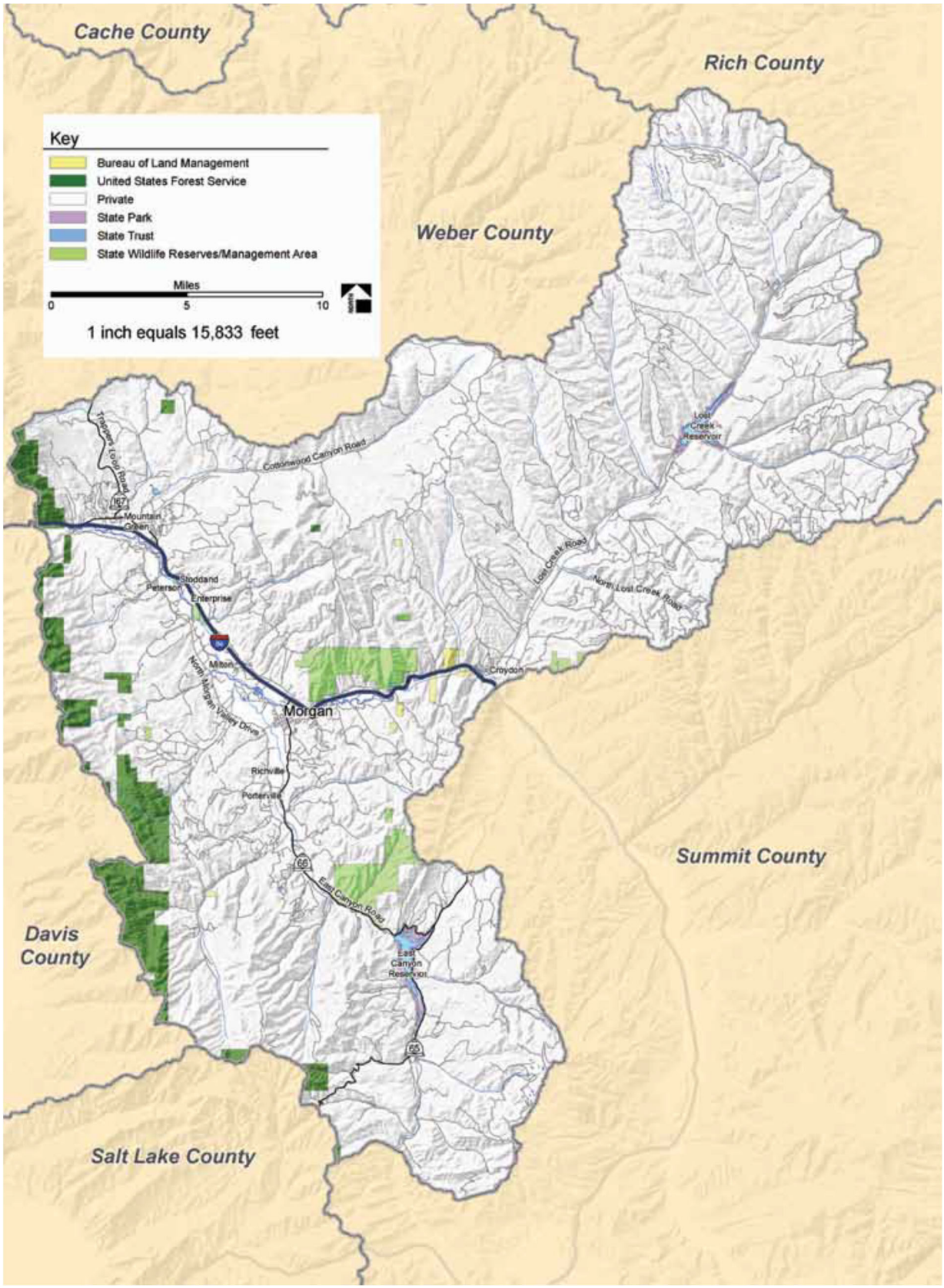
Morgan County
Natural Hazard Pre-Disaster Mitigation Plan

Produced by Morgan County, Morgan City and Special Service Districts

Assistance and guidance provided by Utah Division of Emergency Management

2016



Morgan County General Plan, 2010: Morgan County Planning and Development

Executive Summary

Plan Mission

Morgan County developed the Pre-Disaster Mitigation (PDM) Plan in partnership with Morgan City to substantially and permanently reduce the county's vulnerability to natural hazards. The Plan is intended to promote sound public policy and protect or reduce the vulnerability of the citizens, critical facilities, infrastructure, private property and the natural environment within the county. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention and identifying activities to guide the development of a less vulnerable and more sustainable community.

Plan Update

This Plan represents an update of the PDM Plan that was approved by the cities, counties, the State and by FEMA in 2009. All of the demographic data, maps, vulnerability assessments and mitigation strategies have been revised to reflect the constant growth throughout the county area. Development pressures in hazard areas will continue to increase the risk to residents. The entire plan was reviewed and analyzed by the planning team throughout the planning process and again at the final draft stage before submittal to the state and FEMA.

Plan Organization

The Plan was developed and organized within the rules and regulations established under 44 Code of Federal Regulations (CFR), Section 201.6. The Plan contains a discussion on the purpose and methodology used to develop the Plan, a profile on communities within the county, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the ability of the county to respond to emergencies and disasters. It will also document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Funding

The Plan has been funded and developed under the PDM Program provided by the Federal Emergency Management Agency (FEMA) and the Utah Department of Public Safety, Division of Emergency Management (DEM).

Plan Participation

This plan was developed in partnership with DeeEll Fifield Consulting who was retained by the county to complete the project.

Plan participation was completed as a result of a collaborative effort between the DEM, county emergency manager, fire department, sheriff's office, public works department, planning commission, assessor's office, city and county geographic information systems (GIS) department, special service districts, school district, elected officials, public employees, and citizens of communities within Morgan County.

Interviews were conducted with stakeholders from the communities and workshops were conducted during the Plan development phase. Additionally, through public hearings, workshops and draft Plan displays, ample opportunity was provided for public participation. Any comments, questions and discussions resulting from these activities were given strong consideration in the development of this Plan.

Hazards Identification

The PDM Plan addresses: earthquake, flood, landslide, problem soils, wildfire, dam failure, and severe weather. Drought is also discussed. Therefore, the hazard identification study recognized the following natural hazards as being the most prevalent and posing the most potential risk to the county. It is recognized that dam failure is not a natural hazard. However, the impact from a catastrophic dam failure would likely be so severe that it warrants inclusion into the Plan.

- Earthquake
- Flood
- Landslide
- Wildfire
- Dam Failure
- Severe Weather

Acknowledgements

Morgan County Emergency Management extends its appreciation to the following agencies, which assisted in the development of this Plan.

- Utah Division of Emergency Management
- Federal Emergency Management Agency
- National Weather Service
- National Climate Data Center
- Utah Army Corps of Engineers
- Utah Geologic Survey
- Utah Division of Forestry, Fire and State Lands
- Utah Department of Agriculture
- Utah Avalanche Center
- Utah Automated Geographic Resource Center
- University of Utah

- University of Utah Seismic Station
- Utah State University
- Morgan Council of Government
- Associations of Governments
- Utah Association of Special Districts
- Utah Office of Education
- Morgan County and Morgan City
- Morgan County Emergency Manager, Terry Turner (Retired 2015)
- Morgan County Emergency Manager, Ian Nelson
- Morgan County Planning and Development Director, Bill Cobabe
- Morgan County Emergency Management Administrative Assistant, Shannon Barker
- Morgan County Public Works
- Morgan City Public Works
- Morgan County GIS Office
- Morgan County Assessor's Office
- Morgan County Local Emergency Planning Committee (LEPC)
- Morgan County Sheriff's Office
- Morgan County Fire Department
- Morgan County School District
- Morgan County Special Service Districts
- Morgan County elected officials
- Morgan County residents and other interested members of the public

I. Introduction

A. Historical Overview

Named in honor of Jedidiah Morgan Grant, Morgan County consists of 600, ten square miles (610) that are nestled within the Wasatch Mountains. The 10,173 (2013) inhabitants enjoy the almost mile high elevation which affords cool nights in the hot summer. The main entrance to Morgan County is through Weber Canyon which opens on both the east and northwest sides of the county. The Weber River flows from the east to the northwest through this canyon. Morgan provides thirteen tributary creeks that add to the flow of the river as it leads its way to the Great Salt Lake.

Two dams, East Canyon and Lost Creek, are situated within Morgan's boundaries. These provide both irrigation and culinary water for the lower counties. Summer recreation is also provided at the designated State Parks surrounding the East Canyon and Lost Creek Reservoirs.

Prior to 1855 wandering tribes of Indians inhabited Weber Valley, later named Morgan County. Long before permanent settlements were made fur traders and trappers visited this region. History records prior to 1826 three or four hundred trappers had a famous rendezvous on the Weber River, but in that year they split into various groups and left the valley. The valley belonged to Mexico until the conclusion of the war between the United States and Mexico. In 1848 Morgan was included in the land ceded to the United States in the treaty of Guadeloupe Hidalgo.

Thomas J. Thurston of Centerville, Davis County was the first man to recognize and evaluate the possibilities of settling Weber Valley.

In 1852 he and his two sons were cutting logs in the mountains east of Centerville. Upon reaching the summit they looked down upon the beautiful valley. The small, wooded valley had ample water and was a strong contrast with the hot, dry and almost barren Salt Lake Valley. Thurston felt that he must explore it, and finally persuaded two of his friends, William Porter and J. B. Nobel, to go with him. They camped in the valley for three days. It looked like paradise to them, with plenty of fish and game. The only great obstacle was the inaccessibility of the valley which was surrounded by mountains. There was only one narrow canyon entrance through which the Weber River flowed. The river had cut gorges at each end of the canyon forming natural barriers to the area.

Thomas Thurston would not give up his dream to settle the lush valley. He talked of it constantly with his friends. Finally, in 1855 he was successful in persuading Charles S. Peterson, two of his sons and a son-in-law, Roswell Stevens, to attempt making an entry route through lower Weber Canyon. With the most primitive tools consisting of shovels, picks, crowbars, and small plows they found the going exceedingly rough. Their small company of men was strengthened by the arrival of several others, including three men with teams sent by Jedediah Morgan Grant.

At last they were successful in completing a crude, though passable road into the valley.

Peterson and Stevens settled at Weber City (later to be named Peterson), while Thurston chose to settle further south at the future town site of Littleton. Other settlers, eager to make homes in this promising green valley soon followed these early residents. It wasn't long before fifteen new settlements were formed in what is now Morgan County.

In January 1862 the Ninth Utah Territorial Legislature which convened in Salt Lake City, passed an act creating the county of Morgan and located the county seat at Weber City (Peterson). For a brief two-year period before 1866-1868 Littleton, a settlement just south of Milton, was designated the county seat. Littleton was named in honor of one of its residents, Colonel Jesse C. Little. In 1868 the county seat was changed to Morgan City and before long plans were made to build a courthouse. Construction of the building started in 1874 and the public building was completed in 1883.

The early government of the county was conducted by a probate court until 1896 when the Territory of Utah was admitted into the Union as the State of Utah. The Constitution of the State of Utah, approved January 1, 1896, provided the general government of the county be a board of three county commissioners, one of who was to be chairman. This form of government has continued until 1999.

A major event to effect Morgan was in 1868-69 when the Union Pacific Railroad track was laid through the east-west length of the valley, following the Weber River. This event literally put Morgan on the map. Constructing the railroad through Weber Canyon helped establish a more navigable and safe road which eventually became a major route and "Gateway to the West."

Education has always played an important role in Morgan. In 1908 the ten school districts in the county consolidated into one school district with several precincts. In 1936 Morgan school district founded the first consolidated school system in the state and received national recognition.
At that time the local community schools were discontinued and all students were bused to the buildings located in Morgan City. In the same general three-block location there is an elementary, middle, and high school. There is also a elementary school in Mountain Green these four schools accommodate 2,809 students (2015).

From the early settlers to the present day, Morgan was considered an agricultural community, with much of the acreage used for farming. However, due to economics there are few who farm as a sole source of income; many have other jobs outside of the valley. As it becomes more difficult for a farmer to operate at a profit much of the land is being sold for residential development. Morgan is the home of several mink ranches and two major companies, Browning Arms and Holcim, Inc.

B. Physiographic Setting

Morgan County is the third smallest county in Utah, consisting of 610 square miles. Elevation ranges from 4,895 feet at Mountain Green to Thurston Peak at 9,706 feet. The primary entry into the county from the west is through Weber Canyon, which opens on both the east and northwest sides of the county. The landscape includes high mountains, steep valleys, the Weber River valley, and two smaller streams, East Canyon Creek and Lost Creek.

Morgan County includes one municipality Morgan City, the county seat, and ten unincorporated areas - Croydon, East Canyon Resort, Enterprise, Milton, Mountain Green, Peterson, Porterville/Richville, Round Valley, Snow Basin Resort and Stoddard. Land ownership in Morgan County is 90% private, 5% federal, 3% state and 2% underwater. Morgan County has the highest percentage of privately owned land in the state.

The Wasatch National Forest extends into the north side of the county. Summit County lies to the east and south. Davis, Weber and Salt Lake Counties are on the western border. Rich County borders on the northeast.

Morgan County's population was projected at 10,608 (2014 projection) which are concentrated primarily in the areas of Morgan City and Mountain Green. Because of Morgan County's close proximity to Salt Lake, Davis and Weber Counties, the population is increasing rapidly. The county is expected to continue growing along the Interstate 84 corridor, with the highest concentration of new development in the northern and western portions of the county. Development is occurring in areas that once were agricultural or farmland. Morgan County prides itself in its rural setting and this is recognized in county codes and ordinances for planned development.

Historically, agriculture, mainly livestock, crop and mink pelt production, has been the primary type of economic activity in Morgan County. Recently, manufacturing, trade, government and construction have begun to diversify the economy. The principle employer is Hill Air Force Base (Morgan County Emergency Operations Plan). Some larger employers include Morgan County School District, Holcim US, Inc., Browning, Ridley's Market, and Morgan County (UDWS 2007).

