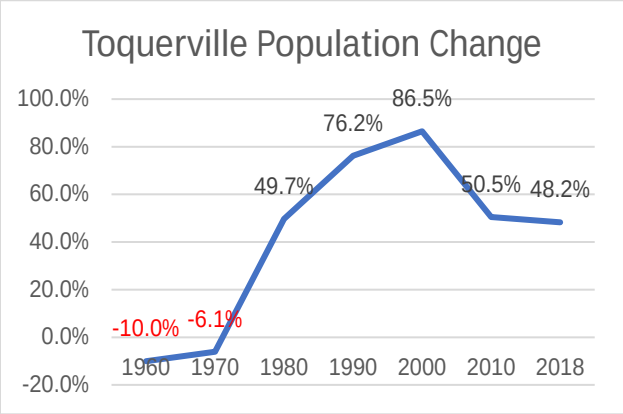


Figure 500: Toquerville Population Change

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Toquerville, the community could see 6,047 people living in the community in the next 45-years[30].

Economy

Toquerville's historic economy revolved around homemaking and wineries in the region at the time of colonial settlement. Since that time, the community has grown to include several local businesses,

[30] This estimate is created using the 2015 ACS population estimate for Toquerville, which was 1,838, and adding 229% of this population estimate to the population for that year.

restaurants, and other commercial endeavors. The community is a gateway to Zion National Park, which draws millions of annual visitors through the community.

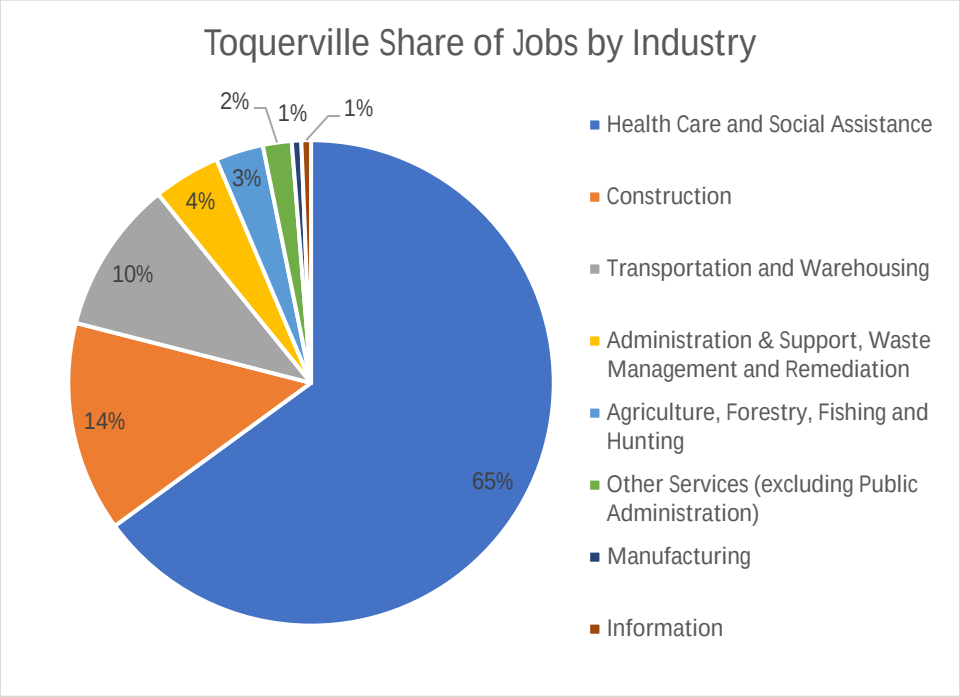


Figure 501: Toquerville share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts Toquerville's prominent industries by the number of jobs supported in the community, illustrated in Figure 501. Over 65% of the jobs in the community are in the Healthcare and Social Assistance industry. A recovery center is in Toquerville, which likely contributes to the prominence of this industry in the community, in addition to an overall aging population which may need additional services. Construction and transportation and warehousing are also significant employers. The community still maintains agriculture, forestry, fishing, and hunting industries, which were historically prominent to the area following colonial settlement.

Development

Toquerville has had a recently proposed 4.5-mile transportation route which will run to the west side of the city, called the Toquerville Parkway. The new roadway is expected to bring more commercial growth to the area.

Toquerville New development is occurring dominantly to the west of the city boundaries. There are three significand residential developments expected to bring several thousand units to the community between the Toquerville boulevard and the Toquerville Parkway Bypass Road. A large athletic complex of 600 acres is being developed in these areas near Bureau of Land Management lands.

Community Capabilities

Toquerville is governed by a mayor and council, who engage in executive and legislative activities for the community, respectively. Elections for these positions are every four years. Administrative staff include a city manager, treasurer, recorder, public works administrator, building inspector, and water and maintenance official who support the implementation of legislative actions. A planning commission also

supports specialized review and recommendation of planning and zoning activities in the community to the council.

Public safety is provided by Washington County, who provides law enforcement through the Sheriff's office. Fire and Emergency Medical Services (EMS) is provided by the Hurricane Valley Fire District.

Garbage, water, and sewer utilities are provided by Toquerville City. Natural Gas is provided through Rocky Mountain Power.

The community has three City parks available for public use and open space.

Plans and Policies

Toquerville City has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Toquerville City's plans and policies as they relate to natural hazards. Additional plans may exist, which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

Local codes and ordinances for Toquerville city address a range of natural hazards, including landslides, floods, wildfire, severe weather, drought, and problem soils. The community sets requirements for development in areas exposed to these natural hazards and practices local homeowners can take to mitigate community wide impacts of the respective natural hazards.

General Plan

The Toquerville General Plan (2017) documents the long-term community vision for the city, as described by residents through public comments and hearings. Natural Hazards are not an element of the general plan; however, the land use, housing, transportation, economy, and public services elements can describe natural hazard risks and gaps to mitigation. General plans are often a vision which is implemented through the adoption of code by a community. The general plan describes the need for consideration of development and placement of infrastructure in potential hazard areas. Standards for residential and commercial properties weed and debris abatement also can act as a hazard mitigation technique. The community addresses severe weather through emphasizing weatherization techniques and managing the stormwater drainage system in line with development, which can reduce exposure of residents to high-risk situations.

Standard and Specifications

The Toquerville Standards of Specifications (2020) describe the conditions and instructions for infrastructure improvements in the city. Standards include the use of irrigation ditches for storm water flows, drainage control requirements, storm drainage and culvert design, description of allowable development in floodplains, and allowable locations of public water mains to address flooding.

Parks Master Plan

The Toquerville Parks Master Plan (2016) describes Natural Hazards in the park aesthetics, location, and features in the community. Steep slopes are described as being integrated into community amenities,

including an amphitheater and in other cases are described needing vegetation, trees, and rock mulch to be added to the steep slopes for aesthetic purposes. Flooding is described as a risk to many parks in their current condition, and potential future growth needs. Actions in the plan describe needs for assessment & mitigation in flood prone areas near parks, the potential for flooding on creeks and streams damaging park improvements, and integration of stormwater detention basins into park amenities.

Water Conservation Plan

The Toquerville Water Conservation Plan (2019) addresses the need for water conservation programs and practices to meet future water needs in the community, considering rapid growth in the state of Utah. Drought is the only natural hazard addressed in this plan. Action for water conservation include addressing outdoor water use locally, recommending that residents use drought resistant vegetation and trees in landscaping.

Capital Facilities Plan

The Toquerville City Capital Facilities Plan (2020) describes the essential facilities needed to support the resident population and the volumes of visitors to the area which use community infrastructure, includes the need to plan for future uses of facilities. Water pipes, streets, storm drainage, trails, parks, and other facilities are described in this plan. Some of the critical facilities included in the plan include steep slopes which could be made more aesthetically pleasing by adding vegetation, tree, and shrub planting, extending storm drain infrastructure on local roads, and adding beautification features to a stormwater detention pond in a local park.

Transportation Plan

The Toquerville City Transportation Master Plan (2018) seeks to identify the transportation network to successfully plan for future needs, development, and growth. The plan highlights certain environmental concerns which the city may be exposed to, which include problem soils and flooding challenges and describes certain transportation “enhancements” which would include water runoff mitigation, which could be a mitigation tactic for severe weather and flooding events.

Risk Assessment

Toquerville is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Toquerville planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 481 describes the relative risks of hazards in the community.

Table 481: Toquerville Risk Assessment Summary

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. High
SEVERE WEATHER	3. Moderate

WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Moderate
RADON	7. Low
PROBLEM SOIL	8. Low

A detailed description and mapping of each of the natural hazards that impact Toquerville can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hurricane include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Toquerville is a town marked by its access to outdoor recreation and open spaces. The urban community is considered a gateway to the recreation opportunities in southeastern Washington County, including Zion National Park. There are also roadway and water assets in the community which may be vulnerable to wildfire, including Ash Creek and I-15.

Figure 502 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Toquerville that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

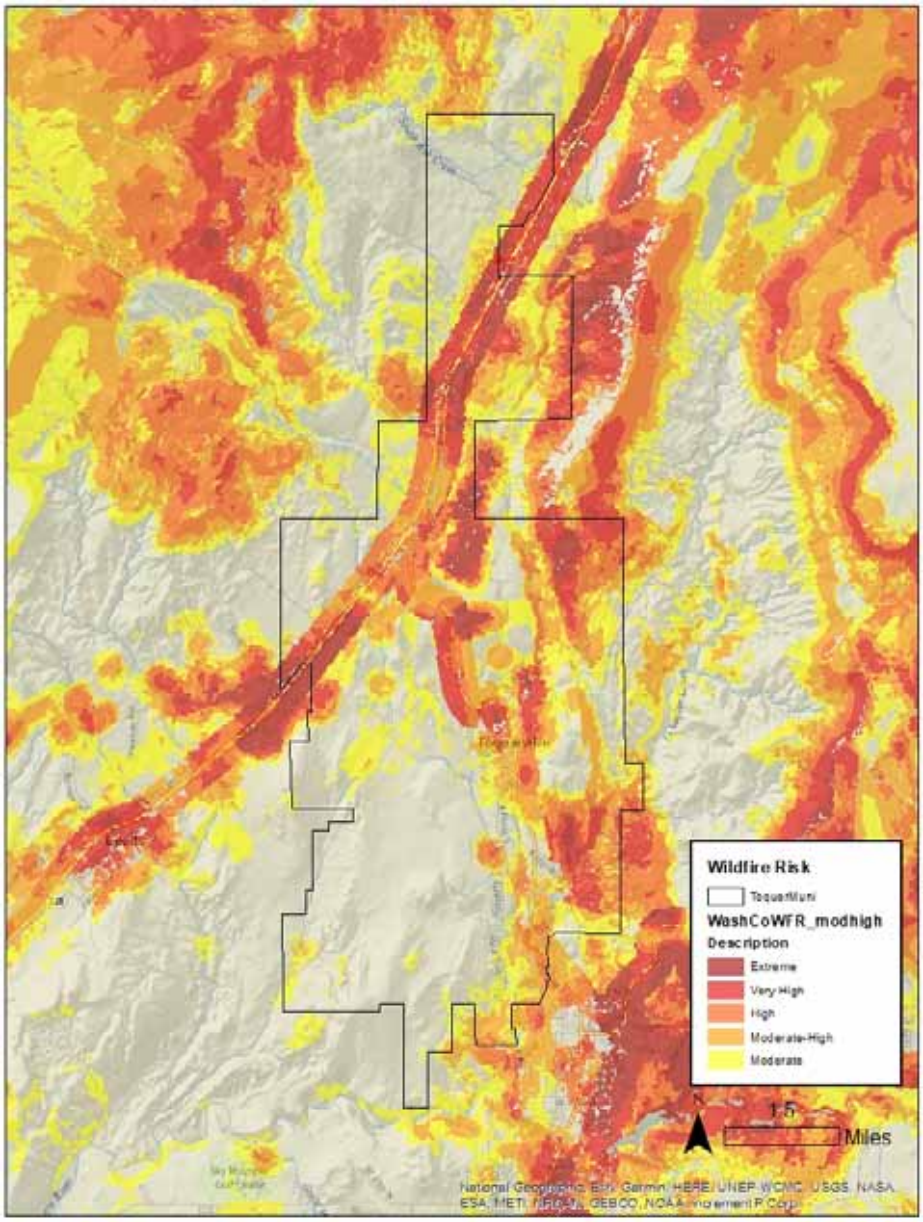


Figure 502: Toquerville Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 482 further describes Toquerville's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Toquerville, which could damage property, impact public health and safety, or impact local economies. Almost all commercial and residential parcels are exposed to wildfire risk areas in Toquerville, which can have an impact on local economies and access to goods and services for residents, in addition to endangering life and personal property. Forty-three percent of the road miles in the community are at moderate to extreme wildfire risk, which can challenge response and recovery and the travel of people and goods. All Toquerville critical facilities are exposed to moderate or greater wildfire risk, which can impact response, equipment, and facilities essential for community function.

Table 482: Toquerville Wildfire Risk

Toquerville Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	100.0%	86.5%	86.7%	43.8%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. In addition to these sources, this plan references previous documentation from the 2016 NHMP and news articles. Table 483 summarizes the wildfire events which have impacted Toquerville.

Table 483: Toquerville Wildfire Record

Fire Name	Year	Acres Burned	Description
Anderson Junction Fire	2020	350	Caused by dragging chains on the roadway. Resulted in the evacuation of several homes.
Sandy Fire	2020	Unknown	Caused by lightning strike. Closed a campground and guard station due to fire danger.

Source: Utah Fire Info

Utah Fire Info reported a 2020 fire which was started by a lightning strike and endangered a campground/guard station near Toquerville. Another fire which was started in 2020 was caused by chains dragging by a vehicle on the roadway, which sparked a brushfire which consumed 500 acres and evacuated homes. Other fires may have occurred near Toquerville but were not documented on the sources used. Fires elsewhere in the county or region may have also impacted Toquerville with secondary impacts.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Hildale, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 503 shows the mapped earthquake epicenters and fault lines in Toquerville.

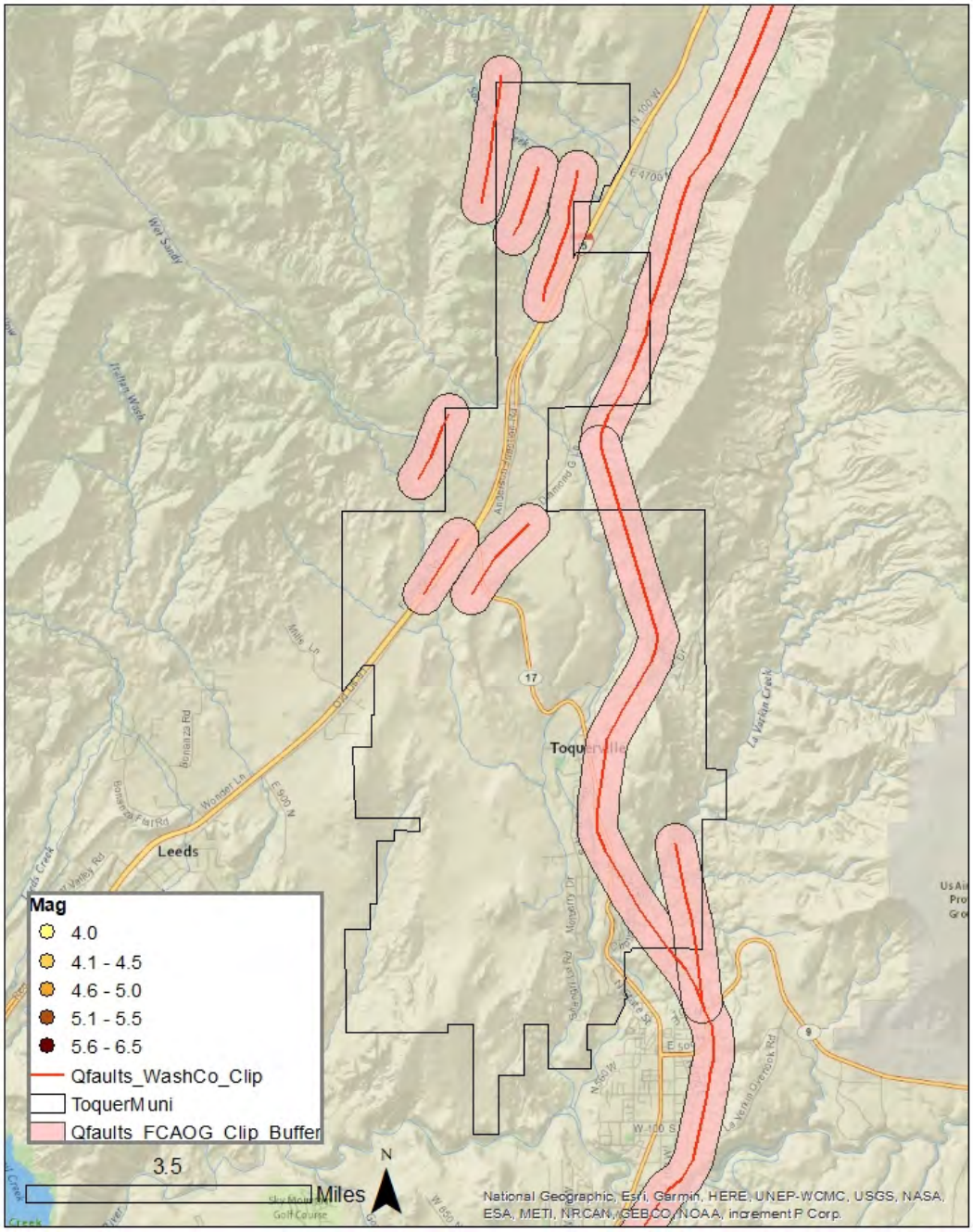


Figure 503: Toquerville Earthquake Epicenters and Quaternary Faults

Source: Utah Geological Survey and University of Utah Seismology

Segments of the Hurricane Fault have been identified in the Toquerville City limits, and impacts community assets, as described in Table 484. Faults are generally identified on the eastern portion of the community, and interact with one critical facility, multiple commercial properties, and several residential properties, which can impact personal safety, property, and emergency response during a ground shaking or earthquake event. Road miles have the greatest exposure to quaternary faults, at approximately 30.3% of the asset within a quarter mile of identified faults.

Table 484: Toquerville Exposure to Quaternary Faults

Toquerville Exposure to Quaternary Faults						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
50.0%	75.0%	47.4%	47.7%	30.3%	N/A	N/A

Source: UGS, Garfield County Assessor, AGRC

Another identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 92 Toquerville structures were built before the adoption of seismic code requirements, approximately 18.3% of the total structures in the city boundaries. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Toquerville. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid, which can be a risk to structures and property on susceptible soils. Figure indicates that Springdale has areas of moderate to very high susceptibility to liquefaction hazards.

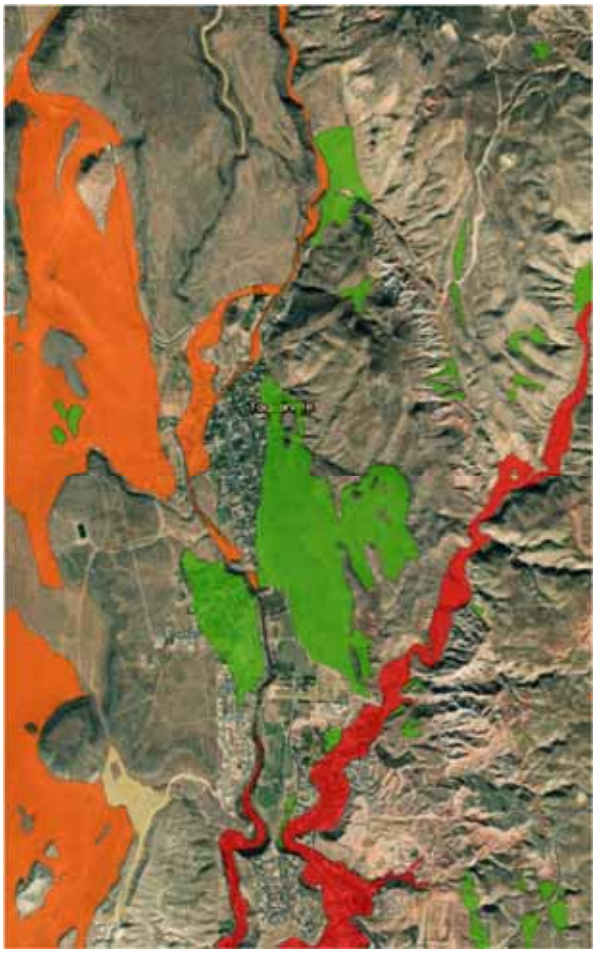


Figure 504: Toquerville Liquefaction Susceptibility

Source: Utah Geological Survey

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters or faults are identified in the municipal boundary, although an earthquake epicenter is identified in the Zion National Park, 4.5 miles from Springdale. Earthquakes elsewhere in the county may have been felt and caused impacts in Toquerville, including the 1992 5.8 magnitude earthquake with an epicenter in Washington City. This earthquake caused impacts from Flagstaff, AZ to Richfield, Utah and from Las Vegas, NV to Escalante, UT. (Peterson) Impacts from this event included damages to building walls as the shaking loosened plaster and walls cracked throughout the region.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining or volcanic eruptions. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 505 depicts the mapped 100-year floodplain, dam inundation, and riverine erosion exposure in Toquerville. The Virgin River seems to be primary corridors for flooding potential.

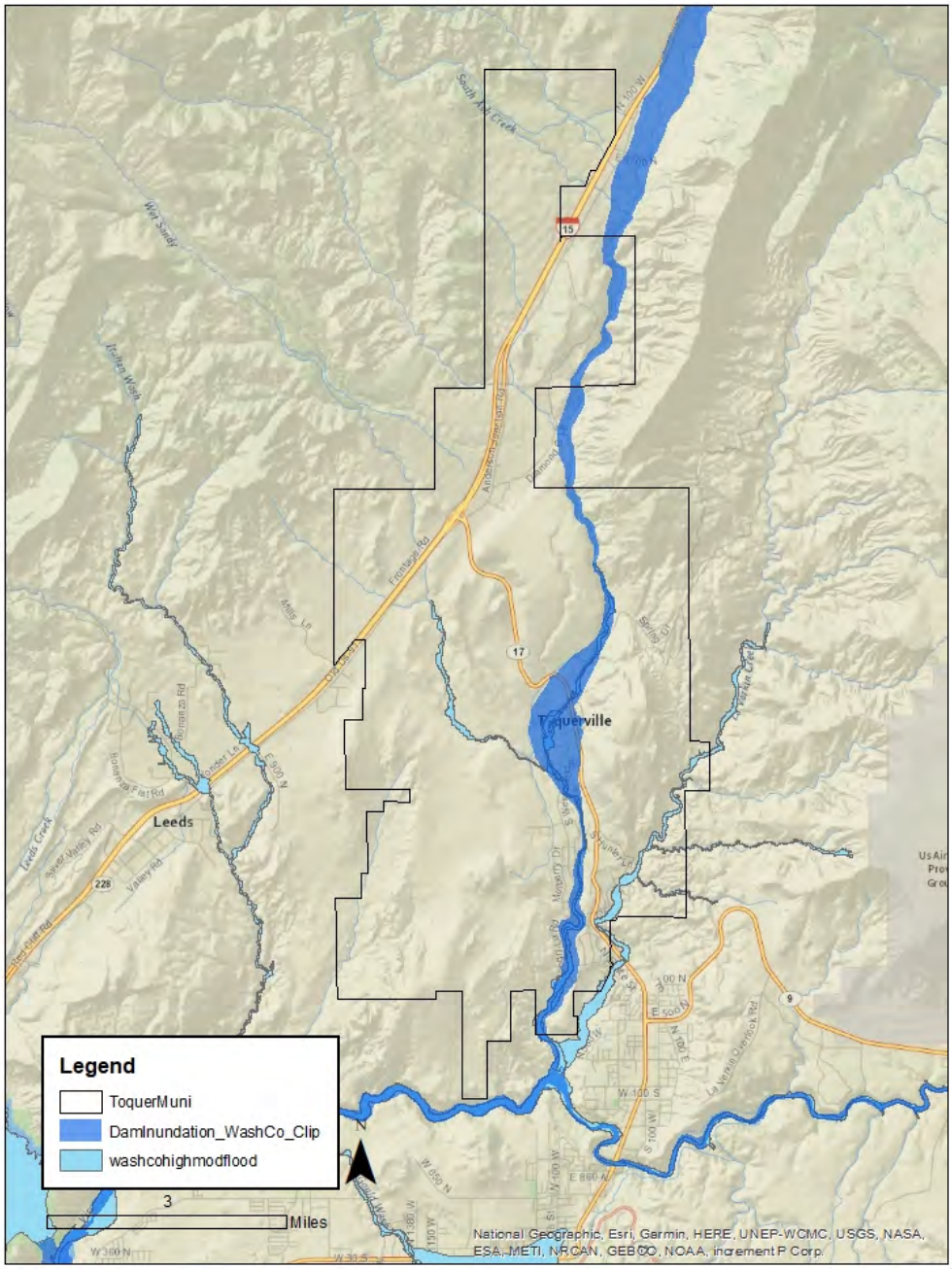


Figure 505: Toquerville Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 485 describes the Toquerville community assets exposed to dam inundation, and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Commercial parcels and critical facilities are also identified in flood risk areas. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood. All the community's critical facilities are exposed to flood risk areas. Impacts from flood on a critical facility may result in delays in service, damage, or loss of equipment, among other potential outcomes.

Table 485: Toquerville Exposure to Floodplain and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
100.0%	75.0%	44.7%	45.0%	14.7%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

Toquerville property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 486: Toquerville NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$5,058	0	3	11	$3,520,000	1	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Toquerville participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. The city has hired a consultant to act as the floodplain administrator who is addressing compliance issues with the State NFIP coordinator. The consultant assists the city in understanding and enforcing the floodplain ordinance, including requiring new development and construction in the floodplain to obtain a floodplain development permit. The city has enacted a development moratorium on building in the floodplain until a new floodplain ordinance can be adopted.

Table 486 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. No repetitive losses have been reported for Toquerville. A Community Assistance Contact and a Community Assistance Visit were completed in 2019 and 2011 respectively.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 487 describes the flooding events which have impacted Toquerville and the surrounding area.

Table 487: Toquerville Reported Flood Events 1997-2020

Date	Damage/Injury	Description
9/6/2002	$20,000	One inch of rain fell in less than ten minutes, causing flooding of a field and a barn, resulting in $10,000 in property damage and $10,000 in crop damage.
10/20/2004	$25,000	A severe storm caused significant flooding in Southwestern Utah. High waters from creeks damaged bridges in Toquerville.
8/19/2012	None Reported	Thunderstorms produced flash flooding in Southern Utah.
8/26/2014	None Reported	Flash flooding on La Verkin Creek in Toquerville had an observed increase in the rain gauge to 800 CFS.
7/17/2018	None Reported	I-15 near Leeds was closed due to flash flooding.

Source: NOAA Storm Database

Other flooding events may have impacted Toquerville but were not reported or did not describe impacts to the community in their report. Referencing the flood history from other communities or Washington County may provide additional context to Toquerville's flood history or potential.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events interact with the built environment and human activity. Figure 506 maps the landslide and rockfall susceptible areas are observed in Washington County, with Toquerville highlighted.

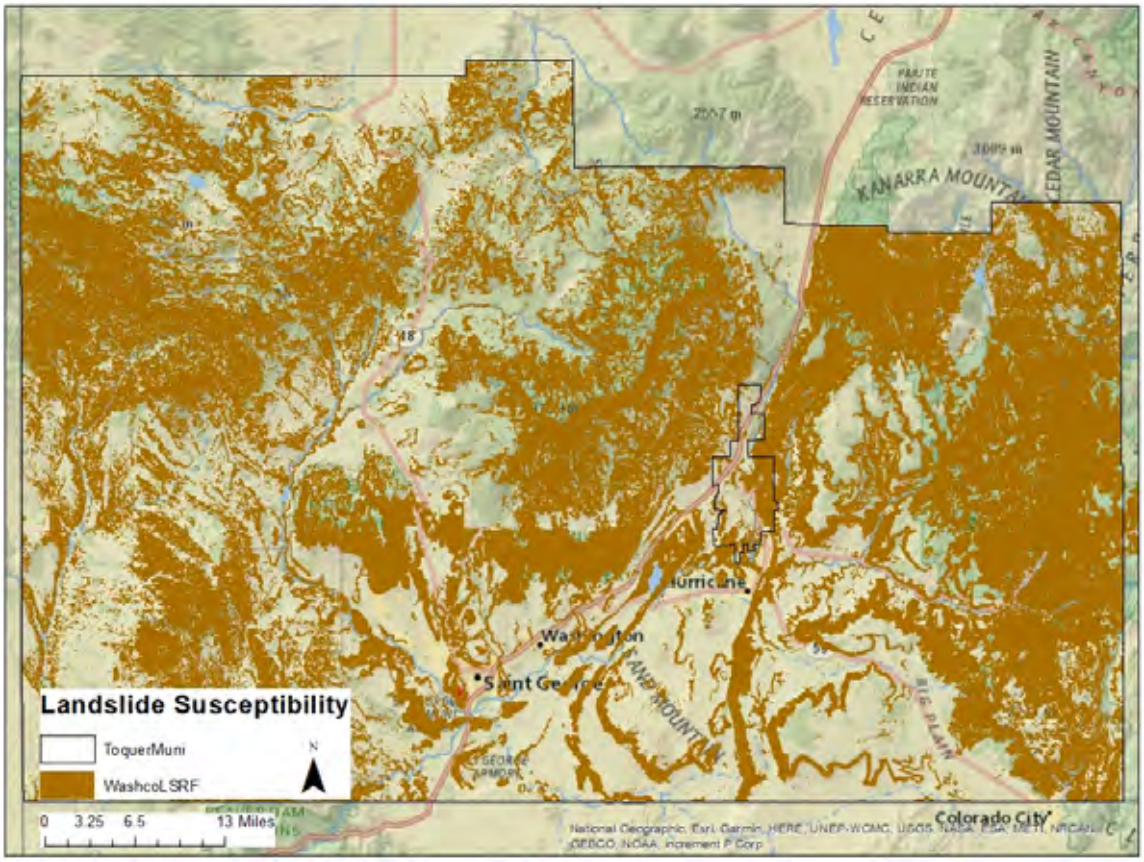


Figure 506: Toquerville Landslide Susceptibility

Source: Utah Geological Survey

Toquerville is exposed to landslide susceptible areas throughout the community, especially along hills and cliffsides. Table 488 describes the exposure of community assets to landslide susceptible areas. At least half of critical facilities, commercial parcels, and road miles are also exposed to landslide and rockfall susceptible areas, which can impact life, property, and essential infrastructure. Landslides can block or damage roadways, causing delays and access challenges within a community. Without proper planning, future growth could place development in landslide risk areas, increasing risk of landslide impacts.

Table 488: Toquerville Landslide Susceptibility Exposure

Toquerville Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			

50.0%	62.5%	29.4%	29.8%	56.5%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. There have been no landslides described for Toquerville in data accessed from news reports, the US Geological Survey, Utah Geological Survey, and other sources. Landslides and rockfall are common to the southwest and although an event has not been reported in the past, a landslide in Toquerville is still possible.

Several factors contribute to the potential or increased risk of landslides. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslide events can trigger or be triggered by other natural hazard events. Landslides can lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 507. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

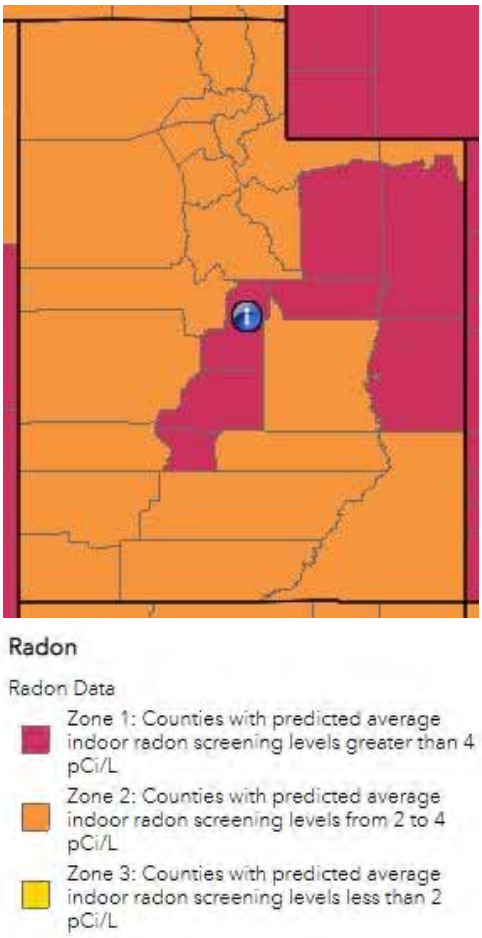


Figure 507: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 489 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 489: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Toquerville, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Toquerville sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning. Winters in the high elevation areas can experience snow and rain fall.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Toquerville has several reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 490. While the deaths reported during the 2013 events did not occur in Springdale, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers, are vulnerable to these extreme temperatures.

Table 490: Toquerville Severe Weather Record

Date	Damage/Injury	Description
8/30/1999	None Reported	A heavy rainstorm produced two inches of rain fall in an hour in Toquerville.
10/16/1999	None Reported	Strong winds with gusts of 50 MPH recorded in Toquerville.
3/28/2006	None Reported	Rain fall of 1.60 inches was reported in Toquerville.
7/16/2012	None Reported	A thunderstorm in in Toquerville produced hail over Hurricane.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.

Source: NOAA Storm Database

Thunderstorms and associated impacts including hail, rain, and high winds impact Toquerville. Hundreds of severe weather events have been reported for Washington County. There may have been events reported for the County or other nearby communities which impacted Toquerville but did not have described impacts for the community. Community members should reference these sections of the plan for further information.

Severe weather is frequently occurring throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. Figure 508 illustrates where the Utah Geological Survey has mapped problem soils in, and surrounding Toquerville. Expansive soils are mapped in the southwestern portion of the community.

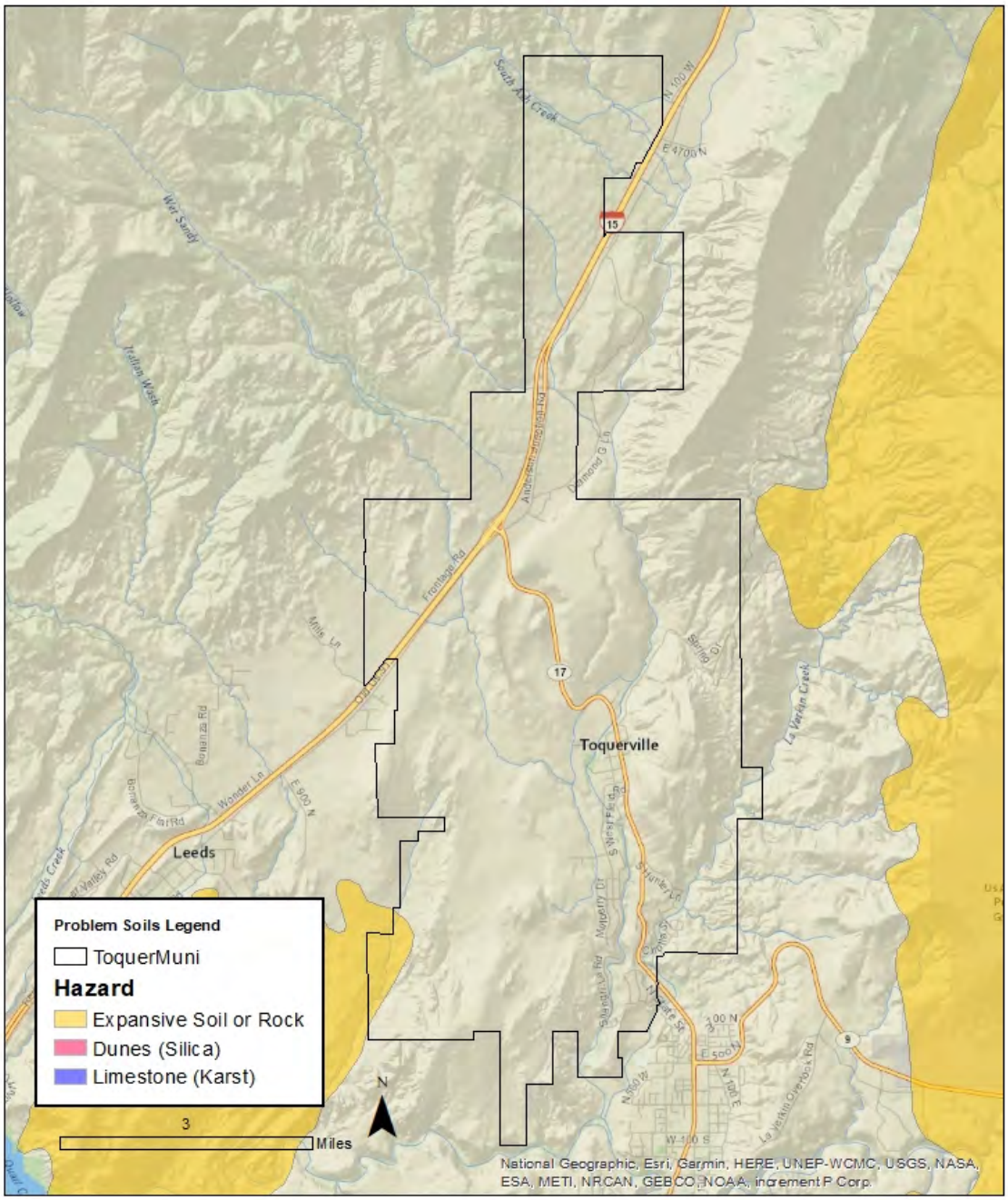


Figure 508: Toquerville Problem Soils Map

Source: UGS, AGRC

Community assets, infrastructure, and property are exposed to problem soils, with the greatest exposure being in road miles, as described in Table 491. Problem soils are often challenging to structures and infrastructure, as when the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure. Only a small portion of road miles are exposed to problem soils, identified as expansive problem soils. Roads and infrastructure under a road can be damaged by soil changes and homes and structures can have foundation stability issues.

Table 491: Toquerville Problem Soil Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	0.0%	0.0%	0.0%	1.6%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, UDOT

The Utah Geological Survey has developed updated mapping for some communities in the region, which provides greater detail about the susceptibility and potential for problem soils and the types prevalent to the region. Toquerville is included in this mapping study area for caliche, collapsible soils and rock, expansive soils and rock, karst features, piping and erosion susceptible soil, shallow bedrock, soluble soil and rock, and wind-blown sand. Figure 509 through Figure 516 map the identified problem soils for the area in greater detail. The updated mapping is available in an online format only and was not used for GIS analysis. Table 491 does not reference the identified soils or extent from the updated mapping.

Caliche

Figure 509: Toquerville Caliche Susceptibility

Collapsible Soil

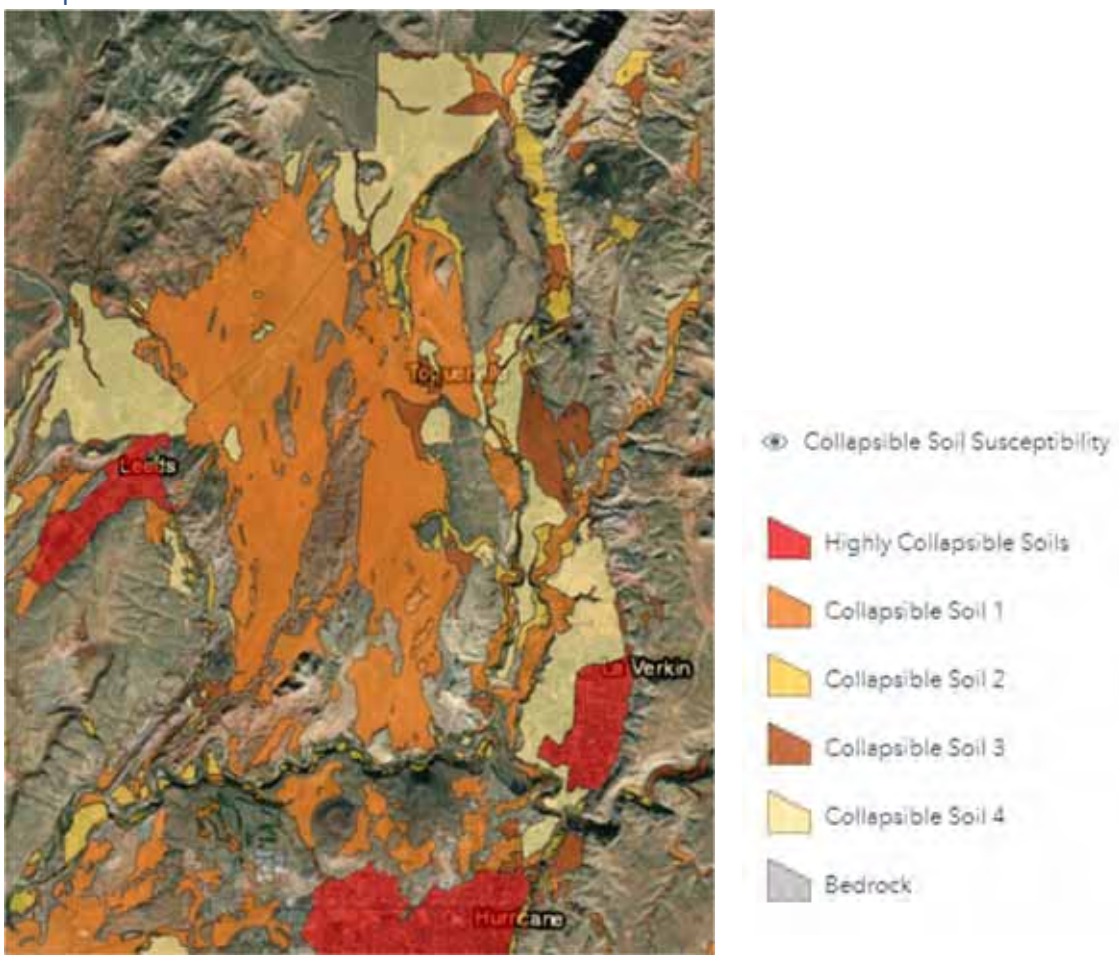


Figure 510: Toquerville Collapsible Soil Susceptibility

Expansive Soil and Rock

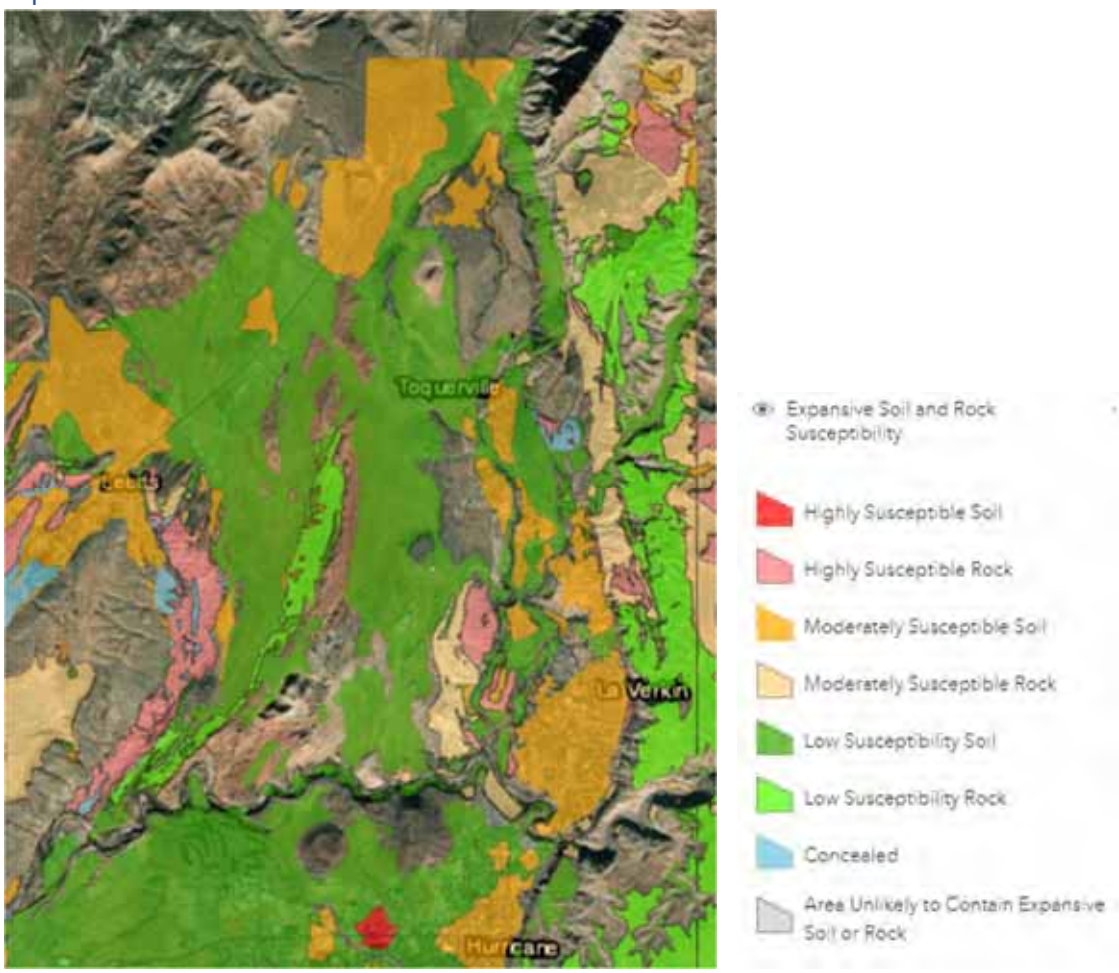


Figure 511: Toquerville Expansive Soil and Rock Susceptibility

Karst Features

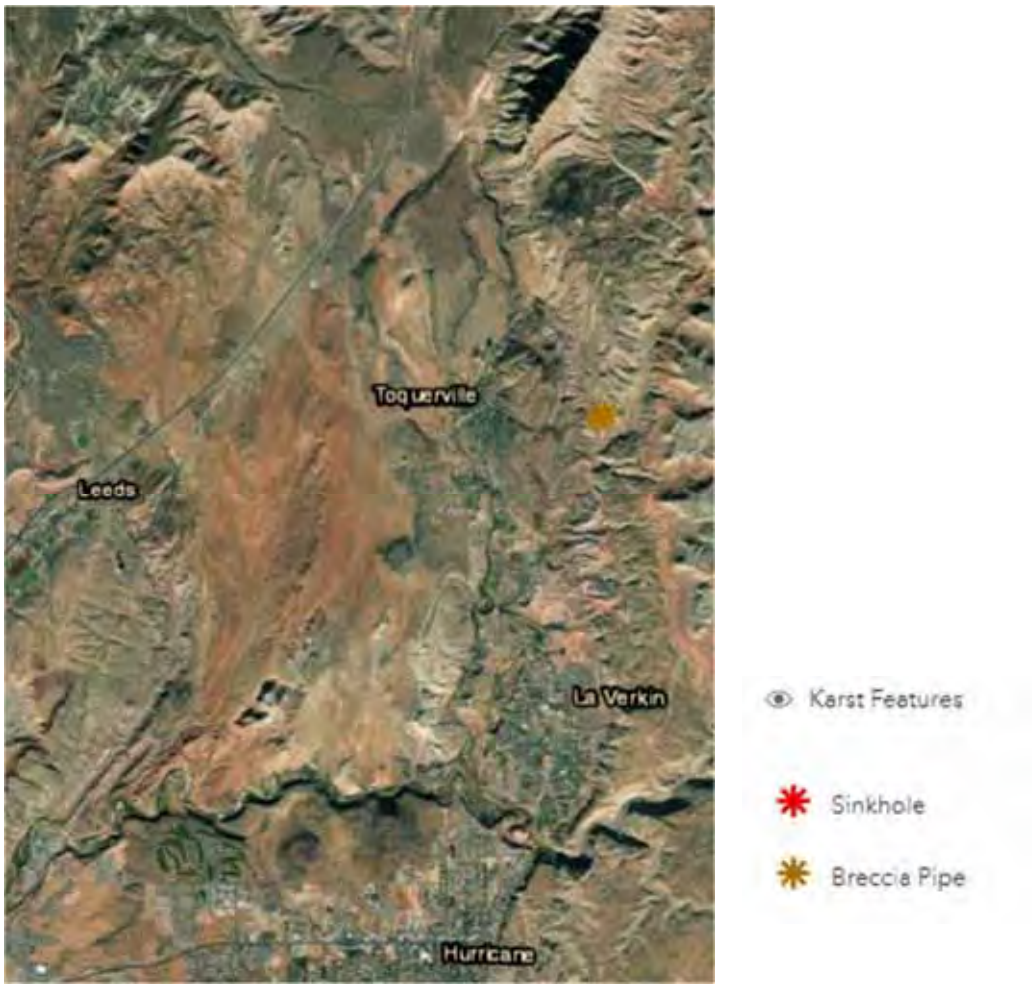


Figure 512: Toquerville Karst Features

Piping and Erosion

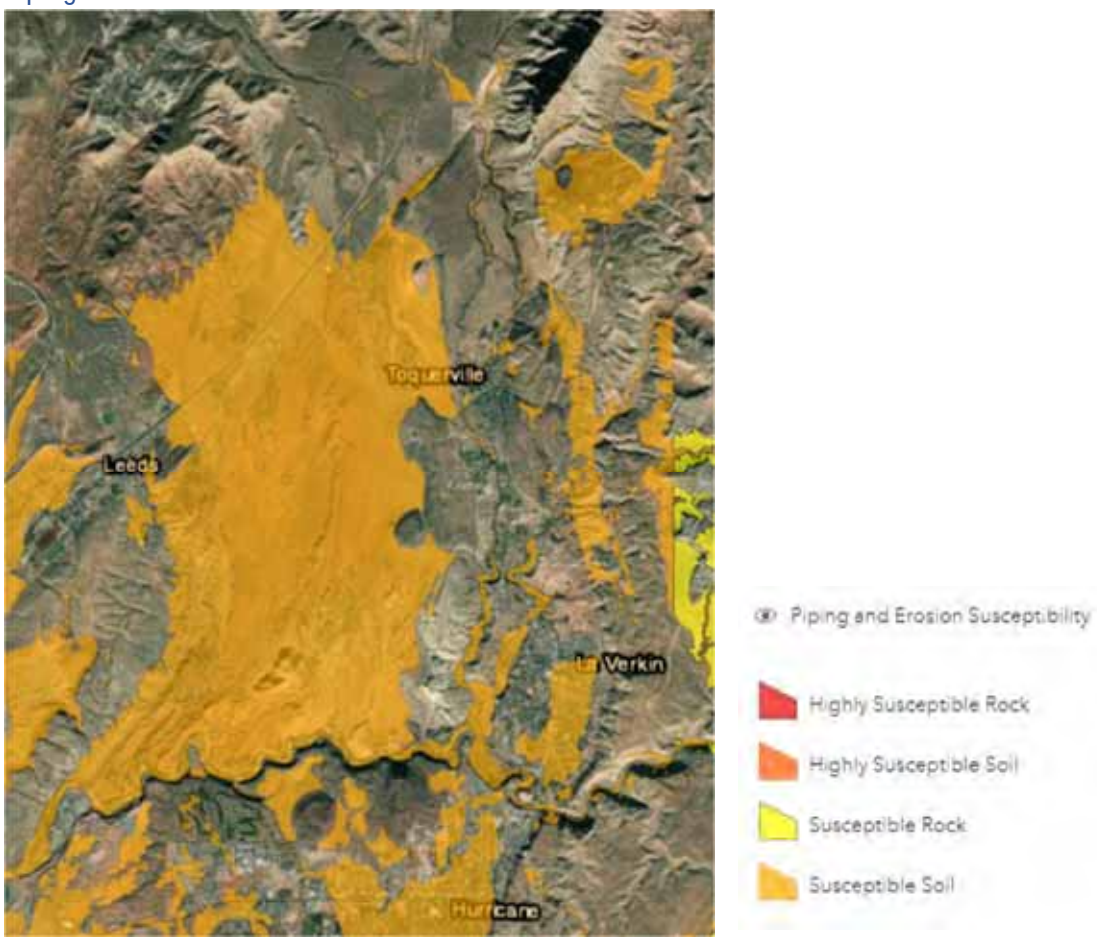


Figure 513: Toquerville Piping and Erosion Susceptibility

Shallow Bedrock Potential

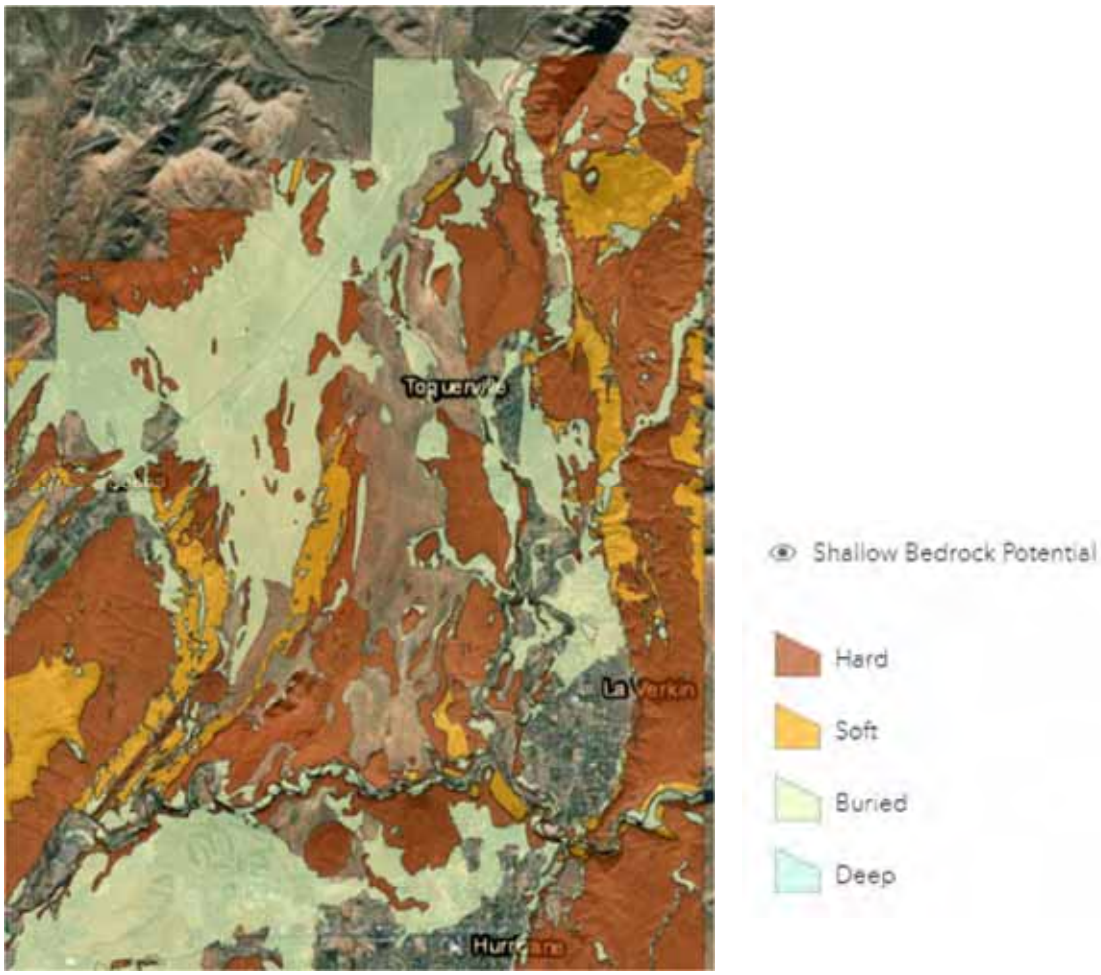


Figure 514: Toquerville Shallow Bedrock Potential

Soluble Soil and Rock

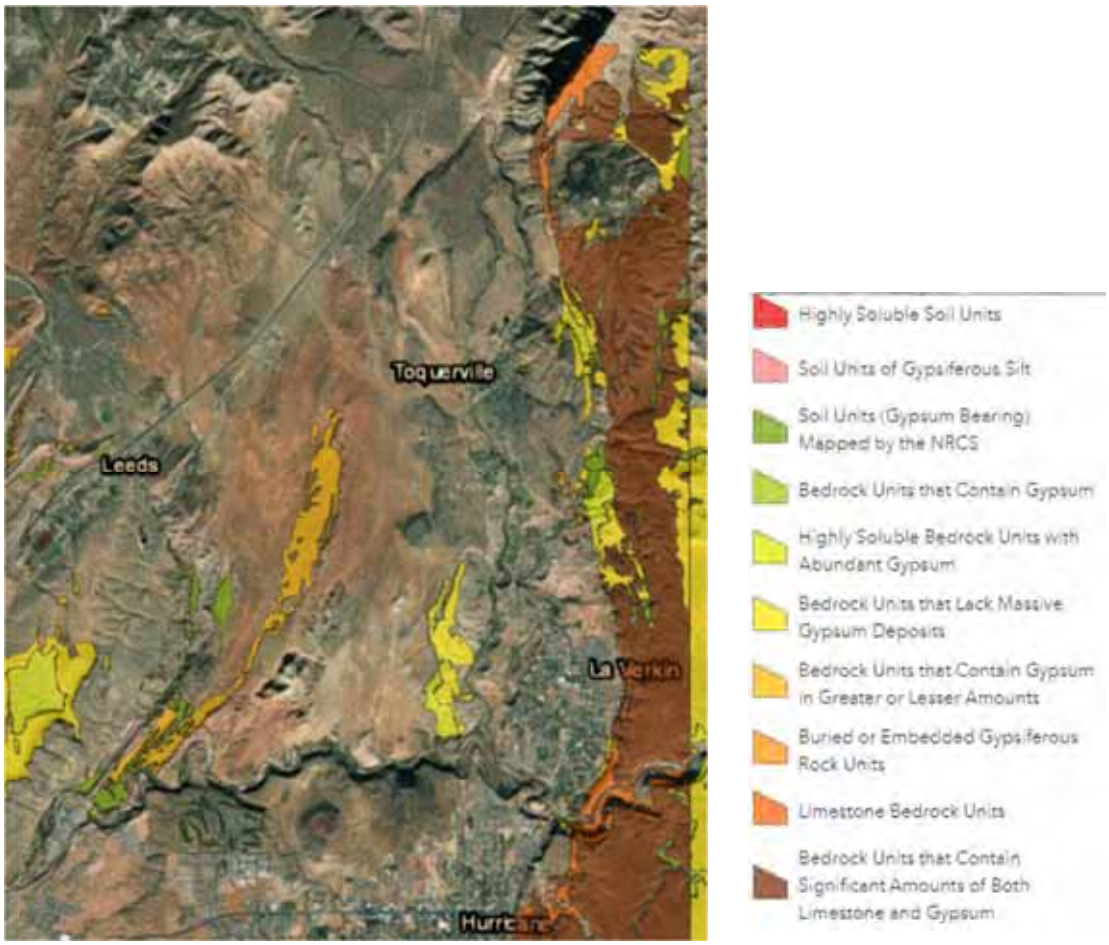


Figure 515: Toquerville Soluble Soil and Rock

Wind-Blown Sand

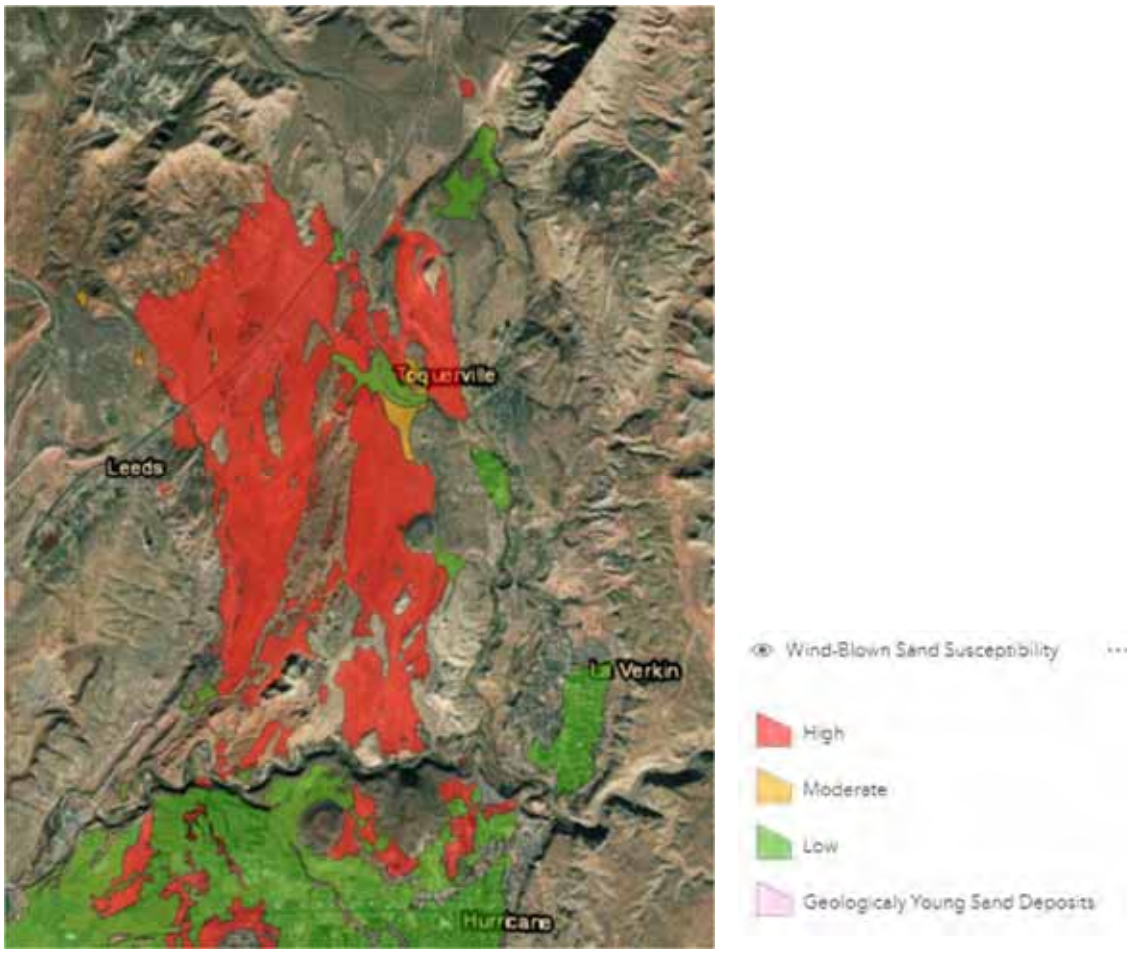


Figure 516:Toquerville Wind-Blown Sand Susceptibility

The new mapping indicates that Toquerville is highly susceptible to windblown sand and is exposed to all the other soil types. Soil types vary across the community, whether near the Virgin River, cliff and hillsides, or valley areas.

The community and the county do not have a record of problem soil impacts, although building permits should identify where studies were required, whether problem soils have been discovered on a site and what types of mitigation were completed.

Risk Assessment Summary

Toquerville is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Residents are at risk to injury and property damage from several natural hazards. Toquerville critical facilities are vulnerable to severe weather, landslide, flood, earthquakes, and wildfires. Impacts from these natural hazards can impact an organizations capacity to respond to an emergency event.

Transportation routes have been impacted by historic natural hazard events and are exposed to several natural hazard susceptible or risk areas. I-15 and SR-17 are the primary access road to the community

and impacts on this road can cause traffic delays locally, impact access to the community, and delay the transportation of goods, depending on the extent of the impacts.

Commercial and residential parcels are likewise exposed to several natural hazards, which can result in loss of property, life, damages, and economic impacts if damages delay regular business operations or transportation routes.

Mitigation Strategy and Actions

Toquerville has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 492 describes progress made on Toquerville mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 492: 2016 Toquerville Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood/ Drought #1	Prevent flood waters from subverting bridge structures. Maintaining dam water levels.	Clear willows and other debris from Ash Creek.	Semi-Annual	Toquerville Operating budget (water Budget) Partnered with the Water District, La Verkin, and Hurricane	Ongoing, still needed.

Source: 2017 Five County Association of Governments NHMP

The Toquerville planning team identified actions to include in the community mitigation strategy. Each action in Table 493: Toquerville 2022 Mitigation Strategy includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 517.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 517: Regional Plan Goals

- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Table 493: Toquerville 2022 Mitigation Strategy

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	1, 2	Protect critical riparian areas and drainages.	Adopt an erosion hazard zone through water courses and drainages in the City.	H	1-year	L	Toquerville City	Toquerville city, Floodplain Manager
Flood #2	1, 2	Collect data to inform mitigation needs and local decision making.	Inventory drainages, washes, and riparian areas for erosion protection needs.	M	Ongoing	L	Toquerville City, BLM, Washington County	Toquerville City, Floodplain Manager
Flood #3	1, 2, 4, 6	Conserve and maintain essential riparian and drainage areas.	On identified drainages, washes, and riparian areas, implement bank stabilization techniques.	M	Ongoing	L	Toquerville City, BLM, Washington County	Toquerville City, Floodplain Manager
Flood #4	2, 5	Collect data to inform mitigation needs and local decision making.	Inventory all bridges along washes for erosion protection, structural stability, and flood capacity.	M	5-years	M	Toquerville City, UDOT, Washington County, FEMA	Toquerville City, Floodplain Manager
Flood #5	2, 5	Maintain critical infrastructure.	At identified bridges, harden bridge infrastructure to address flooding, erosion, and structural stability concerns.	M	Ongoing	M	Toquerville City, UDOT, Washington County, FEMA	Toquerville City, Floodplain Manager

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #6	2	Prevent flood waters from subverting bridge structures. Maintaining dam water levels.	Clear willows and other debris from Ash Creek.	H	Semi-Annual	L	Toquerville Operating budget (water Budget) Partnered with the Water District, La Verkin, and Hurricane	Toquerville City
Wildfire #1	1, 2, 4, 6	Reduce fuel loads in interface areas.	Inventory hillsides and washes in need of fuels mitigation in the community. Remove fuels in identified areas of need.	M	Ongoing	L	Toquerville City	Toquerville City, Hurricane Valley Fire SSD
Wildfire #2	1, 2, 4, 6	Reduce fuel loads in interface areas.	Inform residents of wildfire risks and activities/programs available for individual or neighborhood level mitigation like Firewise, on the City website and social media.	H	Annually	L	Toquerville City	Toquerville City, Hurricane Valley Fire SSD
Severe Weather #1	2	Protect identified vulnerable power infrastructure	Removal of hazardous trees and tree limbs which threaten power infrastructure.	H	Ongoing	L	Toquerville City	Toquerville City
Drought #1	2	Increase water storage capacity.	Work with the Washington County Water Conservancy District to complete the Toquerville Reservoir.	H	5-10 years	H	Toquerville City, Washington County Water Conservancy District.	Toquerville City, Washington County Water Conservancy District.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #2	2	Increase water storage capacity.	Pump water from the Springs Drive water storage tank to relocate and rehabilitate the Springs Drive Tank.	M	2-years	M	Toquerville City, CIB, CDBG	Toquerville City
Earthquake #1	2	Retrofit historic town property.	Complete an assessment of the historic town hall constructed of sandstone for seismic safety. Implement recommended retrofits to preserve the historic structure.	M	2-5 years	M	Federal and State Historic Tax Credit, Preservation Utah	Toquerville City
Earthquake #2	1, 2,	Upgrade infrastructure to more resilient materials.	Replace water lines on Toquerville Boulevard and Ash Creek with flexible materials resilient to earthquake.	M	5-years	H	Toquerville City, CIB, CDBG	Toquerville City
Landslide #1	1, 2, 4	Address public safety hazards on roadways	Inventory potential rockfall locations from Anderson Junction south. Coordinate with UDOT to address landslide mitigation.	L	Ongoing	L	Toquerville City, UDOT	Toquerville City, UDOT
Landslide #2	6	Limit development on land with identified natural hazards.	Acquire identified property on the south end of Toquerville, near La Verkin, where slopes greater than 30% grade pose significant development challenges.	L	5-years	M /H	Toquerville City, FEMA	Toquerville City, private property owners.

Hazard ID	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Problem Soils #1	2, 5	Address public safety hazards on roadways	Inventory Toquerville roads which collect windblown sand. On identified roadways, implement potential mitigation measures.	M	Ongoing	M	Toquerville City, UDOT, Washington County	Toquerville City, UDOT, Washington County
Radon #1	3	Inform residents of natural hazard risks and mitigation options available.	Inform the public of radon gas risks, testing, and mitigation techniques using City website and social media.	H	Ongoing, annually	L	Toquerville City	Toquerville City, Utah DEQ
Multi Hazard #1	5	Develop plans to guide emergency response and recovery.	Complete an Emergency Operations Plan for the community.	H	3-years	M	Toquerville City, FEMA, Utah DEM	Toquerville City

Source: Local Planning Team

Virgin

The Town of Virgin was settled by Mormon Pioneers in the mid-1800s and was originally named Pocketville. The city incorporated as Virgin Town in 1929 and the community maintains historic ties, through the preservation of the Heritage Town Square, a historic structure built in 1866.

Virgin Town is approximately 11.9 square miles and sits at an elevation of 3,552 feet The community lies underneath the northernly Hurricane Mesa, with the Virgin River flowing south of the town. State Road 9 runs east to west through Virgin and parallels the Virgin River. The landscape of the community was historically shaped by natural events from erosion, landslides, flooding, and severe weather.

Virgin has significant camping, hotels, and outdoor recreation access near the community. The area is an access point to the Kolob area of Zion National Park, which draws visitors to and through the community. Several hotels, RV parks, campsites, and boutique glamping can be found in the community today, catering to these visitors to Kolob, and the nearby south entrance to Zion National Park. Other recreation in the area includes systems on the Hurricane Mesa and Hurricane Cliffs, drawing hikers and mountain bikers to the area.

This chapter further describes the characteristics and capabilities of the community to frame the discussion about hazard risks and mitigation strategies.

Demographics

Virgin is a rural community in southwestern Utah. As of the 2018 American Community Survey, the community has a population of 530 people, described in Figure 518. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

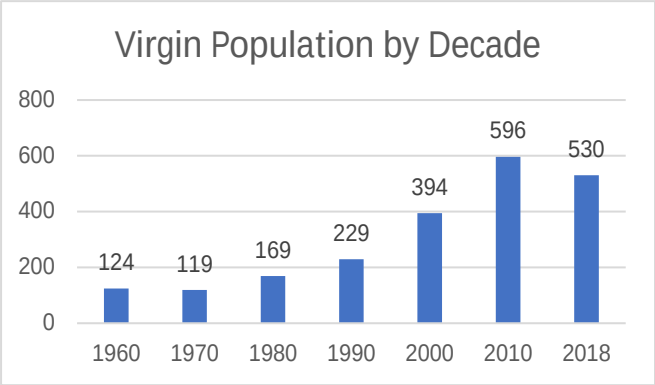


Figure 518: Virgin Population by Decade

Source: US Census Bureau

The Virgin population saw continuous growth from 1980 to 2010, although the 2018 estimated population indicates a decline in population by 11% Figure 519. shows the population change by decade in Virgin. Population change over the past several years shows that the population has been increasing by an average of 30% each decade between 1960 and 2010.

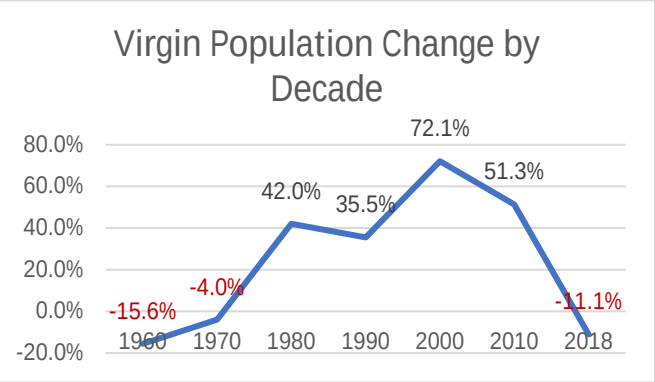


Figure 519: Virgin Population Change

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is

expected to see an 229% increase in population between 2015 and 2065. If applied to Virgin, the community could see 1,654 people living in the community in the next 45-years[31].

Economy

Virgin was settled in the mid-1800s with an emphasis on agriculture in the local economy. Over time the community moved to extractive industries in the early 1900s, home to Utah's first oil field. Since that time, the community has grown to include several local businesses, restaurants, and other commercial endeavors in their economy.

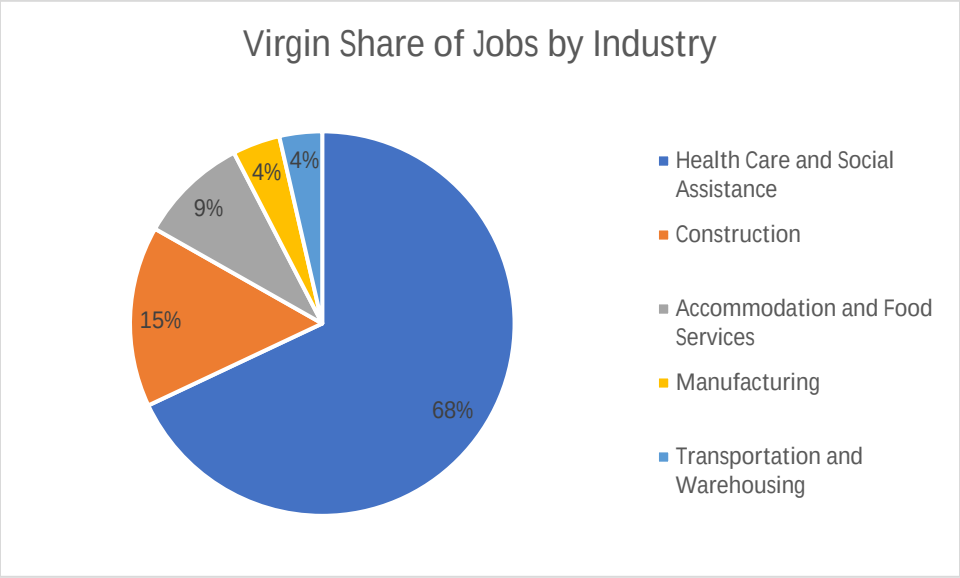


Figure 520: Virgin share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts Virgin's prominent industries by the number of jobs supported in the community, illustrated in Figure 520. Accommodation and food services make up nine percent of the local economy, likely tied to visits to nearby recreation assets. The most prominent industry is the Health Care and Social Assistance, likely from local treatment centers in the community.

In addition to the figures identified in the OnTheMap tool, the town describes that nearly 10% of the workforce is employed in agriculture and farming. This may not have been included in the tool due to data availability, or location of farms and agriculture respective to the town limits. Farming and agriculture have long been valuable economic assets to the area and that tradition is maintained in the Town of Virgin.

Development

Virgin has seen new commercial and residential development in the past several years, with new subdivisions throughout the town. The commercial corridor in the town is on SR-9, which runs through the center of the town.

[31] This estimate is created using the 2015 ACS population estimate for Virgin, which was 503, and adding 229% of this population estimate to the population for that year.

Community Capabilities

Virgin is governed by a mayor and four-person town council, who engage in executive and legislative activities for the community, respectively. Administrative staff include town clerk, zoning administrator, building inspector, attorney, assistant maintenance, and town newsletter editor who support the implementation of legislative actions. A five-person elected planning commission supports review and recommendation of planning and zoning activities in the community to the council.

Public safety and emergency response is provided by agencies outside of the Virgin Town Boundaries. Fire suppression and emergency medical services are provided by the Hurricane Valley Fire District and the Washington County Sheriff provides law enforcement in the community.

Virgin Town does not have natural gas or sewer. Residences and business must use propane and septic systems. Power is provided by Rocky Mountain Power and the towns water is provided by Washington County Water Conservancy District. Solid waste removal is provided to residents through Washington County Solid Waste Removal.

Plans and Policies

Virgin Town has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Virgin Town's plans and policies as they relate to natural hazards. Additional plans may exist, which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only.

Codes and Ordinances

The Virgin Town Codes and Ordinances seek to protect resident's welfare, health, and the community natural and cultural resources through local policy. The Municipal Code describe requirements for road and building standards to avoid hazard situations, which protect the community from impacts of a natural hazard event. Ordinances which describe natural hazards describe responsibilities of the road and building inspectors in the community, define allowable methods to reduce flood losses, weatherizing vacant buildings, and set standards for new construction in areas of special flood hazard.

The land use code sets specific requirements for a variety of natural hazards, and address problem soils, severe weather, wildfires, flood, landslide, and earthquake. The Land Use code defines allowable uses of land in identified hazard risk areas and sets requirements for the application and plat submissions for new development.

General Plan

The Virgin Town General Plan (2018) describes the vision for the community, promoting "a safe, comfortable, neighborly environment that adds to the beauty of the scenic surroundings". Several of the policies and goals for the community address natural hazards, including flood and drought. The community seeks to avoid flooding by maintaining natural drainages or approved diversions. One method is to strengthen ordinances defining the requirements of new developments in maintenance and management of drainages and clarifying the town requirements for floodplain and drainages. The community describes drought mitigation through water conservation in site and landscaping plans.

Risk Assessment

Virgin is at risk to several natural hazards addressed in this Natural Hazard Mitigation Plan. Five County has worked with the Virgin Town planning team to develop a ranking the highest risk hazards based on probability, and local exposure of the hazard. Table 494 describes the relative risks of hazards in the community.

Table 494: Virgin Town Hazard Risk

HAZARD	RISK
DROUGHT	1. High
FLOOD	2. Moderate
SEVERE WEATHER	3. Moderate
WILDFIRE	4. Moderate
EARTHQUAKE	5. Moderate
LANDSLIDE	6. Moderate
PROBLEM SOIL	7. Low
RADON	8. Low

A detailed description and mapping of each of the natural hazards that impact Virgin can be found in this chapter, concluding with a mitigation strategy for the community. The mitigation strategy aims to reduce the risks and vulnerabilities in the community to natural hazards described in this plan and has been developed by the local planning team.

Five County assessments for Hurricane include reviewing the exposure that critical facilities, residential parcels, parks, and roads have to the natural hazards that impact the area. Critical facilities include schools, medical facilities, fire stations, and police stations and law enforcement facilities.

Wildfire

Virgin is a town marked by its access to outdoor recreation and open spaces. A portion of Zion National Park is located to the north of the community and the Virgin River, which is a water source to the region, runs to the south of the community. The area sees many visitors to the area for recreation, who may be on trails or in the backcountry, which highlights a vulnerability to wildfire.

Figure 521 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. Mapping completed by the Five County AOG describes those areas in and surrounding Rockville that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification section of this plan.

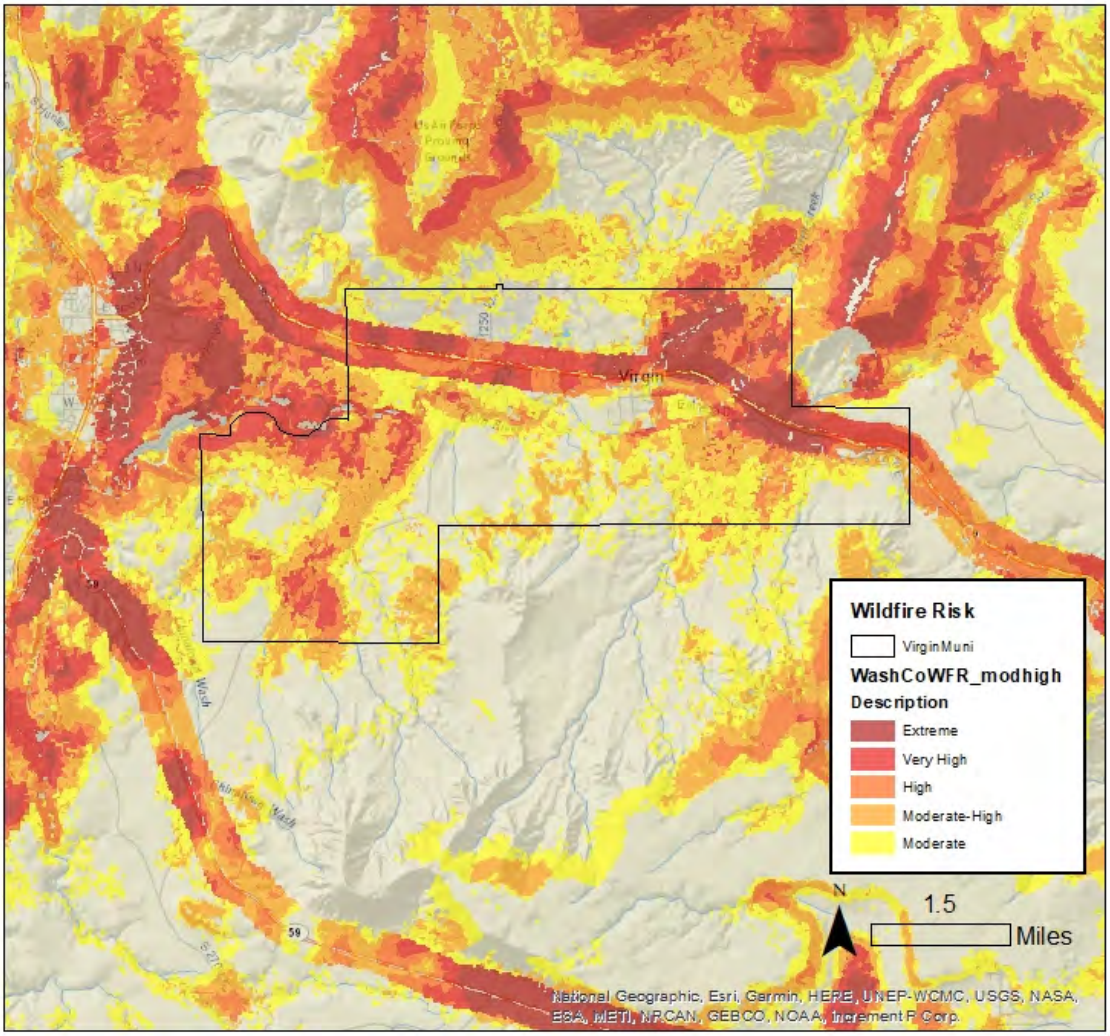


Figure 521: Virgin Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 495 further describes Virgin's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Virgin, which could damage property, impact public health and safety, or impact local economies. All commercial parcels and critical facilities are exposed to wildfire risk areas in Virgin,

which can have an impact on local economies and access to goods and services for residents, in addition to impacting response capacity, equipment, and facilities essential to community function. Nearly two third of the road miles in the community are at moderate to extreme wildfire risk, which can challenge response and recovery and the travel of people and goods.

Table 495: Virgin Wildfire Risk

Virgin Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
100.0%	100.0%	88.8%	89.4%	61.3%	N/A	N/A

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. In addition to these sources, this plan references previous documentation from the 2016 NHMP and news articles. Table 496 describes the wildfires which have impacted Virgin.

Table 496: Virgin Wildfire Record

Fire Name	Year	Acres Burned	Description
Kolob	2006	17,632	The largest wildfire in Zion National Park in recorded history, burning 10,516 in the park and was human caused.

Source: National Parks Service "ZNP fire management fire factsheet"

The Kolob Fire in 2006 occurred about 5 miles north of Virgin. The fire threatened power infrastructure and homes on Kolob Terrace Road, near Zion National Park. (The Associated Press, 2006) The fire also resulted in closure of multiple trails in the area. Several other fires are documented for Zion National Park, although it is unclear the extent to which these fires impacted Virgin Town.

Wildfire impacts air and water quality and can affect public health through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. This ash settles on the ground and riparian areas, affecting water quality for a region. Riparian areas and drinking water assets can be at risk to settling debris from burning.

Wildfire can have economic impacts through damage to infrastructure and structures. In this area of Southern Utah, where public lands are an asset to a local economy, damage in these spaces can impact industries for several seasons, including tourism.

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. Changing climate conditions will also contribute to wildfire risk long-term as dry conditions are expected to continue. Drought, flash flooding, and landslides all pose risks to Hildale, and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Utah has regular seismic activity, reporting several earthquakes annually. Earthquakes in Utah occur frequently and most of these earthquakes are small shaking events which may by susceptible to people. Several faults in the state that have the potential to produce severe earthquakes, which can cause damage to structures and infrastructure, injury, or death. The Southwest has a history of large earthquakes which cause impacts. Figure 522 shows that no epicenters or fault lines are mapped in Virgin, although the Hurricane Fault is just to the east of the town.

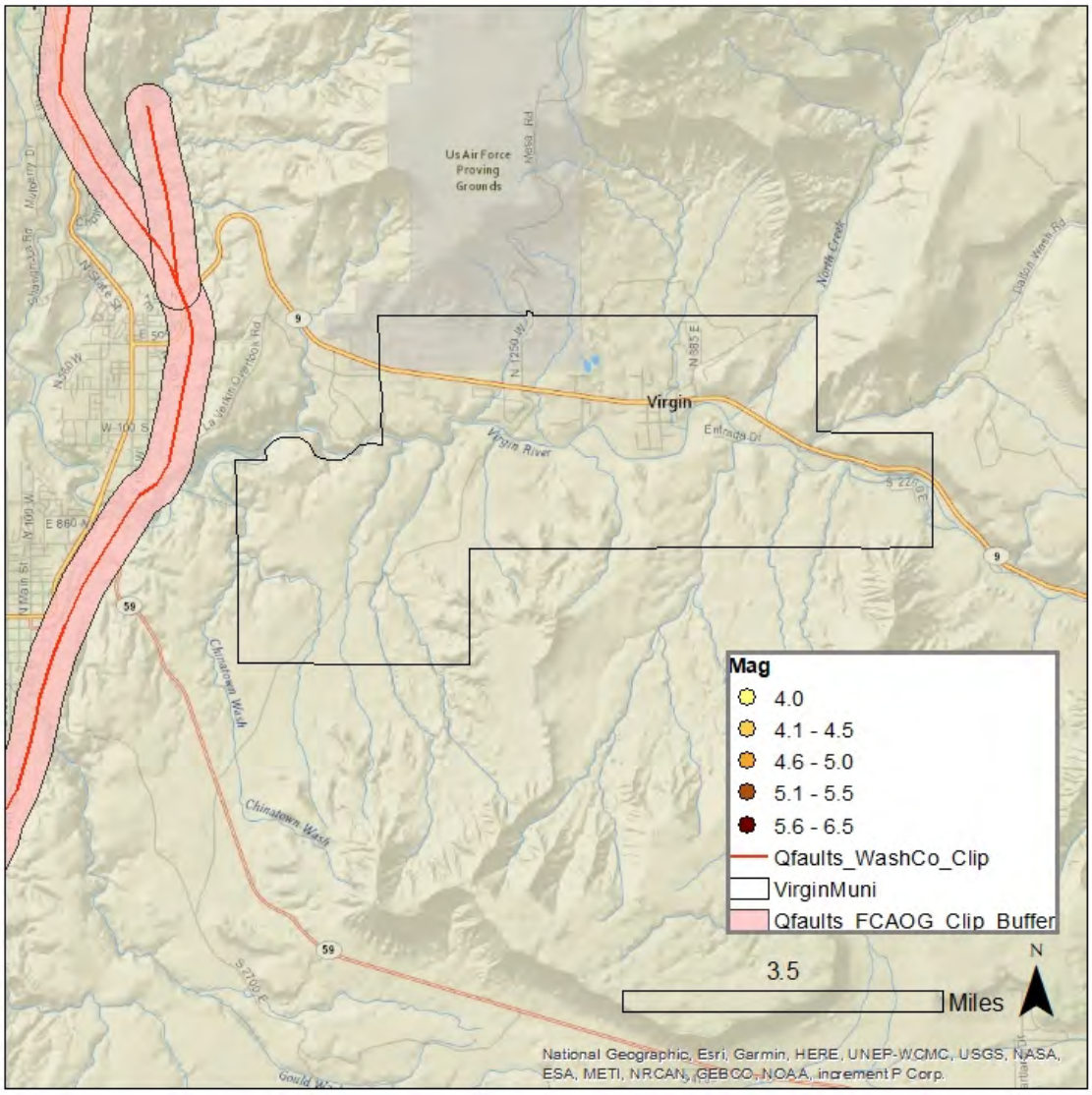


Figure 522: Virgin Earthquake Epicenter and Quaternary Faults

Source: Utah Geological Survey and University of Utah Seismology

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 38 structures

were built before the adoption of seismic code requirements, approximately 13.4% of the total structures in the city boundaries. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Liquefaction

The Utah Geological Survey has completed mapping of liquefaction susceptibility for southern Washington County, which includes Virgin Town, mapped in Figure 523. Liquefaction is a secondary hazard that can occur following strong shaking, where the soil loses its structure and becomes fluid, which can be a risk to structures and property on susceptible soils. Figure indicates that Virgin has areas of moderate to very high susceptibility to liquefaction hazards throughout the community.