The 2013 labor force totaled 4,411 persons with 4,241 employed and 170 unemployed. The average monthly non-farm wage for 1,805 non-farm jobs was $2,998 (UDWS 2006).

Demographic Data

Morgan County		Morgan City
Population, 2014 estimate	10,608	
Population, 2013 estimate	10,198	9,303
Population, 2010 (April 1) estimates base	9,469	
Population, percent change - April 1, 2010 to July 1, 2014	12.0%	
Population, percent change - April 1, 2010 to July 1, 2013	7.7%	
Population, 2010	9,469	3,687
Persons under 5 years, percent, 2013	8.5%	
Persons under 18 years, percent, 2013	34.8%	
Persons 65 years and over, percent, 2013	11.4%	
Female persons, percent, 2013	49.3%	
White alone, percent, 2013 (a)	97.8%	

Black or African American alone, percent, 2013 (a)	0.3%	
American Indian and Alaska Native alone, percent, 2013 (a)	0.4%	
Asian alone, percent, 2013 (a)	0.5%	
Native Hawaiian and Other Pacific Islander alone, percent, 2013 (a)	0.1%	
Two or More Races, percent, 2013	0.9%	
Hispanic or Latino, percent, 2013 (b)	2.9%	
White alone, not Hispanic or Latino, percent, 2013	95.3%	
Living in same house 1 year & over, percent, 2009-2013	91.7%	
Foreign born persons, percent, 2009-2013	1.8%	
Language other than English spoken at home, pct age 5+, 2009-2013	3.3%	
High school graduate or higher, percent of persons age 25+, 2009-2013	97.6%	
Bachelor's degree or higher, percent of persons age 25+, 2009-2013	33.4%	
Veterans, 2009-2013	725	
Mean travel time to work (minutes), workers age 16+, 2009-2013	26.1	
Housing units, 2013	3,212	
Homeownership rate, 2009-2013	89.2%	
Housing units in multi-unit structures, percent, 2009-2013	2.8%	
Median value of owner-occupied housing units, 2009-2013	$264,400	
Households, 2009-2013	2,860	
Persons per household, 2009-2013	3.39	
Per capita money income in past 12 months (2013 dollars), 2009-2013	$26,274	
Median household income, 2009-2013	$80,337	
Persons below poverty level, percent, 2009-2013	4.0%	
Private Sector		
Private nonfarm establishments, 2013	235	
Private nonfarm employment, 2013	1,452	
Private nonfarm employment, percent change, 2012-2013	2.5%	
Non-employer establishments, 2012	897	
Total number of firms, 2007	1,191	
Black-owned firms, percent, 2007	F	
American Indian- and Alaska Native-owned firms, percent, 2007	F	
Asian-owned firms, percent, 2007	S	
Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007	F	
Hispanic-owned firms, percent, 2007	S	
Women-owned firms, percent, 2007	S	

Manufacturers shipments, 2007 ($1000)	0[1]	
Merchant wholesaler sales, 2007 ($1000)	D	
Retail sales, 2007 ($1000)	42,681	
Retail sales per capita, 2007	$5,058	
Accommodation and food services sales, 2007 ($1000)	5,686	
Building permits, 2013	96	
Geography		
Land area in square miles, 2010	609.20	
Persons per square mile, 2010	15.5	
Metropolitan Statistical Area	Ogden-Clearfield, UT Metro Area	

C. Hazard History

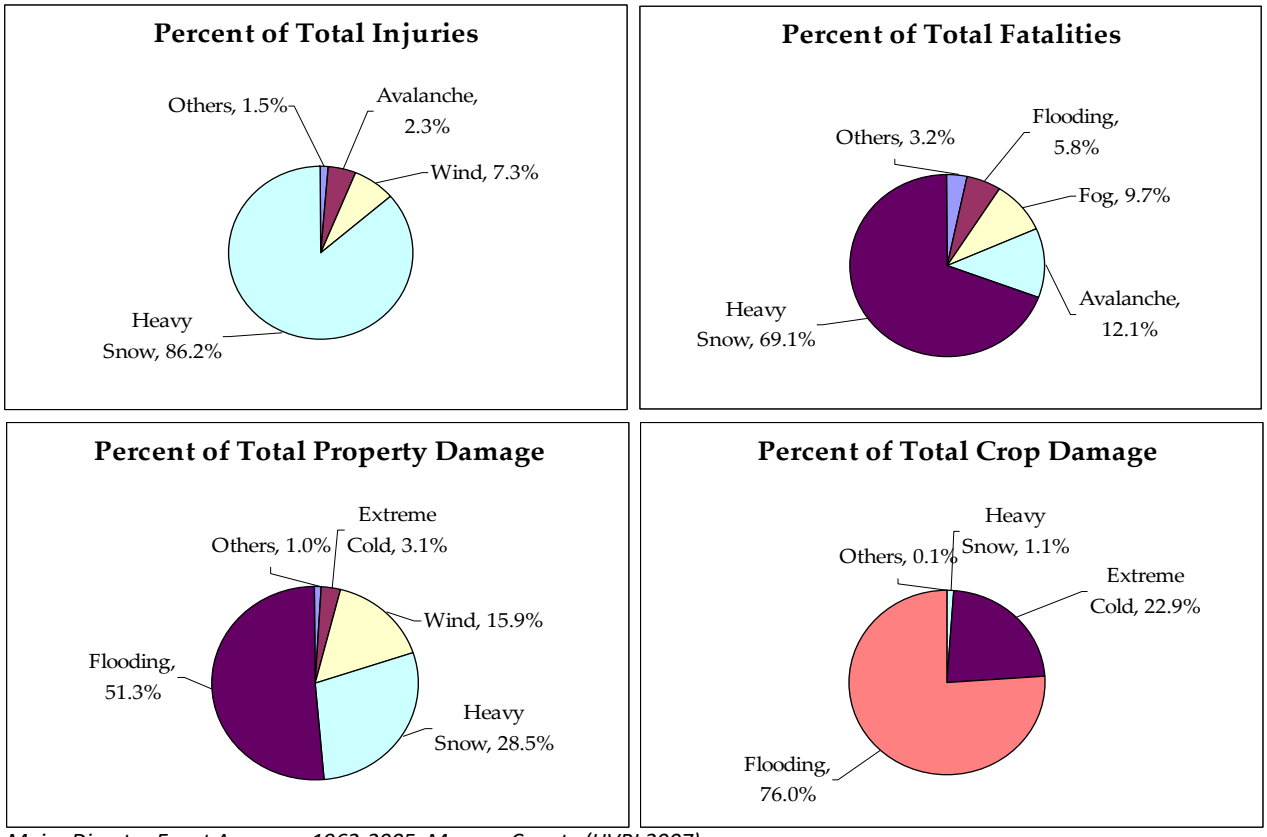
Within the mitigation planning process, it is important to remember that the past is the key to the future. Identifying past hazard events provide a starting point for predicting where future events could potentially occur. The following historical hazard event statistics were consolidated from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) of the Hazards and Vulnerability Research Institute. The database records reported natural hazard events for Morgan County which caused greater than $50,000 in damages.

D. Risk Assessment

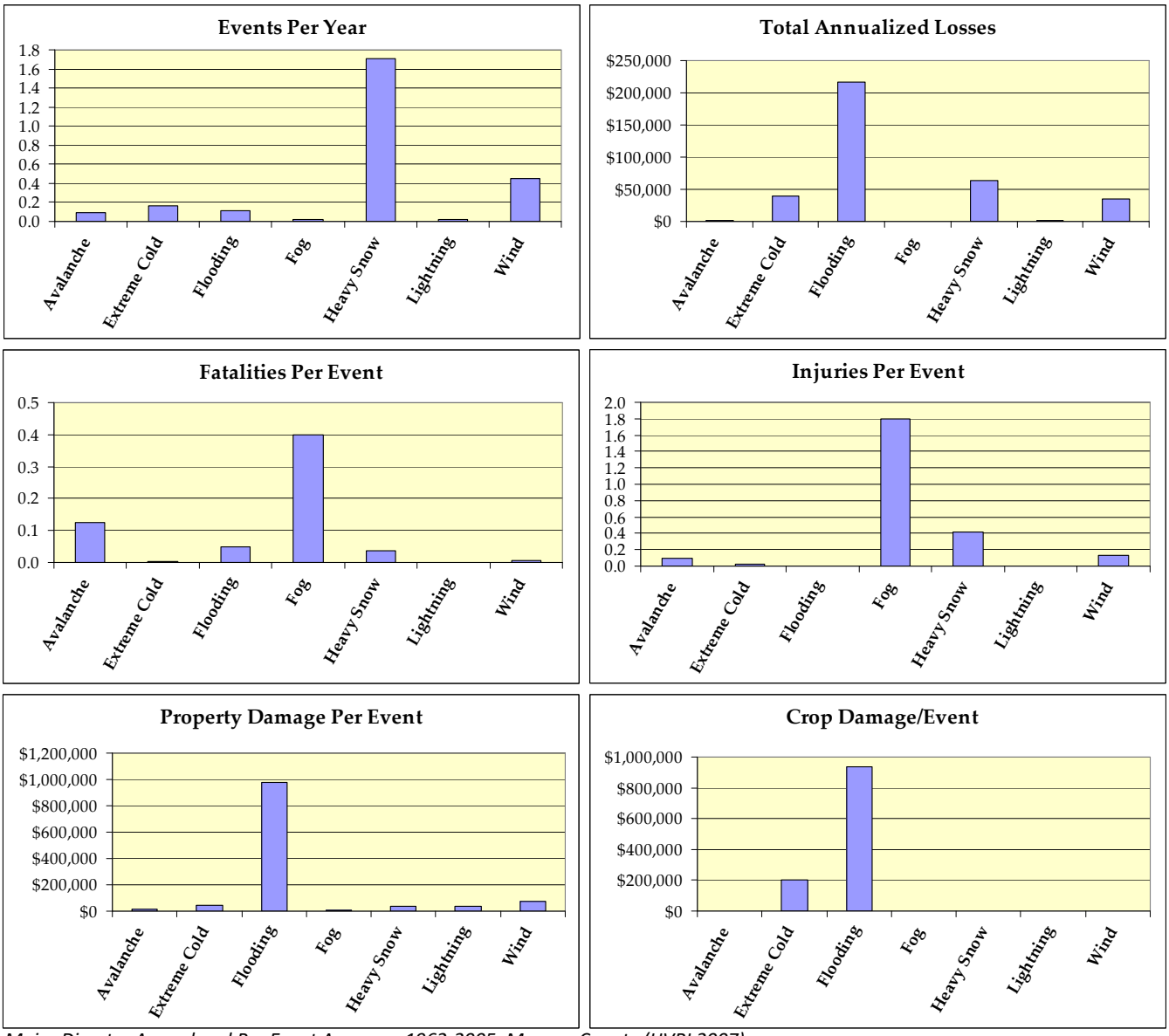
The risk assessment process revealed the following for the identified hazards of earthquake, flood, dam failure, wildland fire, slope failure, infestation, severe weather and drought. Risk assessment maps were completed for each hazard and are included in each section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 7 critical facilities in Morgan County. The table below outlines the total number of critical facilities within the county with moderate or greater levels of risk.

Number of Structures with Moderate or Greater Vulnerability (% of Total)								
Critical Facilities	**Total**	**Dam Failure**	**Flood**	**Earthquake**	**Liquefaction**	**Problem Soils**	**Slope Failure**	**Wildfire**
Amateur Radio Repeaters	4	0 (0%)	0 (0%)	4 (100%)	0 (0%)	0 (0%)	0 (0%)	4 (100%)
Emergency Operations Centers	1	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Fire Stations	2	1 (50%)	1 (50%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Police Stations	1	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Schools	4	3	3	4	0	0	0	0

Critical Facilities Vulnerability Matrix for Local Hazards, Morgan



Major Disaster Event Averages 1962-2005, Morgan County (HVRI 2007)



Major Disaster Annual and Per Event Averages 1962-2005, Morgan County (HVRI 2007)

II. Natural Hazards Pre-Disaster Mitigation Planning

A. Introduction

Utah is vulnerable to natural and technological (human-caused) hazards that threaten the health, welfare and security of its citizens. The cost of response to and recovery from potential disasters can be substantially reduced when mitigating these impacts before they occur or re-occur.

Hazard mitigation is defined as any cost-effective action that has the effect of reducing, limiting, or preventing vulnerability of people, property, and/or the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation actions, which can be used to eliminate or minimize the risk to life and property, fall into three categories:

First, those that keep the hazard away from people, property and structures; second, those that keep people, property and structures away from the hazard; and third, those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation Plan has strategies that fall into all three categories.

Hazard mitigation actions must be practical, cost effective, environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be costlier than the anticipated damages.

Capital investment decisions must be considered in conjunction with natural hazard vulnerability. Capital investments can include homes, roads, public utilities, pipelines, power plants, chemical plants, warehouses and public works facilities. These decisions can influence the degree of hazard vulnerability of a community.

Once a capital facility is in place, few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which could restrict development in high vulnerability areas, and building codes, which could ensure that new buildings are built to withstand the damaging forces of hazards, can be a very useful mitigation tool that a city can implement.

When local governments place a low priority on mitigation implementation activities relative to the actual threat, some important mitigation measures may be neglected in favor of higher priority activities. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to greatly reducing long-term risk to people and property from natural hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources and the need to mitigate each jurisdictional hazard.

B. Purpose

The purposes of this Plan are (1) identify threats to the community, (2) create mitigation strategies to address those threats, (3) develop long-term mitigation planning goals and objectives, and (4) to fulfill federal, state and local hazard mitigation planning obligations. Mitigation actions in particular would serve to minimize conditions that have an undesirable impact on the economy, environment and the well-being of Morgan County. This Plan is intended to enhance the awareness and to provide mitigation strategies for elected officials, agencies and the public of these hazards and their associated threat to life and property. The Plan also details what actions can be taken to help prevent or reduce hazard vulnerability to each jurisdiction.

C. Scope

The Morgan County Natural Hazards Pre-Disaster Mitigation (PDM) Plan was developed in accordance with the requirements of the FEMA Section 322 regulations, the Utah Division of Emergency Management (DEM) and local planning agencies.