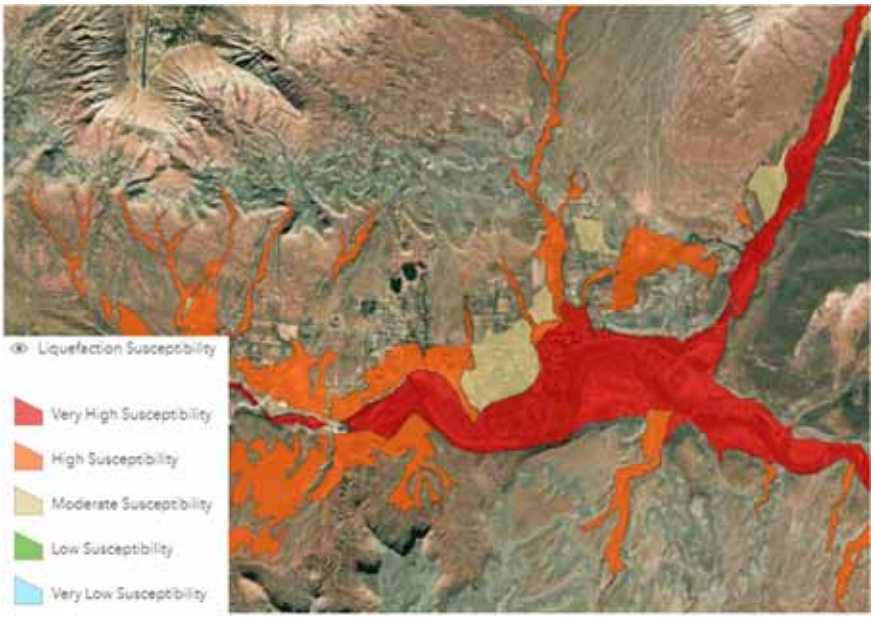


Figure 523: Virgin Liquefaction Susceptibility

Source: Utah Geological Survey

Hazard History

The University of Utah Geology Departments and the US Geological Survey document seismic history, which has been used for this plan. To focus on severe earthquake events, Five County includes earthquakes with magnitudes of 4.0 or greater. The University of Utah and USGS sources documented magnitude differ slightly in their measurement.

No earthquake epicenters or faults are identified in the municipal boundary. Earthquakes elsewhere in the county may have been felt and caused impacts in Springdale, including the 1992 5.8 magnitude earthquake with an epicenter in Washington City. This earthquake caused impacts from Flagstaff, AZ to Richfield, Utah and from Las Vegas, NV to Escalante, UT. (Peterson) Impacts from this event included damages to building walls as the shaking loosened plaster and walls cracked.

Earthquakes are generally not triggered by other natural hazard events prevalent in the Southwest, although they can be caused by human activities like drilling or mining. Several hazards can be caused by earthquakes, including flooding, landslide, and wildfire.

Flood

Flooding events are common in the southwest, especially flash flooding as severe summer thunderstorms produce rapid downfalls of rain. Dams in the region contribute to potential flooding hazard as failure could inundate an area downslope. Figure 524 depicts the mapped 100-year floodplain and dam inundation exposure in Virgin. The Virgin River seems to be primary corridors for flooding potential.

Figure 524: Virgin Floodplain and Dam Inundation Exposure

Source: Flood Insurance Rate Map, AGRC

Table 497 describes the Virgin community assets exposed to dam inundation, and the 100-year floodplain zones. Residents, visitors, and personal property may be vulnerable to flooding impacts. Commercial parcels and critical facilities are also identified in flood risk areas. Businesses can see loss of inventory, delay in providing services, and costs to recover from flood impacts. Damages can take significant time and cost to repair following a flood. Roadways impacted by flood can damage the

roadways and associated infrastructure, in addition to causing traffic delays, vehicle accidents, or deaths. SR-9 through Virgin is a moderately trafficked road, connecting Virgin and several other communities to larger urban areas and I-15, making several communities vulnerable if significant flooding causes delays or damages which take an extended period to address.

Table 497: Virgin Exposure to Floodplain and Dam Inundation

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			
0.0%	35.7%	21.9%	22.6%	6.8%	N/A	N/A

Source: Floodplain Map, Washington County Assessor, UDOT, AGRC.

National Flood Insurance Program

The Town of Virgin property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 498: Virgin NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$9,057	0	4	5	$517,200	0	$0

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Virgin participates in the NFIP and had a Flood Insurance Rate Map (FIRM) developed in 2009. Table 498 describes the number of flood insurance policies, and dollar value insured and claimed since participation began. There have been no claims and no repetitive losses. A Community Assistance Contact and a Community Assistance Visit were completed in 2019 and 2005 respectively.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 499 describes the flooding events which have impacted Virgin and the surrounding area.

Table 499: Virgin Reported Flood Events 1997-2020

Date	Damage/Injury	Description
8/11/2006	None Reported	Flash flooding caused river gauges to rise across southwest Utah, including in Virgin Utah, where the Virgin River gauge rose from 2 CFS to 1341 CFS in one hour.
8/1/2007	$2,120,000	Flash Flooding reported in Zion National Park and in the towns of Virgin and Toquerville, damaging six homes. Residents were evacuated from roofs. Kolob Terrace Road was closed due to the event.
9/22/2007	None Reported	In four hours, the Virgin River had an increase from 85 CFS to 3755 CFS.

8/4/2008	None Reported	The Virgin River increased near Virgin Town from 54 to 2562 CFS after heavy rain.
7/26/2013	None Reported	Flash Flooding on North Creek caused the river gauge near Virgin Town to increase to 626 CFS.
7/18/2015	$50,000	Heavy rainfall produced flash flooding in Zion National Park and significant rises along the Virgin River from Zion to St. George.
9/22/2016	None Reported	The Virgin River Gauge near Virgin Town increased from under 100 CFS to 3300 CFS following heavy rains.

Source: NOAA Storm Database

Several other flooding events are reported on the Virgin River, describing impacts and rising in other communities along the river. It is possible that these events may have impacted Virgin Town, but the impacts were not described in the report. Referencing the Washington County flood section, or the sections for other communities on the Virgin River, may describe historic events impacting the area around Virgin Town.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslides

The landscape in Southwestern Utah, marked by mesas, cliffsides, and valleys can see landslides and rockfall over time. Landslide and rockfall activity can be observed on slopes and cliffsides throughout the area and become a risk when events interact with the built environment and human activity. Figure 525 maps the landslide and rockfall susceptible areas observed throughout Virgin.

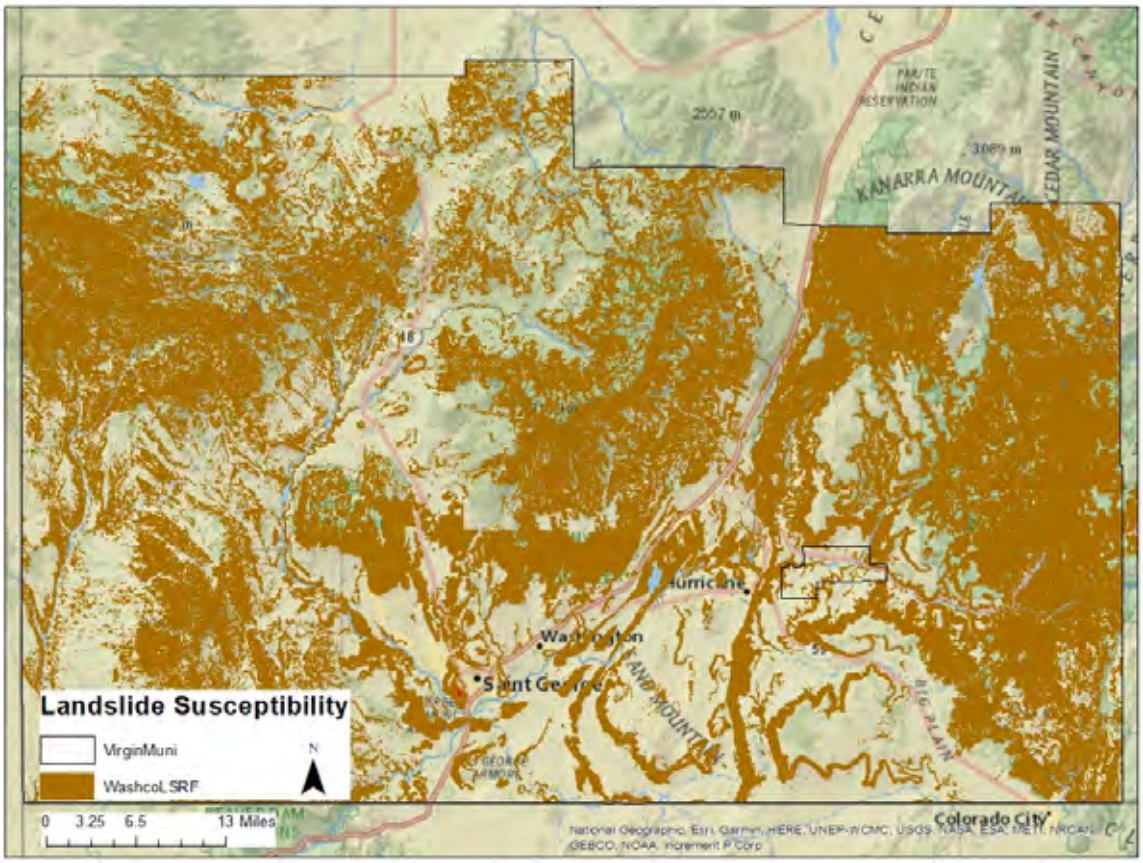


Figure 525: Virgin Landslide Susceptibility

Source: Utah Geological Survey

Virgin is exposed to landslide susceptible areas throughout the community, given the local landscape, Table 500 describes the exposure of community assets to landslide susceptible areas. Residential parcels in Virgin see the greatest exposure to landslides with 19.0% exposed, which poses risks to personal property and public safety. Landslides can block or damage roadways, causing delays and access challenges within a community. Without proper planning, future growth could place development in landslide risk areas, increasing risk of landslide impacts.

Table 500: Virgin Landslide Susceptibility Exposure

Virgin Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	14.3%	19.0%	18.7%	13.9%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, AGRC.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Virgin does not have a record of landslides impacting the municipal boundaries from the sources reviewed from this plan. The town does include some landslide susceptible areas and landslides are possible in the community.

Several other natural hazard events may contribute to the potential or increased risk of landslides. Landslide events can trigger or be triggered by other natural hazard events. Earthquake, drought, flooding, wildfire, and severe weather can cause or worsen landslide events as the soil content and vegetation destroyed during these events. Landslides can likewise lead to flooding as ground materials can block or change flood and drainage areas.

Drought

The Five County region has recorded seven instances of extended drought conditions since 1895 that have impacted the region. The hazard history is described in the Hazard Identification and County section of this plan, as Drought is a regional hazard. The southwest is no stranger to drought, however as the region continues to grow, extended drought can have greater negative impacts. Utah entering an extended period of drought, with 2020 being the driest year on record, there are implications from this natural hazard on the regional economy and people in the area.

Both tourism and agriculture economies would be impacted by a drought event, which can create dry, hot conditions. Drought may also impact the local water supply, for the town includes wells and spring water. Tourism and related industries are portions of the economy in Washington County. A University of Colorado report indicated that perceived risk of hazards from visitors can influence their selection of a destination. Perceptions included low water for river trips or wildfire risk, both of which are influenced by drought.

Drought conditions create visibility and air and water quality concerns as well. Dry soils can blow in the wind, increasing dust in the air which people breathe in. Increased wildfire risks can also lead to more smoke and ash in the air. Dust, smoke, and ash impact water quality.

Drought is connected to other natural hazards, primarily wildfire. Dry fuels can increase the severity of wildfire risk and wildfire events. Changes in the vegetation in an area due to lack of water can lead to invasive species and bare soils which can result in flooding, debris flow, and landslide events when water does flow on drought impacted areas.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 526. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

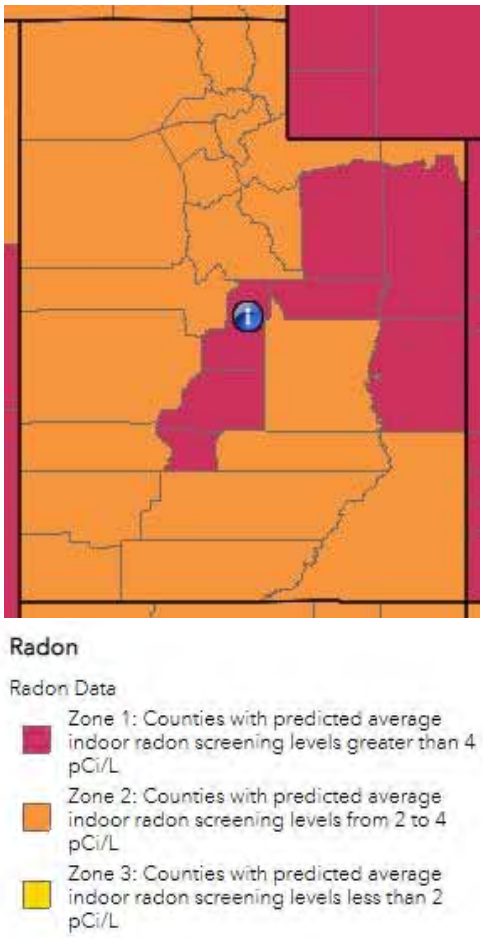


Figure 526: Estimated Indoor Radon Level Zones-Utah

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 501 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 501: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Virgin, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Virgin sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning. Winters in high elevation areas can produce snow and rain fall.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020. Virgin has several reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington County and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 502. While the deaths reported during the 2013 events did not occur in Virgin, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers, are vulnerable to these extreme temperatures.

Table 502: Virgin Severe Weather Record

Date	Damage/Injury	Description
4/12/1996	None Reported	A thunderstorm produced high winds of 65 MPH and lightning in Virgin Town. Lightning was reported to have damaged trees in the community.
7/9/1996	None Reported	A thunderstorm produced 68 MPH winds which uprooted trees in Virgin.
1/6/1997	None Reported	Winds in Virgin were reported at 66 MPH during a storm.
6/6/1997	None Reported	Trees were damaged by High Winds with a gust of 67 MPH during a thunderstorm in Virgin.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
8/10/2016	None Reported	Virgin reported penny-sized hail during a thunderstorm.

Source: NOAA Storm Database

Thunderstorms, heavy rain, and high winds appear to be common severe weather events which impact Virgin. Other Washington County severe weather impacts include snow events, which can cause impacts including, traffic delays, vehicle accidents, and damage to structures and utilities, as evidenced by the 2013 snow event. Snow events occur infrequently in this area of the County, and while no impacts or events are described for Virgin Town, neighboring cities and towns do describe the impacts of snow. It is possible that some of these events did cause delays or impacts in Virgin, and we recommend referencing those community's section in this plan for a more thorough account.

Severe weather occurs regularly throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area,

which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Communities throughout the southwest have experienced challenges to construction and development attributed to problem soils, which can impact structures and infrastructure, as soil moisture and other environmental factors cause the soil stability to change. These soil types and their characteristics are further described in the Hazard Identification Section. Figure 527 illustrates where the Utah Geological Survey has mapped problem soils in, and surrounding Virgin. Expansive soils are mapped throughout the community.

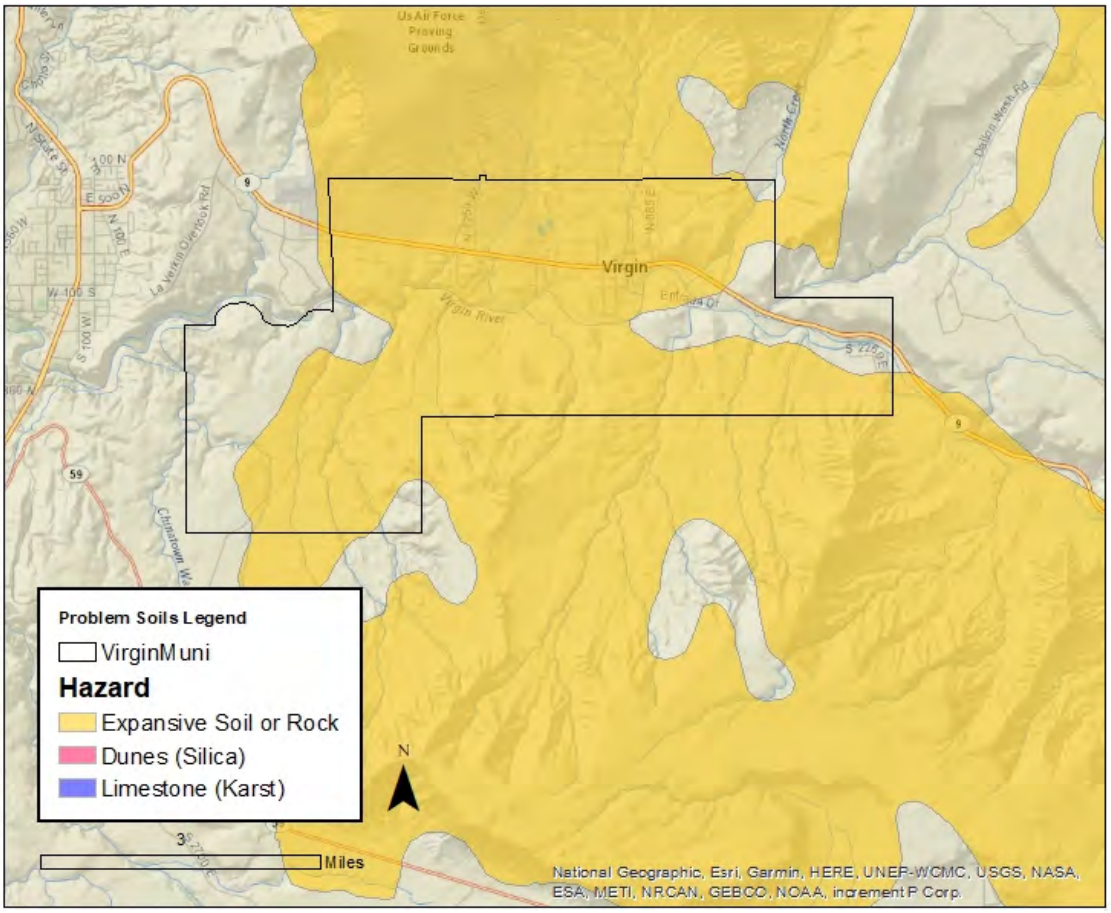


Figure 527: Virgin Problem Soils Map

Source: UGS, AGRC

Community assets, infrastructure, and property are exposed to problem soils, with the greatest exposure being in critical facilities. Problem soils are often challenging to structures and infrastructure, as when the soils dissolve or expand and contract, they can damage or impact structures that are on top of the changing soil structure. Critical Facilities, commercial and residential parcels, and road miles are all exposed to problem soils according to this data. The impacts of problem soils are likely to be costly to repair structures and infrastructure impacted by unmitigated development.

Table 503: Virgin Problem Soils Exposure

Critical Facilities	Parcels			Road Miles	Rail Miles	Local Parks
	Commercial	Residential	Total			

50.0%	92.9%	91.4%	91.5%	74.2%	N/A	N/A

Source: Utah Geological Survey, Washington County Assessor, UDOT

The Utah Geological Survey has developed updated problem soils mapping for some communities in the region, which provides greater detail about the susceptibility and potential for problem soils and the types prevalent to the region. Virgin is included in this mapping study area for collapsible soils and rock, expansive soils, piping and erosion susceptible soil, soluble soil and rock, and windblown sand, described by Figure 528 to Figure 532. The updated mapping is available in an online format only and was not used for GIS analysis, Table 503 does not refer to the updated mapping.

Collapsible Soil

Figure 528: Virgin Collapsible Soil Susceptibility

Source: Utah Geological Survey

Expansive Soil and Rock

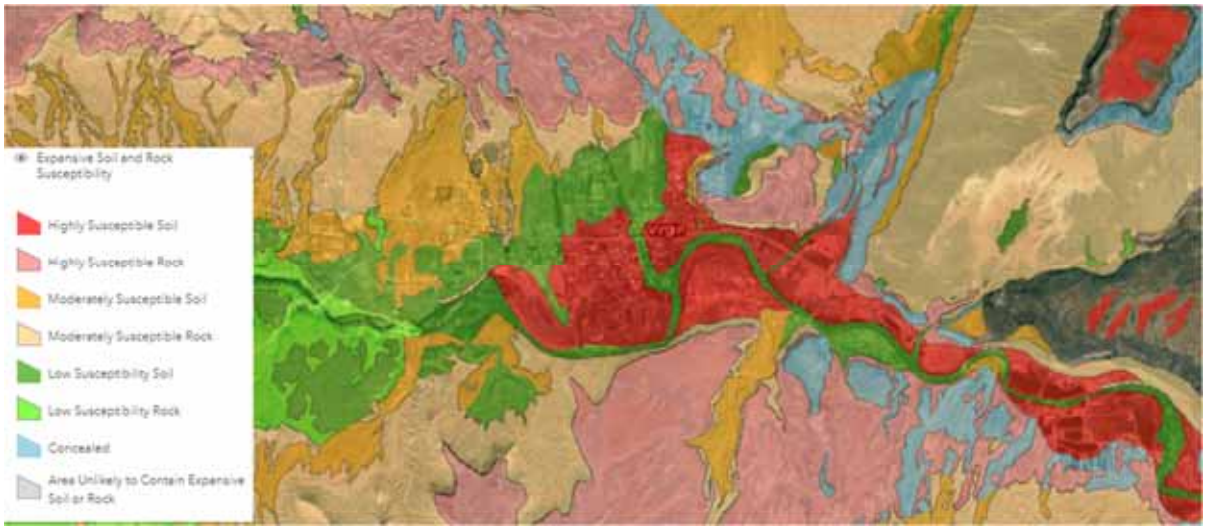


Figure 529: Virgin Expansive Soil and Rock Susceptibility

Source: Utah Geological Survey

Piping and Erosion

Figure 530: Virgin Piping and Erosion Susceptibility

Source: Utah Geological Survey

Soluble Soil and Rock

Figure 531: Virgin Soluble Soil and Rock

Source: Utah Geological Survey

Windblown Sand

Figure 532: Virgin Wind-Blown Sand Susceptibility

Source: Utah Geological Survey

The new mapping indicates that Virgin has areas of high susceptibility to expansive soils and rock. There are also several identified types of collapsible soils in the community.

The community and the county do not have a record of problem soil impacts, although building permits should identify where studies were required, whether problem soils have been discovered on a site and what types of mitigation were completed. Site analysis will provide the best understanding of the potential problem soil exposure for a specific site.

Risk Assessment Summary

Virgin is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Residents are at risk to injury and property damage from several natural hazards. Virgin critical facilities are vulnerable to severe weather, problem soils, earthquakes, and wildfires. Impacts from these natural hazards can impact a facility's capacity to respond to an emergency event.

Tourists and visitors are vulnerable to natural hazards in the area, with the Hurricane Cliffs and Kolob Terrace Road access to Zion National Park bringing visitors through the community each year. Visitors may not be aware of the natural hazard risks of being in the park and may not be prepared for events like severe weather, extreme heat, flash flooding, or landslides. Visitors to recreational areas have been impacted by severe weather and have the potential to be impacted by flooding, drought, landslides, and wildfires throughout the region and should.

Transportation routes have been impacted by historic natural hazard events and are exposed to several natural hazard susceptible or risk areas. State Route 9 is the primary access road to the community and impacts on this road can cause traffic delays locally, impact access to the community, and delay the transportation of goods, depending on the extent of the impacts.

Mitigation Strategy and Actions

Virgin has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 504 describes progress made on Virgin mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 504: 2016 Virgin Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Flood #1	(Sierra Bella Subdivision Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Clean and rehabilitate Cornelius Wash that directs water to the Virgin River. Clean and rehabilitate wash to the west of the above mentioned was. Install new culvert with rip rap at inlet and outlet of culvert to prevent erosion. Redesign culvert outlet on the more west wash.	5 Years	Virgin, CIB, CDBG, FEMA	Rehabilitation around the subdivision was started. Next step was to vacate 2 lots to be converted to flood control outlets.
Flood #2	(Sierra Bella Subdivision Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Re-grade waterways and construct swales to direct flow of water on and along the north end of Sierra Bella Subdivision. Clear Debris from wash and through bridge from the north end of subdivision to Kolob Terrace Road. Place rip rap along points of erosion (turns, steep slopes, and culvert inlets and outlets). Coordination and a project is underway with NRCS and Virgin Town for improvements of small area west of Pocketville Road and north of Hwy 9.	5 Years	Virgin, CIB, CDBG, FEMA	Cleaning to Kolob Terrace Road was completed but nothing on the North side.
Flood #3	(Mill Street to North Street City Block Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Re-grade wash. Clear trees and debris from wash. Place rip rap along points of erosion and outlet to the Virgin River (turns, steep slopes, and culvert inlets and outlets)	5 Years	Virgin, CIB, CDBG, FEMA	This objective was mostly completed.

Flood #4	100 North Street and 150 South Street Storm Drain Improvements) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Construct concrete swales and waterways to direct storm water to the Virgin River. Direct underground piping to convey water discharge into Virgin River Washes.	5 Years	Virgin, CIB, CDBG, FEMA	Incomplete.
Flood #5	(Town Storm Water Drainage Plan) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Develop a storm water drainage and management plan for planning and maintenance planning. Plan outline costs for such maintenance and planning for future improvements. GIS mapping of project with portable management device.	5 Years	Virgin, CIB, CDBG, FEMA	We received funding for this project but have not moved forward with it.

Source: 2017 Five County Association of Governments NHMP

The Virgin Town planning team identified actions to include in the community mitigation strategy. Each action in Table 505: Virgin 2022 NHMP Mitigation Strategy includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Table 505: Virgin 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #1	2	(Town Storm Water Drainage Plan) Storm water management projects to prevent residential flooding and prevent flood waters from washing out roadways and drainage ditches.	Develop a storm water drainage and management plan for planning and maintenance planning. Plan outline costs for such maintenance and planning for future improvements. GIS mapping of project with portable management device.	M	5 Years	M	Virgin, CIB, FEMA	Virgin Town
Flood #2	6	Mitigate erosion at Rio de Sion bridge entrance.	Install gabion baskets and/or riprap at the Rio de Sion Bridge.	M	5 years	M	Virgin, CIB, CDBG, FEMA	Virgin Town
Flood #3	1, 2	Prevent residential flooding and manage flood waters at culvert between 170 E. and Mills St. on 100 S.	Improve flood drainage by reaming out culvert and adding riprap below 100 S. and/or replacing pipe with larger pipe to improve flood capacity to the river.	M	5 years	M	Virgin, CIB, CDBG, FEMA	Virgin Town
Flood #4	6	Improve DGE drainage	Reinforcing banks by adding gabion baskets along roadway to keep flow in roadway. This was done at South end of subdivision but needs to be continued to north end.	M	5 years	M	Virgin, CIB, CDBG, FEMA	Virgin Town
Flood #5	6	Prevent residential flooding and manage flood waters in Sierra Bella Subdivision.	Create and enforce ditch along north end until it reaches natural drainage.	M	5 years	M	Virgin, CIB, CDBG, FEMA	Virgin Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #6	1, 2	Prevent residential flooding and manage flood waters on 170 E.	Replace box culvert with a larger size.	M	5 years	M	Virgin, CIB, CDBG, FEMA	Virgin Town
Radon #1	3	Inform residents of Radon Hazard.	Provide public information on Radon risk, testing, and mitigation information to residents in the local emergency preparedness newsletter.	H	Ongoing annually	L	Virgin Town	Virgin Town
Drought #1	1, 2	Expand municipal water storage capacity.	Construct an additional water tank in the Town.	M	5-years	H	Virgin, CIB, CDBG, Division of Drinking Water	Virgin Town
Earthquake #1	1, 2	Identify and address unreinforced masonry in the town.	Inventory unreinforced masonry structures and implement structural and nonstructural retrofit of town owned structures.	L	5-years	H	Virgin Town, Preservation Utah, State and Federal Historic Tax Credit	Virgin Town
Earthquake #2	1, 3	Identify and address unreinforced masonry in the town.	Directly contact private property owners with URM structures on the property to inform them of potential hazard, assessment, and retrofit options.	L	5-years	L	Virgin Town	Virgin Town
Severe Weather #1	1, 2	Assess town policies to mitigate severe weather hazards.	Review current codes regarding engineering design to address high wind and modify if necessary.	H	3-years	L	Virgin Town	Virgin Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Severe Weather #2	3, 5	Inform residents of extreme temperatures hazards.	Educate residents and visitors of the dangers of extreme temperatures and severe weather events, including steps they can take to protect themselves during an event. Information to be distributed in the emergency preparedness newsletter.	H	Ongoing, annually	L	Virgin Town	Virgin Town
Severe Weather #3	2	Protect town facilities and infrastructure.	Installing and maintaining surge protection on critical electronic equipment.	H	1-year	L	Virgin Town	Virgin Town
Landslide #1	1, 2	Protect new development from landslide and debris flow hazards.	Assess and identify set back requirements and other code provisions to address landslides/debris flows at the bottom of the mesas in town.	H	5-years	L	Virgin Town	Virgin Town
Problem Soils #1	1, 2	Assess town policies to mitigate geologic hazards.	Review current codes regarding geologic hazard reports and studies prior to construction. Where necessary, adopt ordinances.	H	5-years	L	Virgin Town	Virgin Town
Wildfire #1	4	Work collaboratively to address wildfire fuels in the town.	Coordinate with County/BLM/NPS for fuels management surrounding the town.	H	Ongoing	M	Virgin Town, BLM, Washington County	Virgin Town, BLM, Washington County
Wildfire #2	1, 2	Assess town policies to mitigate wildfire hazards.	Require in town code that large propane tanks on personal property are protected.	M	3-years	L	Virgin Town	Virgin Town

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Wildfire #3	4, 5	Assess town policies to mitigate wildfire hazards.	Work with the Hurricane Valley Fire Service District to review the need for and implications of adopting the Wildland Urban Interface Code.	M	5-years	L	Virgin Town	Virgin Town

Source: Local Planning Team

Washington City

Washington City was the first town established in the Virgin basin for cotton production, with the arrival of Mormon settlers in 1857. The settlement experienced repeated flooding on the river, which damaged dams. As part of the cotton mission, settlers built a cotton factory in Washington City to process the cotton harvested.

Washington City is located with the Red Desert Tortoise preserve to the north, Sand Hollow Reservoir to the southeast, and St. George City to the southwest. I-15 runs in the north portion of the community and the Virgin River runs to the south. Washington City attracts visitors for local trail use and as visitors continue to state and national parks in the region. The community has continued to grow to accommodate that visitation and population growth in the region.

This chapter describes the characteristics and capabilities of the community in relation to the natural hazard risks and mitigation strategies for the community.

Demographics

Washington City is an urban community in southwestern Utah. As of the 2018 American Community Survey, the population is 25,395, described in Figure 533. The 2020 census is not yet available to include in this document, so the 2018 ACS estimates the most recent population for the area.

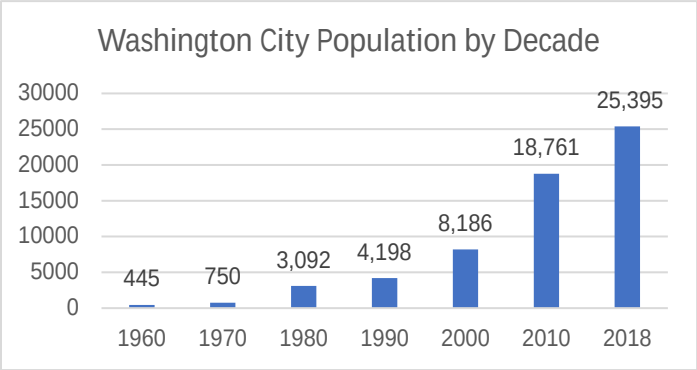


Figure 533: Washington City Population by Decade

Source: US Census Bureau

The Washington City population has seen continued growth in the past fifty years, although the community saw significant growth reported in 1980, 2000, and 2010. Figure 534 shows the population change by decade in Washington City. Population changes over the past several years shows that the population has been increasing by an average of 107% each decade between 1960 and 2010.

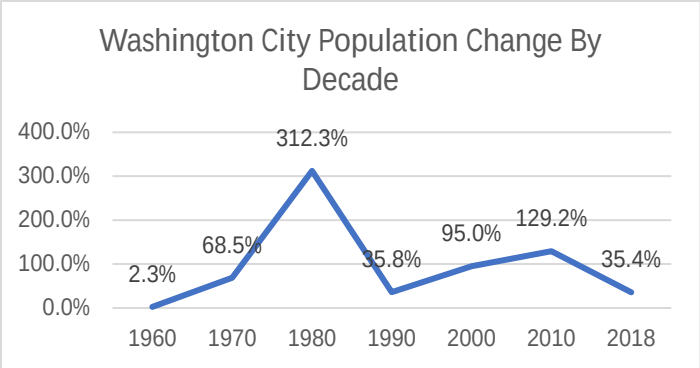


Figure 534: Washington City Population Change by Decade

Source: US Census Bureau

Population projections for the county have been completed by the Kem C. Gardner Institute describe that Washington County is expected to see an 229% increase in population between 2015 and 2065. If applied to Washington City, the community could 72,643 people living in the community in the next 45-years[32].

[32] This estimate is created using the 2015 ACS population estimate for Washington City, which was 22,080, and adding 229% of this population estimate to the population for that year.

Economy

Washington City was settled in the mid-1800s with a local economy focused on agriculture, to support the Cotton Mission. Over time the community moved from agriculture to more emphasis on retail, local businesses, and tourism, described by Figure 535, which shows the current prominent industries.

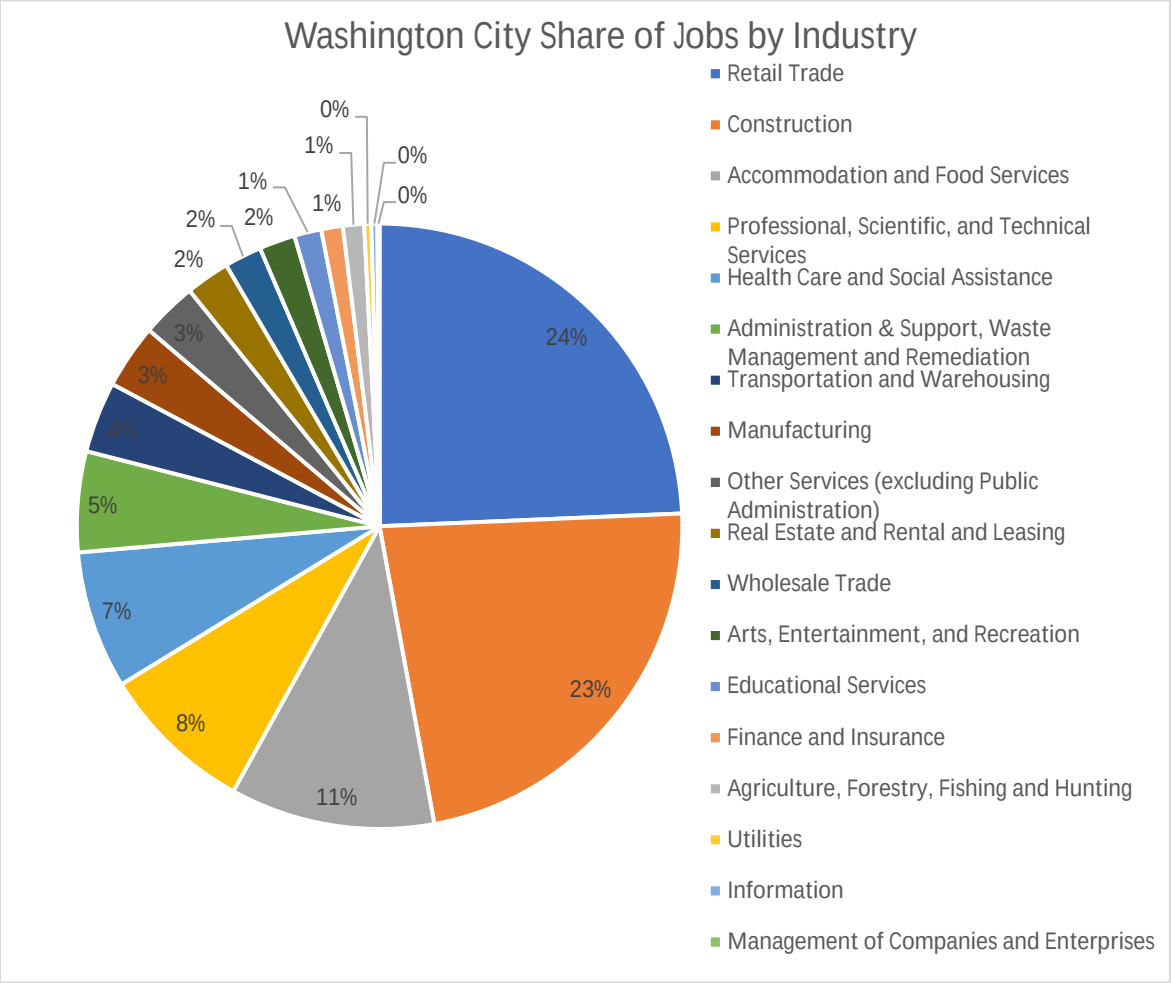


Figure 535: Washington City share of Private Primary Jobs by Industry

The US Census Bureau OnTheMap tool depicts Washington City's prominent industries by the number of jobs supported in the community, illustrated in Figure 535. Retail, construction, and accommodation and food services are the dominant industries in the community. The prominence of the accommodation and food services point to the tourism prevalent in the area. Construction is likely prominent from the growth experienced in the area. Agriculture remains a portion of the community economy. The community has a diversity of industries which support the local economy.

Development

New development in Washington city has dominantly included new residential subdivisions and developments. Projects include Long Valley, Brio, Coral Canyon, and new homes near Stucki Farms and Washington Fields. Some of the new growth is in former open space or agriculture land.

New commercial development is occurring at I-15 exit 13 and Washington Parkway and on Washington Dam Road.

Community Capabilities

Washington City is governed by a mayor and five-person town council, who engage in executive and legislative activities for the community, respectively. Administrative staff include a City Manager, Treasurer, Recorder, Finance Manager, planning and zoning staff, building department, Community and Economic Development staff, and public works and utilities. A five-person elected planning commission supports review and recommendation of planning and zoning activities in the community to the council.

Public safety and emergency response is provided by Washington City, which has a police, fire, code enforcement, and animal welfare departments. The fire department is made up of both full-time employees and volunteers and provides Emergency Medical Services in addition to fire suppression. The Washington City Code Enforcement office enforces laws which affect the standard of living in the community.

Washington City provides water and electrical services to the city. Dixie Power provides electrical service to residents south of the Virgin River in the Washington City boundaries. Gas utilities are provided by a private company, Dominion Energy. Trash and recycling removal is provided to residents through Washington County Solid Waste Removal.

Plans and Policies

Washington City has developed plans and policies which set goals, objectives, and laws for the community. Several of these documents describe natural hazards in the goals, objectives, and laws, which have been summarized here. The following section provides an overview of Washington City's plans and policies as they relate to natural hazards. Additional plans may exist, which were not made available for review.

Please review the community plans in full to understand current policies and ordinances. The section below is for summary purposes only and is not intended to interpret local codes and plans for development.

Codes and Ordinances

The Washington City codes and ordinances address several natural hazards, including flood, problem soils, earthquakes, landslides, drought, fire, and severe weather, in relation to new and existing development to protect public health, safety, and the environment. Methods to address natural hazards include regulating location, construction materials, maintaining natural features, requiring reporting and mitigation from the developer, among other methods to address hazards. In one case, the city has used an overlay district to address potential landslides and rockfall hazards called the Hillsides Protection Overlay, which the Hillside Review Board provides advise about proposed development in the overlay to council and the planning commission.

General Plan

The Washington City General Plan (2017) describes the long-range vision for the community, identifying goals and policies for the community to grow into the future. Chapters of this plan relate to the community land use, transportation, housing, community design, economic development, parks and recreation, and public services. These chapters highlight areas in which the community can address

natural hazard mitigation and risk reduction. Methods described to address natural hazards include preservation of natural features, regulating development location and setting requirements in areas with natural hazards, and enforcing local codes and ordinances locally which can reduce natural hazard exposure and impacts.

Transportation Plan

The Washington City Transportation Master Plan (2021) pulls from transportation goals in the General Plan to identify the existing infrastructure and plan for improvements over time to accommodate growth and changes in the community. This plan addresses both short and long-range planning for the community's transportation infrastructure. The Transportation Master Plan does not identify natural hazard mitigation activities; however, the plan describes that there are several natural hazards prevalent to the area, including fire, earthquakes, drought, flood, and severe weather.

Access Management Plan

The Washington City Access Management Plan (2010) balances land development with preserving traffic flows in a community. This plan describes the need for constructing driveways to fire lane standards and impacts of driveway slope on drainage.

Active Transportation Plan

The Washington City Active Transportation Plan (2017) assesses existing infrastructure and improvements for transportation by walking or biking. The plan describes that adding active transportation contributes to a more resilient community able to be flexible to natural disasters or closures in the system. This plan also describes needs for long term maintenance, including in response to natural hazards like floods, which can leave debris on shared use paths. Addressing flooding concerns is included in this plan through several floodplain projects, including a study in the floodplain.

The active transportation plan highlights design elements which can be used to protect the system from severe weather and flooding, using bioswales for storm water management. Drought is also addressed, through the recommendation that furnishing zones include drought-resistant plant types.

Affordable Housing Plan

The Affordable Housing Plan (2017) assesses the existing housing stock and sets goals and policies to provide adequate housing to the population at a variety of income levels. While the plan does not describe specific natural hazards, the plan describes the importance of weatherization to make housing affordable to low-income families and seniors. Weatherization can save residents on utility costs associated with heating and cooling by making their property more efficient. This in turn, can protect those residents from severe weather events like extreme heat, prevalent to the area.

City Sewer System Management Plan

The Washington City Sewer System Management Plan (2012) "describes activities to manage a wastewater collection system effectively, including improving the collection system infrastructure, providing adequate capacity, and minimizing number and impact of sanitary sewer overflows. The plan describes potential challenges to the sewer system caused by natural disasters, like floods or fires, which would trigger response and repair measures and impacts to the public. The plan also describes that corrosion, unstable soil foundation, or erosion can cause pipe failure.

Storm Water Management Program Information

The Stormwater Management Program sets goals for Washington City Stormwater Management. Goals include preservation and maintaining water bodies, educating industries, businesses, and citizens on water quality, and providing guidelines for development to preserve stormwater quality. The document describes that development sites can contribute to water pollution if not considering sensitivity and proximity of water bodies, soil erosion potential, and slope on the site.

Storm Water Capital Facilities Master Plan Update

The Washington City Storm Drainage Capital Facilities Master Plan describes the continued maintenance and improvements to address stormwater drainage patterns in the city. This plan describes the standard for which public facility drainage systems should be able to accommodate, which is the 100-year three-hour storm event.

Water Management and Conservation Plan

The Washington City Water Management and Conservation Plan (2015) describes the current water use and projected future need to accommodate the local population and economy. This plan includes identifying water problems, measures for conservation, and setting goals for reduction in the community. This plan describes a drought management ordinance which was adopted in 2009 which includes staged increase in water use rates during times of water shortage as a method to encourage water conservation.

Hazard Risk Assessment

The Five County Association of Governments sourced and assessed natural hazard data, community assets, recent hazard histories, and anticipated community changes to develop a risk assessment for Washington City. This assessment describes the natural hazards considered in this plan which pose risks to Washington City. The planning process and methodology chapter describes the variables and process for this assessment in greater detail. Table 506 summarizes the natural hazards in a list from High to low hazard risk as it pertains to Washington City.

Table 506: Washington City Hazard Risk Assessment

HAZARD	RISK
DROUGHT	High
WILDFIRE	High
FLOOD	High
SEVERE WEATHER	Moderate
EARTHQUAKE	Moderate
LANDSLIDE	Moderate
RADON	Low
PROBLEM SOILS	Low

The remainder of this section will describe each hazard in greater detail and the variables that contributed to the risk ranking. The section will conclude with a mitigation strategy based on Washington City's risk assessment.

Wildfire

Washington City is a small city with I-15 running north to south through the northern portion of the community. The community is surrounded by neighboring cities to the east and west, with the Red Cliffs National Conservation Area in the north of the community.

Figure 536 maps the wildfire risk using data obtained from the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal. The map describes those areas in and surrounding Washington City that are at moderate to extreme risk to wildfire. The metrics used to determine risk rating can be found in the Hazard Identification and Methods sections of this plan.

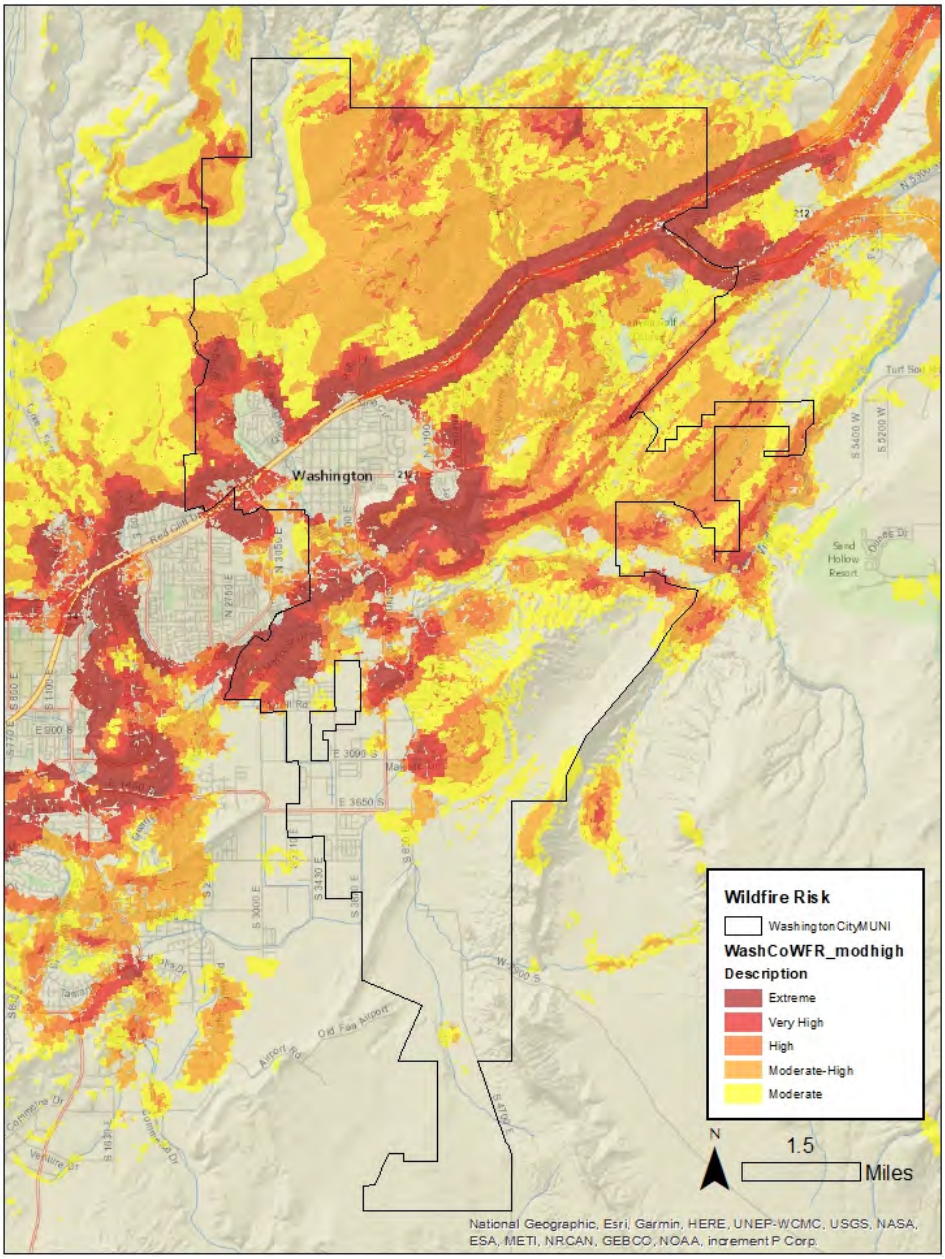


Figure 536: Washington City Wildfire Risk

Source: Oregon Department of Forestry, AGRC.

Table 507 further describes Washington City's risk by measuring assets that fall in identified wildfire risk areas. Exposure to wildfire risk areas of moderate or greater ranking impacts critical facilities, parcels, and miles of roadway in Washington City, which could damage property, impact public health and safety, or impact local economies. Over 50% of commercial and residential parcels and road miles are exposed to wildfire risk areas in Washington City, which can have an impact on local economies and access to goods and services for residents and can challenge response and recovery and the travel of people and goods. Forty-four of the critical facilities in the community are exposed to wildfire risk areas, which can impact the ability to respond to a natural hazard event or other emergency and can affect operations during an event due to damages to the structure and equipment.

Table 507: Washington City Wildfire Risk

Washington City Exposure to Wildfire Risk						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
44.4%	73.1%	61.2%	61.5%	53.7%	N/A	0.0%

Source: Oregon Department of Forestry, Washington County Assessor, Utah AGRC.

Hazard History

Several agencies track and manage wildfire data, leading to some differences in the record. This plan references the Utah Wildfire Info database, which records recent, large wildfires from 2017 to present and fires designated under Fire Mitigation Assistance Grant program from FEMA. In addition to these sources, this plan references previous documentation from the 2016 NHMP and news articles. Table 508 describes the wildfires which have impacted Washington City. It is likely that regional fires had secondary impacts on Washington City, including smoke and ash, traffic and changes in available services, economic consequences, among other possible effects.

Table 508: Washington County Fire History

Fire Name	Year	Acres Burned	Description
Turkey Farm Road	2020	11,993	Human caused by fireworks. Suppression costs exceeded $2.5 million.

Source: Utah Wildfire Info, (St. George News, 2020)

Most fires in Washington County have been suppressed by BLM, forest service or state and local entities. These fires are documented on the Utah Wildfire Info website going back to 2017. The fires that have impacted Washington County are listed in table 14. Fires which occurred prior to 2017 were identified in previous iterations of this plan and in news reports. Many of fires in Washington County are human caused. In 2020, of the County's 160 wildfires, 133 are attributed to human causes, including the Turkey Road Fire, which makes up more than 50% of the acres burned in that year. (Utah Wildfire Info, 2020) Fires from natural causes were most often triggered by lightning strike.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. Ash settles on the ground and can blow into watershed areas, impacting water quality for a region.

Wildfire impacts are not limited to damages to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and

recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Other impacts include potential slowing of tourism and service industries as people reconsider visits to a place impacted by large wildfires. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires can also cause and have heightened risks depending on other ongoing climate, weather, and geologic conditions. Wildfires can cause or exacerbate flash flooding, landslides, debris flows as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate change conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, flash flooding, and landslides are all hazards that Washington City is at risk to and it is essential to be aware of the interrelated nature of these hazards.

Earthquake

Washington City has a series of fault segments running through the community, named the Washington Fault. While earthquakes are frequent in the region, these are typically low magnitude earthquakes that do not cause impacts. Since pioneer settlement there have been two earthquakes with a greater magnitude than 5.0 in Washington County, one of which occurred in Washington City, as illustrated by Figure 537.

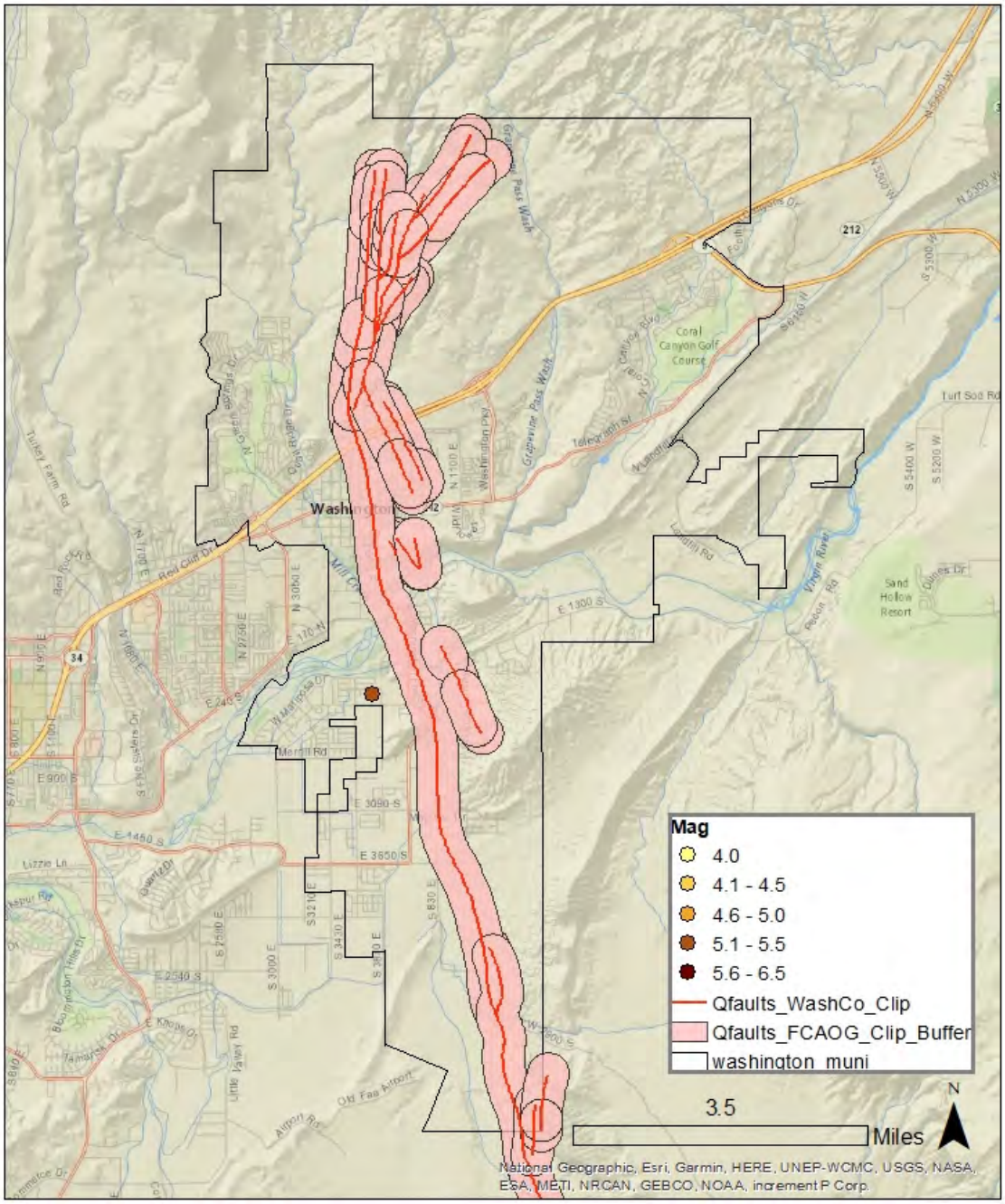


Figure 537: Washington City Quaternary Faults and Earthquake Epicenters

Annually there are dozens of earthquakes recorded in the southwest, many of which are not large enough to be felt or pose significant threat to the residents in the region. Earthquakes at a magnitude 4.0 are typically able to be felt by people during an event and magnitudes near 5.0 can cause some damage, with impact potential increasing as the magnitude continues to increase. In the region, the Hurricane fault has the potential to cause up to a 7.0 magnitude earthquake. High magnitude earthquakes are less frequent and an average of 18 are recorded globally each year.

The Five County Association of Governments completed an assessment of the number of community assets that are within a quarter mile of a quaternary faulty, illustrated in Table 509. Residential parcels are most exposed to quaternary faults within the municipal boundary, with 27% within a quarter mile of the fault. Critical facilities, commercial parcels, and road miles are all exposed,

Table 509: Washington County Exposure within a quarter mile of Quaternary Fault

Washington County Exposure within a Quarter Mile of a Quaternary Fault						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
22.2%	14.2%	27.1%	26.8%	23.1%	N/A	0.0%

Source:

An identified vulnerability to earthquakes in the region includes structures built before 1975, when seismic code requirements were adopted by the State of Utah. Many of these structures are built using unreinforced masonry construction, which does not have steel reinforcements in the structure to protect it during a shaking event. Structures built in this style can collapse and see increased damages to the structure during a shaking event. According to Washington County Assessors data, 448 structures were built before the adoption of seismic code requirements, approximately 3.8% of the total structures in the city boundaries. Southern Utah has a pride in the pioneer history of the region, which often includes preservation of historic buildings. Preservation should include retrofitting of structures to ensure the safety of those inside and outside of structures made from unreinforced masonry during a shaking event. Such preservation will also improve the safety of people inside and outside of the structure during a shaking event.

Hazard History

Table 510 shows the recorded earthquake events with a magnitude of 4.0 or greater in Washington City. A 1992 event with an epicenter in Washington City and a magnitude of 5.6 impacted multiple municipalities in the south end of the county. This earthquake damaged structures throughout the county and triggered other hazards, including a landslide event near Springdale which destroyed three homes. This earthquake was likely caused by the Hurricane Fault. (Wayman, 2016)

Table 510: Washington County Earthquake History

Incident Date	Location	Magnitude
1992	Washington City	5.93

Source: University of Utah Seismology

Liquefaction

The Utah Geologic Survey has also published mapping of liquefaction hazards, which can occur because of strong ground shaking during an earthquake. Figure 538 shows that high and very high liquefaction susceptibility is observed in Washington City, especially along the Virgin River corridor. In susceptible zones, strong shaking events can cause the soil and rock to lose their integrity and become fluid. Liquefaction is a concern near built environments as it can damage structures and infrastructure as the ground and rock move.

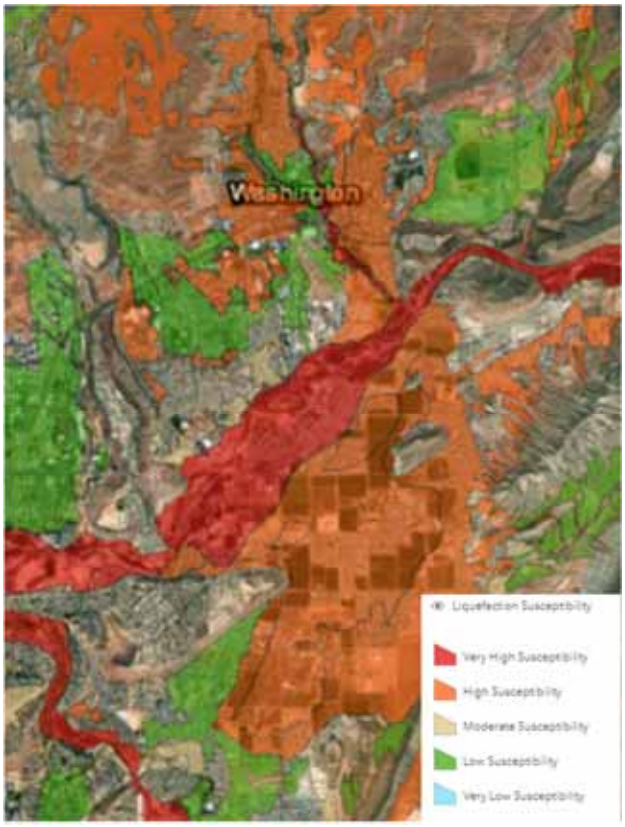


Figure 538: Washington City Liquefaction Hazard

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many of geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah experiences with flooding are often because of severe weather, which can cause flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. These floods can be harmful to communities causing damages to structures and infrastructure, traffic delays, injuries, and other losses. Flood maps are completed by FEMA and used for local regulations of construction in observed flood risk areas. These maps provide important information about the likelihood of a flood happening in each area. Figure 539 describes the 100-year floodplain, and the dam inundation zone for the city.

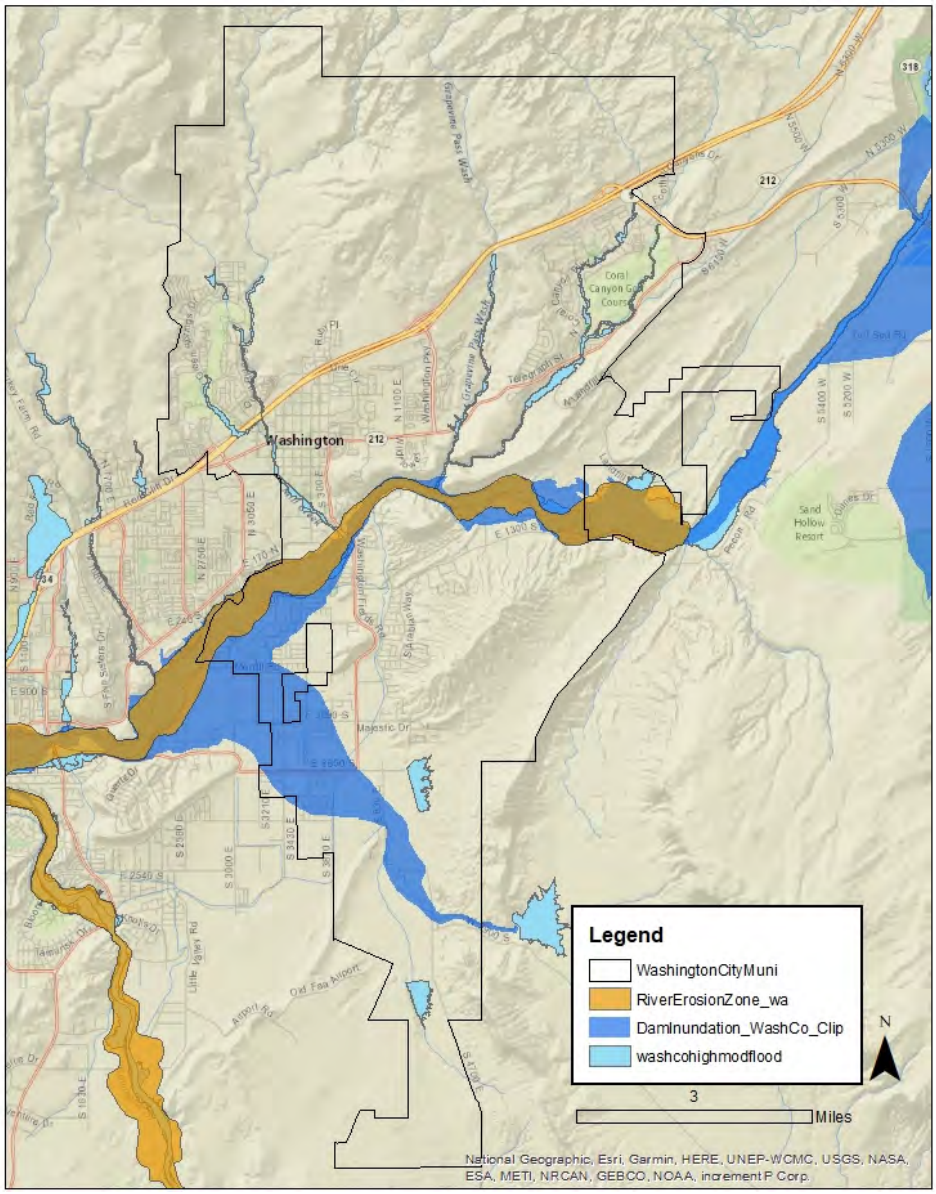


Figure 539: Washington City Floodplain and Dam Inundation Zones

Source:

To this analysis, the Five County Association of Governments merged Dam Inundation areas with floodplains to understand the total assets that could be at risk within a mapped flood area. These calculations can be seen in Appendix D. Table 511 shows the combined exposure to the floodplain and dam inundation zones in the unincorporated county.

Table 511: Washington City Exposure to Floodplain and Dam Inundation Zones

Washington City Exposure to Floodplain and Dam Inundation Zones						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	9.7%	9.1%	9.1%	7.7%	N/A	0.0%

Riverine Erosion

The soil erosion zone is mapped for Washington City, St. George, Santa Clara, and some unincorporated areas near these municipalities. Erosion zone intended to reduce damages due to erosion during flooding and uses similar data as the FEMA 100-year floodplain, according to the River Sustainability Study. This study was completed following 2005 flooding which caused significant erosion damages to community assets, property, and open space. (JE Fuller Hydrology and Geomorphology, Inc. , 2005) These zones are based on the geomorphic, historical, quantitative, and engineered structures analysis to develop the erosion zone.

Five County compared Soil Erosion zones with Washington City infrastructure to understand the interaction of certain assets and features of the community's interaction with the erosion zone. Only one residential parcel and 1.12% of road miles in Washington City falls in the mapped erosion zone. Given the limited scope of the available mapped data, soil erosion may pose additional risks elsewhere in the county. Future growth in the community may increase local exposure to riverine erosion areas.

National Flood Insurance Program (NFIP)

Washington City property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year? , 2021) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

Table 512: Washington City NFIP Participation and Claims Paid

Total Premium	V-Zone	A-Zone	# Policies	Total Coverage	Claims since 1978	Total Paid since 1978
$26,245	0	11	55	$18,207,500	3	$6,377

Source: FEMA NFIP Insurance Report, Repetitive Loss/BCX Claims, and Community Status Book Report; accessed July 23, 2020.

Washington City participates in the NFIP and had the most recent Flood Insurance Rate Maps were developed for the community in 2009. Table 512describes the number of flood insurance policies, and dollar value insured and claimed since participation began in the unincorporated county. Three properties have reported claims to the NFIP in Washington City and none of these properties are considered repetitive losses.

Washington City does not participate in the Community Rating System (CRS). The CRS program scores a community for actions taken that surpass the requirements of NFIP participation. These CRS scores can result in a reduction in flood insurance rates in a community.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 513 describes the flooding events which have impacted Washington City and the surrounding area.

Table 513: Washington City Reported Flood Events 1997-2020

Date	Damage/Injury	Description
12/19/2010	$19,700,000	Rain caused flooding throughout Washington County, causing damages. In Washington City, a phone call from the National Weather Service alerting the Public Works Department of high flow on the Virgin River saved $300,000 in equipment from being swept away.
7/12/2013	$10,000	Heavy rain caused flash flooding. Two homes were evacuated and experienced minor damage from flood waters. Elsewhere, damage was reported in outdoor spaces.
7/20/2013	$20,000	Flash Flooding in Washington City occurred on Washington Drive, I-15, and in the Coral Canyon Subdivision. One home was flooded with two inches of mud and water and a neighboring home had damage to the yard due to the flood.
7/26/2013	$75,000	Flash flooding in the Coral Canyon Subdivision caused basement flooding in six homes and high water damaged the exteriors of some mobile homes.
8/18/2014	$75,000	Heavy rain caused flooding along Main Street, damaging six homes and a grocery store.
7/18/2015	$50,000	Flooding was reported on roads in Washington City.
7/13/2018	$75,000	Heavy rain resulted in the flooding of six homes in Washington City
7/17/2018	None Reported	Flash flooding reported in Washington City following a heavy rain event.

Source: NOAA Storm Database

Several flooding events have occurred in roads in Washington City, with impacts to residential homes and businesses. Throughout Washington County, flood events have been impactful throughout Washington County. To recognize the scope of flood challenges and risks which have been damaging in the county, please reference the Washington County flood section, or the sections for other communities on the Virgin River. This can provide additional context to events which have impacted Washington City, or reference events that impacted Washington City, but did not document damages to Washington City.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can burn or kill vegetation, reducing the amount of water absorbed by the ground, which can in turn result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslide

Washington City is marked by desert cliffsides and hills throughout the city boundary. The geology in this region is a unique meeting of the Mojave Desert and Colorado Plateau. The distinctive landscape and access to the outdoors present in this region draws residents and visitors annually, also contributes to a heightened risk to landslide hazards in the area. Some of the geology in the area is notably formed by landslide events. Zion National Park, for example has features that point to historic landslides as formative to the current landscape. Figure 540 describes the landslide and rockfall areas considered to have moderate or greater risk in the county, which covers much of the land in the Bull Valley Mountains, Pine Valley Mountains, Zion National Park and nearby mesas and cliffsides. Washington City does include landslide and rockfall susceptible areas.

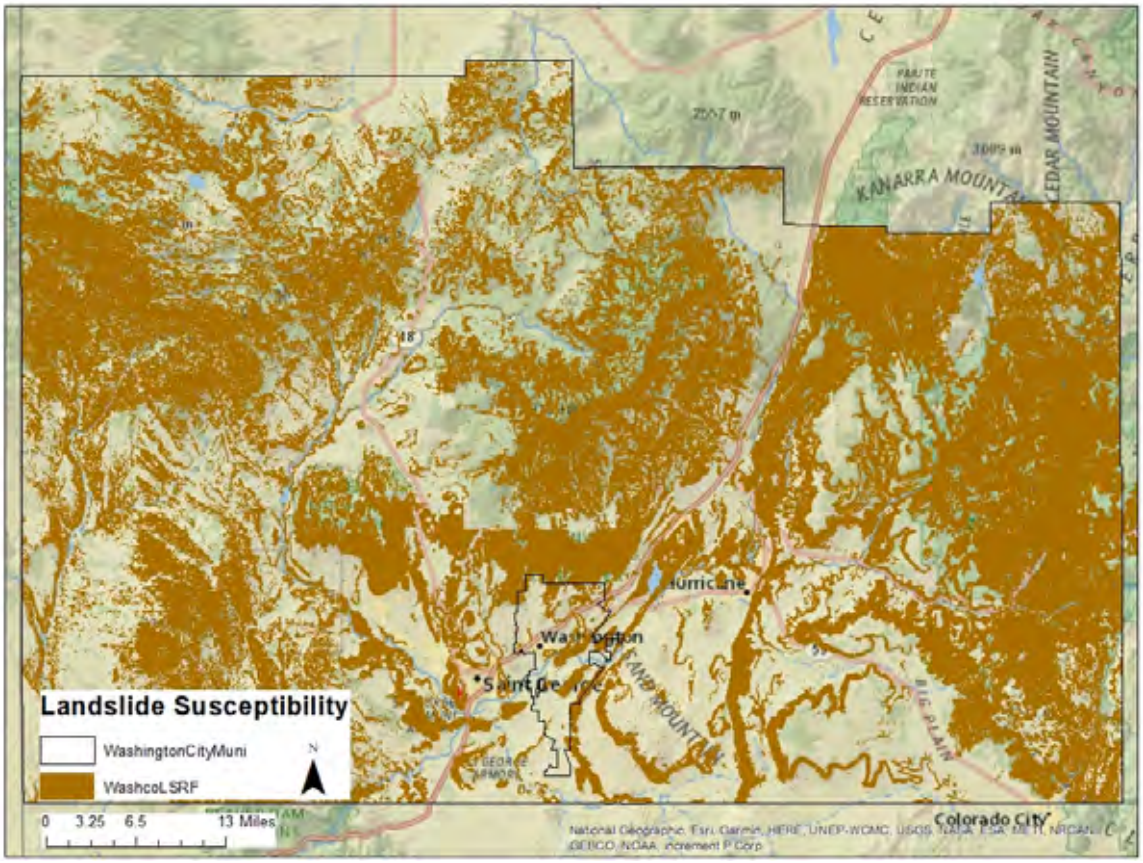


Figure 540: Washington City Landslide Susceptibility

Table 514 describes the community assets which interact with landslide and rockfall susceptible areas. Commercial parcels in Washington City are the most at-risk asset to landslides or rockfall in the municipal boundary. Residential parcels and road miles are also exposed to susceptible areas. Roadways can be damaged or blocked by landslide or rockfall events, which can result in delays in travel, separated communities, and expense to repair or replace. The 8.1% of parcels exposed to landslide and rockfall hazards can result in damage to structures, deaths, and injury among the users or residents of these spaces.

Table 514: Washington City Exposure to Landslide Susceptible Areas

Washington City Exposure to Landslide Susceptible Areas						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
0.0%	12.1%	8.0%	8.1%	7.4%	N/A	N/A

Source:

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. Washington City does not have a record of landslides impacting the municipal boundaries from the sources reviewed from this plan, however the 2016 Natural Hazard Plan describes a landslide on Telegraph Drive in need of mitigation. The city has experienced or identified landslide areas which have not been reported in state or national databases. The city also includes some landslide susceptible areas and landslides are possible in the community.

Drought

The Five County Region has experienced 7 periods of drought conditions since the 1895. Drought periods are marked by lower-than-normal precipitation and can result hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten high risk environments that can cause other hazards, for example, dry and hot environments can make fuels more likely to ignite or increased impacts of flash floods and landslides following severe weather. The Virgin River watershed is identified as a drought prone water source, according to the Washington County Water Conservation District.

Monitoring drought generally occurs across several climate division. Washington County lies in the Dixie division, which includes only southwestern Washington County. Drought, given its regional scope will impact the residents, facilities, infrastructure, businesses, and property in the community.

Hot and dry drought conditions, especially in summers can lead to lost or damaged crops or livestock. Tourism can also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. Further, decreases in water supply due to drought can lead to water quality concerns, according to the EPA. These challenges can cause direct impacts on residents and essential functions in a community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. The Environmental Protection Agency has identified that Southwestern Utah is expected to have an average indoor level between 2.0 and 4.0 Pci/L of air, illustrated by Figure 541. At this level, mitigation is recommended, although mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

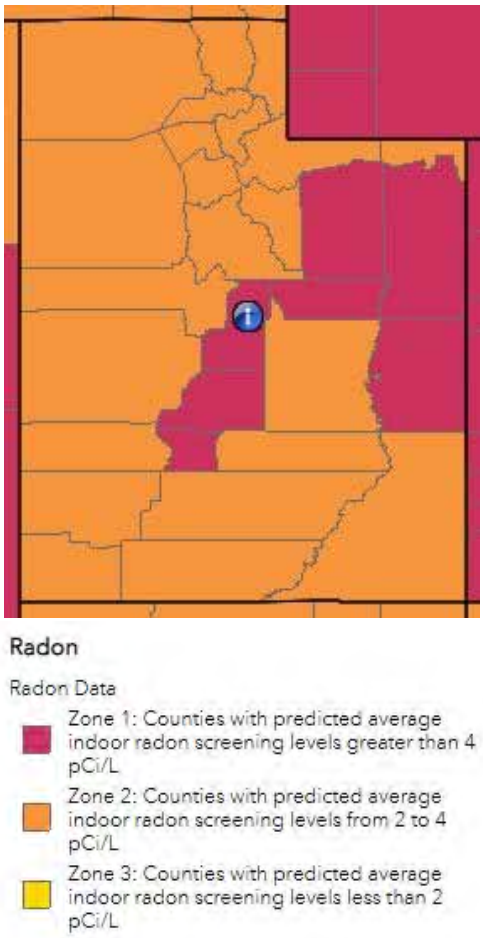


Figure 541: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 515 describes the reported findings from short term radon testing across Washington County. The countywide average test result is 2.2 pCi/L of air. While this average is within the radon estimate for the region, radon tests with high levels of radon in the air have been reported which would require mitigation for human occupation of a space. The takeaway from this data is that radon gas has been identified in structures in the County and that testing, and information is necessary to understand and reduce risk.

Table 515: Washington County Short Term Radon Testing Reported

Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the testing record, with even less being available at the town level. Increased testing and reporting would improve the understanding of radon risks and vulnerabilities for home and property owners. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the only way to understand the potential risk and exposure of radon gasses for a residence or structure. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Severe weather often affects a region or county at large and can be difficult to accurately document, as coverage often relies on local documentation and reporting to NOAA or other weather agencies. There is not GIS data to show where or how severe weather will impact Washington City, however our analysis assumes that severe weather events will impact the whole of the community, residents, facilities, infrastructure, businesses, and property.

Washington City traditionally sees summers marked by high heat, dry weather, and rapid downfalls of monsoon rains. Thunderstorms frequently impact Washington County, which can produce hail, high winds, rain, and lightning.

Hazard History

NOAA reports that there have been 451 severe weather events reported for Washington County between 1950 and 2020, 56 of which caused damages or injury. Washington City has several reported severe weather events which have impacted the area. Severe winds and thunderstorms are common to Washington City and can damage structures and economic assets, delay traffic, and block roads. Extreme heat is also a challenge throughout the Southwest, two such events are described in Table 516. While the deaths reported during the 2013 events did not occur in Washington City, the area likely saw extreme heat during these events which could cause impacts on residents and visitors. Outdoor recreators, unhoused persons, and outdoor workers, are vulnerable to these extreme temperatures.

Table 516: Washington City Severe Weather Record

Date	Damage/Injury	Description
2/16/2011	$35,000	Strong winds associated with a thunderstorm blew a portion of a barn across a road, causing damage to powerlines.
7/4/2013	3 deaths	Hot temperatures contributed to the death of three hikers in Garfield and Kane Counties.
7/21/2013	1 death	Hot temperatures killed a hiker in Kane County.
2/23/2015	None Reported	Two to three inches of snow was reported in Washington City.

Source: NOAA Storm Database

Strong winds and snow have impacted Washington City in the past. Other severe weather events throughout the region include snow, rain, and thunderstorm events, which can cause impacts including, traffic delays, vehicle accidents, and damage to structures and utilities. It is possible that some weather events reported in other communities also caused delays or impacts in Washington City, and we recommend referencing those community's section in this plan for a more thorough account.

Severe weather occurs regularly throughout the region and can cause damages to structures and infrastructure. Severe weather events have the potential to trigger other natural hazards in the area, which can include flooding or landslide from severe rain, fires from lightning strikes, and blowing sand with high winds, for example.

Problem Soils

Problem soils can create some challenges for structural integrity as changes in weather and soil moisture change, which in some cases can lead to soil expansion or collapse. Expansive, collapsible, gypsum, and piping susceptible soils are prevalent in many areas. The city requires a soils report for development in some cases to understand the prevalent soils on a site and set requirements to mitigate if necessary.

Five County used Problem Soil Susceptibility that describes the extent of problem soils for some additional portions of the county, primarily the southwest and northeastern areas of the county. Figure 542 maps the data available and Table 517 shows the exposure of Washington City assets, infrastructure, and parcels to problem soils. Expansive soils are prevalent in the southern portion of the city, as seen in Figure 542. There are presently a small percentage of parcels and 15% of road miles located in mapped problem soil areas.

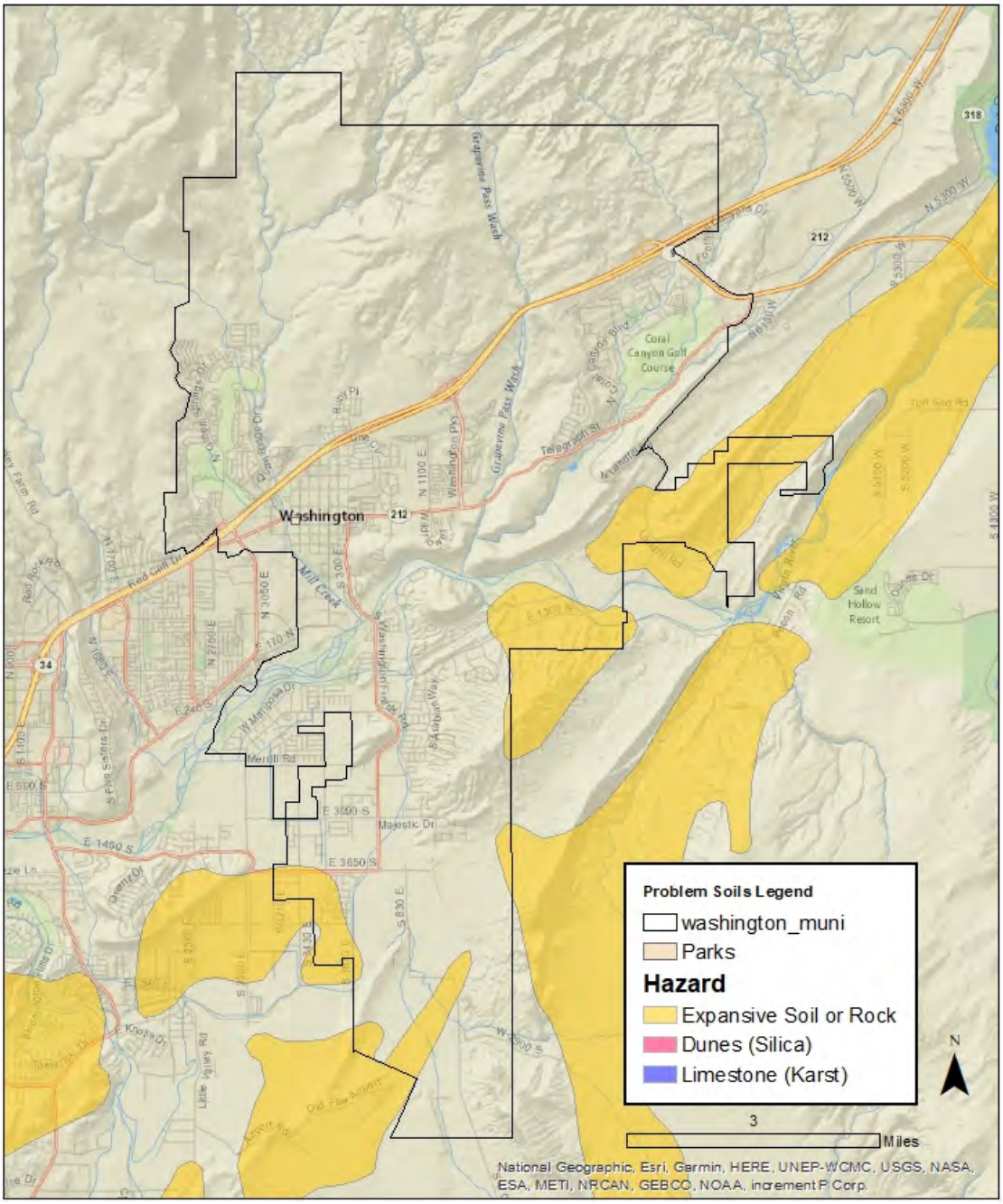


Figure 542: Washington City Problem Soils Mapping

Table 517: Washington City Exposure to Problem Soils

Washington City Exposure to Problem Soils						
Critical Facilities	Parcels			Road Miles	Rail Miles	Parks
	Commercial	Residential	Total			
11.1%	11.8%	2.4%	2.7%	6.0%	N/A	0.0%

Source: Utah Geological Survey

The Utah Geologic study has completed new mapping to describe the extent of certain problem soil hazards in the region and includes Washington City. This data was not available in a format to compare to community assets and infrastructure; however, this data gives greater detail of the prevalent types of problem soils. Figures x- x illustrate the problem soils mapped in areas of Washington County in this most recent mapping effort.