The goal of this Plan is to assist Morgan County in reducing the costs of natural disasters by providing comprehensive hazards identification, risk assessment, vulnerability analysis, mitigation strategy an implementation schedule. Regulations set forth by FEMA were followed during the development of this Plan. There are only 2 participating jurisdictions, Morgan County and Morgan City. Future monitoring, evaluating, updating and implementation will occur annually or following any natural disaster. A major revision will occur every five years. Annual or any interim Plan review, updates and revisions will be the responsibility of Morgan County.

D. Authority

Federal

Public Law (PL) 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs, places emphasis on hazard mitigation planning directed toward hazards with high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 (DMA 2000) into law on October 30, 2000. Section 322 defines mitigation planning requirements for state, local and tribal governments.

Under Section 322, states are eligible for an increase in the federal share of hazard mitigation, if they submit a mitigation plan (which is a summary of local and/or regional mitigation plans) that identifies natural hazards, risks, vulnerabilities and actions to mitigate risks.

State

Some examples of legislation enhancing the ability of government and persons to mitigate, respond and recover from natural disasters include the Governor's Emergency Operation Directive, The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title 44, CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code 53-2, 63-5, Disaster Response Recovery Act, 63-5A, Executive Order of the Governor 11, and the Emergency Interim Succession Act, 63-5B.

Local

Local governments play an essential role in implementing effective mitigation. For the purposes of this Plan, local governments include not only cities and counties, but also special service districts with elected boards.

Each local government will review all present or potential damages, losses and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In Morgan County, the local executives responsible for carrying out plans and policies are the County Council and Morgan City Mayor and Council. Local governments must be prepared to participate in the post-disaster hazard mitigation team process and pre-mitigation planning as outlined in this document in order to effectively protect their citizens. All relative jurisdictions in Morgan County participated in the development of this plan.

E. Goals and Objectives

The goals and objectives of the PDM Plan include coordinating with local governments to develop a regional planning process that meets each planning component identified in the FEMA Region VIII Crosswalk document, Utah Division of Emergency Management (DEM) planning expectation and local input. Another goal is to meet the need of reducing risk from natural and technological hazards in Utah through the implementation of and updating of regional plans.

Short Term Local Goals

The following general goals were used in the development of the PDM Plan. They are shown from highest to lowest priority.

- Life safety
- Eliminate and/or reduce property damage
- Protect emergency response capabilities (critical infrastructure)
- Protect/create communication and warning systems

- Protect emergency medical services and medical facilities
- Ensure mobile resource survivability
- Protect critical facilities
- Ensure government continuity
- Protect developed property, homes, businesses, industry, education opportunities and the cultural fabric of a community
- Combine hazard loss reduction efforts with the environmental, social and economic needs of the community
- Protect natural resources and the environment
- Promote public awareness through education of community hazards and mitigation measures
- Preserve and/or restore natural features

Long Term Local Goals

- Eliminate or reduce long-term risk to human life and property
- Aid private and public sectors in understanding the risks they may be exposed to and identify mitigation strategies to reduce those risks
- Avoid risk of exposure to natural and technological hazards
- Minimize the impacts of risks that cannot be avoided
- Mitigate the impacts of damage as a result of identified hazards
- Accomplish mitigation strategies in such a way that negative environmental impacts are minimized
- Provide a basis for prioritizing and funding mitigation projects
- Establish a regional platform to enable the community to take advantage of shared goals and resources

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation strategies can be evaluated. These objectives become especially important when two or more projects are competing for limited resources.

- Identify persons, agencies or organizations responsible for implementation
- Project a time frame for implementation
- Explain how the project will be financed including the conditions for financing and implementation (as information is available)
- Identify alternative measures, should financing not be available
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place
- Projects should significantly reduce potential damages to public and/or private property and/or reduce the cost of state and federal recovery for future disasters

- Projects should be practical, cost-effective and environmentally sound after consideration of the options
- Projects should address a repetitive problem, or one that has the potential to have a major impact on an area or population
- Projects should meet applicable permit requirements
- Discourage development in hazard areas
- Projects should contribute to short and long term solutions
- Project benefits should outweigh the costs
- Projects should have manageable maintenance and modification costs
- Projects should accomplish multiple objectives when possible
- Projects should be implemented using existing resources, agencies and programs when possible

III. Adoption Process and Documentation

This is a County Plan. In order to meet the requirements of Section 322 of the local hazard planning regulations, the final Plan must be adopted by Morgan City and County. This section documents the adoption process of each local government in order to demonstrate compliance with this requirement. The Plan will be adopted following FEMA Region VIII approval. These jurisdictions are seeking plan approval. A copy of the completed 2016 PDM revision will be placed on the Morgan County website for public review and comment. A hard copy of the plan will also be available at the Morgan County Emergency Management office.

Morgan County participates with the State Homeland Security Region 1 (northern region). The region meets on a regular basis and Morgan County actively participates at the regional meetings. On several occasions the Morgan County Emergency Management Director has discussed the PDM update with Emergency Managers in Davis, Weber, Rich, Summit, and Salt Lake Counties. Morgan County will continue to coordinate activities with these neighboring jurisdictions.

A sample of the adoption resolution is given at the end of this section. Each of these jurisdictions also participated in and adopted the previous PDM Plan in 2010.

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Morgan County	Yes	
Morgan City	Yes	

Participating Communities, Morgan County

Sample Resolution

RESOLUTION NO._____

A RESOLUTION ADOPTING THE NATURAL HAZARD PRE-DISASTER MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

(Name of Jurisdiction) Morgan City_____

(Governing Body) City Council_____

(Address) 100 Main Street, Johnson City, UT 84001_____

WHEREAS, President William J. Clinton signed H.R. 707, the Disaster Mitigation and Cost Reduction Act of 2000, into law on October 30, 2000; and,

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds; and,

WHEREAS, the *Natural Hazard Pre-Disaster Mitigation Plan* has been prepared in accordance with FEMA requirements at 44 C.F.R. 201.6; and,

WHEREAS, Morgan City participated in the update of the multi-jurisdictional Plan, the *Natural Hazard Pre-Disaster Mitigation Plan*; and,

WHEREAS, Morgan City is a local unit of government that has afforded its citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and,

WHEREAS, Morgan City is concerned about mitigating potential losses and has determined that it would be in the best interest of the community to adopt the *Natural Hazard Pre-Disaster Mitigation Plan*;

NOW THEREFORE, BE IT RESOLVED by Morgan City Council that Morgan City adopts the *Natural Hazard Pre-Disaster Mitigation Plan* as this jurisdiction's Multi-Hazard Mitigation Plan.

ADOPTED this XX day of XX, 2008 at the meeting of the Morgan City Council.

Signed: Chief Elected Official _____

City Council _____

IV. Planning Process

This updated Plan was prepared by Morgan County Emergency Management Staff; Carrie Lane, Terry Turner, Ian Nelson, Shannon Barker, supported by the local working group members, and other state and local personnel. DeeEll Fifield Consulting was contracted to update and develop the Plan. County and City agencies that have aided in the plan development process include; County Geographic Information Systems (GIS), elected and departmental officials, Fire Department, Sheriff's Office, Planning and Development Services, and public works departments. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and supporting guidance documents developed by FEMA and the Utah Division of Emergency Management (DEM).

The planning process included the following steps:

Step 1: Organize Resources

Utah DEM contracted with Morgan County to update the 2009 Pre-Disaster Mitigation Plan under the planning guidelines included in the DMA 2000. In the fall of 2014, Morgan County sub-contracted with DeeEll Fifield Consulting to assist in completion of the Plan.

The Morgan County Emergency Manager and Administrative Assistant, and the Planning and Development Services Director comprised the planning team and working group for this project. DeeEll Fifield Consulting provided technical assistance during the final phase of the process. In addition to the planning team, technical assistance was provided by Morgan County staff. All county jurisdictions were invited to provide a representative to serve on the working group. Some jurisdictions were not able to provide a representative; however, relevant input was solicited and obtained from every jurisdiction in the County.

Name	Organization
Terry Turner	Morgan County Emergency Manager
Carrie Lane	Morgan County Emergency Management Administrative Assistant
Ian Nelson	Morgan County Emergency Manager
Shannon Barker	Morgan County Fire Department Office Administrative Assistant
DeeEll Fifield	DeeEll Fifield Consulting

Core Planning Team/Working Group

Name	Organization
Eric Martineau	Utah Division of Emergency Management, PDM Program Manager

Technical Advisor

Step 2: Planning Process Timeline

To ensure the public and county officials were supportive of the planning process, a series of public meetings were conducted throughout the planning period. Additionally, the Morgan County Emergency Manager attended and briefed the County Council on the progress at several council meetings.

The chart below summarizes PDM meetings associated with the planning process.

Year	Date	Meeting Attendees	Activity	Purpose
2012	**October 1**		Scope of Work designates Morgan County as sub-grantees of the state to revise the 2009 Wasatch Front PDM Plan.	Continued the relationship with local council members and municipalities.
	October - December		Gather information.	Data collection.
	November 6	Carrie Lane, EM Admin Assistant Terry Turner, EM Director Kevin Edwards, Deputy Sheriff Charles Ewert, Planning Director Kent Smith, Bldg. Inspection Tina Kelley, County Council Robert Kilmer, County Council Jim Egbert, Morgan City Mayor	Kick-off meeting with city and county officials.	Identified planning team and available resources.
	November 27	Carrie Lane, EM Admin Assistant Terry Turner, EM Director Kevin Edwards, Deputy Sheriff Charles Ewert, Planning Director Kent Smith, Bldg. Inspection Tina Kelley, County Council Robert Kilmer, County Council Jim Egbert, Morgan City Mayor Mike Waite, County PW Supervisor Ray Little, Morgan City Council	Working group and planning team meeting.	Identified levels of involvement. Review and revision of Morgan County risk assessment.
2013	**January 29**	Carrie Lane, EM Admin Assistant Terry Turner, EM Director Charles Ewert, Planning Director Kent Smith, Bldg. Inspection Logan Wilde, County Council Mark Schmid, Morgan City PW	Planning group meeting.	Review and revise hazard information.
	March 13	Carrie Lane, EM Admin Assistant Dave Manning, County GIS Boyd Carrigan - County Fire Marshall Mark Schmid, Morgan City PW Logan Wilde, County Council Terry Turner, EM Director Kent Smith, Bldg. Inspection Charles Ewert, Planning Director	Planning group meeting.	Update hazard information, consider risk assessment.
	September 10	Carrie Lane, EM Admin Assistant Dave Manning, County GIS Charles Ewert, Planning Director Kent Smith, Bldg. Inspection	Planning group phone meeting.	Progress report teleconference.
2014	**August**		Meeting with DEM PDM program officials.	Discuss the need for a consultant to finish the plan.
	September 15	Carrie Lane, EM Admin Assistant Terry Turner, EM Director DeeEll Fifield, Consultant	PDM Project planning meeting.	Discuss availability to work on the PDM Plan and request that a contract be prepared.
	October 7	Carrie Lane, EM Admin Assistant Terry Turner, EM Director Morgan County Council	Meeting with County Council.	Request signatures on the Fifield Consulting contract.

Year	Date	Meeting Attendees	Activity	Purpose
	December 17	Terry Turner, Morgan Co. EM Director Ellis Bruch, Davis Co. EM Director DeeEll Fifield, Consultant Eric Martineau, State PDM Manager Brad Bartholomew, State Hazard Mitigation Officer Joan ???, FEMA Margaret ???, FEMA	Meeting at State DEM with state and FEMA PDM managers, and DeeEll Fifield Consulting	Review and discuss PDM program requirements and outline project milestones
2015	**January 6**	Eric Martineau, State PDM Manager DeeEll Fifield, Consultant	Meeting with the State PDM program manager and DeeEll Fifield Consulting.	Update and review new FEMA PDM guidance.
	March 30	DeeEll Fifield, Consultant Bill Cobabe, County PDM Manager	PDM program coordination meeting	Carrie Lane, the former County PDM Manager moved out of state and Bill Cobabe was appointed to fill her position as the PDM Program Manager. This was an initial introduction and program overview meeting.
	May 18	Eric Martineau, State PDM Manager DeeEll Fifield, Consultant Bill Cobabe, County PDM Manager Terry Turner, EM Director	State/County PDM program introduction and update	Meeting with County PDM Planner, Emergency Manager, Consultant, State PDM program Manager. Milestones and deadlines were discussed, and the consensus was that the county should request a plan completion extension.
	May 26	LEPC Members	Meeting with the County Local Emergency Planning Committee (LEPC).	Discuss and review ongoing mitigation strategies and solicit public input.
	July 21	DeeEll Fifield, Consultant Terry Turner, EM Director	Plan coordination meeting.	Discuss and review ongoing mitigation strategies.
	August 25	LEPC Members (Pre-meeting strategy session with Terry Turner	Meeting with the County Local Emergency Planning Committee (LEPC).	Discuss and review ongoing mitigation strategies and solicit public input.
	October 5	DeeEll Fifield, Consultant Eric Martineau, State PDM Manager	Meeting with the State PDM program manager and DeeEll Fifield Consulting.	Update and review new FEMA PDM guidance.
	November 24	DeeEll Fifield, Consultant Dion Dostaler, Amateur Radio Association Grant Laughter, Amateur Radio Association George Archibeque, Morgan County Sheriff's Office Kevin Christensen, Bear River Health Department Kimberly Giles, State DHS Steve Duffield, Mountain Green Fire	Meeting with the County Local Emergency Planning Committee (LEPC).	Discuss and review ongoing mitigation strategies and solicit public input.
	December 10	DeeEll Fifield, Consultant Terry Turner, EM Director	Plan coordination meeting.	Discuss and review ongoing mitigation strategies.
2016	**January 12**	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Shannon Barker, Admin Terry Turner Boyd Carrigan, Morgan County Fire Warden	Plan coordination meeting.	Discuss and review ongoing mitigation strategies.