Caliche

Figure 543: Washington City Caliche Susceptibility

Source: Utah Geological Survey

Collapsible Soil

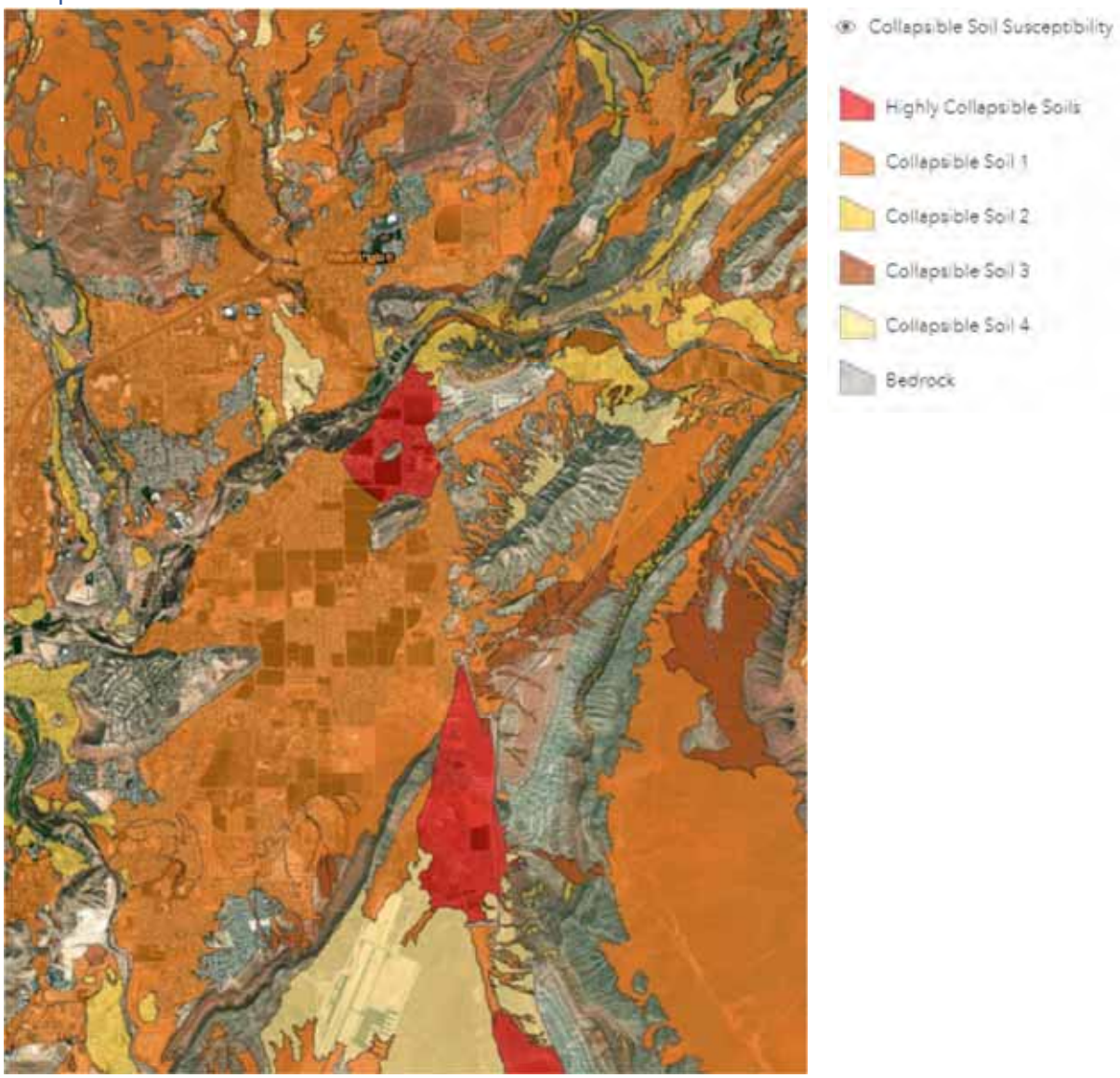


Figure 544: Washington City Collapsible Soil Susceptibility

Source: Utah Geological Survey

Expansive Soil and Rock

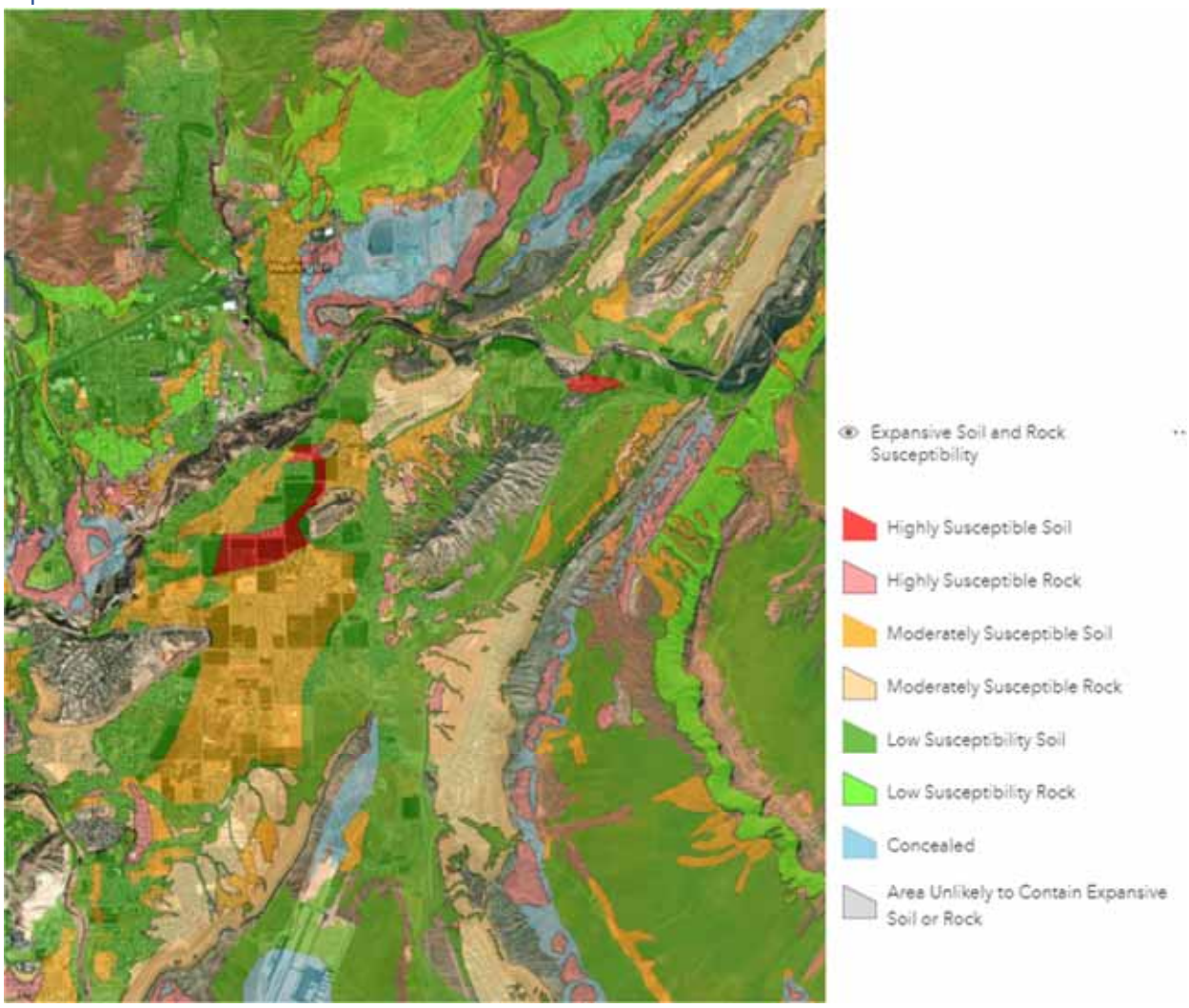


Figure 545: Washington City Expansive Soil and Rock Susceptibility

Source: Utah Geological Survey

Karst Formations

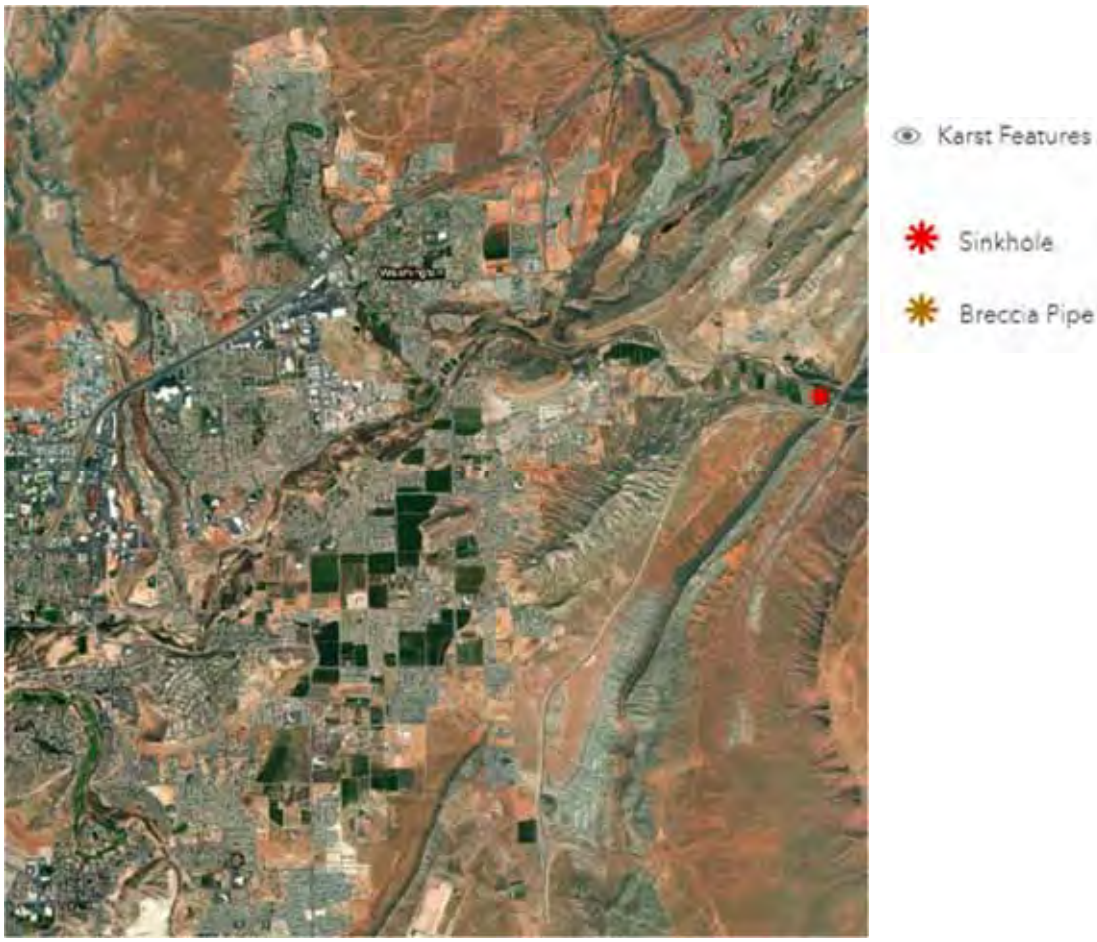


Figure 546: Washington City Karst Features

Source: Utah Geological Survey

Piping and Erosion

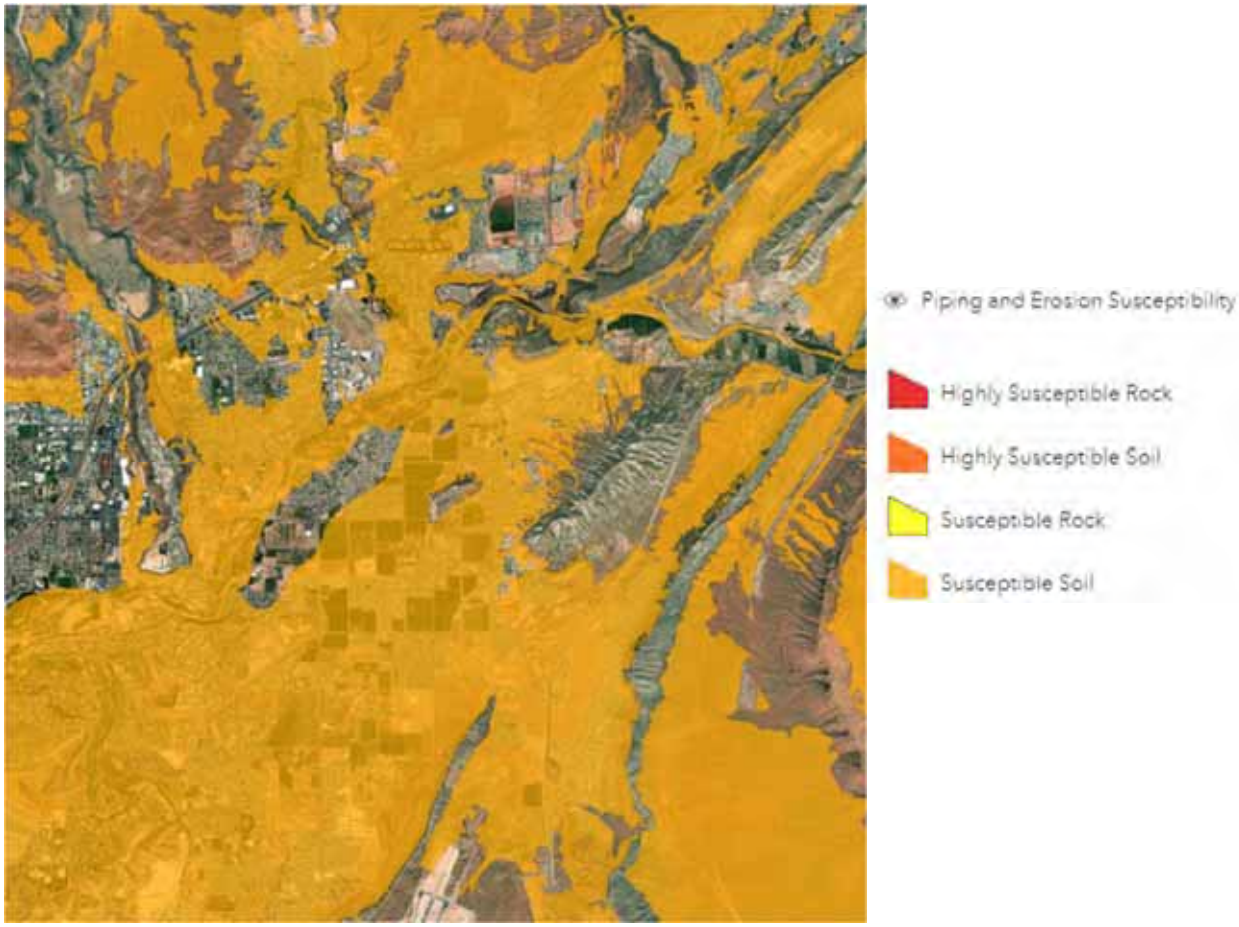


Figure 547: Washington City Piping and Erosion Susceptibility

Source: Utah Geological Survey

Shallow Bedrock

Figure 548: Washington City Shallow Bedrock Potential

Source: Utah Geological Survey

Soluble Soil and Rock

Figure 549: Washington City Soluble Soil and Rock Susceptibility

Source: Utah Geological Survey

Wind-Blown Sand

Figure 550: Washington City Wind-Blown Sand Susceptibility

Source: Utah Geological Survey

Risk Assessment Summary

Washington City is at risk to wildfire, landslides, earthquake, flooding, drought, severe weather, problem soils, and radon. Residents are at risk to injury and property damage from several natural hazards. Washington City critical facilities are vulnerable to severe weather, problem soils, earthquake, and wildfire. Impacts from these natural hazards can impact a facility's capacity to respond to an emergency event, in addition to damaging equipment, structures, and infrastructure at the facility.

Transportation routes have been impacted by past natural hazard events and are exposed to several natural hazard susceptible or risk areas in the region. I-15 has repeatedly had significant impacts on the corridor. While this may have not directly impacted Washington City, it causes delays and travel challenges for the community during the event.

Mitigation strategy & actions

Washington City has participated in previous iterations of the Five County Multi-Jurisdictional Natural Hazard Plan and identified strategies to mitigate natural hazard risks. Table 518 describes progress made on Washington City mitigation strategy as detailed in the 2016 iteration of the Natural Hazard Mitigation Plan.

Table 518: 2016 Washington City Mitigation Strategy

Hazard	Objective	Action	Timeline	Funding Source	Progress
Landslide #1	Stabilize the landslide on Telegraph Road and repair the road to a safe operating condition.	Stabilize the road to stop future movement and repair the road surface to a level and safe condition.	Repair needs to be immediately to prevent loss of life and property.	City Funds, Possible grant/loan	Complete.

Source: 2017 Five County Association of Governments NHMP

Washington City identified actions to include in the community mitigation strategy. Each action in Table 519 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 551.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action, indicated by L=low, M=moderate, and H=high
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or persons who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 551: Regional Plan Goals

Table 519: Washington City 2022 NHMP Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Radon #1	3	Inform residents of Radon risk.	Provide public education about radon.	H	Ongoing annually	L	Washington City	Washington City, Department of Environmental Quality.
Flood #1	1, 2, 6	Reduce residential and street flooding.	Implement stormwater measures identified in the Stormwater master plan (adopted 2022)	M	5-years	H	Washington City, CDBG, CIB	Washington City
Flood #2	1, 2, 6	Implement bank stabilization measures along vulnerable areas of the Virgin River.	Install rip rap on the Virgin River at Sullivan Park & Pine View Park to stabilize riverbanks.	H	3-years	H	Washington City	Washington City, Washington County Flood committee
Flood #3	1, 2, 6	Stabilize dams.	Repair the dams and spillways at the Stucki Debris Basin, Warner Valley Draw and the Gypsum Debris Basin.	H	3-years	H	NRCS, Washington County.	NRCS, Washington City, Washington County Flood committee
Drought #1	2, 6	Conserve resources used on city property.	Replace City owned unused grass areas with native vegetation on town owned property.	M	3-years	M	Washington City, State of Utah	Washington City
Drought #2	2, 6	Conserve culinary water for indoor use.	Install secondary water system for outdoor irrigation throughout Washington City.	M	5-years	H	Washington City, CDBG, CIB.	Washington City, Water Conservancy District.

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Drought #3	2, 6	Conserve resources used on new developments	Adopt a new ordinance limiting the amount of grass on new development.	M	5-years	H	Washington City, CDBG, CIB.	Washington City, Water Conservancy District.
Earthquake #1	1, 2, 3	Identify and mitigate vulnerable construction.	Inventory City Owned structures in the city that are constructed with unreinforced masonry and plan for retrofit of structures for the safety of occupants.	M	3-years	M	Washington City, preservation Utah, Federal and State Historic Tax Credit.	Washington City, Earthquake. Utah.gov
Earthquake #2	3	Inform residents of earthquake risks.	Use public meetings as an opportunity to share earthquake risk and mitigation activities in homes, schools, and businesses.	H	Ongoing, annually	L	Washington City	Washington City
Severe Weather #1	3	Inform residents of extreme temperature risks.	Educate residents and visitors of the dangers of extreme temperatures and severe weather events, including steps they can take to protect themselves during an event.	H	Ongoing	L	Washington City	Washington City
Severe Weather #2	1, 3	Identify assets to be used or adapted to address vulnerable communities' extreme temperature exposure.	Produce a map of cooling locations where visitors and residents may go during daytime hot temperature events.	L	2-years.	L	Washington City	Washington City GIS staff

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Landslide #1	6	Maintain identified and previously mitigated hazards.	Monitoring of Telegraph landslide and as needed implement slope stabilization measures.	H	Ongoing	M	Washington City	Washington City
Problem Soils #1	1	Identify damages caused to inform future planning needs.	Inventory locations where problem soils have caused damages to properties.	L	1-year, ongoing	L	Washington City	Washington City GIS Staff
Wildfire #1	1, 2, 5, 6	Identify hazard areas within town boundaries to inform plans and action.	Inventory and reduce fuel loads in areas most vulnerable to wildfire in the city boundary.	M	Ongoing	M	Washington City	Washington City Fire Department
Wildfire #2	1, 2, 4, 5, 6	Reduce fuels at junctions between natural systems and development.	Coordinate fuels mitigation and reduction on the Virgin River Corridor.	H	Ongoing	M	Washington City	Washington City, Fire Department, Flood TAC.

Source: Local Planning Team

Paiute Indian Tribe of Utah

Paiute Indian Tribe of Utah members are descendants of Paiute people who traditionally lived in Central and Southwest Utah, Northern Nevada, Southwestern California, and Northern Arizona. These ancestral lands were home to thousands of Paiute people. Figure 552 illustrates the area.

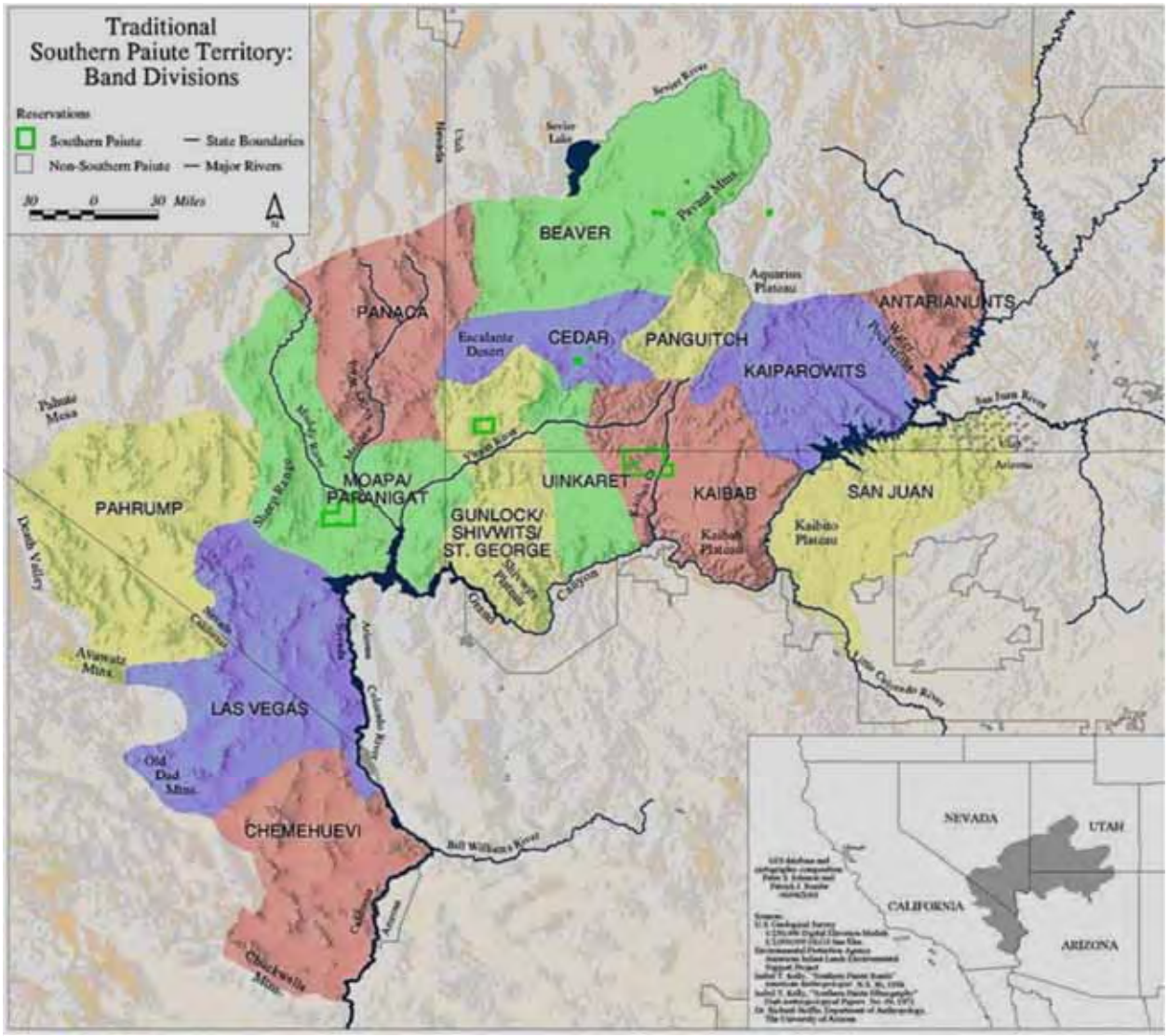


Figure 552: Traditional Southern Paiute Territory

Source: Paiute Indian Tribe of Utah

Like other Tribes, cultural disruptions during the past two centuries have threatened the continuation of the Paiutes traditional life. Over the years, we have seen our land and water seized and our ancestral lands reduced to a fraction. The Paiutes were subject to ungratified treaties, forceful removal and consolidation, unfilled promises, and mistreatment.

Traditionally, the Paiutes were a peaceful people. The Paiutes were culturally well adapted; they combined farming with hunting and gathering. They used the resources of the land with great ingenuity.

Today, the Paiute Indian Tribe of Utah strives to protect and preserve our culture, legends, songs, and dances.

The history of the Paiute Indian Tribe of Utah ("Tribe") is unique and demonstrates the Tribe's resiliency and determination to do what is best for its people. The Tribe has faced numerous obstacles and setbacks but is resolute to strengthen its sovereignty, its ability to self-govern and strengthen its capacity to perpetuate its culture, traditions, and values for the generations to come. The Tribe is not content to merely survive, it is our goal to thrive, and control our future and destiny.

In 1954, the United States Congress, without the agreement or authority of the Tribe, passed the Termination Act ("An Act to provide for the termination of Federal supervision over the property of certain tribes, bands, and colonies of Indians in the State of Utah and the individual members thereof, and for other purposes," approved September 1, 1954, 68 Stat. 1099). That Act provided for the termination of federal recognition and services to the Tribe and ultimately resulted in the almost complete dispossession of the reservation lands. Although the Paiutes did not meet the criteria for termination, as outlined by Congress, it was believed that tribes should be assimilated, and that the Utah Tribes were to be the example for the termination policy.

The Paiute Bands were terminated, denied official recognition, and cut off from all federal benefits, services, and economic support. The Cedar Band was overlooked in the Termination Act but was treated the same as the other Band's and received no further federal assistance and consequently suffered de facto termination. These set of events were detrimental to the Paiutes. Upon termination, the Bands found themselves with marginal land and little else. Not being integrated into the white man's society, they were unaware of the legal requirements of land ownership. Those Bands that did not lose their reservation land could sell their land before it was lost and collect some income. Except for the Shivwits Band, all the bands lost their lands due to termination.

The Termination Act was devastating to the Tribe. During the Termination Era, for every birth, there were three (3) deaths. The Paiute Bands saw a decline in life and the average life expectancy was 42 years of age. Nearly one-half of the PITU membership died due to ill health, poor housing conditions, and nutritional deficiencies. Inadequate healthcare, housing, education, and no economic growth left the Paiutes in bleak living situations with poverty and social disruption. Many of the children had been taken and placed in foster care, placed in the Indian Placement Program run by the Church of Jesus Christ of Latter-Day Saints, or adopted out. Due to termination, the Paiute pride and culture diminished dramatically. The termination era was detrimental to the Tribe and resulted in the dramatic diminishing of our Paiute culture and traditions.

In 1972, the Paiute Bands established the Utah Paiute Tribal Corporation, a non-profit corporation, with the goal of uniting the five Paiute Bands in the fight to restore federal restoration. The Board of Directors of the Corporation was composed of representatives from each of the five Paiute Bands. The Utah Paiute Tribal Corporation began performing governmental functions and operating as a governmentally organized Tribe.

In 1975 the Utah Paiute Tribal Corporation began its effort to regain federal restoration. The Paiute Bands understood that there was more influence and power through unification. The Paiute Bands worked towards forming a single cooperative tribal government that would represent all Paiute Bands, as reflected in the structure of the Utah Paiute Tribal Corporation.

The hard work, dedication, perseverance, and vision of these leaders was rewarded.

On April 3, 1980, Congress restored the Paiute Indian Tribe of Utah's federal recognition pursuant to the Paiute Restoration Act, P.L. 96-227, which restored the federal trust relationship to the Paiute Indian Tribe of Utah. The PITU Restoration Act established the Paiute Indian Tribe of Utah as the federally recognized Tribe, comprised of five constituent bands (Cedar, Indian Peaks, Kanosh, Koosharem, and Shivwits).

The Paiute Restoration Act (P.L. 96-227) acknowledged that the Indian Peaks, Kanosh, and Koosharem Bands lost their ancestral Reservation lands and that Cedar Band never had reservation lands and provided language for the Tribe to choose lands to establish a reservation for the Tribe, through the creation of a reservation land use plan which included the acquisition of a total of fifteen thousand acres of land. On February 17, 1984, Congress passed "An Act to declare certain lands to be held in trust for the benefit of the Paiute Indian Tribe of Utah, and for other purposes" (P.L. 98-219, 98 STAT. 11). The 1984 Act approved 4,770 acres of reservation lands, 10,230 less than the original promise of 15,000 acres of land as enlargement of the reservation land as authorized in the Paiute Restoration Act (P.L. 96-227). The 1984 Act also established the Paiute Indian Tribe of Utah Economic Development and Tribal Government Fund, an irrevocable trust fund, with one half of the principal of the interest designated for Economic Development and the other half designated to support Tribal Government. This fund was considered the fulfillment of the promise of acquiring fifteen thousand acres of land as enlargement of the reservation land as authorized in the Paiute Restoration Act (P.L. 96-227).

The Paiute Indian Tribe of Utah's form of government is established in its constitution. The Paiute Indian Tribe of Utah Tribal Council is the official governing body of the Tribe and is vested with all executive and legislative powers of the Tribe, including the power to make and implement laws. The Tribal Council has the authority to represent the Tribe and act in all matters that concern the welfare of the Tribe, and tribal sovereignty as recognized by the Federal Government. The Tribe's Constitution and the ordinances of the Tribal Council are the supreme law of the Tribe. The Tribe's headquarters are located on its reservation in Cedar City, UT, where programs and services are delivered to Members.

The Paiute Indian Tribe of Utah's Tribal Council consists of six (6) members, one (1) elected from and by each constituent band, and the sixth elected as the chairperson for the Tribe. The Tribal Council serves a term of four (4) years.

Each constituent Band has its own organizational government structure, by-laws, and operational procedures to direct and govern the Band and its business. Each Band has the authority and responsibility to manage its natural resources and all activities within its Band Lands. Each Band has its own community located on or near its traditional lands or former reservation lands: the Cedar and Indian Peaks in Cedar City, Utah; the Kanosh in Kanosh Indian Village near Kanosh, Utah; the Koosharem in and near Richfield, Utah; and the Shivwits reservation near St. George, Utah.

This chapter describes the natural hazard risks identified by the tribal government and tribal land and develops actions to mitigate the risks of natural hazards to the residents, economies, environment, and cultural elements that make up the communities on and around tribal lands.

Planning Process

The planning process to develop a natural hazard mitigation plan began in summer of 2020, in conjunction with the process for the Five County Association of Governments, an intergovernmental organization which coordinates local governments in southwestern Utah, in the traditional Southern Paiute territory. A description of the planning process for the Association of Governments, counties, cities, and towns can be found in the Introduction of the plan.

Tribal governments also participate in mitigation planning efforts to meet the requirements of 44 CFR § 201.7 to reduce long-term risk from natural hazards. Mitigation has been shown most effective when implemented pre-event, through a planning process. Mitigation can include adopting codes or ordinances, the preservation of natural features, new structures or infrastructure, and public engagement to address a natural hazard.

The Five County Association of Governments engaged the Tribal Administration with an invitation to participate in the Five County Association of Governments Multi-Jurisdictional Natural Hazard Plan process. A Memorandum of Understanding was developed to describe that the Paiute Indian Tribe of Utah was interested in participating in the planning process.

The Tribal Administrator participated in several multi-jurisdictional stakeholder meetings, as described in the table below:

The Tribal Administrator coordinated the development of the planning teams to provide input on this plan, which includes the Tribal Emergency Response Team (TERT) and the Tribal Council.

Public Engagement

Public input and engagement for this section of the plan was focused on Tribal Members, as this section of the multi-jurisdictional plan serves primarily Tribal Members. Membership is defined in the Paiute Indian Tribe of Utah's Constitution. Tribal Members were provided opportunities for public engagement as it pertains to describing risks and mitigation strategy for the Paiute Indian Tribe of Utah's Hazard Mitigation Plan section. During this planning process members were invited to participate in a survey, and feedback was solicited from both the Tribal Emergency Response Team and the Tribal Council.

Hazard Mitigation Plan Survey

We are currently working to develop a Hazard Mitigation Plan that will be used by the Tribe and it's five constituent bands.

We have developed the following survey to get input from our communities for the planning and development of the Hazard Mitigation Plan, working with Five County Association of Governments. Due to the project timelines, we need all survey responses completed by **Friday, March 4th**.

Please review and complete the survey:
https://www.surveymonkey.com/r/LMG87MV

We appreciate and value your feedback!

Figure 553: Hazard Mitigation Plan Survey

Source: Paiute Indian Tribe of Utah

Methods for data collection and analysis are described in Chapter 2 of the Multi-Jurisdictional Natural Hazard Mitigation Plan.

Community Characteristics

The Paiute Indian Tribe of Utah total membership is 917 as of February 24, 2022. The communities cover an area of approximately 54 square miles. The Tribe has Tribal Lands, and its constituent Bands have Band Lands throughout southwestern Utah. The focus of the community characteristics is to describe the populations, assets, infrastructure, and facilities within the boundaries of the reservation.

Paiute Indian Tribe of Utah Headquarters: Cedar City, UT (Iron County)
Federal Recognition: April 3, 1980

In addition to the headquarters in Cedar City, the Paiute Indian Tribe of Utah has additional tracts of land in Springdale, Utah and near Sand Hollow State Park, in Washington County. Neither of these areas are part of the Tribe's reservation as of this writing. Shapefiles were not available to map the additional tracts and risks to these sites will be described in each section.

Bands

The Paiute Indian Tribe of Utah supports its constituent Bands, but the Bands are responsible for the management of their lands.

Cedar Band – Cedar City, UT (Iron County)
Membership: 284

Indian Peaks Band – Cedar City, UT (Iron County)
Membership: 42

Shivwits Band – Ivins, UT (Washington County)
Membership 321

Kanosh Band – Kanosh, UT (Millard County)
Membership 151

Koosharem Band – Richfield, UT (Sevier County)
Membership 119

Demographics

The population living in the Paiute Reservation is estimated at 439 per the American Community Survey Five Year Estimates. Reservations are home to both members and nonmembers. It is estimated that out of the total population, most residents are between 20 and 54 years old, female, and identify as American Indian and Alaska Native, according to Figure 554- Figure 556. Over 8% of the population identifies as another race and 5.9% as two or more races.

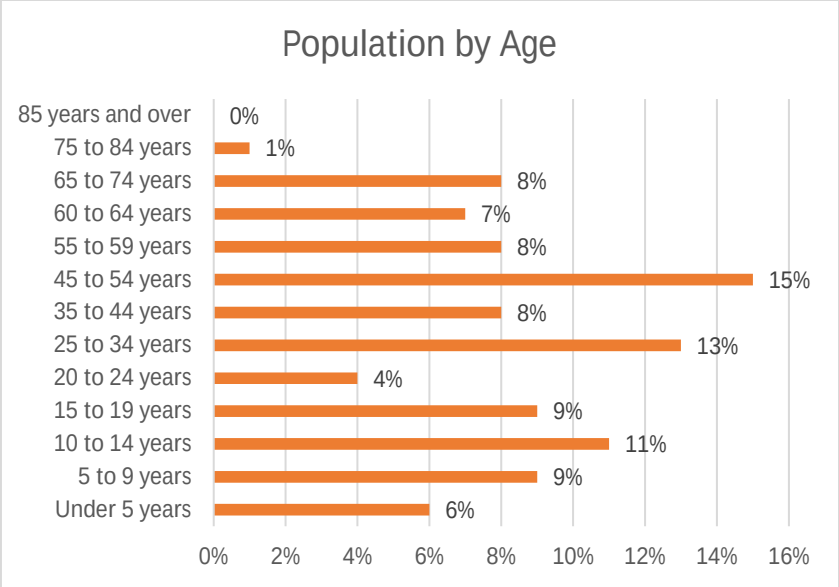


Figure 554: Paiute Indian Tribe of Utah Population by Age

Source: US Census Bureau

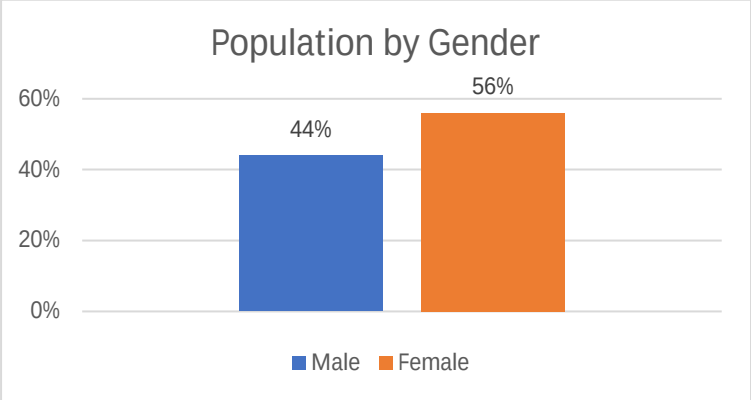


Figure 555: Paiute Indian Tribe of Utah Population by Gender

Source: US Census Bureau

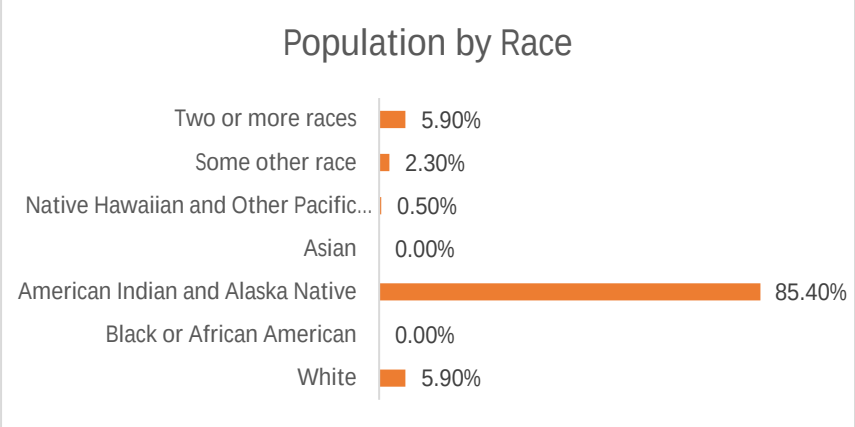


Figure 556: Paiute Indian Tribe of Utah Population by Race

Source: US Census Bureau

Economy

The civilian workforce consists of 162 people, making up approximately 25% of the total population. The unemployment rate is 2.7%, which is near the Utah total unemployment rate of 2.2% as of October 2021. Workers living on the Paiute Indian Tribe of Utah Reservations work in a diverse array of industries, described in Figure 557. The industries which employ the most workers are educational services, healthcare, and social assistance; public administration; and retail trade. No workers are currently employed in finance or information industries.

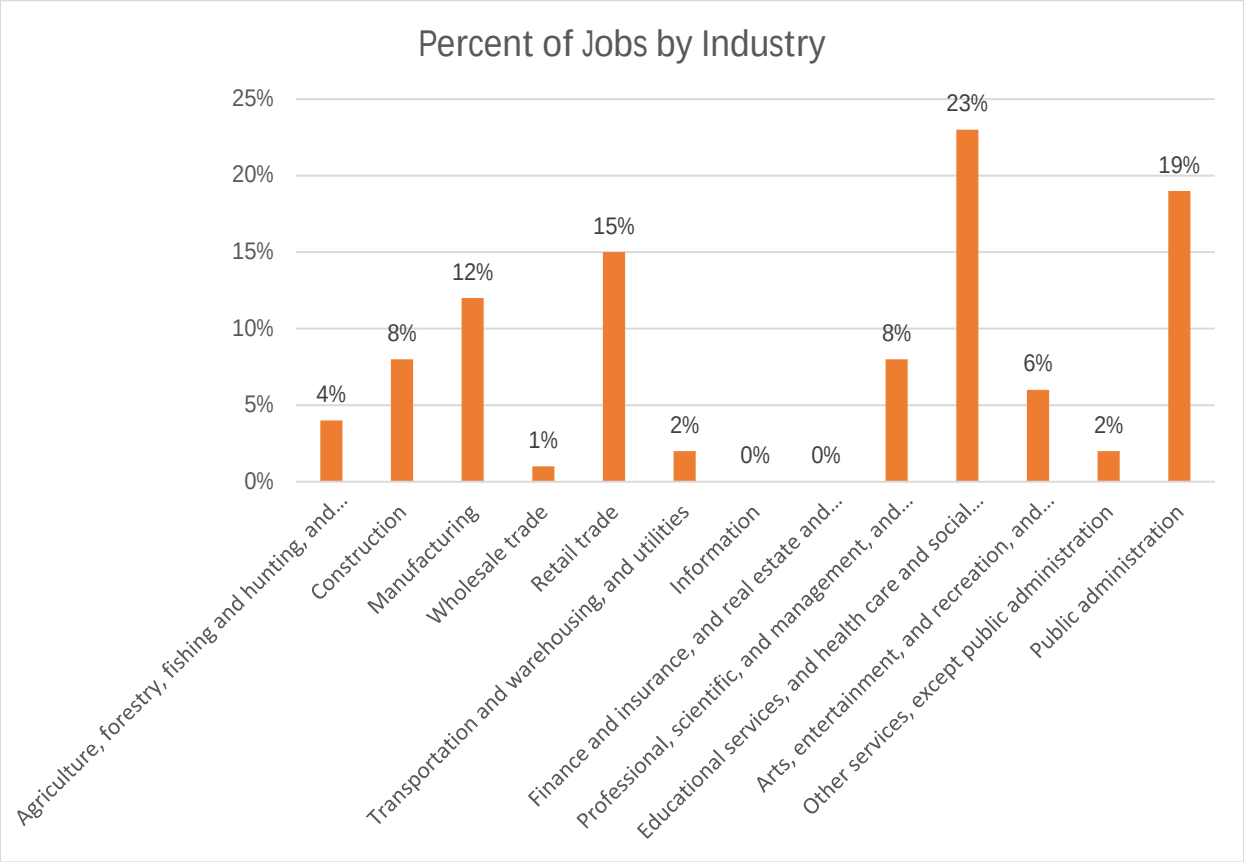


Figure 557: Paiute Indian Tribe of Utah Percent of Jobs by Industry

Source: US Census Bureau

Most workers are private wage and salary workers, and only 28% of workers are government workers. The median household income for the community is $36,613. Figure 558 describes the breakdown of incomes at several income brackets. The largest share of residents earns between $35,000 and $49,999 annually. The next highest concentration of incomes includes those who earn less than $10,000 annually, at 14% of the working population.

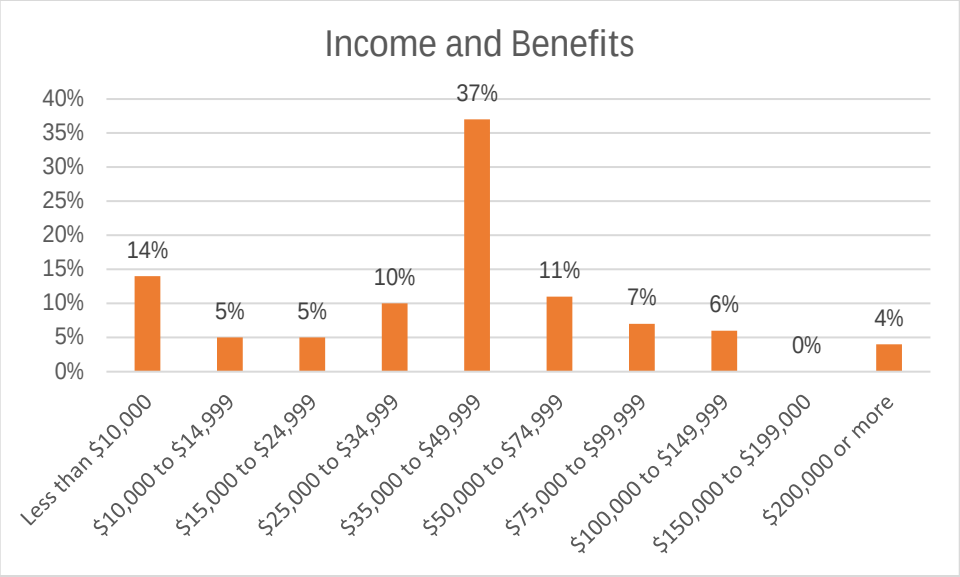


Figure 558: Paiute Indian Tribe of Utah Income Ranges

Source: US Census Bureau

Housing

On the Tribe lands, the average household size of owner-occupied units is 3.11 and of rented units is 3.54 people. Referring to data sourced from the US Census Bureau, most homes are owner occupied, without a mortgage. The median value of housing is $92,900 and nearly 50% of all units are valued between $50,000 and $99,999.

The US Census indicates that most rental properties on reservations are rented at less than $1,000 per month. As 37% of residents earn between $35,000 and $49,999, the average rent would need to be less than $875 to $1,250 monthly for renters to avoid cost burden[33].

Development

The Tribe and its constituent Bands have completed several community developments in recent years, including:

1. Kanosh K-Rez C-Store (Cove Fort, UT)
2. Safety Pedestrian Trail in Shivwits (Ivins, UT)
3. Maintenance Shop (Cedar City, UT)
4. Cedar Band Travel Plaza (Hamilton Fort, UT)
5. Richfield Community Health Center (Richfield, UT)
6. Youth and Senior Center (Cedar City, UT)
7. Koosharem Community Road Improvement (Richfield, UT)
8. Metal Storage Building (Cedar City, UT)
9. Shivwits Soccer Field Complex (Ivins, UT)
10. Kanosh Water System improvements (Kanosh, UT)
11. Paiute Play Park (Cedar City, UT)

[33] Cost burden is defined as a household spending 30% or more of their income on housing.

Geography and Climate

Southwestern Utah is marked by an arid climate. The northern latitudes may experience snow fall and cooler temperatures, while the Washington County geography is marked by low elevation, desert terrain and experiences high annual temperatures with significant sun exposure. Seasonal monsoon rains are common annually throughout the area and can cause flooding.

Climate changes in the region have the potential to influence water levels, storm severity, drought conditions, water quality, and wildfire risk.

Culture

The Paiute Indian Tribe of Utah strives to protect and preserve our culture, legends, songs, and dances. Like other Tribes, cultural disruptions during the past two centuries have threatened the continuation of our traditional life. The termination era was detrimental to the Tribe and resulted in the dramatic diminishing of our Paiute culture and traditions. Over the years, we have seen our land and water seized and our ancestral lands reduced to a fraction.

Traditionally, the Paiutes were a peaceful people. The Paiutes were culturally well adapted; they combined farming with hunting and gathering. They used the resources of the land with great ingenuity.

Most of the domestic objects of our Paiute ancestors were various forms of intricately designed basketry, including water jars, winnowing and parching trays, cradle boards, cooking baskets and seed beaters. They had great skill in the use of animal skins and plants. Their knowledge of nutritional and medicinal uses of plants was extensive.

The natural hazard mitigation plan is intended to protect those areas, elements, and places which are of historic, cultural, or spiritual significance to a community. Cultural spaces may also be vulnerable to natural hazards and would be protected by mitigation. The Tribe and its constituent Bands have considered how best to protect important spaces to the culture and residents. In this process, the Tribe and Bands will not identify or share the location, purpose, or any details about their cultural important spaces, to protect these areas from looting or other damage.

Tribal governments have the sovereign right to determine how and whether to document planning for the preservation of cultural spaces.

Community Capabilities

The Paiute Indian Tribe of Utah Tribal Council is the official governing body of the Tribe. The Tribal Council makes decisions on behalf of the entire Tribal membership. The Band Councils are the governing bodies for each Band and carry out activities and responsibilities directly for the Band and its members.

The Tribal Council approves and directs all actions of the Tribal Chairperson. The Tribal Chairperson is the official representative of the Tribe and carries out all directives, assignments, and other duties and powers as designated by the Tribal Council. The Tribal Council, which consists of an elected body of six (6) members, includes a representative from each constituent band.

The Tribal Administrator directs the PITU Tribal Government's planning and operating efforts. The Tribal Administrator directs the overall operations of the PITU which include implementing strategies that improve productivity, development of key objectives, creating high levels of accountability and

compliance, utilization of strong performance management, and promoting a culture of continuous process improvement that maximizes productivity and efficiency.

Directors and Program Managers are key components of the PITU Tribal Operations. Directors work with the Tribal Administrator to: execute strategic plans, complete key initiatives, manage program funds, enforce policies and procedures, carry out program deliverables, provide essential services, and ensure the community needs are met.

The Tribe establishes and works with Committees, comprised of representatives from each constituent Band, to ensure information and activities are delivered and carried out at a local level.

Infrastructure and Critical Facilities

The Paiute Indian Tribe of Utah performs overall road maintenance and supports with water management for its constituent Bands. Utilities are provided by local cities, towns, and counties unless otherwise indicated below.

The Tribe is responsible for the operations and maintenance of the following facilities:

12. Tribal Administration Building (Cedar City, UT)
13. Youth and Senior Center (Cedar City, UT)
14. Maintenance Shop (Cedar City, UT)
15. Metal Storage Building (Cedar City, UT)
16. Paiute Play Park (Cedar City, UT)
17. Pow-Wow Restrooms (Cedar City, UT)
18. FourPoints Health Community Health Center – Cedar City (Cedar City, UT)
19. FourPoints Health Community Health Center – Kanosh (Kanosh, UT)
20. FourPoints Health Community Health Center - Richfield (Richfield, UT)
21. FourPoints Health Community Health Center - Shivwits (Ivins, UT)
22. FourPoints Health Community Health Center - St. George (St. George, UT)
23. Koosharem Community Health Center (Richfield, UT)

Cedar Band:

24. Cedar Band Community Building.
25. Band managed water system on reservation.
26. Provides water to the residential homes on the reservation and the Band C-Store.
27. Cedar Band Travel Plaza.
28. Cedar Band Play Park.

Indian Peaks Band:

29. Band managed water system on reservation.
30. Provides water to the Band's RV Park.
31. Indian Peaks RV Park.
32. Utilities including Electrical, septic, and fire hydrants.

Kanosh Band:

33. Kanosh Band Community Building.
34. Band managed water system on reservation.
35. Provides water to residential homes, the community building, and the Kanosh Community Health Center located on the reservation.
36. K-Rez C-Store.
37. K-Rez C-Store Well & Well House.
38. Old Red Building in Kanosh (vacant).
39. Kanosh Play Park.

Koosharem Band:

40. Koosharem Band Community Building.
41. RV Park
42. RV Park Well & Well House.
43. Koosharem Play Park.

Shivwits Band:

44. Shivwits Band Community Building.
45. Shivwits Band Gym.
46. Shivwits Convenience Store.
47. Shivwits Cemetery.
48. Shivwits Manufacturing Facilities (vacant).
49. Shivwits Play Park.
50. Shivwits Soccer Field (under construction)
51. RV & Parking Lot (under construction)

Emergency Response and Medical Services

The Paiute Indian Tribe of Utah employs an Emergency Manager. The Emergency Manager is responsible for identifying and addressing current emergency gaps, developing and/or improving the Tribe's Emergency Operations Plan (EOP), Hazard Mitigation Plan, and collaborating closely with Federal, State, and local emergency management, to provide for the safety and protection of the people and property during disaster or emergency situations. The Emergency Manager coordinates and collaborates response efforts with the TERT Team and with community, state, and federal partners.

The Paiute Tribe Emergency Response Team (TERT) plans, prepares, and coordinates the response to emergencies affecting Tribal lands.

TERT work group consists of Emergency Managers from each constituent Band. Band Emergency Managers (EM) are elected by each Band every four years and are key components of the Tribe's emergency preparedness framework. Band EMs are charged with cultivating positive relationships with response partners, particularly city and county offices that support the Tribe with life-saving services such as police, fire, ambulance, and emergency medical care. They are also encouraged to participate in emergency management training and exercises, promote preparedness in their communities, support band members during disaster, and keep tribal leaders informed.

Band Emergency Managers (EMs) help establish and achieve overarching goals, objectives, and timelines to help prepare the Tribe for disaster. It is important to note the distinction between "Tribe" and "Band" levels during response. The Tribe in this context refers to collectively owned agencies, employees, and resources. The Band is the first level of the Tribe's response organization and will serve as incident "command" during a disaster. The Tribal level of response organization will be the source of incident "support" versus command. Band EM and Tribal response functions are described in the Tribe's Emergency Operations Plan. Tribal leaders support the roles and responsibilities of Band Emergency Managers before, during, and after any type of disaster.

The Tribe has a radio communication site at its Headquarters in Cedar City, UT.

The Tribe employs professional medical staff. These individuals are trained in general and family medicine. These employees may be tasked to support tribal members in several ways following a disaster from support to the walking, wounded, or distributing life-saving medicines or immunizations. The Tribe's medical staff do not provide emergency services. Emergency medical care is referred to the local emergency room/hospital.

Emergency response such as law enforcement is provided by the local Sheriff or police department.

Fire suppression and ambulatory services are provided by the local response team in each town, city, or county.

Plans and Policies

The Tribe's Constitution is the guiding document which organizes the Tribal government and sets procedures for the Tribe and constituent Bands. In addition to the constitution, the Tribe has an Emergency Operations Plan to guide emergency preparedness and response efforts in the event of an emergency.

The Tribe does not have formally adopted building codes but utilizes construction best practices to construct their community facilities. The tribe will use certain standards as dictated by funding sources for projects as needed to complete their community infrastructure. All structures, community facilities and infrastructure are built understanding the need for longevity of the structure and supporting the health and safety of users of the facilities.

Risk Assessment

The Paiute Indian Tribe of Utah experiences and is at risk to the natural hazards addressed in this Natural Hazard Mitigation Plan. This area regularly experiences storms in the winter and summer that cause flooding and damages to structures and landscaping.

Five County has worked with the Tribe to develop a ranking of the highest risk hazards based on probability and local exposure of the hazard. Exposure identifies where in the community this hazard is experienced and is illustrated using mapping and narrative.

Probability of future occurrence in the community considers the historic record and the geography of the area. The probability of an event occurring is described in the hazard descriptions below. This risk assessment is based on local insight and input, available data, Table 520 displays the relative risks of hazards in the Paiute Indian Tribe of Utah.

Table 520: Paiute Indian Tribe of Utah Risk Assessment Summary

HAZARD	RISK
SEVERE WEATHER	High
WILDFIRE	High
DROUGHT	High
FLOOD	Moderate
LANDSLIDE	Moderate
EARTHQUAKE	Low/Moderate
RADON	Low
PROBLEM SOILS	Low

A detailed description and mapping of each of the natural hazards that impact each of the tribal/band areas can be found in this chapter, concluding with a mitigation strategy. This strategy aims to support the community in lowering the risks and vulnerabilities to the hazards described in this plan and has been developed by the local planning team.

Wildfire

The Paiute Indian Tribe of Utah is exposed to wildfire in all Tribal lands, exposing infrastructure, structures, and critical facilities to wildfires. Mapping completed by the Oregon Department of Forestry on the Utah Wildland Risk Assessment Portal indicates where moderate or greater risk exists to Tribal lands. The metrics used to determine risk ratings on this portal can be found in the hazard identification section of this plan.

All tribal lands are vulnerable to wildfire risk, as described in Figure 559 - Figure 566.

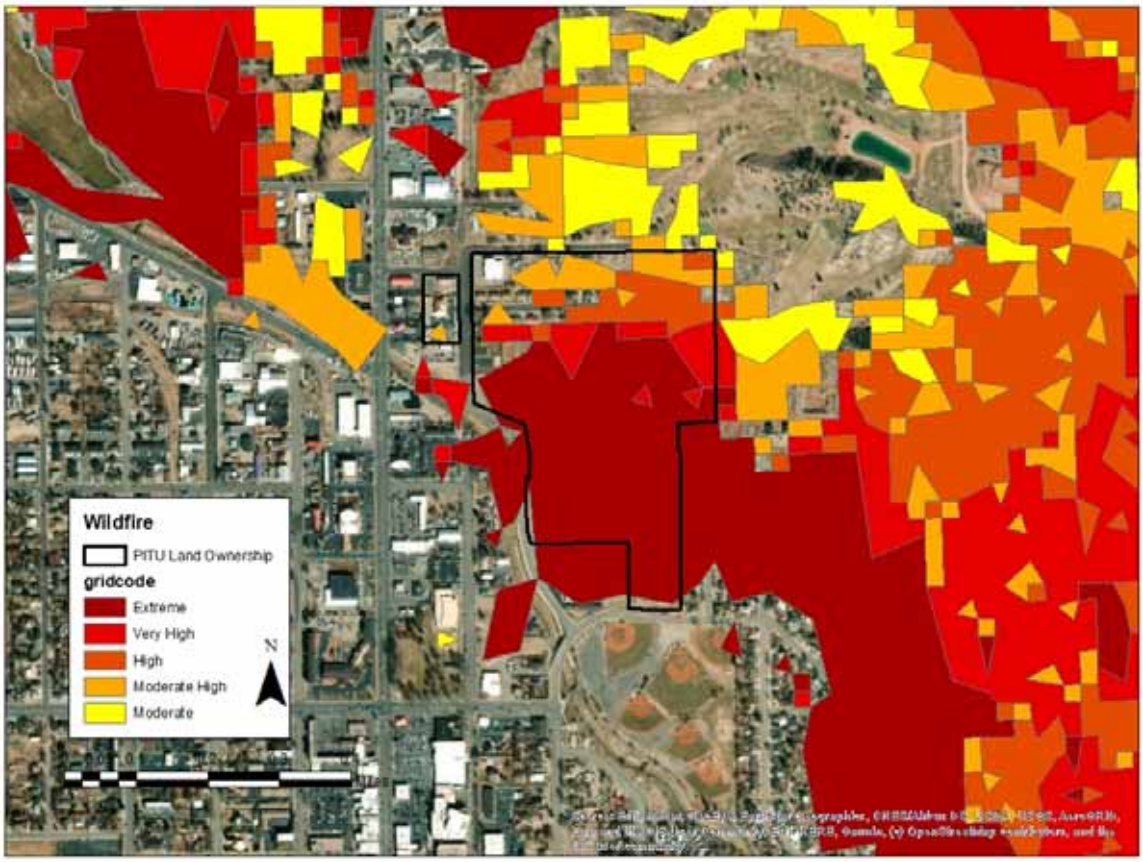


Figure 559: Paiute Indian Tribe of Utah Headquarters Wildfire Risk

The Paiute Indian Tribe of Utah Headquarters is in Cedar City, Utah, near the western hillsides in the community. The area faces high exposure to wildfire. Given several of the assets available to Tribe members are located at this site, vulnerability is also high, as the medical facility, offices, housing authority, and other assets are located at this site.

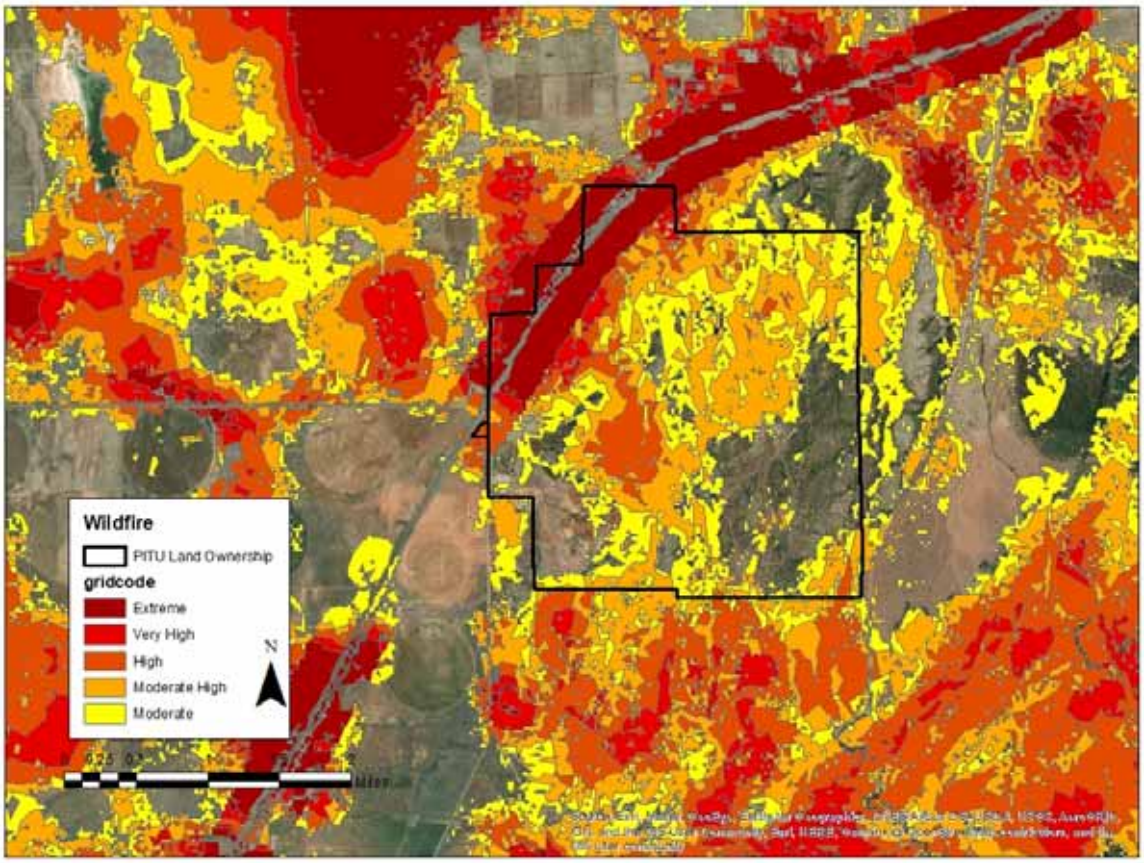


Figure 560: Cedar Band and Indian Peaks Band Wildfire Risk

The Indian Peaks Band is in the southwestern corner of the boundary described in Figure 560. A significant portion of this area is considered a moderate-to-moderate high to wildfire, especially in the south and east of the Band. An RV Park is considered at risk in this reservation.

The Cedar Band includes the rest of the bounded land in Figure 560 and has elevated wildfire risk throughout the area, but the greatest risk is identified in the northwest portion, where mountains and foothills interact with roadway infrastructure. The Cedar Band also has a Travel Plaza in the northwestern section of their reservation, which shows an extreme risk to wildfire.

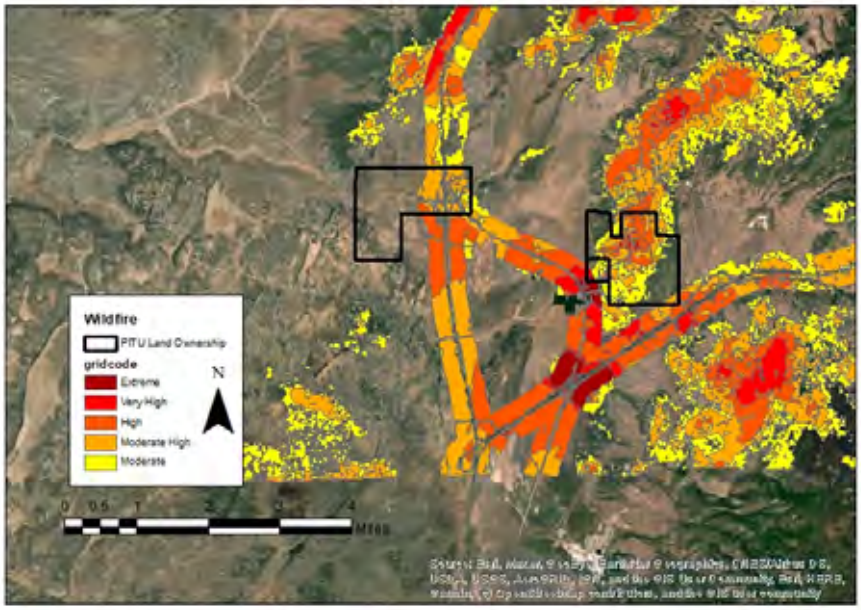


Figure 561: Kanosh Band Wildfire Risk

The two Kanosh Band reservations which lie on the Beaver and Millard County Line also have increased exposure to wildfire risks, especially along major roadways through the communities and in the hills to the east. The mountainous region near Cove Fort also experiences notable wildfire risk.

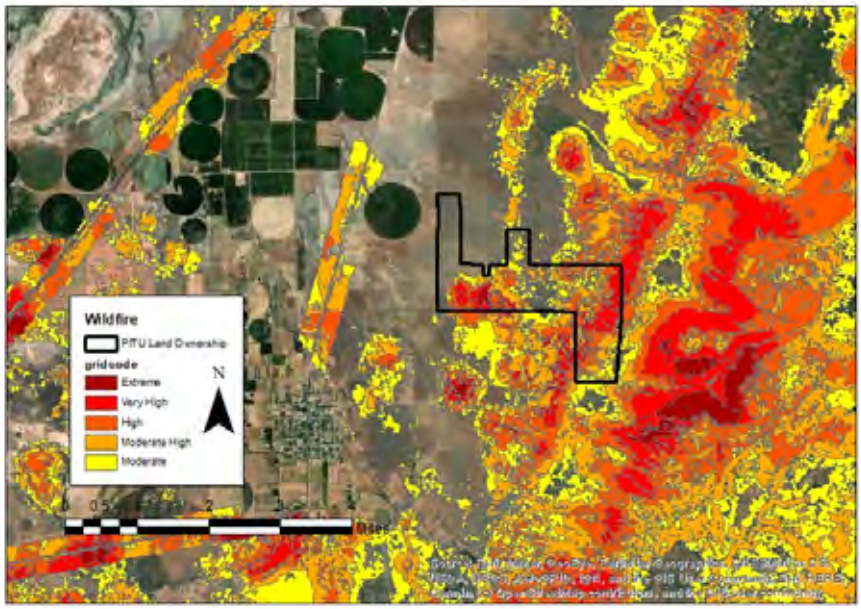


Figure 562: Kanosh Band Wildfire Risk

The third Kanosh Band reservation, which is in northern Millard County near the town of Kanosh has a significant portion of the area exposed to moderate to extreme wildfire risk, in the southeastern portion of the community, near the foothills. Residents, structures, and infrastructure may be vulnerable, including if roadway access is impacted during an event.

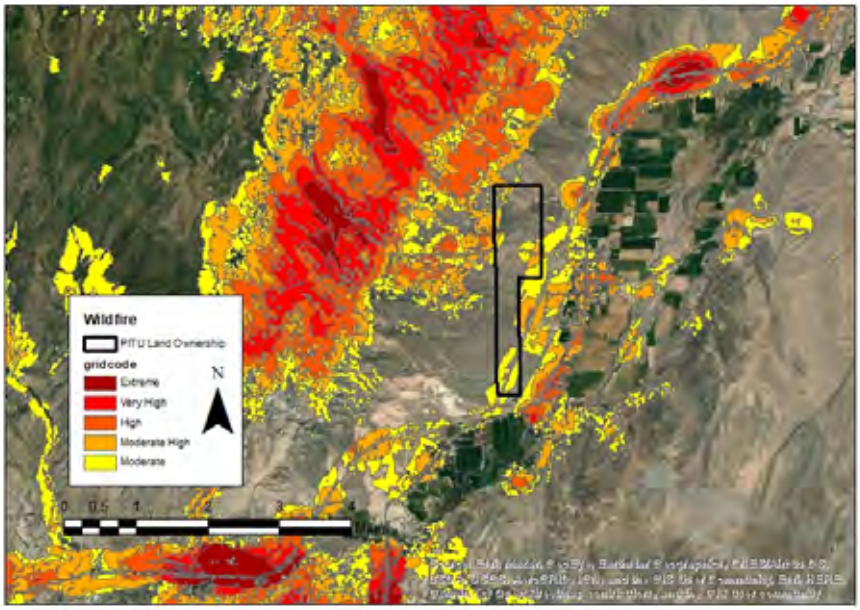


Figure 563: Koosharem Band Wildfire Risk

The Koosharem Band reservation near the town of Joseph has moderate to moderate-high wildfire risk identified along Highway-89 where it intersects the community. The Koosharem Band sees nearby wildfire risk in the foothills to the west of the reservation and to the east in and around Joseph.

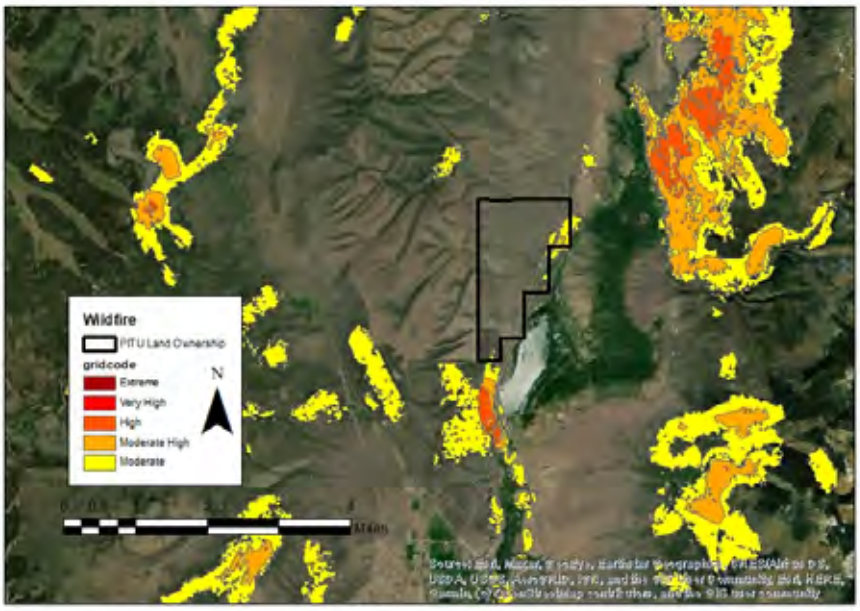


Figure 564: Koosharem Band Wildfire Risk

The Koosharem Band reservation in central Sevier County is directly north of a recreation area for the Koosharem Reservoir. An RV Park is in the reservation, on the southern end. Wildfire risk is mapped at moderate/moderate high levels near the reservation, with some documented exposure within the boundaries to the south and northeast.

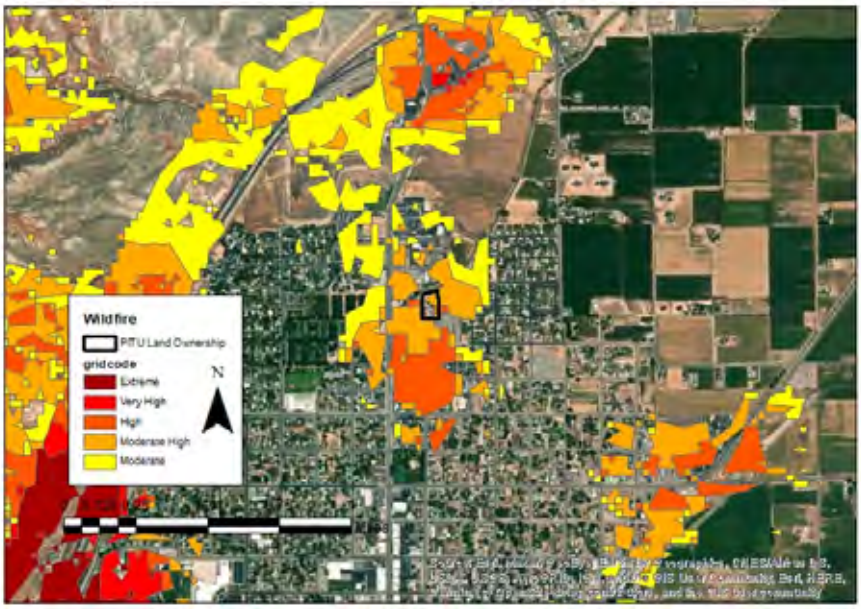


Figure 565: Koosharem Band Wildfire Risk

The Koosharem Band reservation in Richfield includes several community assets. The lands are in an urban environment but does still include some identified wildfire risk. This may be attributed to population centers and infrastructure near potential wildfire threat areas.

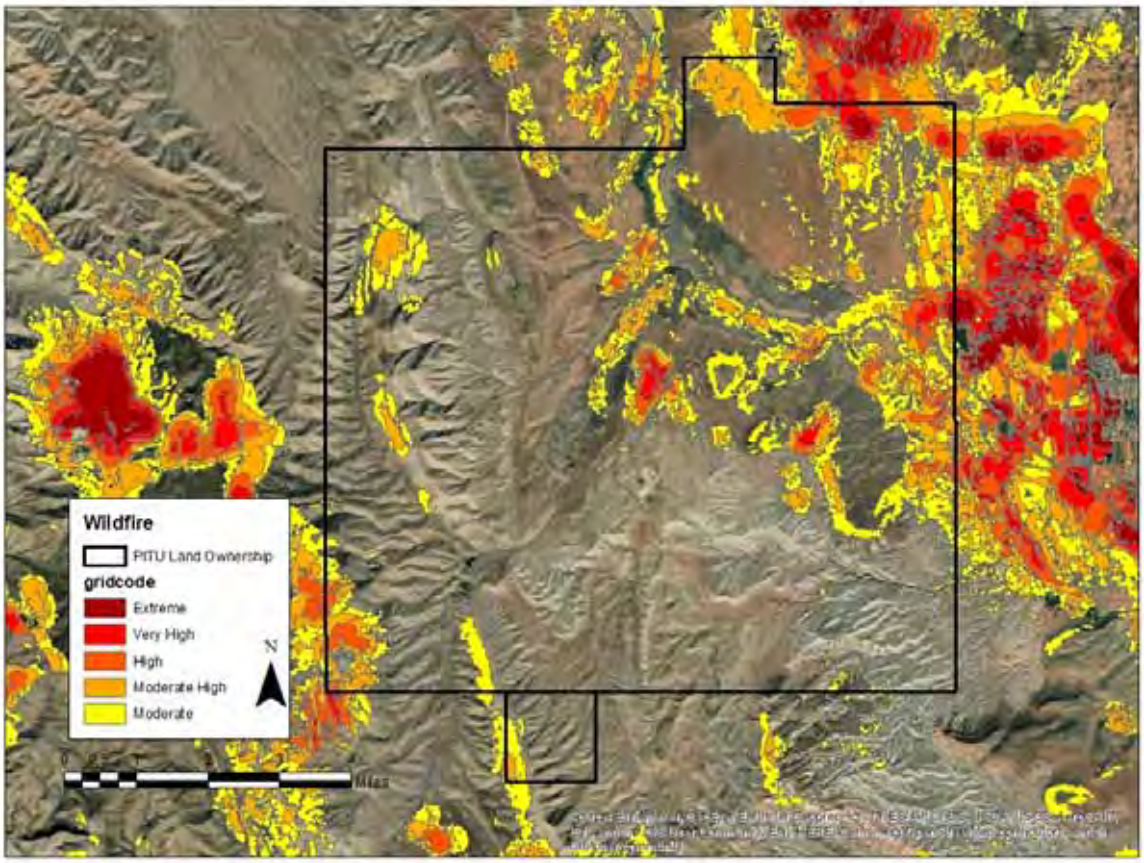


Figure 566: Shivwits Band Wildfire Risk

The Shivwits Band has identified wildfire risk of moderate to extreme throughout the community, particularly on the northern and eastern portions of the community. Old Highway 91 runs through the Shivwits Reservation, from east to west. The Tribal Administrator described that this area sees increased traffic flows, which also creates a vulnerability to wildfire for the community, as access is impeded and there is the potential for vehicular caused fires.

Hazard History

Wildfire is a common hazard to the Southwest and has impacted communities in the area. Wildfires can spread rapidly during the hot summer months, which in the southwest are often marked by high winds and dry conditions.

Table 521: Paiute Indian Tribe of Utah Wildfire History

Band Impacted	Year	Fire Name	Acres Burned	Description
Koosharem	1995	Rock Canyon	0.1	Lightning caused fire.
Koosharem	1995	Upper Sauls	8	Natural caused fire.
Koosharem	1998	Richfield	0.1	Lightning caused.
Shivwits	2003	Apex	29,930	A human ignition fire that cost approximately $4.3 million and impacted culturally significant

				areas of the Shivwits Reservation. Highway 91 was closed during the fire, cutting off access to the community and residents were required to evacuate.
Kanosh	2007	Milford Flat	363,000	Utah's largest fire required evacuation of Cove Fort and required protecting I-15. The fire burned down the Dog Valley Trading Post, resulting in lost goods.
Koosharem	2011	I-70 Mile post 39	0.1	Unknown.
Koosharem	2011	Twelve Timbers	0.1	Unknown.
Shivwits	2011	Barn Fire	1,237	A human caused fire caused the evacuation of 35 homes and burned one out building.
Koosharem	2012	Cove View	0.8	Unknown.
Koosharem	2018	Willow Patch	4,583	A human caused fire burned near Highway 24, requiring the closure of several roads. The fire impacted powerlines, causing power outages in the area.
Kanosh	2018	Miner Camp Peak	2-3	A fire near Meadow had low accessibility and required a team of smoke jumpers to suppress the fire. Three were injured during the jump.
Kanosh	2019	Meadow Creek	4,231	A lightning strike caused a fire two miles east of Meadow, Utah. The fire put the nearby watershed area at risk.
Koosharem	2020	Rock Path and Antelope	20,941	A lightning strike and wind contributed to the spread of the Rock Path and Antelope Fires, which burned in Millard and Beaver Counties. The fires combined, which is why they are listed here together.
Kanosh	2021	Monk Springs	170	A fire southeast of the town of Kanosh caused the closure of several roads and campgrounds in the area.
Paiute Indian Tribe of Utah- Cedar City	No wildfires have been reported.			

Source: Utah Wildfire Info, KSL "Families of Boys Who Started Apex Fire to Pay $390,000", Deseret News "Grief as thick as ashes at Shivwits", Deseret News "Firefighters gain small edge Monday evening on record-setting central Utah wildfire", NASA Earth Observatory Milford Flat Fire, Utah.

The wildfires described in Table 521 the majority of which occurred in areas near Paiute Tribe of Utah reservations and were potential threats to the communities. These fires may have caused smoke and ash impacts in the community. One Tribal member described the Paulina Fire almost burning down their home on the Shivwits Reservation. No news reports or dates were found to date this fire.

The 2003 Apex fire and 2007 Milford Flat fire had direct impacts to reservations, requiring evacuation, fire suppression, and recovery. The Milford Flat fire is Utah's largest wildfire to date and caused significant impacts to the tribe and transportation access on I-15.

Paiute populations living on reservations are vulnerable to fire as it can impact water sources and infrastructure, can damage structures, and can also cut residents off from transportation routes, as happened in the Apex fire.

Wildfire impacts air and water quality and can lead to public health impacts through airborne ash and smoke. Individuals with respiratory disease, athletes, or people using outdoor spaces can be impacted by smoke and ash in the air. Ash settles on the ground and can blow into watershed areas, impacting water quality for a region. Damaging wildfires which interact with human environments can force a family to leave everything behind, resulting in losses of personal items, property, and injury to pets and livestock. Evacuating fire can also have impacts, as high temperatures and exposure common during fire season can be damaging.

Wildfire impacts and damages are not limited to people and the built environment. Large wildfires can result in slowing and changes in local economic growth, especially observed in the response and recovery phases of a wildfire event. (Nielsen-Pincus, Moseley, & Gebert, 2013) Commuters and travel can be impacted during an event, causing delays in certain industries as employees and goods may not be able to access businesses. Slow growth trends are observed in communities in the years following a large wildfire, despite often tracking growth during wildfire events, often considered as supporting the increases in staffing to suppress a fire. (Nielsen-Pincus, Moseley, & Gebert, 2013)

Wildfires risks may be heightened by other ongoing climate, weather, and geologic conditions or changes. Wildfires can cause or exacerbate flash flooding, landslides, debris flows; as burned area does not have vegetation to secure the soil, allowing it to wash away in a flood or landslide. Drought hazards can contribute to conditions which lead to heightened wildfire risk, with excessively dry vegetation and low water levels. It is expected that climate change conditions in the southwest will also contribute to wildfire risk long-term, with continued dry conditions. Drought, flooding, and landslides are all hazards that pose risks to the Paiute Indian Tribe of Utah.

Earthquake

Earthquakes occur when two blocks of earth slip past each other, releasing energy. All communities contain some degree of risk from earthquakes due to surface fault rupture, liquefaction, ground shaking, or other hazards. Ground shaking is generally the most destructive aspect of an earthquake because the seismic waves move both vertically and horizontally and can be felt miles from the epicenter. Structural damage usually varies depending on the distance from the epicenter, magnitude of the earthquake, and type of sediment in the area.

An identified vulnerability throughout southwestern Utah are structures which were not built using seismic codes. Historically, certain types of construction, like unreinforced masonry, produce poorer outcomes during a shaking event. FEMA considers older buildings as some of the greatest contributors to seismic risk. Other earthquake vulnerabilities include utilities, roads, and other critical infrastructure in the communities.

Figure 567 to Figure 574 map the earthquake fault lines and epicenters in Paiute Indian Tribe of Utah reservations. Significant earthquakes can impact a large geographic area. Large earthquakes elsewhere in the southwest can cause impacts to the Paiute Indian Tribe of Utah.

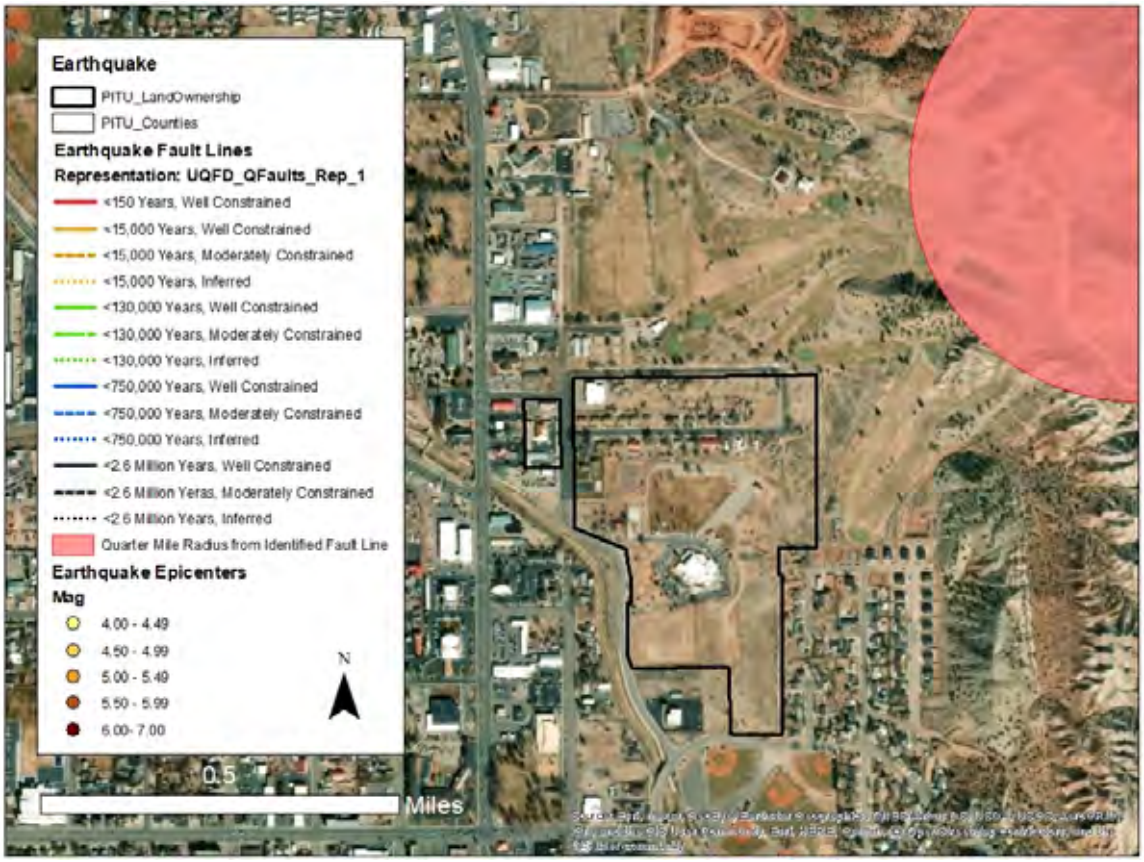


Figure 567: Paiute Indian Tribe of Utah Headquarters Quaternary Fault and Earthquake Epicenters

Source: University of Utah Seismology

The Paiute Indian Tribe of Utah Headquarters in Cedar City has an identified fault to the northeast of the reservation and is not vulnerable to surface fault rupture, although the site may experience other effects such as liquefaction and ground shaking.

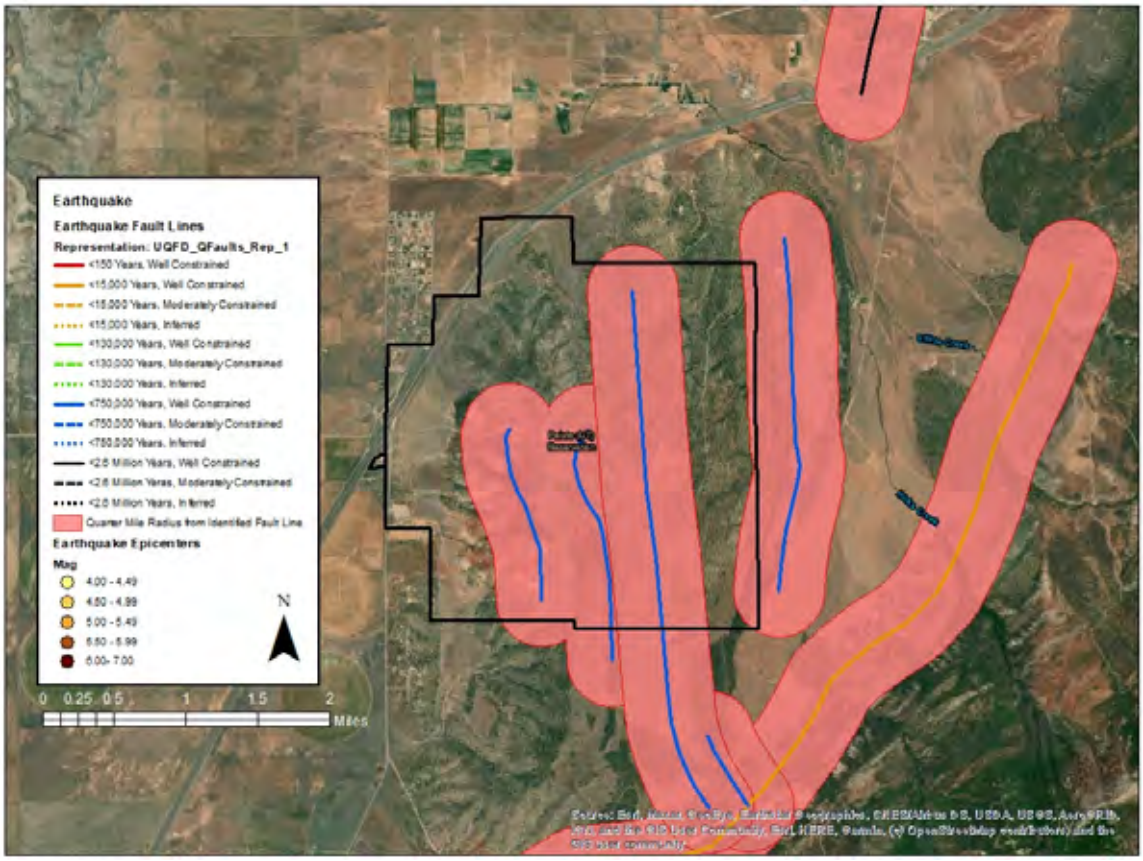


Figure 568: Cedar Band and Indian Peaks Band Quaternary Fault and Earthquake Epicenters