Year	Date	Meeting Attendees	Activity	Purpose
	February 23	DeeEll Fifield, Consultant Boyd Carrigan, Morgan County Fire Colt Farley, Pioneer Pipeline Dion Dostaler, Amateur Radio Grant Laughter, Amateur Radio Association George Archibeque, Morgan Houston Smith, Plains Pipeline Kimberly Giles, State DHS	Meeting with the County Local Emergency Planning Committee (LEPC).	Discuss and review ongoing mitigation strategies and solicit public input.
	March 29	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Dave Rich, Fire Chief Bill Cobabe, Community Development Director Kent Smith, Building Official	Meeting with Technical Advisory Committee.	Discuss and review ongoing mitigation strategies and solicit public input.
	June 2	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Shannon Barker, Admin Boyd Carrigan, Morgan County Fire Warden Colt Farley, Pioneer Pipeline Houston Smith, Plains Pipeline Mark Crane, Envirocare Ryan Perkins, Ogden City Emergency Management Neil Taylor, Utah DEQ Bill Craig, Utah DEQ Blaine Breshears, Morgan County Sheriff Kevin Edwards, Morgan County Chief Deputy Sheriff	LEPC Meeting	Discuss and review ongoing mitigation strategies and solicit public input.
	June 2	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Shannon Barker, Admin Boyd Carrigan, Morgan County Fire Warden Mike Waite, Morgan County Facilities Director Mark Schmid, Morgan City Public Works Director	Technical Advisory Committee Meeting	Discuss Public Works activities in the City and the County for the past 6 years, and planned mitigation activities going forward to 2022
	June 27	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Shannon Barker, Admin	Work Meeting	Met with the consultant to prepare and submit to the State an extension request for the PDM plan.
	July 26	DeeEll Fifield, Consultant Ian Nelson, Public Safety Director Shannon Barker, Admin	Work Meeting	Met with the consultant to review latest current draft of the plan and discuss technical issues and revisions.

Planning Process Timeline

Step 3: Establish Continuity in the Planning Process

To meet the requirements set forth by DMA 2000, Morgan County was contracted by DEM to update the PDM plan.

Step 4: Data Review and Acquisition

The 2009 WFRC PDM Plan was reviewed by Morgan County and it was determined that all Plan sections would need to be updated and revised. Contact was made with the GIS technician and/or planning commission staff in the county to assess available data at the local level. Mapping data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs and land development data.

Step 5: County Hazard Identification and Profile

These steps were conducted by gathering data on the hazards that threaten the county. This information was gathered from local, state and federal agencies, organizations, newspapers and other local media accounts, state and local weather records, conversations with the public and local officials, surveys, interviews and meetings with key informants within Morgan County. County-level mitigation planning meetings were held during this process and are explained in further detail in a previous section. During these meetings, attendees had the opportunity to review hazard information and provide comment. These meetings also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation and natural resources of the county.

Step 6: County Vulnerability Assessment

This step was conducted through a review of local base maps, topographical maps, floodplain maps, United States Geological Survey (USGS) and Utah Geological Survey (UGS) maps, Automated Geographic Reference Center (AGRC) maps, FEMA hazard maps and climate maps from the National Climatic Data Center (NCDC). A detailed vulnerability assessment was completed with the use of GIS software for the county. The FEMA modeling program Hazards United States – Multi-Hazards (HAZUS-MH) was used to determine vulnerability to earthquakes and floods. Loss estimation methodology was developed by the planners, with technical assistance, to determine vulnerability from each identified hazard. Transportation Analysis Zone (TAZ) and Census 2010 data were used to estimate the number of residents and households that could be affected by the hazard. Utah State sales tax and Equifax Business data were used to find the total number of businesses and annual sales vulnerable to hazards. HAZUS-MH infrastructure data was used to analyze the amount of infrastructure vulnerable to hazards.

Step 7: Review Existing Local Mitigation Actions

This step was conducted through a review of the governing documents of the county, as well as, conversations, interviews and meetings with interested community leaders and members. This step identified what goals are already established and adopted for the county.

Step 8: Form a Local Working Group

Morgan County organized a working group. This working group was comprised of individuals with an interest in hazards mitigation, as well as, technical experts from the government sector having mitigation expertise. The committee included the county and city planners, engineers, county GIS staff, floodplain managers, sheriff and fire staff, and the county emergency manager. Each completed section of the updated Plan was reviewed and analyzed for accuracy by the working group, county emergency manger and DEM staff. Every section of the Plan was updated and revised as part of the planning process.

Step 9: Risk Assessment Review

The working group was tasked with reviewing the county risk assessment for accuracy and completeness and with developing mitigation strategies for all natural hazards threatening the county. Changes or additions were conveyed to the Planning Team for revision.

Step 10: Mitigation Strategy Development

Developing the mitigation strategies was a process in which all of the previous steps were taken into account. The county evaluated, identified and profiled the hazards, and vulnerability assessment. Each Mitigation Strategy developed underwent a cost/benefit analysis to determine the best action to take given limited budgets allocated to hazard mitigation efforts at the local level.

Step 11: Prioritization of Identified Mitigation Strategies

DMA 2000 requires state, tribal, and local governments to show how mitigation actions were evaluated and prioritized. The prioritization process was completed by the county planning team and the technical team over a series of planning meetings. Prioritization was accomplished using the STAPLEE method as explained in the FEMA How to Guide, Document 386-3. This process resulted in each Mitigation Strategy given a High, Medium or Low priority by the local planning teams.

Step 12: State Review

DEM staff will conduct a formal PDM Plan review to insure local plans met the requirements of DMA 2000 following submission of the PDM Plan by the County. Informal PDM reviews will be conducted throughout the PDM planning process.

Step 13: Adoption

The Plan went through a public adoption process between September and October 2016, and was adopted by Morgan City and Morgan County. Date??? (To be added)

Year	Date	Activity	Purpose
2016	August 18	Final rough draft submitted to Morgan County /DEM for initial review	Required State review

A. Public Involvement

Public involvement opportunities were available and incorporated throughout the development of this Plan. Such opportunities included a public website and public meetings for comment review. The quarterly Morgan County Local Emergency Planning Committee (LEPC) was utilized as the venue for public input during the planning process. LEPC attendees typically included; Emergency Manager and representatives from the Fire Department, Sheriff's Office, State and local agencies, business leaders, educators, private and non-profit organizations, and other interested public.

B. Information Sources

Background information and data for this Plan was obtained from the sources listed below. From these sources, the County PDM planner and the consultant extracted relevant information and data.
That information and data was subsequently submitted to the County Work Group for their consideration and approval for inclusion into the Plan.

- Federal Emergency Management Agency (How-to Guides)
- National Weather Service (hazard profile)
- National Climate Data Center (drought, severe weather)
- Utah Division of Emergency Services and Emergency Management
- Utah Geologic Survey (GIS data, geologic information)
- Utah Division of Forestry Fire and State Lands (fire data)

- Utah Avalanche Center, Snow and Avalanches, Annual Report 2006-2007 Forest Service
- Utah Department of Transportation (traffic data)
- Utah Automated Geographic Resource Center (GIS data)
- University of Utah Seismic Station (earthquake data)
- Utah State University (climate data)
- Utah Association of Special Districts
- State Office of Education
- Morgan County and Morgan City (Emergency Operations Plans, histories, mitigation actions, public input, data: GIS, transportation, property and infrastructure)
- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah
- State of Utah Community Wildfire Plan 2008
- State of Utah, Water Plan, Drought In Utah: Learning From the Past—Preparing For the Future 2008

V. 2009 Mitigation Goals and Objectives Review

The 2009 Wasatch Front Pre-Disaster Mitigation Plan required each county to develop a prioritized set of mitigation goals, objectives, and actions for each identified hazard. Below is a review of each of the goals and actions and a status update.

Mitigation Strategies

The following mitigation strategies were formulated in a series of meetings of the Morgan County Mitigation Strategies Working Group beginning late 2012 through 2016, at Morgan County Emergency Services. The Working Group sought to refine and expand on efforts already in place. Information on Working Group members can be found in Part IV.

A. Dam Failure

Problem Identification: Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.

Goal: Reduce loss of life and limit damage to property.

Objective (Priority MEDIUM): Increase community awareness of dams that could impact the County.

Action #1: Educate community of evacuation routes.

Status: Ongoing - The County Emergency Manager and local officials have encouraged the Bureau of Reclamation (BOR) to increase water storage capacity at all of the impoundments upstream from Morgan County/City. That proposal is difficult due to the very high costs of raising the height of these dams. However, beginning in 2012, a seismic overhaul of an aging dam is the largest federal project of its kind ever in Utah, representing a four-year, $50 million effort. When completed in late 2014, the earthquake safety modifications on Echo Dam met or exceed federal standards, and the U.S. Bureau of Reclamation will be able to say one less dam in the state is at risk of catastrophic failure. Echo was built in the late 1920s and early 1930s as a single-purpose irrigation project. Crews removed approximately 665,000 cubic yards of dirt down to bedrock at the downstream slope of the dam, using heavy equipment to gouge out a massive hole. A safety analysis of the 85-year-old dam found that dirt at its foundation and underneath the spillway controls could liquefy in an earthquake. Loosely deposited soils could liquefy, losing strength. As a result, the top of the dam may drop, leading to a catastrophic failure. A seismic analysis shows a fault plane between Henefer and East Canyon Dam to the west that is capable of a 6.5-magnitude earthquake. A collapse of the dam would have imperiled all the communities downstream — Henefer, Morgan, Peterson, Stoddard, Uintah and South Weber. Flood waters would reach the flatlands of Plain City — more than 50 miles away in Weber County.

An estimated 1.2 million cubic yards of that new fill material was used. Contractors constructed an earthen stability berm designed to buttress the dam. Another upstream berm was also constructed and compacted to further minimize the risk of any catastrophic failure. The BOR has developed comprehensive dam safety plans for all of these impoundments and conducts annual dam failure exercises with all the downstream jurisdictions. Morgan County participated in a BOR table top exercise, March 2016.

Action #2: Tie dam failure notification system to emergency notification system.

Status: Completed - The emergency notification system (Code RED) became operational in 2015 and the County completed training for city and county officials and first responders.

B. Drought

Problem Identification: The residents of Morgan County are unaware of the water conservation options that are available to them.

Goal: Decrease the impact of drought on the community.

Objective (Priority LOW): Develop and promote water conservation measures.

Action #1: Promote water conservation utilizing the Drought Contingency Plan.

Status: Ongoing - Morgan County is in the process of developing a Drought Contingency Plan. The County Conservation District is in charge of this process. It is unknown how soon the plan will be completed.

Action #2: Promote the use of the secondary water system.

Status: Ongoing - The Morgan Secondary Water Association promotes secondary water use in the city, and new subdivisions are required to connect to the system. Secondary water is delivered as a separate water system for outside irrigation, separate from the culinary water system. Morgan City has a separate board.

C. Earthquake

Problem Identification: Critical facilities (public safety, commercial buildings, and schools) need to be made less vulnerable from the impact of earthquakes to allow a timelier response and to decrease the impact to lives.

Goal: Reduce loss of life and damage to property.

Objective (Priority HIGH): Decrease the negative effect of earthquakes within the County.

Action #1: Begin an earthquake awareness campaign to include awareness of availability of earthquake insurance.

Status: Ongoing - The County Emergency Management Director has been promoting earthquake safety at a variety of public meetings and every year at the county fair. The Mountain Green Stake conducted a preparedness fair in September, 2015 and earthquake preparedness information was disseminated.

Action #2: Facilitate a pre-earthquake damage assessment to evaluate critical facilities in need of retrofitting and the design criteria for the new county building.

Status: Not Accomplished - The County is planning to schedule an ATC-20 course with the state to better educate the county engineer and building inspector on earthquake design criteria.

Action #3: Work with the County businesses to ensure proper earthquake preparedness training.

Status: Ongoing - County Emergency Management Director has planned on doing this. The Emergency Manager conducted two CERT classes were conducted in Mountain Green in 2015.

D. Flooding

Problem Identification: Morgan County has two major streams (East Canyon, Weber) and several smaller ones that threaten communities during spring runoff.

Goal #1 : Lessen impacts from flooding.

Objective #1 (Priority HIGH): To reduce flood threat to Morgan County.

Action #1: Maintenance of channels and bridge openings.

Status: Accomplished - Every year, county public works clears debris from stream channels, canals and ditches to alleviate potential flood problems. In 2014 FEMA conducted a revision of the watershed for Cottonwood Creek from confluence with Weber River to Cottonwood Canyon Road Crossing East Canyon Creek from confluence with Weber River to confluence with Hardscrabble Creek Weber River from Stoddard Diversion Dam upstream to I-84 crossing. This study will update Flood Insurance Rate Maps (FIRMs), and Flood Insurance Study (FIS) in Morgan County. The Cottonwood Creek Study has a reach length of 4 miles, East Canyon Creek is 8 miles, and the Weber River is 9 miles.

Action #2: Work with storm drain facilities, water conservation districts, state legislators and other state agencies to increase flood storage area.

Status: Not Accomplished - This action is not a likely possibility given the current status of water storage. These dams are owned and managed by the Bureau of Reclamation.

Action #3: Advise residents and develop outreach materials on the availability of flood insurance.

Status: Ongoing - The County Emergency Manager refers requests for flood insurance information to the State DEM and to the FEMA website.

Action #4: Enact land use ordinances to preserve floodplain/open space due to increasing development pressure in floodplain areas. Pursue open space preservation in planning practice and floodplain development regulation.

Status: Ongoing - The County has land use ordinances regarding flood plain development. There is currently a development proposal in the Peterson area mapped for flood zone mitigation.

Action #5: Form storm water improvement district for storm water disposal.

Status: Not Accomplished - Morgan City has storm water drains but has not yet put in place a storm water improvement district or plan.

Goal #2: Reduce threat of unstable canals throughout the County.

Objective #2 (Priority HIGH): Identify countywide canal systems.

Action: Map and assess the structural integrity of canal systems in the County. Determine the vulnerability of persons and infrastructure.

Status: Ongoing - There are more than 50 irrigation companies in Morgan County, all primarily sourcing their water from the Weber River, groundwater, or springs. All are privately managed and owned by the shareholders. The water is primarily used for agricultural purposes. The structural integrity of these systems is unclear and varies. The state requires these systems to be maintained and updated (Check with Weber Basin for specific information).