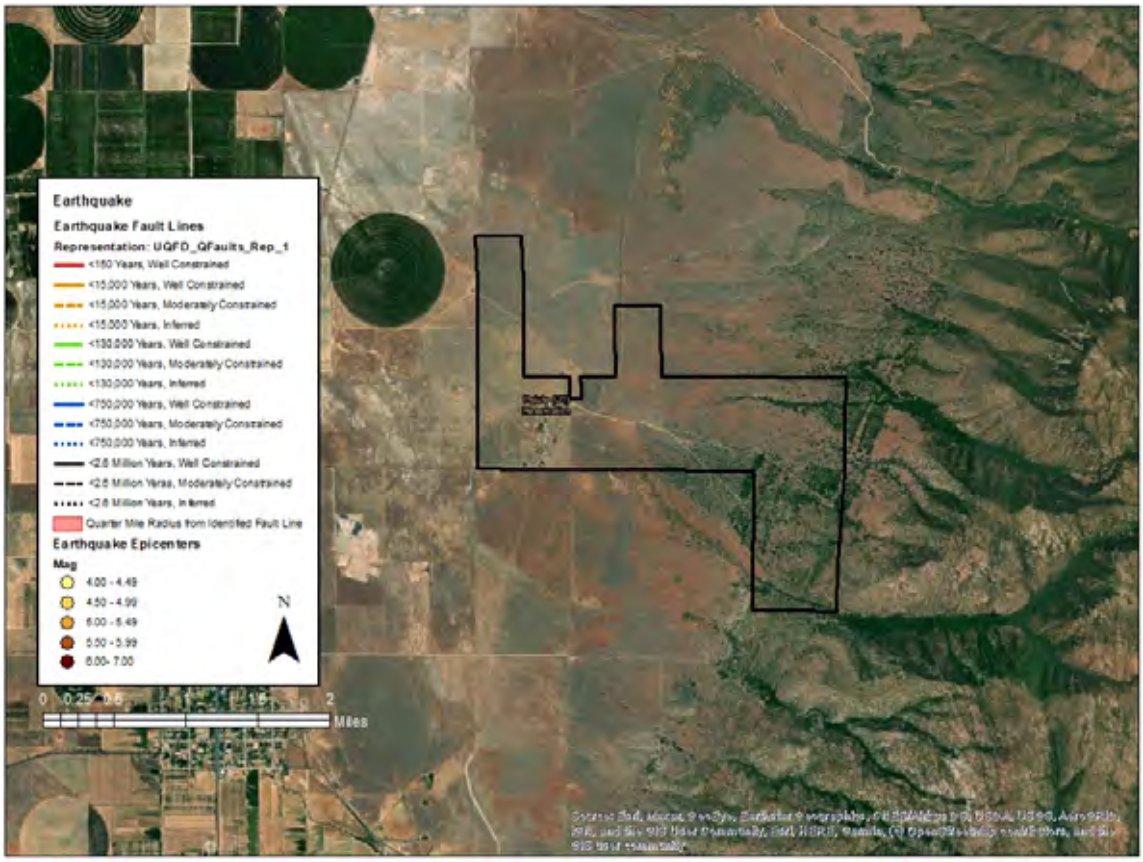


Figure 569: Kanosh Band Quaternary Fault and Earthquake Epicenters

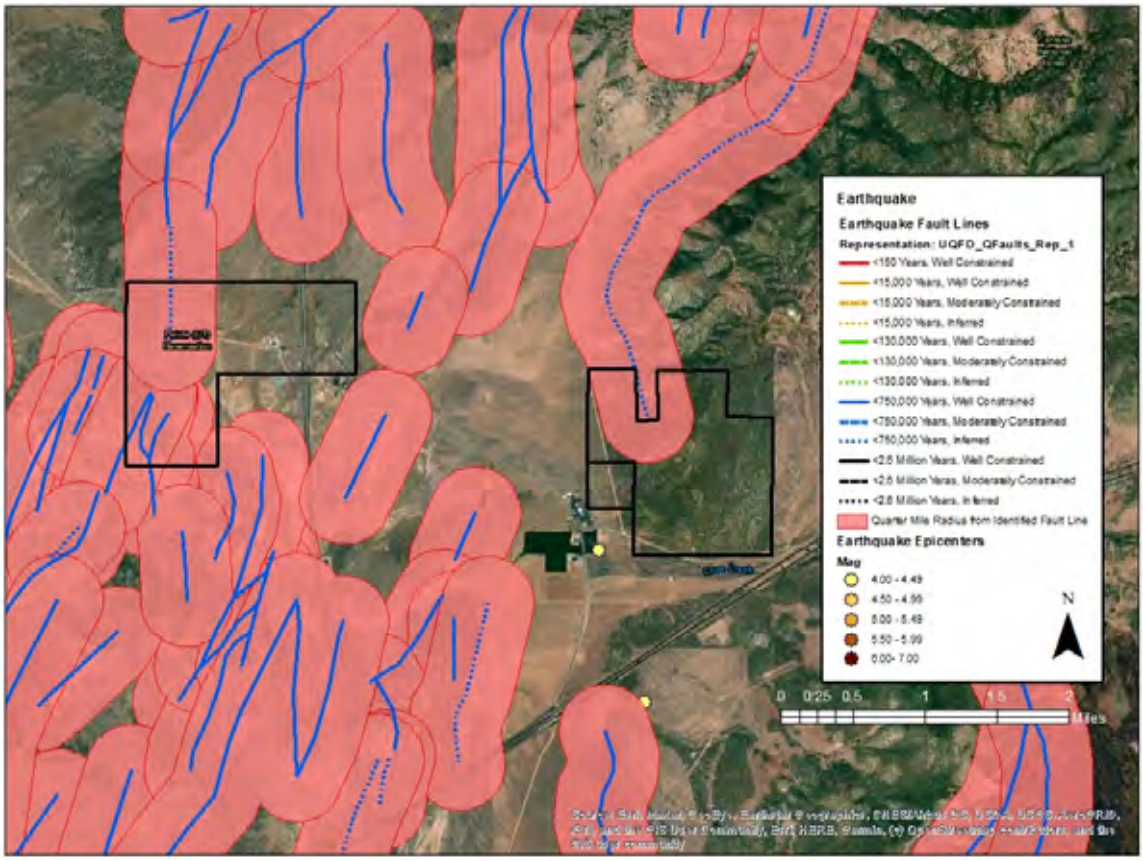


Figure 570: Kanosh Band Quaternary Fault and Earthquake Epicenters

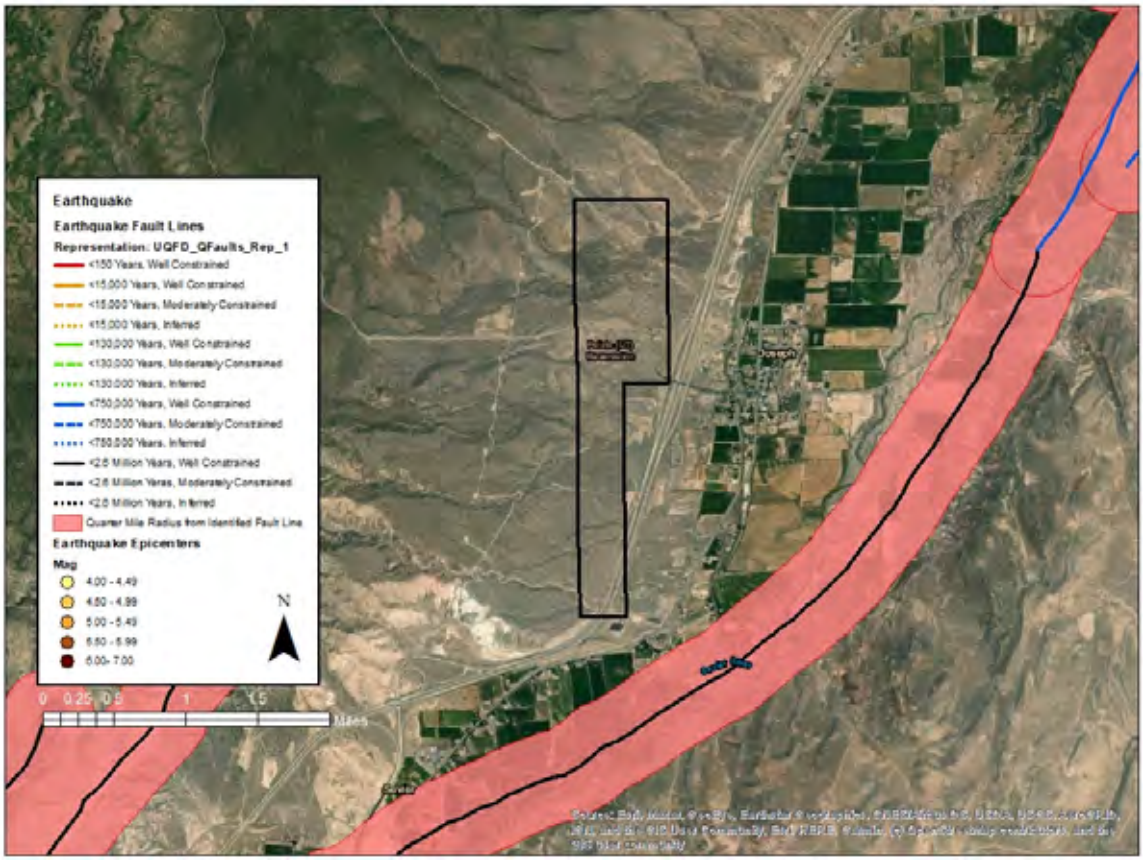


Figure 571: Koosharem Band Quaternary Fault and Earthquake Epicenters

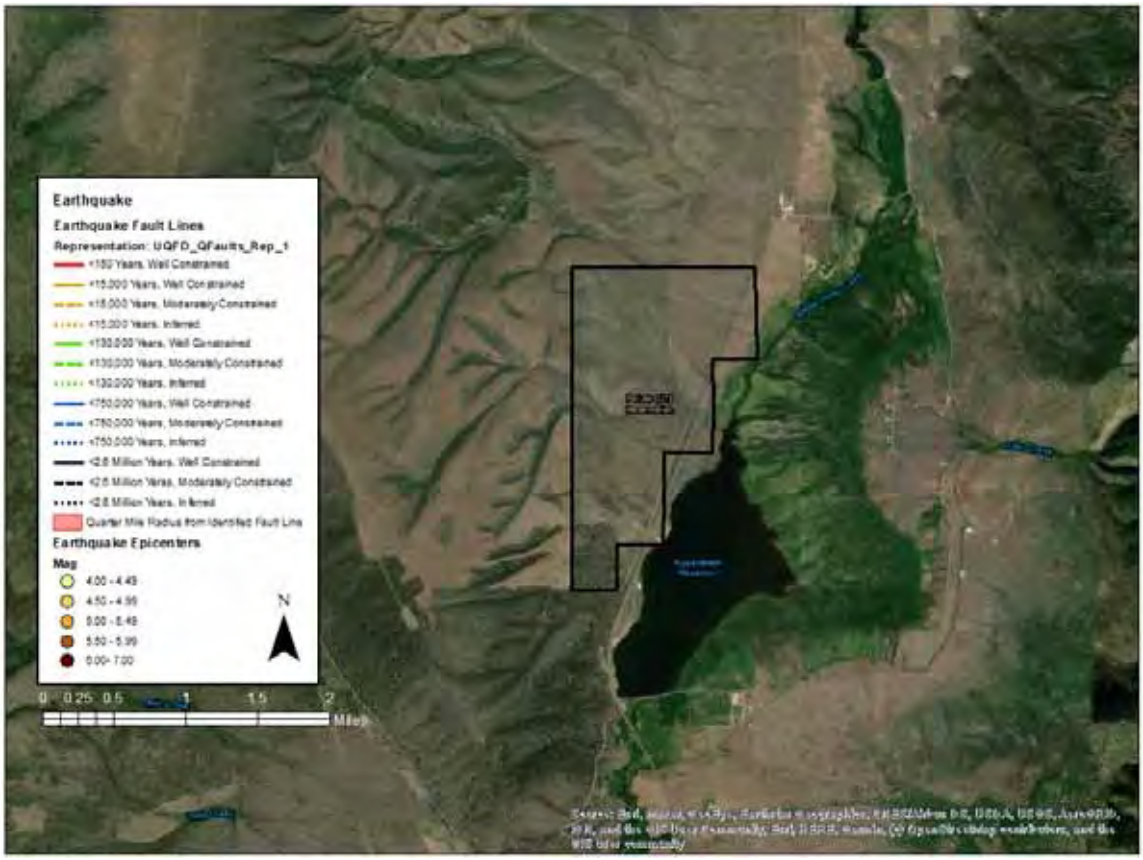


Figure 572: Koosharem Band Quaternary Fault and Earthquake Epicenters

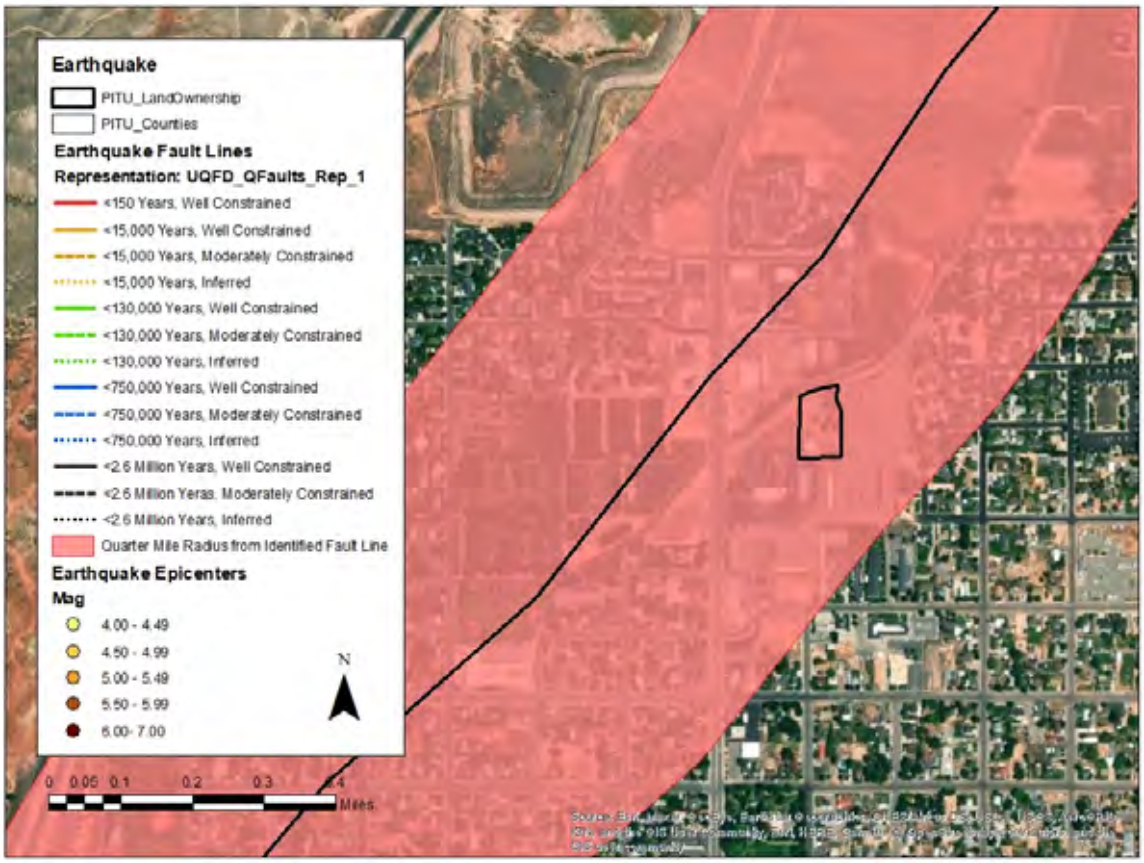


Figure 573: Koosharem Band Quaternary Fault and Earthquake Epicenters

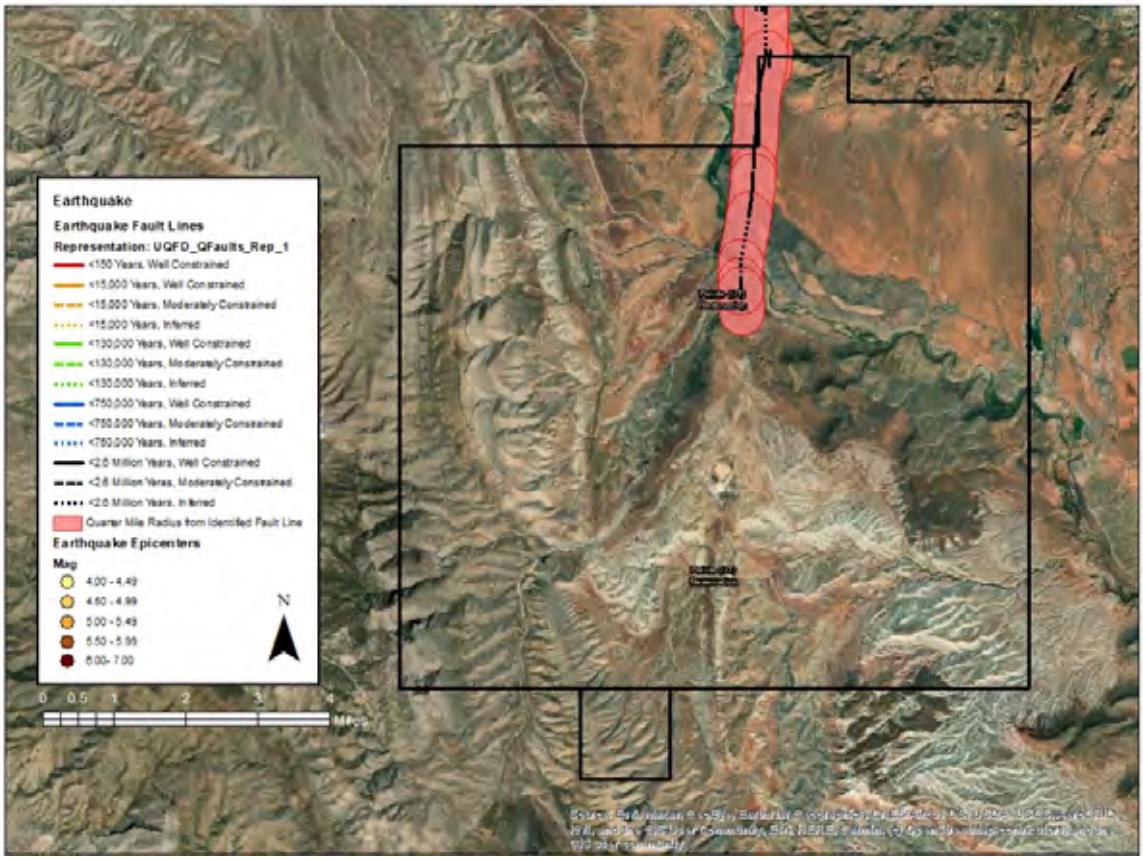


Figure 574: Shivwits Band Quaternary Fault and Earthquake Epicenters

Hazard History

Earthquakes have a history throughout the southwest and have been recorded near Paiute Indian Tribe of Utah lands. Table 522 describes the events with epicenters which have occurred in proximity to the bands. Cedar City and Kanosh areas have a greater frequency of earthquake epicenters, but the earthquake in Washington County had a much higher magnitude, causing widespread impacts. Earthquakes tend to have a low frequency in the area, but the potential for a large event, and thus significant impacts exists throughout the region.

Table 522: Paiute Indian Tribe of Utah Earthquake Epicenters

Incident Date	Location	Description
1901	Richfield, Sevier County	6.5 magnitude earthquake
1921	Richfield, Sevier County	6.0 magnitude earthquake
1934	Richfield, Sevier County	6.6 magnitude earthquake
1962	Richfield, Sevier County	5.7 magnitude earthquake
1966	Richfield, Sevier County	5.6 magnitude earthquake
1972	Richfield, Sevier County	4.0 magnitude earthquake reported.
1981	Cedar City, Iron County	A 4.18 magnitude earthquake recorded 7.2 miles southwest of Cedar City.
1982	Richfield, Sevier County	A 4.0 magnitude was recorded near Richfield, Utah
1992	Washington City, Washington County	A 5.93 magnitude earthquake impacted Washington City, triggering a landslide that destroyed 3 homes and blocked a highway.

1992	Cedar City, Iron County	A 4.19 magnitude earthquake recorded 2 miles northwest of Cedar City.
1992	Cedar City, Iron County	A 4.17 magnitude earthquake recorded 1.8 miles northwest of Cedar City.
2010	Cedar City, Iron County	A 4.12 magnitude earthquake recorded 3.8 miles southeast of Cedar City.
2019	Kanosh, Millard County	A 4.0 earthquake was reported southwest of Kanosh on the same day that a cluster of 17 earthquakes occurred in the area.
2019	Kanosh, Millard County	A 4.1 magnitude earthquake was reported 18 miles west of Kanosh. A cluster of 19 earthquakes occurred in a two-day period in the area associated with this event.

Source: Utah Seismology, Six County NHMP

While seismic events are not often caused by other hazards of risk to this area, earthquakes can trigger or cause many geologic natural hazards, as shaking shifts the ground and interacts with the built environment. Liquefaction is a risk in some areas following ground shaking, as certain soil types lose stability during shaking events. Fires, flooding, landslides, rockfall, and subsidence are all potential outcomes during and after an earthquake event. While strong earthquakes are infrequent and have a low probability of occurring, the expected impacts of a strong event are high and widespread across an area.

Earthquake and other ground movement events can impact infrastructure and industrial uses. Near the Shivwits reservation there is a waste site for the OMG gold mining mill. Residents worry that seismic impacts could potentially expose residents to chemicals and pollutants following a seismic event affecting the site.

Flood

Flooding is considered Utah's most common natural hazard event by the Department of Public Safety. Southwestern Utah floods often occur following severe weather, which can cause flash flooding events. Rapid downfalls of rain or snow can lead to fast flowing bodies of water over sparsely vegetated ground. These quick moving floods often do not have any warning and can emerge from storms miles away from the flood site. Flash floods can be harmful to communities causing damage to structures and infrastructure, traffic delays, injuries, and other losses. Figure 575 to Figure 579 illustrates the mapped flood risks to Tribal lands.

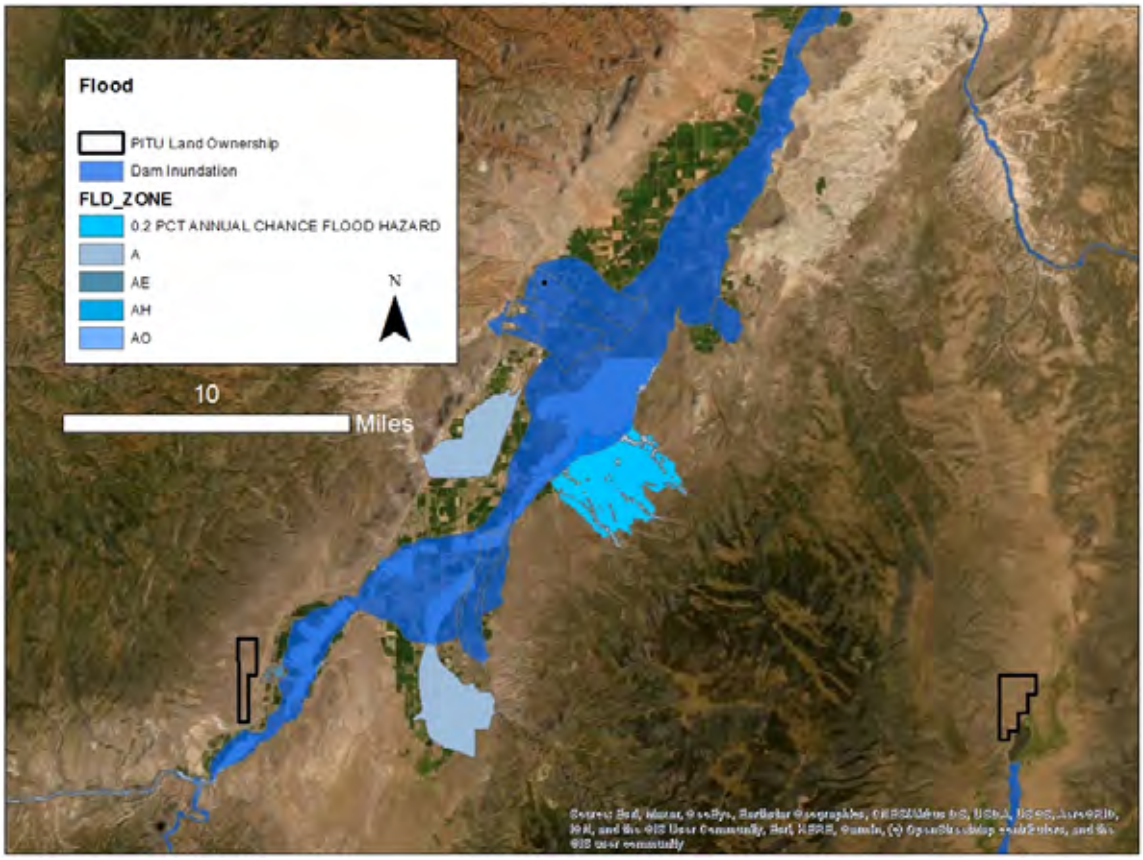


Figure 575: Koosharem Band Flood Risk

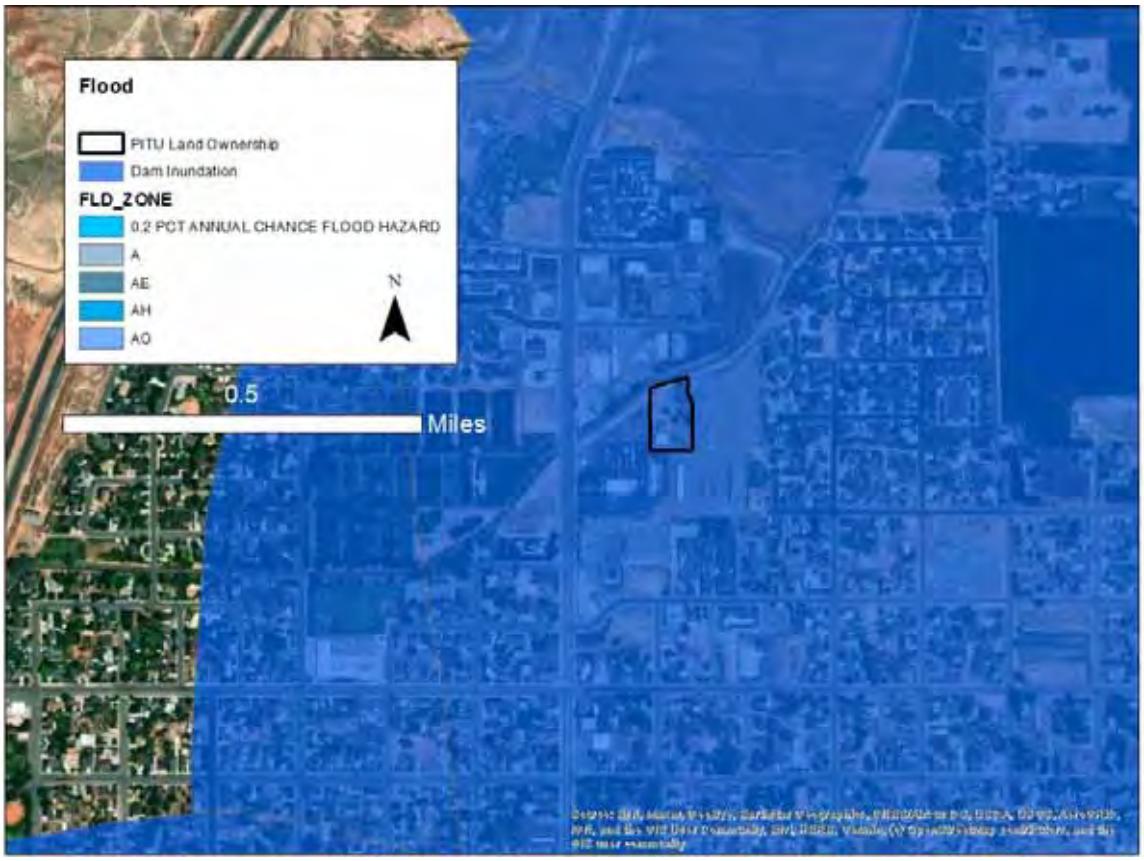


Figure 576: Koosharem Band-Richfield Flood Risk

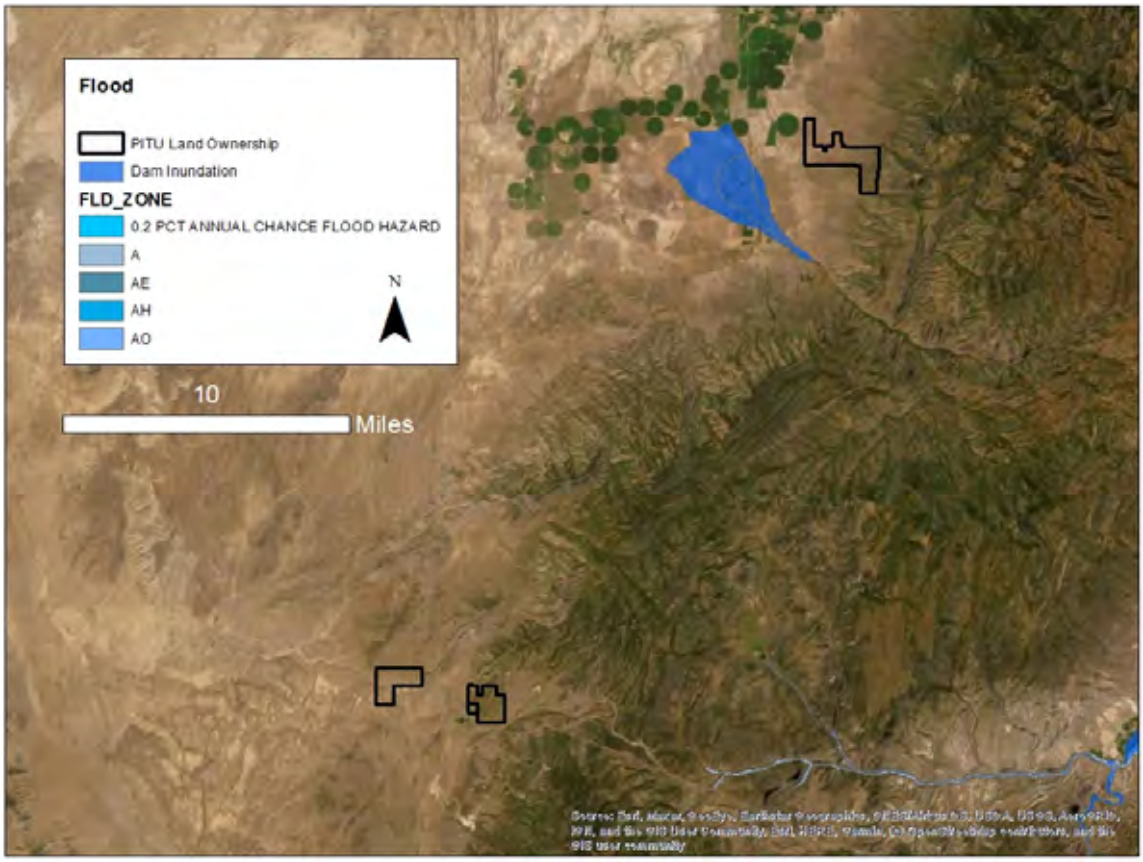


Figure 577: Kanosh Band Flood Risk

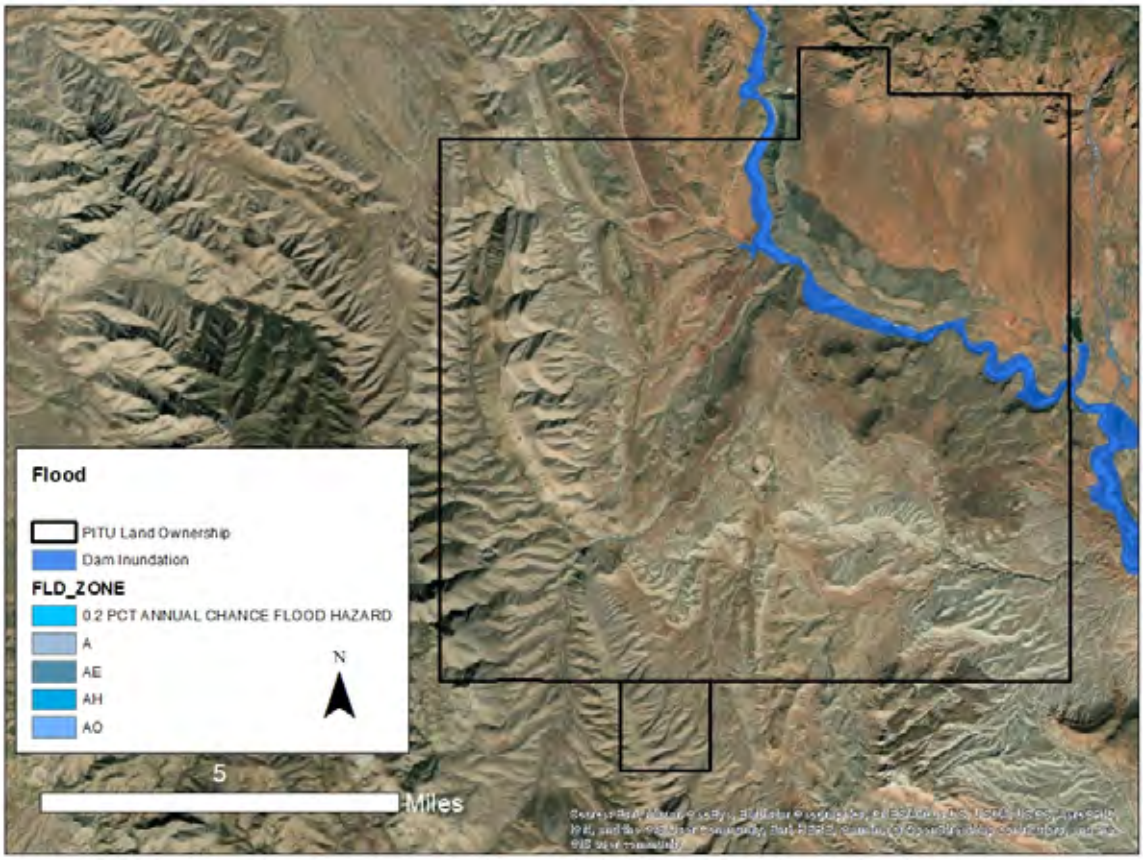


Figure 578: Shivwits Band Flood Risk

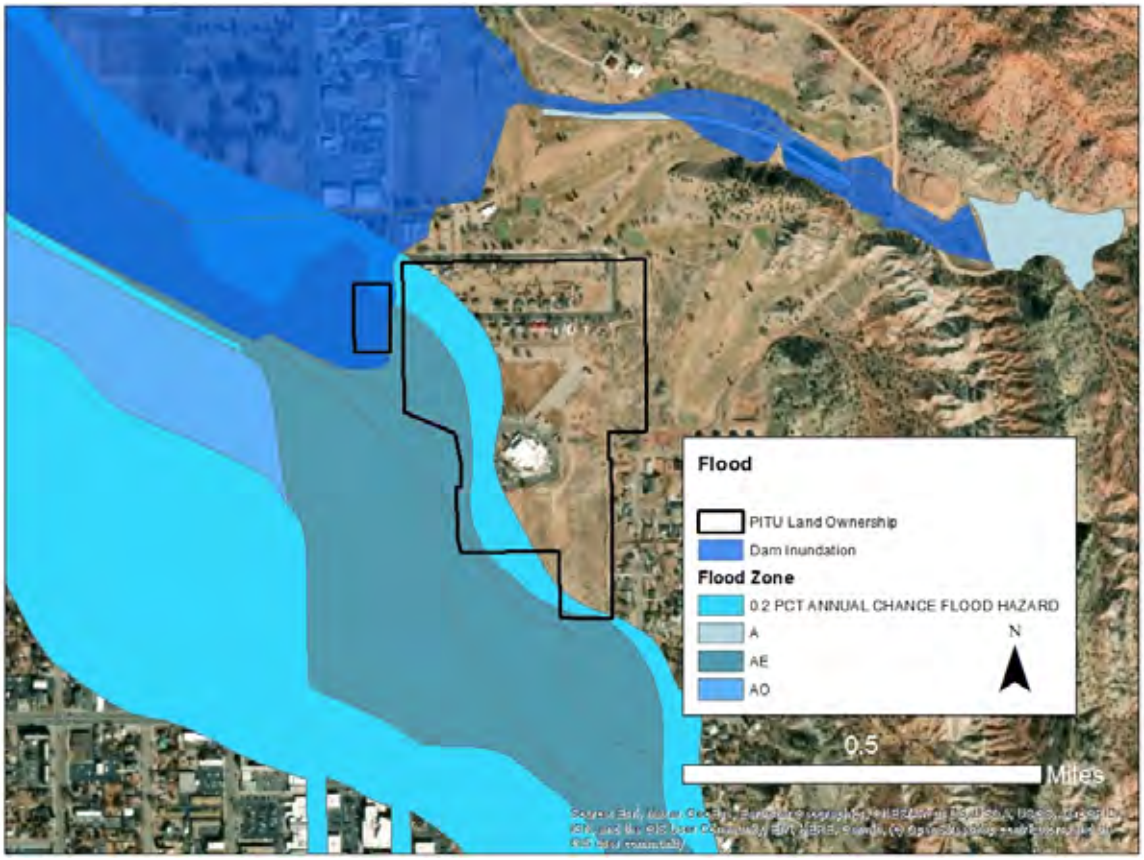


Figure 579: Paiute Tribe of Utah Flood Risk

Floodplain mapping has been completed for most of southwest Utah, and some of the Tribal lands have been included. The mapping in Figure 575 to Figure 579 demonstrate that Shivwits, Koosharem Richfield Reservation, and the Paiute Indian Tribe of Utah Headquarters in Cedar City are exposed to the mapped floodplain and dam inundation zone. In Cedar City, The Tribe is constructing a new 21,000 sf medical clinic, which an environmental assessment identified that the floodplain runs close to property. Further, the Tribe's property owned in Springdale is documented to be within the floodplain.

The Cedar Band, Indian Peaks Band, and Koosharem Bands at Joseph and Koosharem are considered Zone X by FEMA flood mapping, meaning that risks due to the floodplain exposure are moderate to low. Maps for these bands have not been included in this plan. FEMA floodplain mapping indicates that Millard County is in Zone D, undetermined but possible flood risk and maps are likewise not included in this plan.

The State of Utah has also mapped dam inundation areas, to address aging dam infrastructure and its potential impacts on a community. Shivwits is the only band with dam inundation risk mapped in the community, along the Santa Clara River. Both Koosharem bands and the northern Kanosh reservation experience dam inundation near the reservations, which may impact access to the community and transportation routes.

National Flood Insurance Program (NFIP)

Property, assets, and homes outside of the mapped zones are not free of flooding risk. Since the inception of the National Flood Insurance Program (NFIP), approximately 25% of all paid claims were not located in a special flood hazard area. (Insurance Information Institute, 2020) It is estimated that more than 70% of flooding in Utah has been outside identified flood hazard areas. (Johnson, Flood Awareness Month: Will Utah experience snowmelt flooding this year?, 2021) The National Flood Insurance Program has provided flood related assistance in rebuilding and repairing structures following flood damages since 1978. Communities must participate in the NFIP for their residents and businesses to purchase insurance. This involvement requires certain policies and practices for the floodplain. Participation in the NFIP can reduce the cost of recovery following flooding.

The Paiute Indian Tribe of Utah does not currently participate in the NFIP and does not have a floodplain manager.

Hazard History

The National Oceanic and Atmospheric Administration (NOAA) collects data about reported flooding and severe weather, which is used for this plan. Monsoon rains occur in the late summer and fall, which bring a rapid and heavy rainfall and can lead to flooding events, damaging structures, overwhelming existing infrastructure, and moving debris throughout the town. Table 523 describes the flooding events which have impacted reservation lands and the surrounding area.

Table 523: Paiute Indian Tribe of Utah Flood History

Band	Date	Damage/Injury	Description
Kanosh	No events documented		
	7/18/2003	None Reported	A flash flood left debris on an I-15 frontage road near Richfield.
	7/14/2018	$1,000,000	Flooding caused by heavy rain damaged fields and homes in Richfield.
Koosharem	8/3/2010	None Reported	Heavy rain caused a mudslide which closed SR-62.
	6/1/2011	$150,000	The Sevier River flooded and remained above flood stage for more than a week. SR 118 between Joseph and Monroe was damaged.
Shivwits	12/19/2010	$19,700,000	Heavy rain caused flooding throughout Washington County. The Santa Clara River increased to an estimated 5,000 CFS.
	9/11/2012	None Reported	A monsoon rainstorm caused heavy rain and flash flooding in southern Utah.
	2014	Unknown	The Shivwits flood of 2014 closed the road at the first Sham bridge. High flows impacted residents safe travel through the area. The old sand and gravel pit wash near Utah Hill saw water up to the road.
Cedar/Indian Peaks Band	No events documented		
Koosharem	8/3/2010	None Reported	Heavy rain caused a mudslide which closed SR-62.
Shivwits	12/19/2010	$19,700,000	Heavy rain caused flooding throughout Washington County. The Santa Clara River increased to an estimated 5,000 CFS.
Paiute Indian Tribe	6/23/2000	$55,000	A thunderstorm caused flooding in Cedar City which led to 4 feet deep flood waters, inundated drainage systems,

of Utah-Cedar City			basement flooding, subdivision evacuations, and vehicles being swept away among the damages.
	8/18/2021	$200,000	A severe thunderstorm caused widespread flooding across Iron County, inundating Coal Creek and resulting in basement flooding, damaged roads, and other impacts.

Flood risks can be increased by certain natural hazards, like wildfire or drought, which can kill vegetation, reducing the amount of water absorbed by the ground. Lack of vegetation can result in landslides or debris flows. Long-term climate trends indicate that severe weather events are expected to become less frequent but increase in magnitude, which will influence flooding locally.

Landslide

The geology in southwestern Utah is the meeting of the Mojave Desert, Great Basin, and Colorado Plateau. The topography is marked by high peaks, cliff sides, and canyons. The Paiute Indian Tribe of Utah reservations similarly have landslide prone geology. Figure 580 and Figure 581 illustrate the landslide susceptibility faced within each Band reservation, except the Koosharem reservation in Richfield. These maps identify landslide susceptible areas statewide and are scaled to 1:500,000. They give a general idea of the most susceptible areas to landslide, based on mapped landslide, geologic units, and slope angle. Areas not included on this map may see landslides caused by natural or human functions.

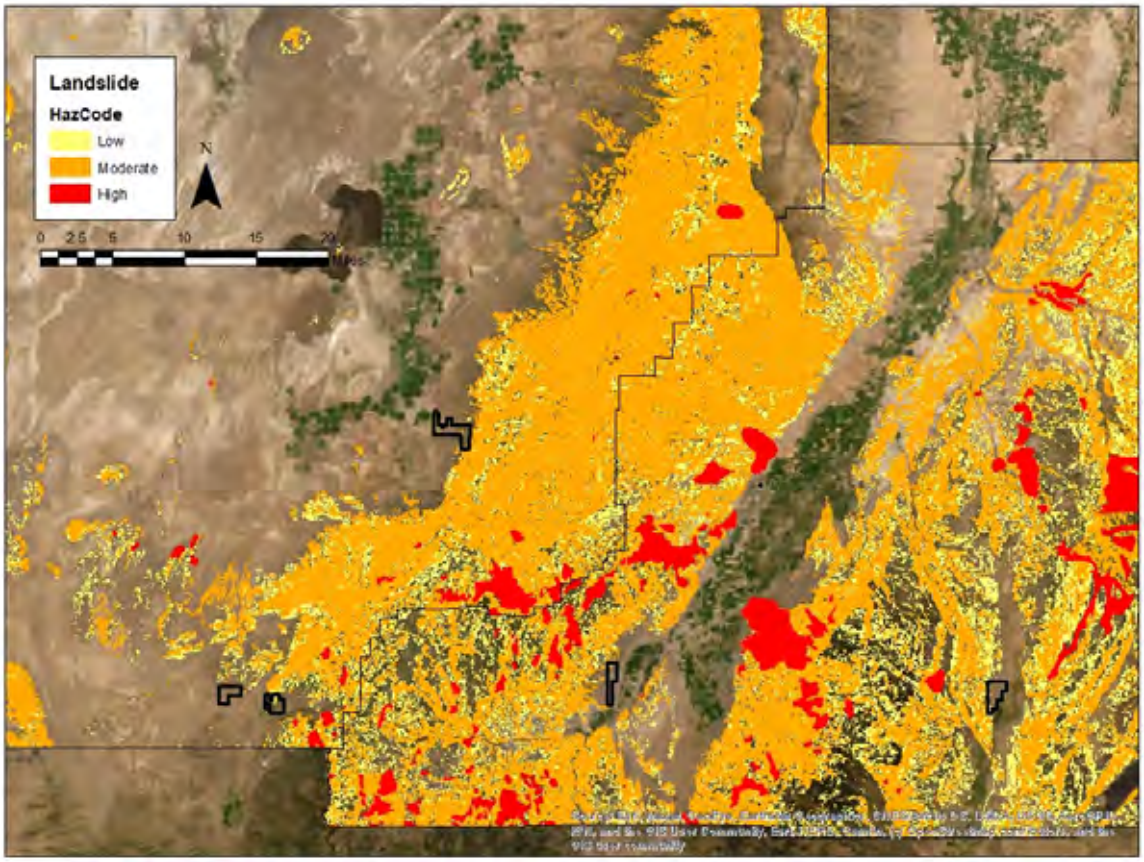


Figure 580: Paiute Indian Tribe of Utah Landslide Risk- Kanosh and Koosharem Bands

As illustrated by the maps, the Kanosh Bands have very little exposure to landslide susceptible areas but have identified susceptible areas near the bands in the foothills and mountains to the east and north.

The southern Koosharem reservations have landslide susceptibility identified in the northwest side of the community. Koosharem reservations are both located at the base of a hillside and have various drainages located near the community. Some of the Koosharem roads interact with these landslide prone areas. The Richfield reservation is in a valley in an urban area and does not appear to have landslide exposure.

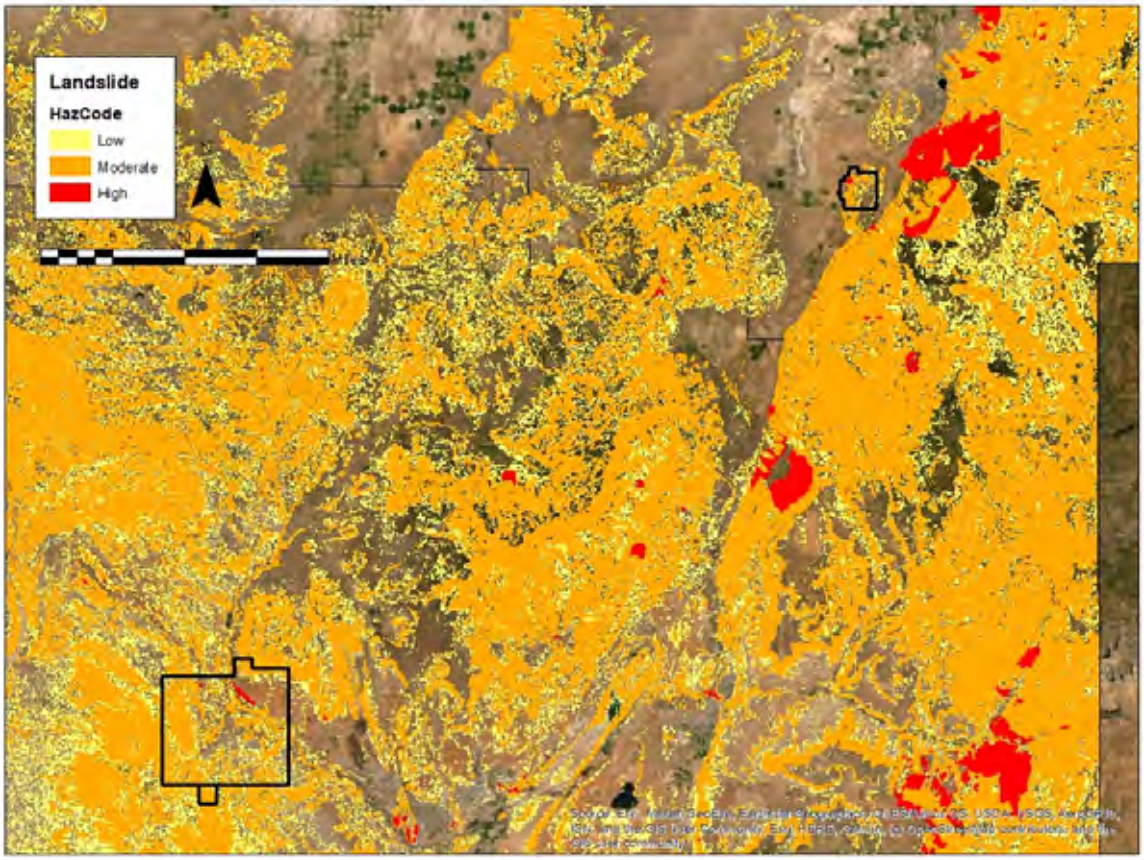


Figure 581: Paiute Indian Tribe of Utah Landslide Risk- Cedar, Indian Peaks, and Shivwits Bands

Based on the scale of the maps, it is unclear the extent that landslides interact with the Paiute Indian Tribe of Utah Headquarters in Cedar City. As the reservation is located at the base of a hillside, near a canyon, there is likely landslide risk near or within the boundaries of the reservation.

Cedar and Indian Peaks Bands are in the foothills of the Cedar Hills and are exposed to landslide susceptible areas. Some of these landslide susceptible areas interact with community roadways.

Shivwits is in hilly, red rock lowlands, marked by riverine areas and drainages. There is a significant portion of the area which is susceptible to landslides, and many community roads and businesses interact with susceptible areas.

Hazard History

The southwest landscape was developed through landslide events, which are common throughout the region. The only landslides documented for areas near Tribe lands are described in Table 524, all of which occurred in the Cedar City area.

Table 524: Paiute Indian Tribe of Utah Landslide History

Incident Date	Location	Description
1961	Cedar City	Debris flow at the Red Hill, near Cedar City.

1989	Iron County	Landslide in Cedar Canyon destroyed a portion of SR-14. The landslide also damaged the sealed entrance to a closed mine and an old power line was damaged.
2005	Iron County	A Debris flow on Black Mountain created a log jam, blocking Coal Creek. The flow damaged SR-14 and caused flooding and erosion.

Source: Utah Geological and Mineral Survey "Technical Reports For 1989-1990 Applied Geology Program" 1990, Utah Geological Survey "Technical Reports for 2002-2009 Geologic Hazards Program" 2010, Utah Geological Survey "Another large landslide closes highway near Cedar City, Utah" 2012, Deseret News "Massive landslide closes road east of Cedar City" 2011.

Landslides are evident and have been documented by the Utah Geological Survey and USGS. Maps of suspected landslide areas can be found in Figure 582 to Figure 589.