E. Severe Weather

Problem Identification: Snowstorms, hail, thunderstorms, lighting, heavy rain, wind and avalanche impact Morgan County. This is intensified by Morgan County's remote location.

Goal #1: Assist in protecting residents from the effects of severe weather.

Objective #1 (Priority MEDIUM): Lessen the impact of severe storms to residents and businesses within Morgan County.

Action #1: Increase residents' awareness of the need for food storage for use during severe storms.

Status: Ongoing – The County continually provides preparedness information to residents including food storage. Preparedness information is heavily promoted every year at the county fair.

Action #2: Increase residents' awareness of where emergency shelters are located.

Status: Ongoing – Approximately 250 cots and 500 blankets are stored at the fire station for use in time of emergency. The American Red Cross has deployed a 40-ft trailer at the Fire Department stocked with emergency shelter supplies that would be used in shelters for any large emergency in the County. The Red Cross has identified shelter locations throughout the county, utilizing LDS church facilities. Emergency Manager provides information to residents at preparedness events.

Action #3: Establish the county in the National Weather Service Storm Ready program.

Status: Ongoing – The County Emergency Manager continues to work toward getting the county Storm Ready certification.

Action #4: Encourage avalanche preparedness for county backcountry users.

Status: Ongoing – The County has a Public Safety radio station, AM 530, that continually broadcasts weather service watches and warnings including avalanche warnings in the winter months.

F. Slope Failure

Problem Identification: Morgan County has a significant landslide threat. The community of Mountain Green and Trappers Loop Road (Highway 167) as well as critical pipeline routes can be impacted by landslides.

Goal #1: Avoid risk or exposure to landslides through informed planning and zoning decisions.

Objective #1 (Priority HIGH): Provide citizens with access to updated geologic hazards maps and information.

Action: Educate officials, landowners, and developers about geologic hazards.

Status: Ongoing: Morgan County has enacted a strong geologic hazards land use ordinance. The Mountain Green area has experienced slope failure in the past and County has conducted a geotechnical study of the area. As a result, any development proposal in the Mountain Green area requires a current geotechnical study of the property.

Objective #2 (Priority HIGH): Maintain coordination with UGS and USGS in the monitoring of historical landslide areas.

Action #1: Expand scope of mapping to identify active landslides and potential landslides.

Status: Ongoing - County Emergency Manager and Community Development have an ongoing public education program for geologic hazards coordinating with the Utah Geological Survey and the U.S. Geological Survey.

Action #2: Coordinate with outside entities to develop and implement long term landslide hazard mitigation measures along the Gateway Canal.

Status: Ongoing - The Weber Basin Water Conservancy District (WBWCD) has identified a potential slope failure hazard above the Gateway Canal south of Mountain Green (See discussion following this section).

Goal #2: Use land use ordinances to reduce the risk of slope failure to public and private property.

Objective (Priority HIGH): Enact land use ordinance.

Action: Present to County/City Councils for adoption.

Status: Accomplished - County Emergency Manager and Community Development have an ongoing public education program for geologic hazards coordinating with the Utah Geological Survey and the U.S. Geological Survey.

G. Wildland Fire

Problem Identification: Continuing non-compliance with existing building codes and fire codes.

Goal #1: Building and fire code compliance.

Objective (Priority HIGH): Increase compliance with existing building and fire codes.

Action: Continue to enforce current local, state and national codes.

Status: Ongoing – The County Fire Warden actively promotes fuels reduction county-wide. The U. S Forest Service provided a Wildland Fire grant to the state. The county applied to the state for a $400,000 5-year Wildland Fuels Reduction Grant that will fund mitigation, educational outreach and preparedness activities.

Goal #2: Wildfire community education.

Objective (Priority HIGH): Reduce overall risk from wild fire through education programs - especially in Mountain Green, Trappers Loop, the area east of Porterville, and East Canyon.

Action: Public awareness through "Fire Wise" programs.

Status: Ongoing - In 2014, the county completed a Community Wildfire Protection Plan (CWPP) that identified 3 major areas for fuels reduction and community outreach with the understanding that as the needs of the community change with increased development, there may be an increase to areas where hazardous fuels reduction will benefit the community.

2011 Morgan County Flood Disaster

Terry Turner and Kimberly Giles Survey Damage Caused By Flooding, April 2011

In the spring of 2011 heavy snowpack runoff and rain caused streams to overflow their banks leading up to June 19 when flooding occurred throughout many sections of Morgan County causing damage to public and private property and infrastructure. East Canyon and Lost Creek Reservoirs overflowed their down spillways threatening homes and property. Lost Creek and the Weber River were at flood stage widespread sandbagging and flood control efforts were undertaken by community public works officials and residents in an attempt to mitigate the flood waters.

Lost Creek Flooding April 2011

The bridge over Peterson Creek was also severely damaged. Morgan County/City declared a State of Emergency on June 19 and submitted it to the governor. The Governor signed a State of Emergency for Flooding June 27, 2011 and immediately submitted it to FEMA.

FEMA approved the declaration and forwarded it on to the President of the United States. A presidential declaration was made August 8 for the following Public Assistance (FEMA-4011-DR).

Flooding at the Confluence of the Weber River and Lost Creek April 2011

Emergency Work:

Category A – Debris Removal

Category B – Emergency Protective Measures

Debris Removal of the Weber River and Lost Creek April 2011

Permanent Work:

Category C – Roads and Bridges

Category D – Water Control Facilities

Category E – Buildings and Equipment

Category F – Utilities

Category G – Parks, Recreational Facilities and Other Item

An applicant briefing was conducted August 23 for Morgan County and City. A County/State/FEMA kickoff meeting was held September 13 to begin the FEMA Assistance Process, and to allow eligible jurisdictions to apply for assistance.

Summary of FEMA Project Worksheets (PW) within Morgan County Disaster # 4011; Declaration Date 8/8/2011As of 12/31/2015

Project Worksheet #	Ref#	Applicant	Category	Large (>$63,900) Small (<$63,900)	Project Amount (100%)	Federal Share Awarded	Federal Share Paid	Date of Final Pmt	Project Name
120	MORC01B	Morgan (County)	B	Small	$53,848.76	$40,386.57	$40,386.57	5/29/12	EPM - Sandbagging, reinforce pre-existing berms
121	MORC02A	Morgan (County)	A	Small	$7,869.40	$5,902.05	$5,902.05	11/22/11	Debris Removal - Countywide
122	MORC04C	Morgan (County)	C	Small	$13,820.70	$10,365.53	$10,365.53	12/23/11	Bridge Replacement/Repair - 4000 N. Street road bridge that crosses Peterson Creek
123	MORC05C	Morgan (County)	C	Small	$45,772.30	$34,329.23	$34,329.23	11/22/11	Bitumious Roadway Repair - Site 1: 400 West St; Site 2: Lost Creek Rd
124	MORC06B	Morgan (County)	B	Small	$2,531.01	$1,898.26	$1,898.26	11/22/11	Emergency Protective Measures - 2" Natural Gas Line
325	MORC03B	Morgan (County)	B	Small	$37,283.13	$16,062.29	$16,062.29	5/29/12	Donated Resources - $37,283.13 - Sandbagging - Cap $16,062.29
141	MORT01A	Morgan City	A	Small	$5,697.80	$4,273.35	$4,273.35	11/23/11	Debris Removal - Site 1: East Canyon Creek; Site 2: Bridge at E 200 St
143	MORT02B	Morgan City	B	Small	$47,489.41	$35,617.06	$35,617.06	1/31/12	EPM - Eliminate Health Hazard
306	MORT04B	Morgan City	B	Small	$5,484.66	$ -	$ -	NA	Emergency Berm Repair and Removal - *** This PW is Ineligible for funding due totemporary berms which had not been removed ***
326	MORT03B	Morgan City	B	Small	$8,570.00	$8,570.00	$8,570.00	5/29/12	Donated Resources - $8,570.00 - Sandbagging - Cap $13,296.80
103	UWRS07B	Utah Division Of Wildlife Resources	C	Small	$9,806.79	$7,355.09	$7,355.09	2/3/12	Henefer Echo Wildlife Management Area - Culvert and Road Wash Out
12	UPRS08B	Utah State Parks And Recreation	B	Small	$19,577.20	$14,682.90	$14,682.90	10/23/11	East Canyon State Park - Double 72 In. Culverts and Roadway - Temp. repairs
79	UPRS06C	Utah State Parks And Recreation	C	Small	$41,644.08	$31,233.06	$31,233.06	4/4/12	East Canyon State Park - Double 60 Inch Culverts and Roadway
178	WBDD02A	Weber Basin Water Conservancy	A	Small	$55,384.15	$41,538.11	$41,538.11	1/25/12	Debris Removal - Stoddard Diversion Dam trash rack
194	WBDD01C	Weber Basin Water Conservancy	C	Small	$29,652.94	$22,239.71	$22,239.71	1/30/12	Canal Access road - 48in x 105ft CMP Culvert Repair; restore riprap
214	WBDD03A	Weber Basin Water Conservancy	A	Small	$45,800.00	$34,350.00	$34,350.00	1/30/12	Debris Removal - Stoddard Diversion Dam and canal
TOTAL					$ 430,232.33	**$308,803.21**	**$308,803.21**		

VI. 2016 Mitigation Goals and Objectives Review

Using the findings from the risk assessment and the capabilities assessment as a guide, several mitigation strategies and implementing actions were identified for Morgan County. Each action has been formalized and placed into this Plan. These actions were identified in the planning group meetings which included input from the planning team, state and local agencies, county government, city and county residents.

Goals and objectives were developed by the above-mentioned groups with a period provided for comment and revision. The county and/or the city identified mitigation actions based on the identified goals and objectives. The mitigation actions identify the responsible agency, the funding source, timeline, background, and their priority. Actions were selected using the information obtained from the capabilities assessment, which identified existing programs and shortfalls related to mitigation activities. The actions were prioritized based on the Social, Technical, Administrative, Political, Legal, Economic, Environmental (STAPLEE) method identified in the FEMA How-To Guides. The STAPLEE method of prioritization emphasizes the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each action is judged and ranked against these criteria and assigned the priority of High, Medium, or Low.

2016 Mitigation Strategies

The following mitigation strategies were formulated in a series of meetings of the Morgan County Mitigation Strategies Working Group beginning late 2012 through 2015, at Morgan County Emergency Management. The Working Group sought to refine and expand on efforts already in place. Information on Working Group members can be found in Part III. Unless otherwise noted, all strategies will be coordinated by Morgan County.

A. Dam Failure

Problem Identification: Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.

Goal: Reduce loss of life and limit damage to property. Dam safety is part of the overall Emergency Operations Plan (EOP) for Morgan County. As the EOP is updated and revised, the Dam Safety section is also updated.

Objective (Priority MEDIUM): Increase community awareness of dams that could impact the County.

Action #1: Update and revise current County dam safety evacuation plan as part of the EOP.

Time Frame: Ongoing
Funding: County

Estimated Cost: Minimal
Staff: Emergency Management Director

Action #2: Partner with the Weber Basin Water Conservancy District (WBWCD) in their efforts to stabilize the slope above the Gateway Canal in the Mountain Green area, and their proposed canal rehabilitation solutions in the slide area.

Time Frame: 6 years
Funding: WBWCD, FEMA mitigation grant
Estimated Cost: $3 - 5 Million
Staff: WBWCD, County

Action #3: Participate in regularly scheduled dam safety exercises in conjunctions with the U.S. Bureau of Reclamation, Weber Basin Water Conservancy District, and neighboring counties.

Time Frame: Annually
Funding: County/grant
Estimated Cost: Minimal
Staff: County Public Safety Staff

B. Drought

Problem Identification: The residents of Morgan County are unaware of the water conservation options that are available to them.

Goal: Decrease the impact of drought on the community.

Objective (Priority LOW): Develop and promote water conservation measures.

Action #1: Continue to promote water conservation utilizing the Drought Contingency Plan.

Time Frame: 1 - 2 years
Funding: County/grant
Estimated Cost: Minimal
Staff: Emergency Management Director, contract, Soil Conservation, Extension Agent

Action #2: Discuss the impacts that climate change will have on future water supplies in the county.

Time Frame: Immediate
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management Director

C. Earthquake

Problem Identification: The earthquake vulnerability of critical facilities (public safety, commercial buildings, and schools) should be decreased to allow for a timelier emergency response, and to decrease the risk of those that regularly utilize these facilities.

Goal: Reduce loss of life and damage to property from seismic events.

Objective (Priority HIGH): Mitigate the impact of earthquakes to Morgan County, with the goal of making the County earthquake disaster resistant.

Action #1: Continue public outreach activities for earthquake awareness campaign to include awareness of availability of earthquake insurance.

Time Frame: Immediate and ongoing
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management Director

Action #2: Promote and conduct a pre-earthquake damage assessment course Applied Technology Council-20 (ATC-20) from the State of Utah. The ATC-20 report provides procedures and guidelines for making on-the-spot evaluations and decisions regarding continued use and occupancy of earthquake damaged buildings. Written specifically for volunteer structural engineers and building inspectors, the report has become the de-facto national standard for safety evaluation of earthquake-damaged buildings. The report includes rapid and detailed evaluation procedures for inspecting buildings and posting them as INSPECTED (apparently safe, green placard), LIMITED ENTRY (yellow placard) or UNSAFE (red placard). Also included are special procedures for evaluation of essential buildings (e.g., hospitals), evaluation procedures for nonstructural elements and geo-technical hazards, and guidance on human behavior following earthquakes.

Time Frame: 1 year
Funding: Grant
Estimated Cost: Minimal
Staff: Emergency Management Director, Community Development Director

Action #3: Continue to reach out to the private sector to promote earthquake preparedness.

Time Frame: Immediate and continued
Funding: County/grant
Estimated Cost: Minimal
Staff: Emergency Management Director, Fire Warden

Action #4: The Morgan County Courthouse houses most government operations. The building is more than 60 years old and needs to be either seismically upgraded or rebuilt to current seismic standards.

The County should hire a structural engineer to determine options and costs for the retrofit or rebuild of the courthouse.

Time Frame: 1-2 years
Funding: County/grants
Estimated Cost: $50,000
Staff: Emergency Management Director, County Engineer, Facilities Director

Action #5: Implement structural engineering recommendations for seismic standards on the courthouse.

Time Frame: Unknown
Funding: Local, FEMA PDM, State Earthquake Program Grant
Estimated Cost: Unknown until solutions determined
Staff: Emergency Management Director, County Engineer, Consulting Engineer

D. Flooding

Problem Identification: Morgan County has two major streams (East Canyon Creek, Weber River) and several smaller ones that threaten communities during spring runoff. Morgan County experienced heavy precipitation in 2011, resulting in serious damage to community infrastructure. Stormwater continues to be a critical flood issue in the county.

Goal #1: Lessen impacts from flooding

Objective #1 (Priority HIGH): To reduce flood threat to Morgan County

Action #1: Maintenance of channels and bridge openings, surface treatment, and road reconstruction.

Time Frame: Immediate
Funding: Routine maintenance
Estimated Cost: $15,000/year
Staff: County/City Public Works

Action #2: Advise residents and develop outreach materials on the availability of flood insurance

Time Frame: Immediate
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management Director, County/City Floodplain Administrators, Community Services Director

Action #3: Enforce land use ordinances to preserve floodplain/open space due to increasing development pressure in floodplain areas. Pursue open space preservation in planning practice and floodplain development regulation.

Time Frame: 1-3 years
Funding: County
Estimated Cost: Minimal
Staff: Community Development Director

Action #4: Enact a County stormwater ordinance to revise discharge rate requirements for new construction, as well as implement and fund identified stormwater projects in the county to lessen impact of flooding.

Time Frame: 2-5 years
Funding: County
Estimated Cost: Minimal
Staff: County Planning and Development Services

Action #5: Design and build a new bridge over the Weber River at the east end of Young Street in Morgan City. A bridge at this location would provide enhanced emergency access to that part of the City.

Time Frame: 2-5 years
Funding: Local/state/federal grants
Estimated Cost: $3.5 million
Staff: City Public Works/ Emergency Management Director

E. Severe Weather

Problem Identification: Snowstorms, hail, thunderstorms, lighting, heavy rain, wind and avalanche impact Morgan County. Morgan County's rural and remote location could delay mutual aid response from adjoining jurisdictions.

Goal: Assist in protecting residents from the effects of severe weather.

Objective#1 (Priority MEDIUM): Lessen the impact of severe storms to residents and businesses within Morgan County.

Action #1: Provide severe storm emergency preparedness information to residents by participating in emergency preparedness fairs, information booth at the county fair, and public service announcements over the public safety radio station AM 530.

Time Frame: Immediate
Funding: County/FEMA
Estimated Cost: Minimal
Staff: Emergency Management Director

Action #2: Conduct emergency preparedness drills and exercises that focus on county emergency sheltering protocols and plans.

Time Frame: Annually
Funding: County/FEMA
Estimated Cost: Minimal
Staff: Emergency Management Director

Action #3: Continue efforts to establish the county in the National Weather Service Storm Ready program.

Time Frame: Immediate
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management Director, National Weather Service, UDEM

Action #4: Continue with supporting the operations and public education regarding the Special Needs Registry. The registry notifies residents that need oxygen, medical equipment, etc. of coming severe storms, extreme heat, power outages and other hazards so they can plan ahead for back-up power, obtain extra supplies, etc.

Time Frame: Immediate
Funding: County/FEMA
Estimated Cost: Minimal
Staff: Emergency Management Director, UDEM

F. Slope Failure

Problem Identification: Parts of Morgan County have a significant landslide threat. The community of Mountain Green and Trappers Loop Road (Highway 167) as well as critical pipeline routes can be impacted by landslides.

Goal: Mitigate the risk and exposure to landslides through consistent planning and zoning decisions.

Objective #1 (Priority HIGH): Provide citizens with access to updated geologic hazards maps and information.

Action: Educate officials, landowners, and developers about geologic hazards.

Time Frame: 1-2 years
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management Director, County Engineer, Community Development Director

Objective #2 (Priority HIGH): Coordinate with UGS, USGS, and WBWCD in monitoring historical landslide areas in the Mountain Green and Trappers Loop areas.

Action #1: Expand scope of mapping to identify active landslides and potential landslides.

Time Frame: Unknown
Funding: Federal grants
Estimated Cost: Unknown
Staff: Emergency Management Director, County Engineer, USGS, UGS, UDEM

Action #2: Coordinate with Weber Basin Water Conservancy District (WBWCD) to develop and implement long term landslide hazard mitigation measures along the Gateway Canal in the Mountain Green area.

Time Frame: 10 years
Funding: FEMA/WBWCD/Bureau of Reclamation grants
Estimated Cost: $1 - $6 million
Staff: County, WBWCD

Action #3: Snow Basin Resort has an approved development plan for the expansion of their facilities to include as many as 1,800 residential units, golf course and expanded ski areas. The County will coordinate its efforts with Weber County to manage and monitor this project.

Time Frame: Immediate
Funding: County/Weber County/FEMA grants
Estimated Cost: Unknown
Staff: Emergency Management Director, Weber County Emergency Management, Community Development Directors

Action #4: Update and revise the County Geologic Hazards Building Ordinance by more narrowly defining standards of care and construction for properties located in known geologic hazard areas to include: faults, slide scarps, problem soil areas.

Time Frame: 3-5 years
Funding: Local
Estimated Cost: Minimal
Staff: County Engineering/County Attorney

G. Wildland Fire

Problem Identification: The Wildland-Urban Interface (WUI) continues to be of concern in the Mountain Green area.

Goal #1: Building wildland fire resistant communities

Objective (Priority MEDIUM): Reduce potential impact to life and property in WUI areas.

Action #1: The Morgan County Fire Warden developed a Mountain Green Community Wildfire Protection Plan (CWPP) in 2015. The plan was then used to apply for a $300,000 State Fire Assistance Grant from the State Division of Forestry, Fire, and State Lands to conduct an extensive wildfire reduction program in the Mountain Green area and other identified portions of the County. All are located in the Wildland Urban Interface. Morgan County didn't receive funding on the grant, but will continue to apply annually for State Fire Assistance funding.

Time Frame: 4 years
Funding: County Fire/State Fire Assistance Grant Program
Estimated Cost: $600,000
Staff: County Fire/Mountain Green Fire District and volunteers

Action #2: The County Fire Warden will develop and implement a county-wide CWPP to encompass all wildland/urban interface areas.

Time Frame: 1 year
Funding: County Fire funds
Estimated Cost: Minimal
Staff: County Fire Warden

Action #3: Mountain Green is in the process of completing a "firewise" community application which will hopefully open new doors for the community to receive federal grant funding for wildland fire fuel mitigation projects.

Time Frame: Ongoing
Funding: Federal and State grants
Estimated Cost: Minimal
Staff: County Emergency Management

Goal #2: Wildfire community education

Objective (Priority HIGH): Reduce overall risk from wild fire through education programs - especially in Mountain Green, Trappers Loop, the area east of Porterville, East Canyon, and Deep Creek Association.

Action: Public awareness through "Fire Wise" programs and fire station educational events.

Time Frame: 2-3 years
Funding: County, State grant
Estimated Cost: Unknown
Staff: County Fire Warden, U.S. Forest Service, UFFSL

H. Epidemic/Pandemic

Problem Identification: Morgan County could experience 1,000 individual influenza cases, 500 outpatient doctor visits, 100 additional hospitalizations, and 50 deaths from a pandemic.

Action #1: Pandemic Influenza Planning

Time Frame: Ongoing
Funding: Centers for Disease Control and Prevention – Investigations and Technical Assistance Public Health Emergency Preparedness/Utah Department of Health
Estimated Cost: Unknown
Staff: Weber-Morgan Health Department

Action #2: Public education, informative booklet: "Family Emergency Preparedness Guide and Flu Home Care Guide."

Time Frame: Ongoing
Funding: County
Estimated Cost: Unknown
Staff: Weber-Morgan Health Department

I. Pipeline Safety

Problem Identification: Within Morgan County there are 6 major transmission pipelines that carry very hazardous materials which include natural gas, jet fuel, crude oil, and other petroleum products. These pipelines are owned and managed by Kern River, Questar, Plains Pipeline, and Phillips 66. The pipelines are located along, over, and/or under the main transportation corridors, rivers and water ways, residential areas and major economic and education hubs within the county.

Goals: Identify/document, collaborate, and educate/inform county residents about the potential risks that may result from the exposure of transporting hazardous materials through the pipelines.

Objective #1: Utilize and apply the data obtained through the Pipeline Safety Technical Assistance Grant (PSTAG) to enhance the safety of Morgan County residents should a natural hazard negatively impact the aforementioned pipelines.

Action: Overlay the data obtained from the PSTAG on the County Natural Hazards map to better understand the vulnerability of pipeline infrastructure.

Time Frame: Immediate
Funding: USDOT Hazard Mitigation Technical Assistance Grant
Estimated Cost: $76,000
Staff: Emergency Management Director, Contractor, Pipeline companies

Objective #2: Map/Gather Critical Infrastructure in GIS. Collect existing GIS data from Morgan County, utility data from Morgan City and private utility companies (Mountain Green area), collect data from pipeline companies and map locations of hazardous pipelines in GIS. Map GIS locations of schools, churches, civic buildings, parks, public gatherings areas, create infrastructure map-books for Morgan County staff to review and redline, and make changes to.

Action: The County Emergency Manager will coordinate with the County Sheriff, public works personnel, power plant staff, school officials, and county engineer to gather data, collect FPS points, inform the public and establish best practices. The County has received support from Kern River, Plains Pipeline, Questar, and Phillips 66 expressing their willingness to work closely, provide information and attend meetings to coordinate with the County and be part of the educational process. Information regarding emergency evacuation zones and routes will be shared with the pipeline companies so they can implement this information into their emergency response plans as well.

Time Frame: 2 years
Funding: USDOT Hazard Mitigation Technical Assistance Grant
Estimated Cost: $76,000
Staff: Emergency Management Director, Contractor, Pipeline companies

J. Morgan City Electric Power Supply

Problem Identification: Morgan City belongs to UAMPS (Utah Associated Municipal Power Systems) and purchases its power (coal, hydro and wind) from them. Morgan city pays Rocky Mountain Power to transmit electricity from generating sources to the city's municipal electrical grid. The city electrical system is more than 70 years old and is very vulnerable to natural hazards. There exists an urgent need for an upgrade. The electrical system's vulnerability surfaced on September 23, 2015, when the city's main 2,400-volt transformer at the Island Road substation (which is shared with Rocky Mountain Power) failed. More than 1/3 of city residents were without power for an extended period of time. The other 2/3 of the city is on the Mahogany Ridge and High School substations which are 7,200 volt circuits. A more reliable and stable electrical system would be for the entire city to be on a 7,200-volt circuit. The current 2,400-volt circuit (poles, wire, insulators etc.) cannot handle 7,200 volts. Morgan Power is temporarily running the whole city from the Mahogany Ridge substation and the High School substation, feeding the 2,400-volt circuit with a step down transformer from the 7,200 volt circuit.

Goal: Complete the system city electrical system upgrade which is approximately 50% complete. The city is negotiating with Rocky Mountain Power to place a replacement transformer back in the Island Road Substation. This will build redundancy in the power grid for the city.

Objective: To provide Morgan City with a natural disaster resistant electrical power system with a new operating substation and a 7,200-volt circuit city wide.

Action: The city is in the process of upgrading the entire 2,400-volt system to a 7,200 volt system.

Time Frame: Immediate
Funding: Morgan City Power
Estimated Cost: $600,000
Staff: Morgan City Power staff

VII. Community Mitigation Activities, 2009-2015

A. Community/Agency Specific Projects

Since the adoption of the 2009 Pre-Disaster Mitigation Plan for Morgan County, the community has specifically outlined the following courses of action in their plan: individual lot clean up and creation of defensible space around homes; creation of defensible space in community areas; review and evaluate fuels reduction areas that are adjacent to public lands; Conduct community outreach and demonstrate fuels reduction; initiate Fire Wise and Ready, Set, Go! Programs and education; develop a pre-attack plan with community, city and county planners.

Jurisdiction	Year	Activity
Mountain Green Sewer Improvement District (MGSID)	2009	The Mountain Green Sewer Improvement District (MGSID) operates a municipal waste treatment plant. The plant was upgraded in 2009 to accommodate new residential developments and to perform a seismic retrofit, which nearly tripled its original capacity. These upgrades consisted of upgrading the lagoons and installing a fine-bubble aeration system. The original plant was designed to handle 2,500 individuals, or 667 equivalent residential units (ERU's) based on an average household size of 3.75. Now with the current upgrades the system is capable of handling 6,750 individuals, or 1,800 ERU's. With the current use there is only room for 2,032 more individuals, or 738 ERU's to be added to the system before further upgrades will be needed. The original capacity of the treatment plant was 8.2 million gallons of material and although upgrades have been made the volume of material the plant can treat hasn't changed. The treatment plant consists of an activated sludge treatment process system. There are two aerated ponds and one non-aerated pond. The MGSID would like to upgrade to a membrane bioreactor system. This upgrade has an estimated cost of $14 million, $11 million of which will be charged to new development (to handle the capacity it is adding), while the existing connections will pay about $3 million (their cost to handle the more stringent nutrient removal that they would have had to do even if there were no new development). The plant is only capable of processing normal household waste and as such any commercial or industrial development that produces anything besides normal household waste will need to have a pre-treatment process installed on site. The plant effluent is discharged into Weber River approximately 600 yards west of their facility. The treated effluent then flows through Weber Canyon and eventually to the Ogden Bay Waterfowl Management Area within the Great Salt Lake. The distribution in the system is currently limited to the Mountain Green community, consisting of the cottonwoods housing development at the eastern boundary to the highlands and Monte Verde housing developments on the western boundary and to the south the districts service area is bounded by Highway 30. With continued expansion of the Mountain Green community the distribution network of the sewer district will need to expand their capital investment to accommodate this growth.
Morgan City	2011	Expended $6,200 to remove a large tree that had floated down in the Weber River and was partially blocking at the confluence with East Canyon Creek. In response to the flooding incident, crews worked to remove obstructions in the channels.