Figure 582: Paiute Indian Tribe of Utah Headquarters Mapped Landslides

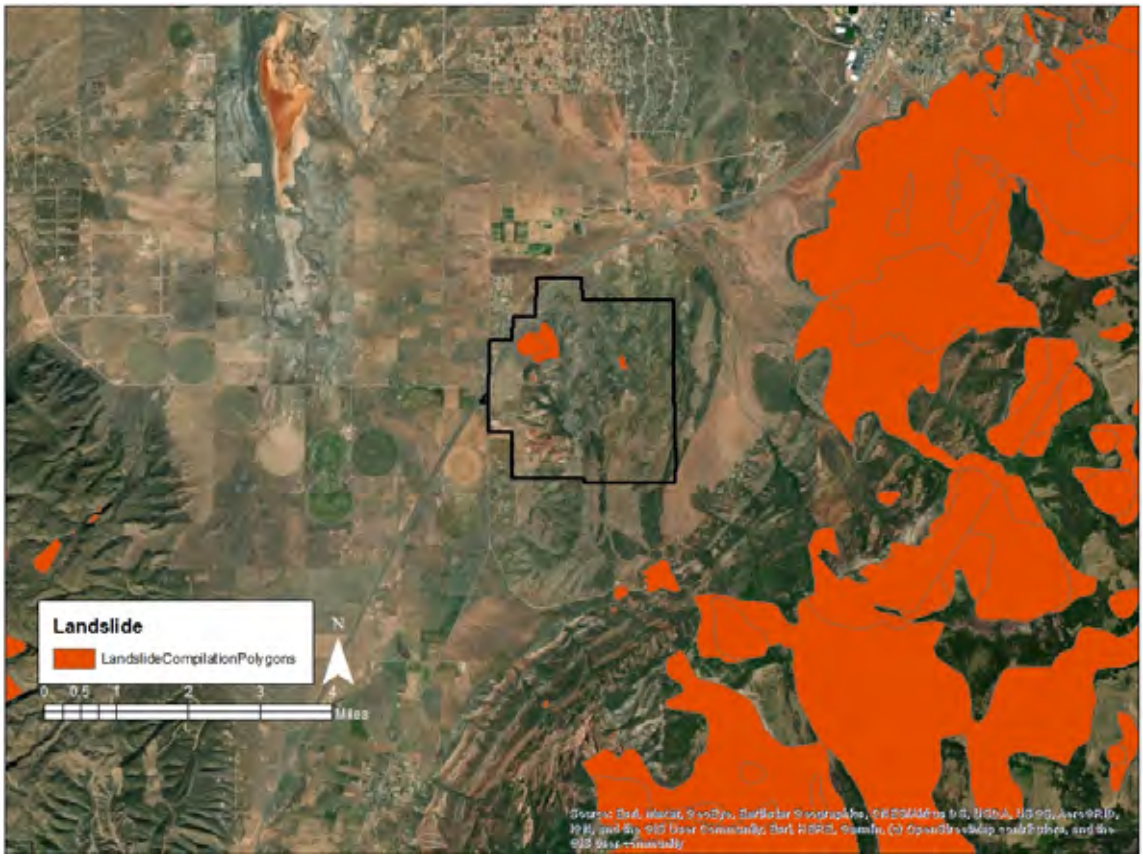


Figure 583: Cedar and Indian Peaks Bands Mapped Landslides

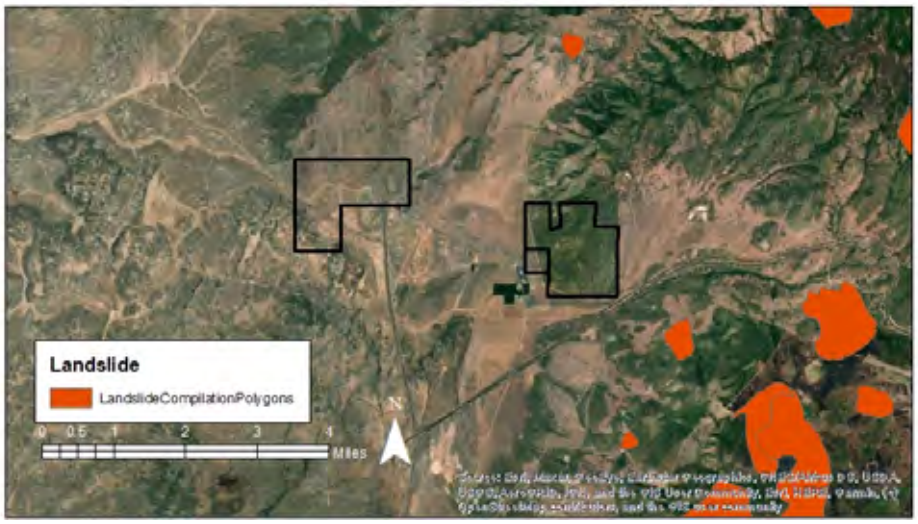


Figure 584: Kanosh Band Mapped Landslides

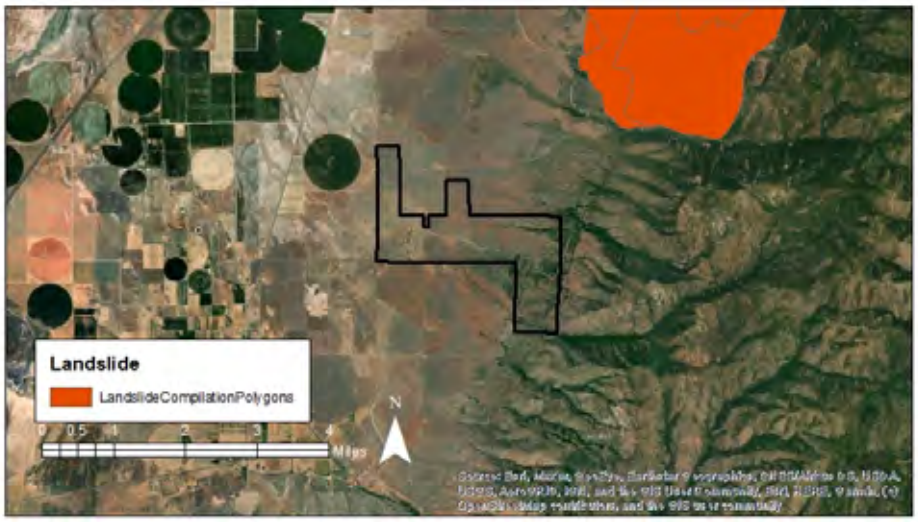


Figure 585: Kanosh Band Mapped Landslides

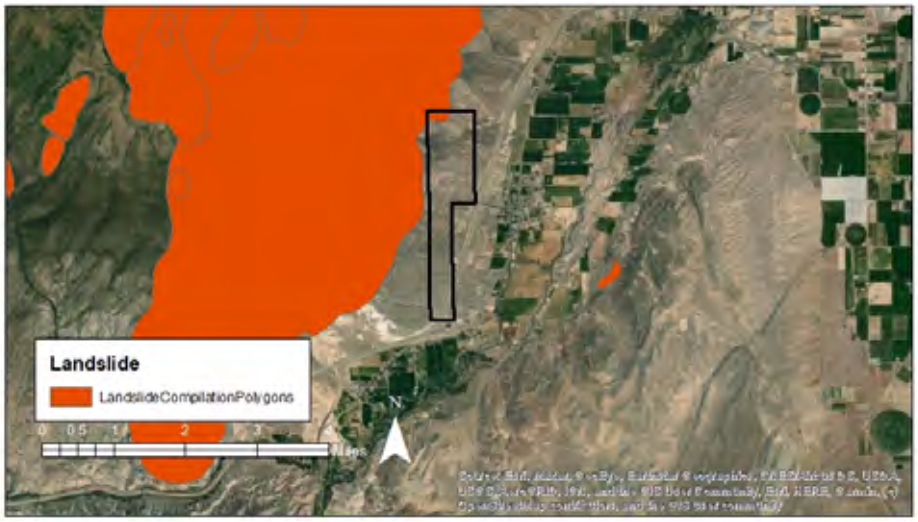


Figure 586: Koosharem Band Mapped Landslides

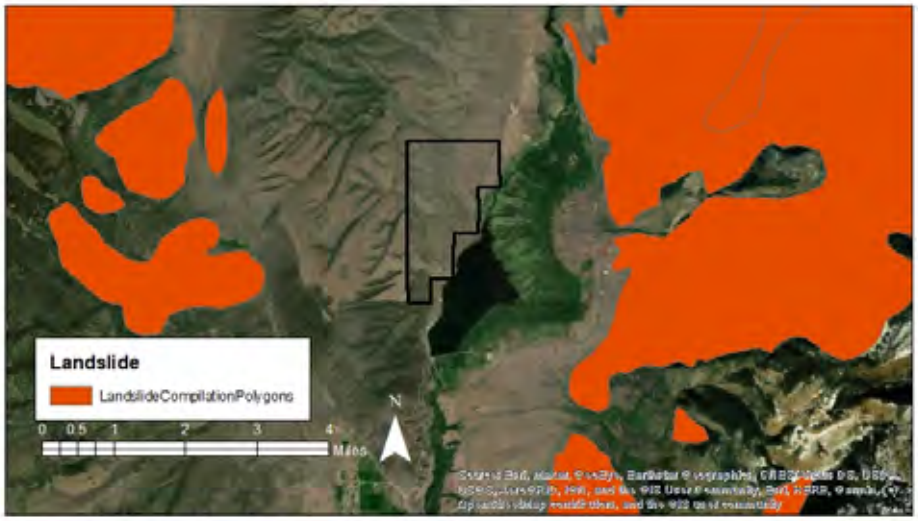


Figure 587: Koosharem Mapped Landslides

Figure 588: Koosharem Mapped Landslides

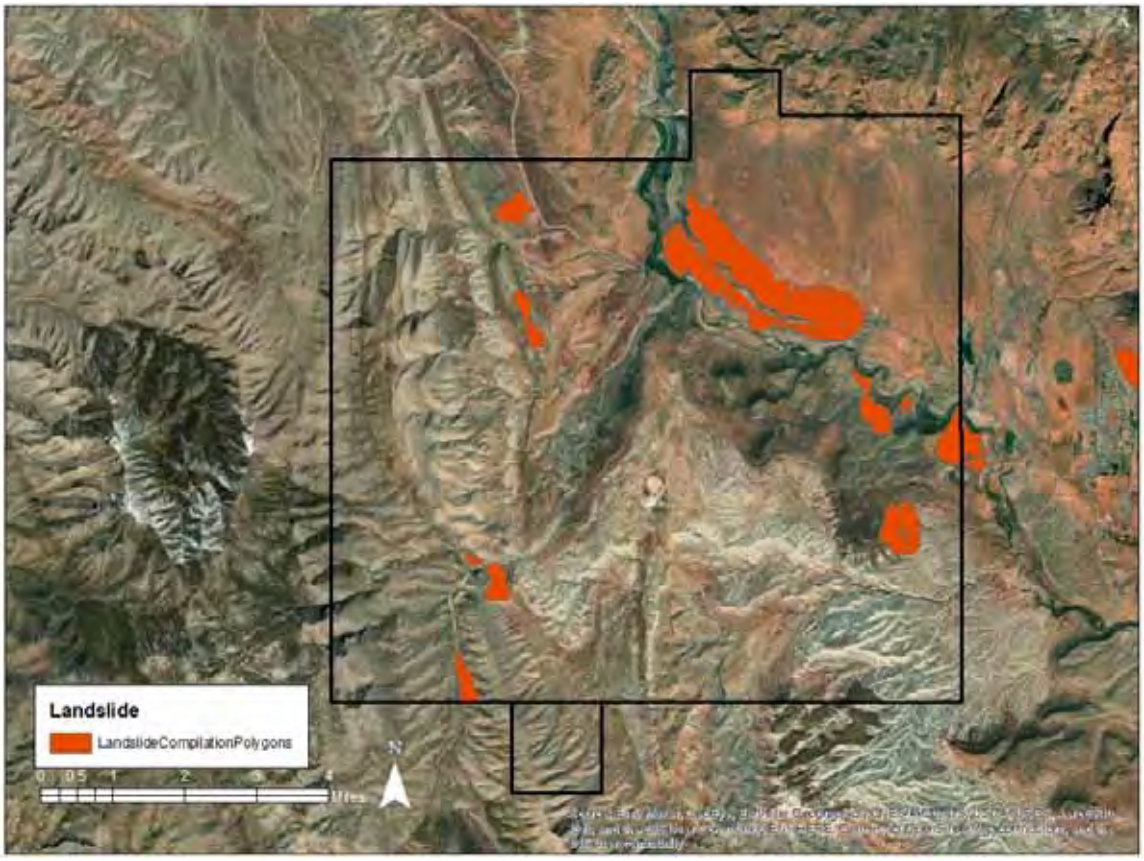


Figure 589: Shivwits Band Mapped Landslides

The Shivwits Reservation experiences consistent landslide and rockfall events on the road by the first bridge into the community, which is not included in the assessment by the Utah Geological Survey. The community describes that during rain events, boulders and rocks consistently flow onto the roadway. Further study and documentation can better represent the landslide events which have occurred in the community.

The Tribe's property owned in Springdale, Utah has topography marked by sandstone cliffs, ridges, and steep hillsides, making this site vulnerable for potential landslide events. Springdale, Utah has an active history of landslides and the Tribe's property likely sees similar risk.

Landslides can be triggered by other natural hazard events, or even human caused. Earthquake or ground shaking, flooding, wildfires, and severe weather are reported to impact or contribute to landslide hazards, depending on conditions. Landslides can likewise cause flooding by blocking or damming drainages or waterways or otherwise interacting with waterways.

Drought

Under normal conditions, Utah receives less precipitation than any other state except Nevada. Southern Utah has an arid climate, receiving very little precipitation annually. Drought periods are extended periods of time marked by lower-than-normal precipitation and can result in hot and dry seasons, reduction in surface water levels, limited groundwater recharge, among other impacts. Drought conditions can also heighten risks of other hazards, for example, dry and hot environments can make fuels more likely to ignite or increase impacts of flash floods and landslides following severe weather.

Monitoring drought generally occurs across several climate divisions. The majority of Paiute Indian Tribe of Utah lies in the South-Central division, with the PITU lands in Washington County and the Shivwits Band being in the Dixie division. At the time of this writing, Southwest Utah is in severe to extreme drought. Drought, given its regional scope, will impact the residents, facilities, infrastructure, businesses, and property in the community.

The Paiute Indian Tribes of Utah have experienced droughts as recorded for the South-Central and Dixie divisions. Across the region, seven (7) instances of extended drought have been reported. Figure 590 and Figure 591describe the drought history for the South Central and Dixie regions.

The Dixie Division

Comprises 1,423 square miles or eight percent of the total land area of the Five Counties, the majority of which is in Washington County, with a small portion found in Kane County to the west. The Dixie Division has had seven major drought periods varying in length since 1895. One of the more notable drought periods began in 1999 and ended in 2009, reaching extreme drought conditions. Droughts in the Dixie Division have been occurring more frequently within the last 60 years.

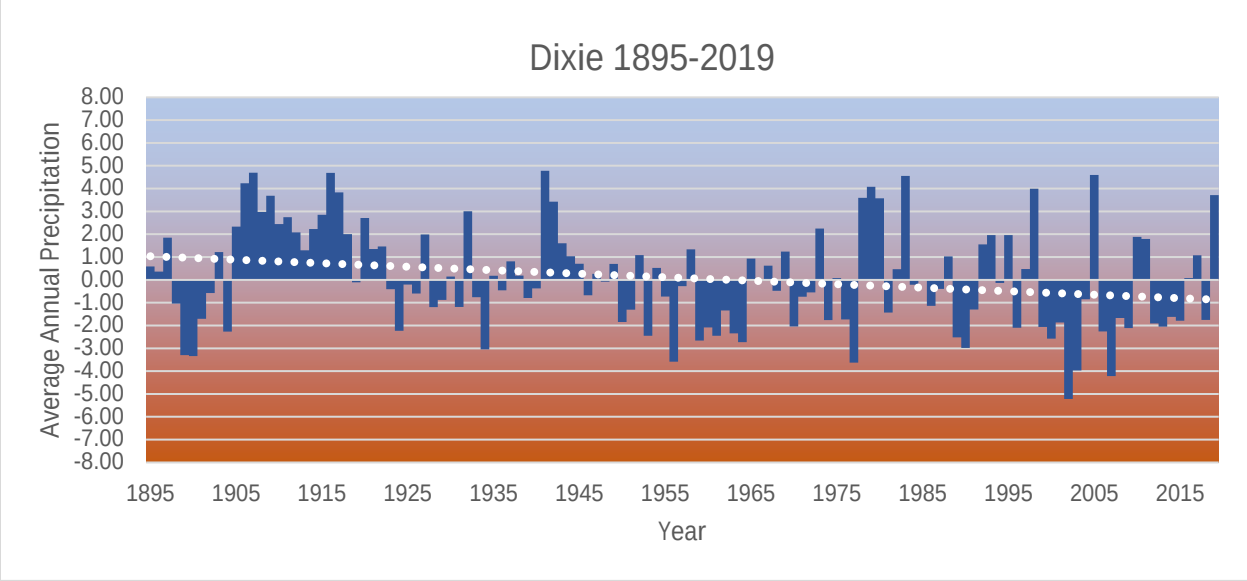


Figure 590: Dixie Division Historic Drought Patterns

The South-Central Division

Comprises 9,9097 square miles (52%) of the total land area of the Five Counties. The South-Central Division includes segments of all five of the counties and lies on the bulk of the region. Over the past 120-years there have been eight major droughts that meet the criteria for drought conditions. The last

50 years saw several droughts, three of which reached extreme conditions. It is expected that droughts continue to be longer and more frequent in future based on the historical record.

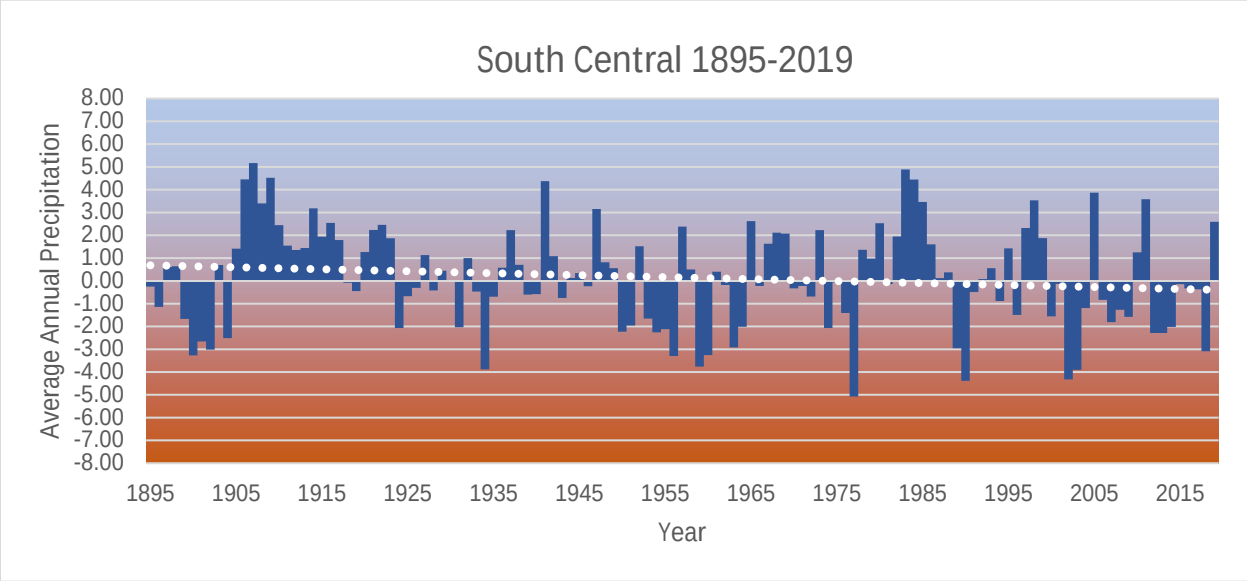


Figure 591: South Central Division Historic Drought Patterns

In the Southwest Tribal Climate Change Assessment Final Report, an assessment describes Paiute Indian Tribe of Utah planning to secure water resources like purchasing water rights and developing wells, pumps, and pipeline to address future droughts. (University of Arizona Native Nations Climate Adaptation Progra tion Program, 2017)

Southwestern dry areas have seen increased temperatures coincide with low humidity during the past several years, connecting that these interactions are cyclical and can be dependent on each other and are influenced on spring soil moisture. (McKinnon, Poppick , & Isla, 2021) Tourism may also suffer from drought impacts. A Colorado study indicated that visitors may choose other outdoor recreation locations, if they feel that there is a risk of wildfire or that conditions will be impacted by drought, such as low water levels in lakes or rivers. Such losses may impact local economies, especially those reliant on tourism and associated industries. Several of the Paiute Bands are near recreation areas and local RV parks, gas stations, and other amenities owned by the Bands may be impacted by drought.

Hot and dry drought conditions can impact crops, livestock, and wildlife.

Dry conditions can impact public health. Drought conditions can compound preexisting water supply, quality, or delivery concerns. Dry conditions that lead to increased fire smoke or debris can enter and impact water supplies. EPA also states that reduced water supply can lead to water quality concerns as contaminants are concentrated. These challenges can cause direct impacts on residents and essential functions in a community.

Radon

Radon is a leading cause of lung cancer and is the natural hazard that kills more people in the State of Utah. Indoor radon concentrations are common throughout the State of Utah, especially in homes, where people spend most of their time in the day. Figure 592describes that radon in southwestern Utah is generally estimated to be between 2 and 4 pCi/L[34]. Mitigation is recommended at this level. Sevier County is among the state's counties with predicted average indoor levels greater than 4pCi/L. At this level, mitigation should take place to address the high levels and reduce the risk of building users or residents. Mitigated indoor levels below 2.0 are difficult to achieve. There is no known level at which radon concentrations become more or less of a risk, as there is no safe level of radon exposure.

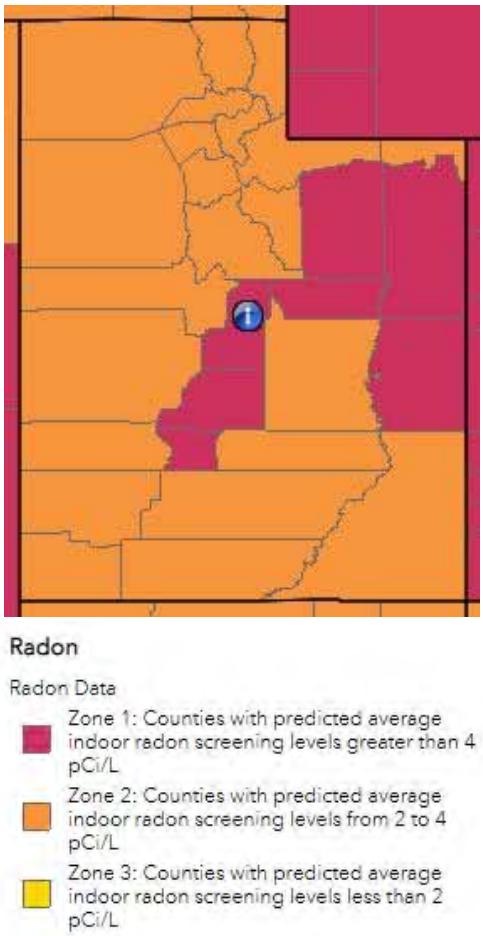


Figure 592: Estimated Indoor Radon Level Zones-Utah

Occurrence and concentrations of radon depend on the soil content, structures foundation, and time spent in a space. Radon is a gas emitted from uranium deposits underground. Radon gas travels through the ground to the surface and can enter homes, become trapped and concentrating. Concentrations of radon gas are unhealthy for humans. Outdoor spaces are not a risk as the airflow dilutes radon.

Radon is not healthy at any level and is annually the natural hazard that kills the most people in Utah. Despite this indicator, few people are aware of radon risks and consequences. Increased public information about radon and reported at home testing results can help to inform the public and residents. Mitigation can be affordable, especially when completed in pre-construction phases.

While radon occurrence data can be difficult to acquire for communities, a 2019 report from the Utah Department of Environmental Quality describes short term radon testing by zip code and County. It is important to understand that testing and mitigation are site specific, based in part on the location and geology, but also the age and quality of the structure (Division of Radiation Control, 2019). The data from this report should not be used to determine where testing or mitigation should or should not be applied.

Table 525describes the reported findings from short term radon testing by County which PITU bands are located. Sevier County notably has high reported average indoor levels of radon, with a high maximum test reported. The takeaway from this data is that radon gas has been identified in the areas surrounding Tribal Lands and that testing, and information is necessary to understand and reduce risk.

[34] Radon is measured in picocuries per liter of air.

Table 525: Radon Testing Record by County

County	Percent of tests with levels <4 pCi/L	Percent of tests with levels ≥4 pCi/L	Maximum Radon Level Reported	Average Radon Level Reported	Number of Tests
Washington	88.3%	11.7%	31.9 pCi/L	2.2 pCi/L	797
Iron	84.3%	15.7%	28.3 pCi/L	2.4 pCi/L	516
Millard	79.7%	20.3%	10.0 pCi/L	2.9 pCi/L	79
Sevier	50.2%	49.8%	101.3 pCi/L	9.8 pCi/L	241

Source: Utah Department of Environmental Quality, Division of Radiation Control 2019.

There is not a hazard history for radon beyond the County testing record and no information documented for the Tribe individually. While estimates of radon levels in the County can be helpful to describe the problem, individual testing is the best way to understand the potential risk and exposure of radon gases at a residence or structure. Many residents are unaware of the risk of radon in their home. Testing and mitigation of radon should be done with the consultation of a Radon mitigation specialist.

Severe Weather

Southwestern Utah's landscape has been shaped by severe weather events. High winds, snowstorms, and heavy rain have developed the valleys, rivers, and other topography in the region. Severe weather events have been reported and documented throughout human occupation of the area.

All Paiute Indian Tribe of Utah reservation lands are at risk to severe weather events. Reservation lands in northern and higher elevation areas are more likely to see snow and extreme cold, where southern and lower elevation areas are subject to heavy rain and high temperatures. The entire region experiences thunderstorms, rain, and high winds. Severe weather events have been known to cause damages to property and cause injury or death to humans.

The National Oceanic and Atmospheric Administration (NOAA) documents severe weather events in a storm event database. In a search from the years 1950 and 2020 hundreds of events have been reported across southwest Utah. To identify events which likely impacted the Paiute Bands, searches for nearby communities and reported impacts directly to bands were assessed. Table 526 documents the reported severe weather events.

Table 526: Paiute Indian Tribe of Utah Severe Weather Record

Band	Date	Damage/Injury	Description
Kanosh	11/28/1996	None Reported	A winter storm dropped 15 inches of snow in Kanosh. The event impacted much of the state of Utah, impacting roads and traffic.
	8/27/1997	None Reported	A severe thunderstorm produced ¾ inch diameter hail in Kanosh.
	2/14/1998	None Reported	A heavy snowstorm dropped 17 inches of snow in Kanosh.
	12/19/1998	None Reported	A heavy snowstorm produced 23 inches of snow in Kanosh. This statewide event caused road closures, power outages, and traffic accidents across Utah.
	9/21/2000	None Reported	A Thunderstorm produced ¾ inch hail in Fillmore and Meadow.
	3/9/2006	None Reported	Cove Fort recorded 14 inches of snow during a snowstorm.
	11/28/2010	None Reported	Snowfall in Kanosh was reported at 16 inches during this event.
	5/10/2014	2 Injuries	A winter storm produced snow and high winds on I-15, causing accidents near Cove Fort.
	12/20/2017	None Reported	Kanosh recorded 18 inches of snow during a snow event.
Koosharem	12/21/1998	None Reported	Extreme cold impacted the state of Utah, with -25 degrees reported in Joseph and -24 in Richfield.
	7/14/2002	$15,000	a 200-foot section of building was knocked down during a severe storm which hit Richfield.
	7/6/2008	1 injury	A woman was struck by lightning in Richfield.
	8/3/2010	None Reported	Heavy rain caused a mudslide that blocked SR 62, closing the highway until the debris was cleaned.
	6/11/2016	$3,000	A severe thunderstorm downed trees in Richfield during high winds.
Shivwits	9/9/1998	$35,000	High winds of 70 MPH were reported in Ivins. This event is reported to have caused $10,000 personal property damage and $25,000 crop damage in Washington County.

	1/5/2003	$100,000	High winds of 70 MPH were reported in Ivins. This storm caused property damages across Washington County.
	8/2/2005	None Reported	3.88 inches of rain were reported in Ivins in a few short hours.
	7/30/2007	None Reported	An inch of rain fell within a 20-minute period, causing dry washes in Ivins to fill.
	12/7/2013	None Reported	Eight inches of snow was reported in Ivins. Roadways throughout Washington County were covered in snow and experienced closures until the snow could be cleared.
Cedar/Indian Peaks Bands	6/28/2020	None reported	Wind gusts of 62 MPH were recorded at Hamilton's Fort.
Paiute Indian Tribe of Utah-Cedar City	7/26/1996	$50,000	Six-tenths of an inch of rain fell in Cedar City in a span of 35 minutes. Flooding from the storm washed mud and rocks on SR-14, which had to be closed for 2 hours.
	4/12/1997	$10,000	Cedar City received 8 inches of snow during a storm. Traffic accidents were attributed to the snowfall.
	10/16/1998	$100,000	Between 9 and 10 inches of snow fell in Cedar City causing tree damage and power outages
	3/21/2011	$5,000	70 MPH winds recorded at the Cedar City ASOS. The winds damaged a building roof.
	10/28/2013	$35,000	Strong winds reported with peak gust recorded at 71 MPH. The winds downed 10 trees on the Southern Utah University campus, damaging a building.
	5/11/2014	$100,000	Cedar city reported a foot of snow. The storm damaged trees and limbs. The I-15 corridor was heavily impacted, and power outages were reported across the region.
	4/14/2015	$10,000	High winds reported across south central Utah with a gust recorded at the Cedar City Airport at 61 MPH.
	2/17/2016	$15,000	Strong winds blew for hours with a peak gust of 70 MPH. Trees were knocked down on SR-14 and one fell on the Southern Utah University campus onto a building.
	3/5/2017	$80,000/ 10 injuries reported across the region.	A cold front brought high winds to the Southwest, impacting several communities, including Enoch, Cedar City, and Filmore with tree and fence damage.

Source: NOAA Storm Database

High winds, heavy snow, thunderstorms, and rain have repeatedly impacted the Paiute Indian Tribe of Utah and it is very likely that these events occur again. Long term climate and weather projections suggest that the severity of weather events will increase in the future.

According to the severe weather records, vulnerabilities include roadways, crops, and electrical structures. Homes and structures may be impacted by rain, hail, high winds, and/or heavy snow. Paiute Band communities are relatively remote, many far from large communities. Road closures in other communities or unincorporated counties due to severe weather would impact residents, as access to their community or others is impacted. Response and recovery, supply chain, and other essential travel may be delayed during a severe weather event.

Problem Soils

Utah Geological survey has completed more recent mapping of problem soils, but The Paiute Indian Tribe of Utah is outside of the boundaries for this study. A statewide dataset indicates where certain problem soils have been mapped which may pose engineering challenges to development. Over time, new data has been compiled for areas of the state describing extent in greater detail. Unfortunately, the Paiute Indian Tribe of Utah, along with much of rural Utah have not been included in these updated. Updated mapping and data that includes the tribes would offer improved understanding and information to facilitate mitigation for property and development.

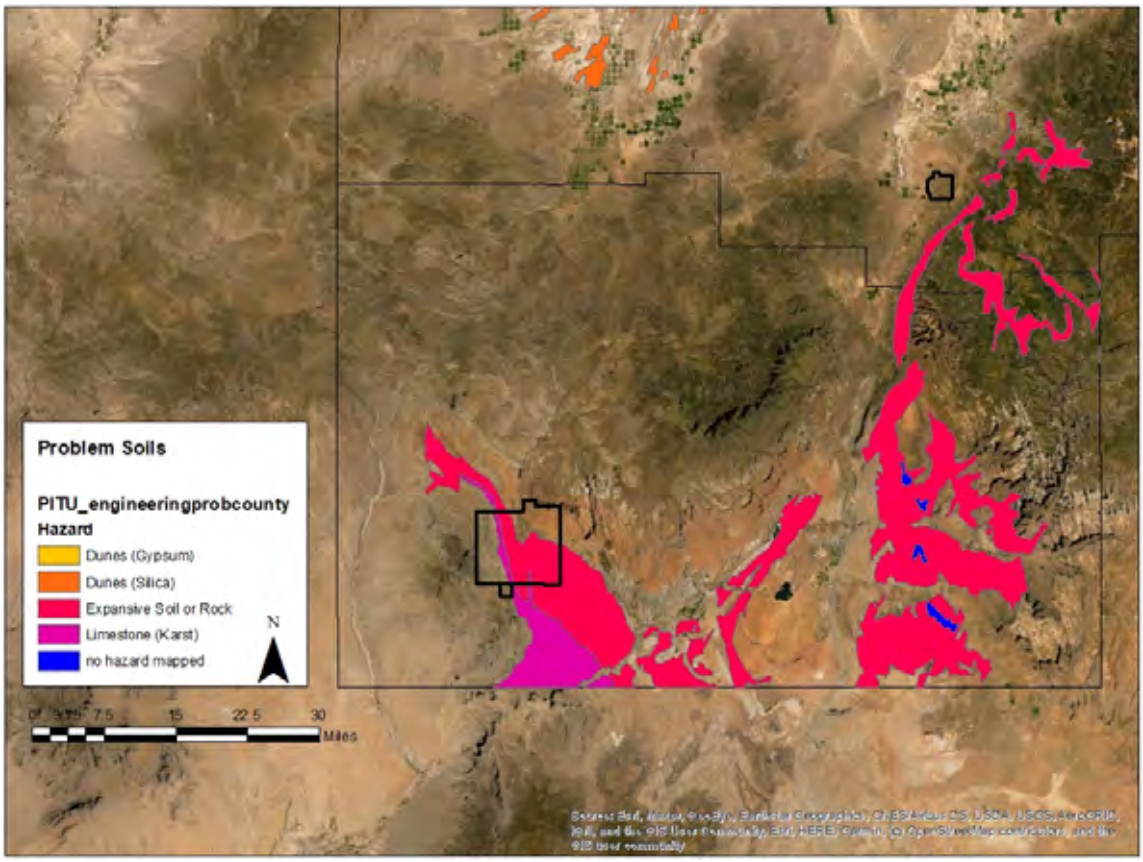


Figure 593: Southwestern Utah Problem Soil Hazard Exposure

Source: Utah Geological Survey

According to the available data, Shivwits is the only band exposed to problem soils, with limestone karst formations and expansive soils and rock identified. Springdale, Utah also reports extensive exposure to problem soils, particularly on the south and east end of the community near the Virgin River, presenting concerns for the Tribe's land owned there.

Limestone can dissolve and create Karst features, which can result in collapse of the formerly stable ground. Expansive soils and rock are reactive to moisture, due to the high clay content of the ground. As moisture is introduced, expansive soils and rock swell and then contract when dry. The swell and contract action causes problems for structures and infrastructure which can be damaged as the soil volume changes. Buildings in southwestern Utah have experienced cracked uneven foundations due to expansive soils.

While there are not mapped problem soils in the Cedar, Indian Peaks, Koosharem, and Kanosh Bands, it is possible that problem soils may have been experienced locally. Throughout the southwest, communities have expressed challenges do development due to the presence of expansive clay soils. Impacts generally include damage to structures and infrastructure. Problem soils are unlikely to cause personal injury of death. Geotechnical study and assessment can provide additional insight to the prevalence of problem soils in the community.

There are no documented reports of impacts attributed to problem soils by tribal members or reservation residents as of this writing.

Mitigation Strategy and Actions

The Tribe's planning team identified actions to include in the community mitigation strategy. Each action in Table 527 includes the following elements:

- Hazard ID- an alpha numeric identifier for the hazard being addressed by the action.
- Goal- the goal section identifies the regional goal that the action meets. Goals set by the region are found in Figure 594.
- Objective- a mid-level description of the purpose for the action.
- Action- Summarizes a specific activity in the community that addresses natural hazard risks.
- Priority- priority description for each action determined through the STAPLEE method indicated by L=low, M=moderate, and H=high.
- Timeline- The estimated amount of time to implement the action.
- Cost- The estimated cost of implementing the action,
- Funding Source- Potential options to pay to implement the action.
- Responsible party- The organization, agency, or entity who will be necessary to implement an action. Potential partnerships are included in this section and are organizations or people who could support successful implementation of the action.

Plan Goals

Goal 1- Protect life & property

Goal 2- Secure critical infrastructure

Goal 3- Public education and outreach

Goal 4- Partnership and coordination

Goal 5- Emergency response

Goal 6- Protect the natural environment

Figure 594: Regional Plan Goals

To address the risks and vulnerabilities identified in this chapter, the Tribe has assembled several actions, addressing each of the natural hazards that the community is at risk to. These actions are detailed in Table 527, which also identifies a timeline, potential funding source, and responsible parties to support implementation of these actions.

Table 527: Paiute Indian Tribe of Utah 2022 Mitigation Strategy

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Multi Hazard #1	5	Plan for community safety.	Update the Emergency Operations Plan.	H	2-years	M	FEMA Tribal Homeland Security Grant	Paiute Indian Tribe of Utah, TERT
Wildfire #1	3	Inform the public of natural hazard risks and personal mitigation.	Public education campaign to inform residents about fuels mitigation on personal property to coincide with	H	1-year, ongoing	L	Paiute Indian Tribe of Utah, TERT	Paiute Indian Tribe of Utah, TERT, participation from county/SSD

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			community yard clean ups.					fire departments.
Wildfire #2	6	Plan for community safety and reduce other hazard risks.	Develop a plan for landscape revegetation and restoration following wildfires.	M	2-years	M	Paiute Indian Tribe of Utah, TERT, Resilient Communities Program	Paiute Indian Tribe of Utah
Wildfire #3	2	Plan for community safety.	Assess transportation routes and communications with residents to address evacuation challenges.	H	1-year	M	Paiute Indian Tribe of Utah, Counties	Paiute Indian Tribe of Utah, UDOT, Counties
Wildfire #4	1, 2, 4, 6	Use natural systems and partnerships to reduce risks.	Participate in fuels management activities with neighboring jurisdictions, local, state, and federal agencies.	M	1-year, ongoing	M	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah, DNR, Counties
Earthquake #1	1, 2	Address community infrastructure and facility vulnerabilities.	Require bracing of generators and equipment at Tribe owned facilities.	M	2-years	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Earthquake #2	2	Address community infrastructure and facility vulnerabilities.	Use flexible piping when extending underground utilities.	L	ongoing	M	Indian CDBG program	Paiute Indian Tribe of Utah
Flood #1	4	Participate with federal programs.	Work with state and FEMA to participate in the NFIP program.	H	Ongoing	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Flood #2	1, 2	Address community infrastructure and facility vulnerabilities.	Increase drainage/absorption capacities of detention basins.	L	5-years	M	FEMA Mitigation Grant, Resilient Communities Program	Paiute Indian Tribe of Utah
Flood #3	4	Address risks through coordination with partner and neighboring organizations.	Coordinate with Cedar City to address stormwater drainage challenges from neighboring subdivision.	M	5-years	L	FEMA Mitigation Grant	Paiute Indian Tribe of Utah, Cedar City

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
Flood #4	1, 2	Address risks through coordination with partner and neighboring organizations.	Assess and implement stormwater drainage infrastructure to protect the access road to the Springdale PITU land.	L	5-years	M	Indian CDBG program, FEMA Mitigation Grant.	Paiute Indian Tribe of Utah
Landslide #1	1, 2	Plan for community safety.	Require new development to be set back from steep slopes and hillsides.	M	1-year, ongoing	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Landslide #2	6	Use natural systems and partnerships to reduce risks.	Conserve land on or near steep slopes and hillsides to reduce landslide risks.	L	2-years	M	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Drought #1	1	Address community infrastructure and facility vulnerabilities.	Development of supplemental water sources.	H	5-10 years.	H	Indian CDBG program	Paiute Indian Tribe of Utah
Drought #2	2	Address community infrastructure and facility vulnerabilities.	Removal of unused turf from tribe/band owned facilities.	L	3-years.	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Radon #1	3	Inform the public of hazard risks and mitigation.	Provide a public education campaign to inform residents of testing and mitigation options for radon.	H	1-year, ongoing	L	TERT, Utah DEQ	Paiute Indian Tribe of Utah
Radon #2	1	Plan for community safety.	Require new residential structures to include radon mitigation during development.	L	1-year, ongoing	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah
Severe Weather #1	1, 2, 6	Use natural systems and partnerships to reduce risks.	Plan for and implement low impact stormwater drainage infrastructure as new infrastructure is needed.	M	5-years	M	Indian CDBG Program, Resilient Communities Program	Paiute Indian Tribe of Utah
Severe Weather #2	1, 2	Plan for community safety.	Discouraging flat roofs in areas that	M	1-year, ongoing	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah

Hazard	Goal	Objective	Action	Priority	Timeline	Cost	Funding Source	Responsible Agency
			experience heavy snowfalls.					
Problem Soils #1	1, 2	Plan for community safety.	Require that new development submit geologic study to demonstrate presence of problem soils and mitigate if soils are present.	M	1-year, ongoing	L	Paiute Indian Tribe of Utah	Paiute Indian Tribe of Utah

Source: Local Planning Team

Funding Sources

The Paiute Indian Tribe of Utah has not previously participated in a Natural Hazard Mitigation Plan process and has not previously used funds from the Federal Emergency Management Agency for natural hazard mitigation activities. In 2020, the Tribe received supplies from FEMA for the Covid-19 pandemic. The tribe has relied on grant funding or state agency support for mitigation and training purposes. Activities include trainings from the Department of Emergency Management and creating fire lines around property to protect the community from wildfire.

To meet the requirements of the Tribal mitigation Planning Process the plan describes each of the identified potential funding sources for actions in the Mitigation Plan.

Tribal Emergency Response Team

The Tribal Emergency Response Team is a volunteer group of tribal members who support emergency response, recovery, and preparedness actions at Paiute reservations. This local body is identified as the funding source and responsible party for mitigation actions which align with their ongoing work, like public information.

Paiute Indian Tribe of Utah

The Paiute Indian Tribe of Utah is a sovereign nation. The Tribe identifies their own policies and practices for development, land use, and governance. Actions which identify the Paiute Indian Tribe of Utah as a funding source are policy related actions which would be addressed by the tribal council and/or staff time. The Tribe does not have funding capacity to fund large infrastructure projects on their own. These projects must have external funding sources like grants.

Indian Community Development Block Grant

The Indian Community Development Block Grant (ICDBG) can be used for housing, economic opportunities, and infrastructure in low- and moderate-income persons in Indian and Alaska Native Communities.

Flood Mitigation Assistance Program

Flood Mitigation Assistance Program funds may be used for projects to reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP. The Tribe does not presently participate in the NFIP and would need to become a participant before applying for this funding source. Flood Mitigation Assistance may be used for mitigation projects, planning, and technical assistance.

Building Resilient Infrastructure and Communities (BRIC)

BRIC funds may be used to promote capability and capacity building, mitigation, and management costs in eligible communities. In 2021, there was a $25 million Tribal Set-Aside and federally recognized tribal governments may apply for $1 million federal cost share per applicant.

Hazard Mitigation Grant Program Post Fire

Federally recognized Tribes affected by fires which resulted in a Fire Management Assistance Grant (FMAG) Declaration may use Hazard Mitigation Grant Program Post Fire funds for wildfire mitigation, 5-percent initiatives, soil and slope stabilization, and post wildfire flood prevention and sediment reduction. The application period closes six months after the end of the fiscal year with the FMAG declaration.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program funds extensive types of mitigation and risk reduction projects, including planning and enforcement, retrofits, and flood prevention measures. The objective is to reduce future losses from disaster events.

Tribal Homeland Security Grant Program

The Tribal Homeland Security Grant Program fund planning, organization, equipment, training, and exercise projects with the goal of prevention, protection, mitigation, response, and recovery. The purposes are to prevent terrorism and prepare for threats and hazards.

Utah Department of Environmental Quality

The Utah Department of Environmental Quality's Waste Management and Radiation Control Division has produced public information for residents and realtors regarding radon hazards. The division also provides information about sourcing radon tests and mitigation professionals.

State Indoor Radon Grants (SIRG)

The Environmental Protection Agency (EPA) provides state and tribal governments funding through the State Indoor Radon Grants program for radon risk reduction programs. Participants must align projects with EPA strategic goals.

Resilient Communities Program

The Resilient Communities Program prepares communities for environmental challenges through green infrastructure, capacity building, and adaptation locally. The hazards addressed by this program include wildfire, flooding, and drought.

Assurances and Plan Adoption

The Paiute Indian Tribe of Utah has successfully managed federally funded projects and fully ensures compliance with contract management, financial management, procurement, implementation, and reporting in accordance with 2 CFR 200 and other applicable regulations. In addition, the Tribe ensures adherence to all cost principles and audit requirement for federal awards in compliance with 2 CFR 200 and other applicable regulations.

Progress and Monitoring

The Paiute Indian Tribe of Utah administrator maintains a record of projects identified as needs and monitors the progress in pursuing funding and project implementation. Projects identified in this hazard mitigation plan will be added to the Tribe's existing project list. Should future plans or policies be adopted by the Paiute Indian Tribe of Utah, the projects identified in the hazard mitigation plan will be included in these planning tools.

Actions and goals identified in this plan will be reviewed by the Tribal Administrator, TERT, and Tribal Council annually. The Tribal Administrator convene this review and TERT and the Tribal Council will serve as contributing parties to inform mitigation needs. As needed, new goals or mitigation actions may be added to the plan as identified by the TERT, Tribal Council, and Tribal Administrator. As mitigation projects are implemented and completed, reports to this body will describe the project process and other identified needs or next steps.

Plan Maintenance

The use of this plan supports information and strategies to address community risk. Several strategies in this plan call for updates to local codes or policies to reduce natural hazard risks and vulnerabilities. Jurisdictions will adopt this plan by resolution and city officials are responsible to integrate this mitigation plan into updates of their local plans and policies.

The Five County Multi-Jurisdictional Natural Hazard Mitigation Plan is updated every five years, according to CFR §201.6(c)(4)(i). To support the implementation of the actions identified in the mitigation strategy, Five County will host a plan maintenance meeting with jurisdictions participating in this plan to discuss the identified actions, new needs, and identify any necessary edits to the natural hazard plan process.

The progress report meetings will be grouped by County, to promote collaboration, information sharing, and discussion about area successes and challenges to mitigation. Responsible parties for participating in the plan maintenance meetings will be the identified local planning team unless the mayor or commissioners select another person or persons to participate in the meeting.

Plan Maintenance meetings will occur in the Spring of each year, following the adoption of this plan. An update to the Five County Multi-Jurisdictional Natural Hazard Mitigation Plan will begin three-years following this plan adoption. It will be a priority during that plan maintenance meeting to discuss with plan maintenance participants to discuss the pending update and begin requesting information from communities to fulfil plan requirements.

Stakeholders and other entities in the community who might be interested in updates or participating in the plan maintenance process will be engaged at the local level, as identified by the local planning team.

Community engagement has played a part throughout the update of this Multi-jurisdictional Natural Hazard Mitigation Plan. The community will be made aware of plan maintenance through the Five County Natural Hazard Plan website and will be able to provide comment and review of plan progress there. As always, interested community members may contact the Association of Governments offices to discuss plan progress and community mitigation needs.

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Appendices

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Appendix D: Mitigation Strategy Summary Table

Appendix A: GIS References

GIS Data Reference	
Boundaries	
Parcels	Utah Automated Geographic Reference Center (AGRC)
City, County, and State Boundaries	Utah Automated Geographic Reference Center (AGRC)
SITLA land ownership	Utah Automated Geographic Reference Center (AGRC)
Climate & Weather	
Climate Division	United States Geological Survey (USGS)
Earthquake	
Earthquakes	Utah Seismograph Stations
Quaternary Faults	Utah Geological Survey (UGS)
Liquefaction	Utah Geological Survey (UGS)
Flood	
100 Year Flood Plains	Federal Emergency Management Agency (FEMA)
Bodies of Water	Utah Automated Geographic Reference Center (AGRC)
Dam Break Inundation Zones	Utah Automated Geographic Reference Center (AGRC)
Infrastructure	
Critical Facilities	Utah Department of Natural Resources (Utah DNR)
Rail	Utah Automated Geographic Reference Center (AGRC)
Roads	Utah Automated Geographic Reference Center (AGRC)
Residential Structures	County Assessor's Data
Commercial Structures	County Assessor's Data
Landslide	
Landslides	Utah Geological Survey (UGS)
Landslide Susceptibility	Utah Geological Survey (UGS)
Rockfall	Utah Geological Survey (UGS)
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Engineering Problems	Utah Automated Geographic Reference Center (AGRC)
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