		With the approaching flooding incident, City Public Works personnel and contractors finished two berms on the Weber River that had been started, but not completed following the 1983 flood, at the cost of $6,000. The flood incident caused the rivers, and the groundwater levels to rise. Several sewer manholes had to be sealed to prevent intrusion of water into the sewer system, costing $10,000. Expended $120,000 to add a booster pump to the culinary water system to provide redundancy for a section of the city which previously only had one water source.
	2012	Reinforced the sewer main and restored the river bed to original elevation, using materials to avoid scouring in the future. $60,000 Designed and built a response trailer that includes pumps, hoses, generator, heater, trench shoring equipment, etc. $12,000 Purchased a gas powered light tower to assist in night emergencies. $4,000 Purchased burn blankets for trucks involved with electrical system, and for buildings in remote locations. $1,000
	2015	Constructed a new storm drain retention pond in an existing part of town that has seen flooding from heavy rain storms. $30,000
	2016	Repaired and rebuilt a walking trail along the Weber River levee, removing dips(areas that have been sandbagged on occasion) and leveling the trail. $45,000 The city is currently rebuilding a section of the power system in the older part of town that has experiences numerous power failures. Due to the age of the system, the area is also prone to damage from severe weather. This part of the electrical grid in the city is now more resilient. This section was also upgraded to the same voltage as the rest of the system, which allows power to be distributed from other areas in an outage. $1,000,000 The city is planning to add an additional substation to the power system to provide redundancy if a substation goes out. Estimated cost of this project is $600,000. (See mitigation strategies)
Morgan County Public Works	2009-2015	The County spends approximately $1,000 each year on stream channel debris removal. The 2011 flood event caused the County to repair and replace several roads, bridges, and other infrastructure damaged by the flooding. Beginning in 2012, the County expanded more than $2.8 million to rebuild and rehabilitate damaged roads and bridges. This work included rebuilding 2.3 miles of Morgan Valley Drive, replacement of the Stoddard Bridge, and river restoration projects primarily east of the fairgrounds. Additionally, the County received a $2.1 million grant from the Federal Highway Administration to reconstruct Morgan Valley Drive scheduled to begin in 2016. Morgan County must match the Federal Grant with $200,000. Bleachers at the fairgrounds arena were unsafe and replaced at a cost of $125,000.

B. Weber Basin Water Conservancy District

The Weber Basin Water Conservancy District (WBWCD) was created on June 26,1950 by a decree of the Second District Court of Utah, under the guidelines of the Utah Water Conservancy Act. The District was formed to act as the local sponsor of the federal project and to further supply water resources to the population within its boundaries. The original project, including reservoirs, canals, irrigation and drainage systems and power plants were constructed by the Bureau of Reclamation from 1952 through 1969. The Weber Basin Water Conservancy District covers over 2,500 square miles within five counties: Davis, Weber, Morgan, Summit and a part of Box Elder.

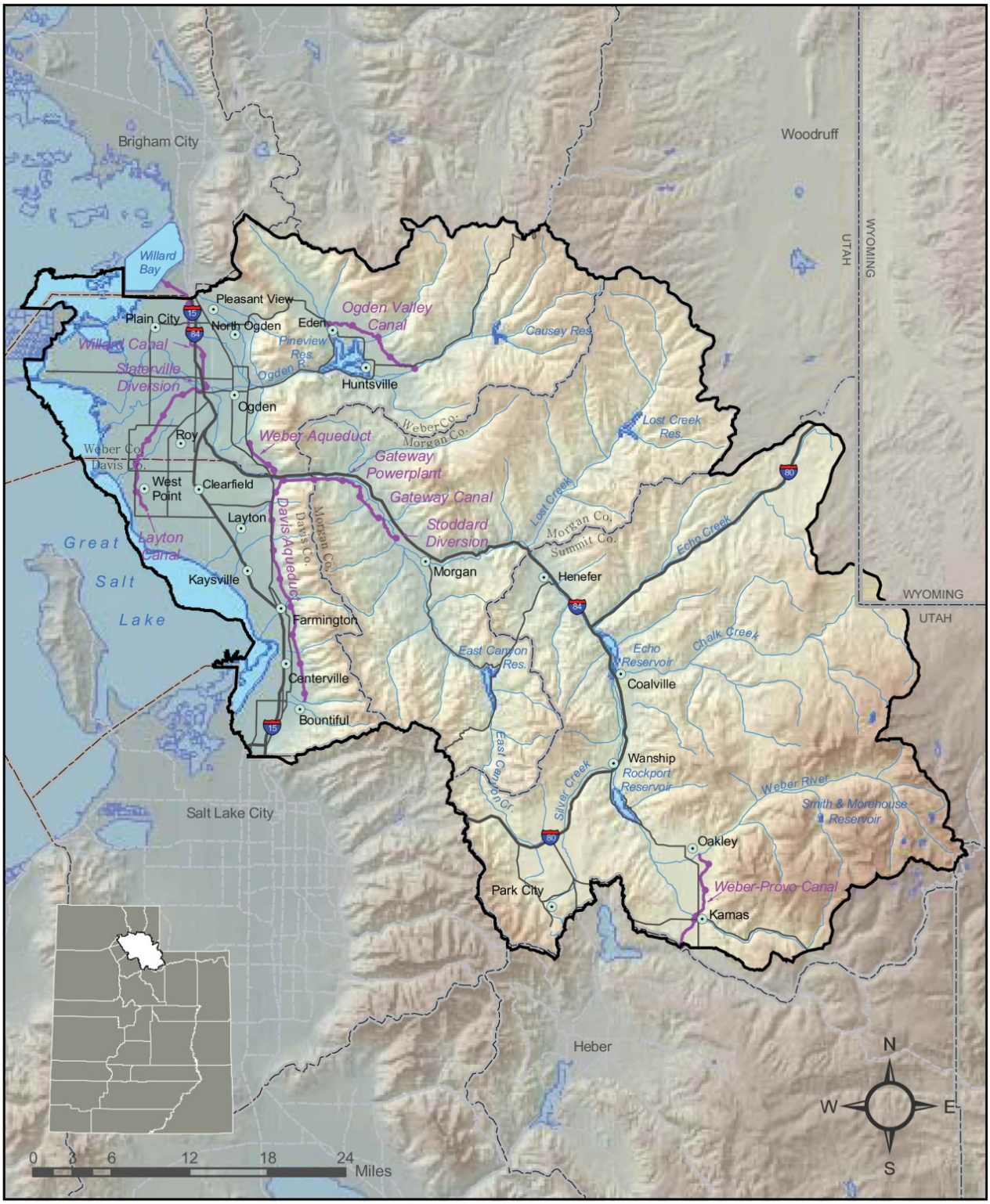
Weber Basin delivers approximately 220,000 acre-feet of water annually: 60,000 acre-feet for municipal and industrial uses and 160,000 acre-feet for irrigation, which includes secondary pressure irrigation systems. The District operates seven large storage reservoirs which store approximately 400,000 acre-feet of the District's water. The reservoirs are: Causey, East Canyon, Lost Creek, Pineview, Smith & Morehouse, Wanship and Willard Bay. Due to the later priority of the District's water rights on the river systems, it is necessary to have storage volume equal to a two-year water supply. The District operates three hydro-power generation plants that can produce up to about 8 megawatts of electricity. Also operated and maintained are over 79 miles of canals, a trans-mountain tunnel, two multi-county aqueducts, hundreds of miles of raw water and culinary pipelines, and nine major pumping stations.

The District is unique for its ability to serve five classifications of water service, including agricultural water (flood and pressure), drinking water, industrial supplies, groundwater replacement and pressurized/ secondary water.

Three drinking water treatment plants and related distribution systems were also constructed by the District between 1959 to 1962. They have all undergone extensive rehabilitation and modernization projects to meet new EPA drinking water standards. The District currently provides culinary water to approximately 425,000 people in the five counties. In addition to the treatment plants, the District operates 17 deep, large capacity wells to increase supply and capacity to the District's customers. Depths are up to 1,200 feet and capacities up to 5,000 gallons per minute. Weber Basin Water acts as a wholesaler of drinking water to cities, and other districts and agencies. These entities then deliver to the tap of individual users.

Future issues for the District center around development of sufficient water supplies and facilities to meet the needs of the growing population within its boundaries. Water conservation plays an increasingly important role as new sources are likely to be difficult and expensive to develop. Water demands on the District are projected to double in the next 40 years even with the assumption that the existing per capita use will reduce significantly. These projections, along with the constant need to upgrade and rehabilitate existing infrastructure, push the financial needs projections to one half billion dollars over the next 30 years.

Beyond conservation, new projects will include completion of groundwater drilling, change of use of local river supplies and probably a large regional importation project.



Source: Weber Basin Water Conservancy District Multi-Hazard Mitigation Plan, 2011

C. WBWCD Mitigation Plan 2009

The risk assessment for the WBWCD MMP has resulted in the identification of areas in the District's system which are vulnerable to damage due to natural disasters. Using the methodology described below, the District has prepared a ten year mitigation plan to implement the highest benefit natural hazard mitigation projects. Projects that the District has identified as high priority projects are listed in the table below.

Ten Year Natural Hazard Mitigation Project Plan Summary

Project Priority	Project Description	Mitigation Cost Estimate	Schedule for Design and Construction (1, 3)
1	Seismic Retrofit of the Davis South Water Treatment Plant Filter Building (2)	$1,023,000	2010 to 2012
2	Seismic Retrofit of Transformers, Switchgear and MCC's at High Priority Pump Stations and Wells (2)	$122,000	2010 to 2012
3	Seismic Retrofit of Culinary Wells	$318,000	2011 to 2014
4	Layton Canal retrofit to accommodate lateral spreading concerns (4)	$1,000,000/mile	2010 to 2012
5	Seismic Retrofit of Water Tanks	$3,380,000	2014 to 2016
6	Seismic Retrofit of Remaining Deficiencies in Water Treatment Plants	$330,000	2014 to 2016
7	Seismic Retrofit of Filter and Flocculation Basins	$3,048,000	2016 to 2020
8	Seismic Retrofit of Pump Stations	$660,000	2016 to 2020
9	Installation of Emergency Shutoff Valves in the Davis and Weber Aqueducts	To be determined	2018 to 2020
10	Perform Fault Crossing Study for Aqueducts (5)	$200,000	2012 to 2014
11	Retrofit of Replacement of Culinary Water Trunk Lines Located in Landslide Areas	To be determined	2011 to 2020
12	Conduct Emergency Repair Needs Study for Culinary and Secondary Water Lines (6)	$20,000	2012
13	Purchase of additional repair materials and emergency response training as defined by future studies	To be determined	2011 to 2020
14	Seismic Retrofit of Power Plants	$51,000	2011 to 2012
15	Landslide Retrofit of the Gateway Canal (7)	$2,200,000	2016 to 2020
16	Study Creation of additional system redundancy and disaster response resilience through construction of additional water storage tanks (8)	$100,000	2017 to 2020
17	Creation of additional system redundancy through construction of alternative water supply sources on the West Site of the Wasatch Fault System	To be determined	2020 or later

Source: Weber Basin Water Conservancy District Multi-Hazard Mitigation Plan, 2011

1) The District intends to pursue a number of methods for funding these projects, of which FEMA PDM funding will be an important component. Therefore the actual implementation schedule for these projects may vary and will be updated as projects are funded and completed. 2) This project has been identified by FEMA for PDM 2010 funding. 3) Costs estimates are in 2010 dollars. 4) This project will be included in a Bureau of Reclamation Funded Canal Lining Project. 5)Cost shown is estimated cost for study only. 6) Cost shown is for study of piping repair material needs for culinary and secondary trunk lines. 7)This project was submitted for PDM funding in 2009, but not approved at that time. The project will be resubmitted in the future. 8) Cost shown is for study only.

Projects Completed 2010-2015	Total	Federal Money
Nonstructural Seismic Retrofit Project	$122,200.00	$91,650.00
11 Culinary Wells seismic Retrofit Project	$291,807.00	$208,497.25
12 MG Tank Vault Seismic Retrofit Project	$94,020.00	$70,515.00
Davis South Filter Building Seismic Retrofit	$1,054,043.55	$589,686.75
Aqueduct joint repairs	$445,954.50	
Update Communications Plan	$500.00	
Replace District Offices	$5,077,000.00	
Update security of facilities	$1,000,000	
Subtotal	**$8,085,525.05**	
Ongoing Projects		
Gateway Canal Stabilization & Lining	$100,000.00	per year
Aqueduct Condition Assessment	$200,000.00	
Replacement of Valves & Structures	$50,000.00	
Seismic Retrofit of Backwash Tanks	$150,000.00	
Security of Facilities	$200,000.00	
Subtotal	**$700,000.00**	
Long Term Projects		
Seismic Retrofit of Remaining Water Tanks	$100,000.00	
Seismic Retrofit of Flocculation/Sediment Basins	$4,000,000.00	
Seismic Retrofit of Pump Stations	$200,000.00	
New Isolation Valves on the Aqueducts	$500,000.00	
Seismic Retrofit of Aqueducts through the fault	$500,000.00	
Seismic Upgrade of Fluoride Buildings	$200,000.00	
Subtotal	**$5,500,000.00**	

D. Gateway Canal Slide Area Rehabilitation

The Gateway Canal near Mountain Green has a capacity of 720 cfs and supplies water to thousands of people along the Wasatch Front in Weber and Davis Counties. Over the past several years, the canal has experienced continual horizontal and vertical displacement where it crosses an active landslide about 500 feet wide and 70 feet deep. In some areas, the deformations on an annual basis have exceeded 12 inches. This requires annual maintenance to repair or replace the concrete canal lining. The creep has been steady over the past 20 years and efforts have been made to stabilize or slow the landslides progress. Increased movement of the landslide associated with an abnormally wet year or the occurrence of a seismic event could result in a catastrophic failure of the canal. The Weber Basin Water Conservancy District (WBWCD) is looking for alternative ways to cross the landslide to eliminate the need for annual maintenance while searching for a long term solution. WBWCD has considered several approaches that could be implemented to provide some movement of the landslide while providing uninterrupted service to the water users.

Photos of the active landslide located uphill of the Gateway Canal near Mountain Green

Source: WBWCD Multi-Hazard Mitigation Plan

VIII. Geographic Data

Morgan County has a distinct geography, population and economy. Morgan County Community Development in 2013 estimated the total County population of 10,173, with 3,903 of those residents living in Morgan City.

A. Geographic and Physiographic Background

Morgan County is located on the east flank of the Wasatch Range in the northern portion of the state. It is the third smallest county making up only 610 square miles. Morgan County's landscape includes the Wasatch Mountain Range, steppe valleys, and the Weber River, which is a major river valley in northern Utah. Two smaller tributaries also run through the county East Canyon Creek and Lost Creek. Morgan County also has farming and grazing lands. The county is bordered to the east by Rich and Summit Counties, the north by Weber County, the west by Davis County and the southwest by Salt Lake County. The county's elevation ranges from 4,895 feet at Mountain Green to 9,547 feet at Francis Peak. Morgan City is the most populated city within the county (Morgan County 2015).

B. Geology

The Wasatch Mountain Range runs north-south and is the eastern border of the valley region of the Wasatch Front. The Uintah Mountain Range runs east-west and is the eastern most range of the Great Basin, which is part of the much larger Basin and Range Province.

The geology of Morgan County is a product of Miocene Epoch faulting and folding followed by a period of upheaval. The upheaval raised the valley 3,000 to 5,000 feet in a dome like manner during the Tertiary Period. This disturbance of the valley floor created a tension and a build-up of stress. To accommodate for the change, "block-faulting" occurred that allowed for the uplift of the mountain ranges and depression of the valley floor. This depression extends to the lowest portion of the Wasatch Front Region: the Great Salt Lake. Erosion is now the main geologic process of this area.

The Wasatch Range is comprised of mainly tertiary lake deposits and tertiary and quaternary volcanic rocks as well as younger Precambrian sedimentary rocks. To the north of Salt Lake City on the Wasatch Front, the hardest, highly altered metamorphosed rocks of schist and gneiss are found and date back about 2.6 billion years. Paleozoic marine sedimentary rocks surround the Precambrian areas of the Range. The Paleozoic sedimentary rocks have a very weak make-up and, in conjunction with Utah's heavy precipitation during the winter and summer months, many landslides, avalanches, debris flows, and rockfalls occur.

C. Climate

Northern Utah has a cold desert climate. Utah has hot dry summers and cold winters. However, Utah's climate is variable, wet in some areas of the state and dry in others. This variability is a function of latitude, elevation, topography, and distance from moisture sources.

Morgan County's climate borders a semi-arid, mid-latitude steppe climate that occurs along the perimeter of the Great Basin Desert, and a humid continental climate found at slightly higher elevations in the Rocky Mountain foothills (Critchfield, 1974).

Northern Utah has four seasons, low annual precipitation, convective and frontal storms, dry summers, low humidity, and large annual and diurnal temperature extremes. The Wasatch Mountain Range brings most of the precipitation to the valley floor. The winter months bring heavy snow accumulation over the mountains that are favorable for winter sport activities.

Spring runoff is at its peak from April through June and can cause flooding along the lower streams. Flash flooding from summer thunderstorms affects smaller more localized areas in this region from summer thunderstorms.

Utah is the second driest state in the nation. The average annual precipitation in the Wasatch Mountain Range can be more than 40 inches, while the Great Salt Lake desert averages less than 5 inches annually. The average annual precipitation in Morgan is 16 inches, which includes as much as 63 inches of snowfall.

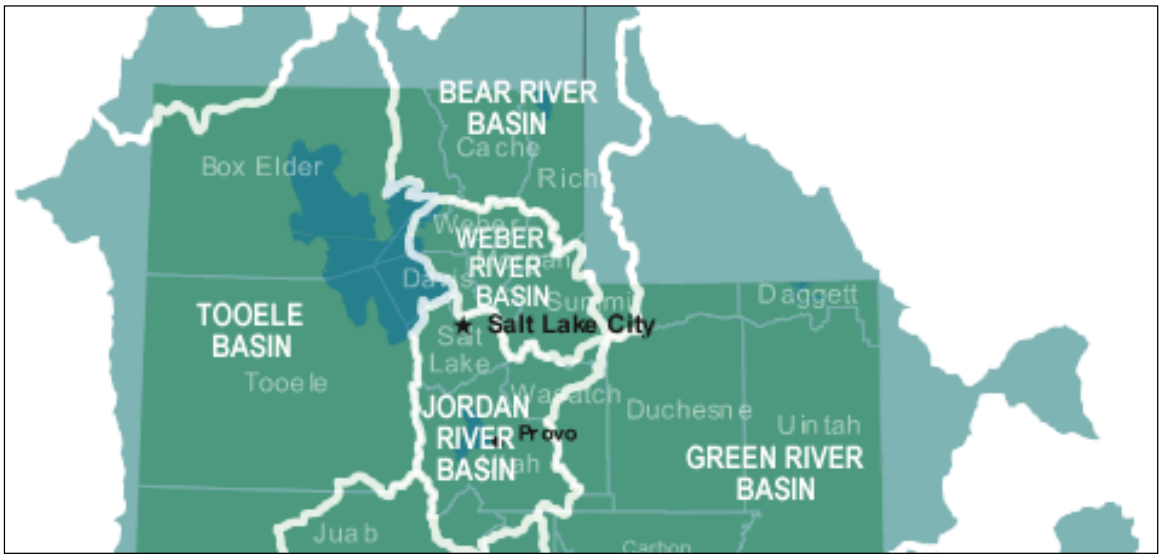
The surrounding mountain ranges act as a barrier to the cold continental arctic masses. This also insulates the area during the day and cools the area rapidly at night. On clear nights, the colder air accumulates on the valley floor, while the foothills and benches remain relatively warm.

During the fall and winter months, smoke, haze, and fog can accumulate in the lower levels of stagnant air over the valley floor and can last for several weeks at a time. This is caused by areas of sinking air or high-pressure anticyclones settling over the Great Basin.

Average wind speeds are usually light to moderate, usually below 20 miles per hour. Strong winds can occur in localized areas, mainly in canyon mouths along the western slopes of the Wasatch Mountains. Dust storms can occur in the western portions of the region. Tornadoes have occurred in northern Utah but are uncommon. Severe hailstorms have also occurred in Morgan County during the spring and summer months.

D. Major Rivers

Most of Utah’s water is from snowmelt that occurs during the spring and summer. Larger drainages or river basins are formed from the mountain ravines or depressions that merge into perennial rivers and then meet forming the larger drainages. Morgan County is part of the Weber River Basin.



Area Drainage Basins (Source: USGS 2006)

Agricultural irrigation is the primary use of developed water in Utah, but municipal, industrial, environmental and recreational uses are increasing and this competition will reform the way water is utilized. With the growing population, agricultural land has decreased, with residential and commercial development on the rise. According to the Utah Water Plan, the Weber River Basin is projected to lose a significant amount of agricultural lands over the next few decades.

E. Water and Drought

Utah is the second driest state in the nation and ranks second in per capita water use of public supplies. According to the Utah Division of Water Resources, northern Utah has experienced drought conditions from 2010 to 2015. Decreased flow from major rivers has led to a decline in most of the reservoir levels and in the Great Salt Lake. The continuing drought is unusual because of the severity.

F. Development Trends

Morgan County continues to grow. Despite nationwide trends, Utah continues to develop. In general, the "developable" areas include agricultural lands throughout the Morgan valley (next page) for projected population and household growth in Morgan County.

While Morgan County's growth is likely to be not as dramatic as growth in Davis, Salt Lake, and Weber counties, its per capita growth is one of the highest in the state. Morgan County's motto is "the best of rural America." Morgan County is sometimes referred to as being part of the "Wasatch Back" (with Summit and Wasatch counties). The "Wasatch Back" is facing great development pressures while still desiring to maintain a rural lifestyle.

Morgan County's growth has been almost all residential on previously agricultural parcels. Some residential growth has occurred on sensitive soils in the Mountain Green area.

Most residents commute to work in Weber, Davis and Salt Lake counties. Morgan County is working on economic development to diversify and expand its tax base with the desire to also maintain their rural lifestyle. Like the Ogden Valley area of Weber County, property values continue to escalate.

Population growth in the county is attributed primarily to residents having children who chose to live in the Morgan valley. There is also significant residential growth that is attributed to in-migration by families seeking a rural lifestyle within a reasonable commuting distance to job opportunities in Weber and Davis counties due to those area's strong job market. Nationally, growth is occurring in the west and in the south.

Morgan County Demographic Trends 2000-2030				
2000	2010	2020	2030	% Growth 2000-2030
7,181	10,589	16,756	24,478	240.9%
Households				
2000	2010	2020	2030	% Growth 2000-2030
2,069	3,348	5,517	8,198	296.2%
Household Size				
2000	2010	2020	2030	Change 2000-2030
3.47	3.16	3.04	2.99	-0.48
Employment				
2001	2010	2020	2030	% Growth 2000-2030
3,135	4,212	7,676	11,497	266.7%

Population and Household Projected Trends (UPEC 2008)

The County's population is projected to continue to increase exponentially. This will result in housing cost increases greater than the rate of inflation. Higher population densities are projected to be concentrated in currently developed areas with recent development occurring at lower densities in the outlying areas.

G. Development Constraints/Opportunities

Influences on development are many and interrelated. A few are geographic, historic layout, transportation, household size, technology, employment trends and public policy. Development influences can encourage and/or discourage growth. For example, floodplains, wetlands, slopes and faults, sensitive species and transportation influences both attract and detract development.

H. Geographic

Geographic constraints on the urban area have created a linear region that stretches the entire length of the Morgan Valley, roughly more than 20 miles east to west, from Round Valley on the east to Mountain Green on the west. Additionally, Snow Basin has announced plans for a significant residential development around and near the ski resort, part of which will be in Morgan County. This development will be on the mountain slopes high above the valley floor.

I. Floodplains

There are a number of identified floodplains in the county that pose challenges, command respect and generate appeal for development. In Morgan County, the Weber River receives water from its significant tributaries; Hardscrabble Creek, Deep Creek, Lost Creek, East Canyon Creek and Cottonwood Creek.

J. National Flood Insurance Program Participation

The National Flood Insurance Program was created in 1968 by the Federal Emergency Management Agency (FEMA) to provide homeowners living in the 100-year floodplain an opportunity to purchase flood insurance for their home. In order for individuals to be eligible to purchase flood insurance, their community needs to participate in the National Flood Insurance Program (NFIP). Assistance for community participation in the NFIP is provided by the State Floodplain Manager at DEM. There is also limited funding for flood mitigation projects for communities participating in the NFIP.

National Flood Insurance Program (NFIP) Participation							
Community Name	CID	County	Date of Entry	Current Effective Map	Policies	Total Claims	Repetitive Loss
Morgan City	4900093#	Morgan County	07/16/87	04/19/10	17	4	0
Morgan County	4900092#	Morgan County	09/28/90	04/19/10	35	5	2

Morgan County and Morgan City both participate in the National Flood Insurance Program (NFIP). Morgan County joined on September 28, 1990 and Morgan City on July 16, 1987. Both are in the Regular Program with their current effective maps dated from 2010. Morgan County and Morgan City currently have a total of 52 flood insurance policies, and have had a total of 9 claims since entering the NFIP. Each jurisdiction strives to follow the requirements of the NFIP, and utilize permitting for development in the floodplains. Neither jurisdiction is a member of the Community Rating System (CRS). In addition, Morgan County has 2 repetitive loss structures within its boundaries. The County is supporting the mitigation efforts of entities like the Weber Basin Water Conservancy District and surrounding jurisdictions to help reduce the impact from hazards including flooding. Mitigation efforts to help address the repetitive loss structures could include acquisition, flood channel stabilization and floodproofing.

K. Wetlands

Wetlands are those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to normally support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands can be categorized according to their quality and type. Jurisdictional wetlands are those wetlands that are within the extent of the U.S. Army Corps of Engineers (USACE) regulatory overview. For an area to be identified as a jurisdictional wetland, the area must exhibit positive indicators of wetland hydrology, hydrophytic vegetation and hydric soils. If wetlands provide a particularly rich habitat for a variety of wildlife species, it is usually considered to be of high quality, or have a high functional value. Also, wetlands can be classified according to their type, including marsh, wet meadow, riparian scrub, playa/mudflat and open water.

L. Farmlands

Over the past several years, many acres of farmland in the county have been developed. Morgan County still maintains a good percentage of its land in agriculture. Historically, development followed farmland in an agrarian economy.

Prime farmlands are important to the agricultural base of the County. Prime farmlands that are located within incorporated city limits, will likely be developed for urban type land uses eventually. Currently, a majority of the acreage of these farmlands in Morgan County are used to grow winter (dry farm) wheat and alfalfa.

M. Slopes and Faults

The steep slopes of the Wasatch Mountain Range were created by the Wasatch Fault, which runs the entire length of the urbanized areas. The Wasatch Fault and other faults in the area highlight the potential for earthquakes in the area and the need to consider their possible impact on infrastructure. As development continues to creep higher on the foothills of the Wasatch Mountains, slope stability, erosion and drainage problems will present engineering challenges in development design. Development is usually attracted more to the views of slopes and faults than repelled by the higher risk of soil instability.

N. Open Space

Open Space is a large influence to residential and commercial development. Generally, people are attracted to open space. Currently in Morgan County, large amounts of land are privately held open space. Only a small portion of the Wasatch Range which comprises the western border of Morgan County is Wasatch National Forest, which is administered by the U.S. Forest Service.

Over the past several years, population growth in the urbanized areas has impacted the open space resources of the Wasatch Range in a variety of ways. Two of these ways are mentioned here. First, there are many more people visiting the popular places in the adjacent mountains. This has jeopardized the environmental quality of the mountains by degrading surface and ground water quality. The Wasatch Range is a major source of water for the adjacent urbanized areas, and water quality degradation can have far-reaching effects. Secondly, many access points or trail heads to the canyon and other mountain destinations located on public lands that were commonly used in the past have been closed off to the public by private developments.

The effect of this is that much of the public open space becomes inaccessible and the opportunity to visit these popular places becomes lost. Remaining access to non-private lands is channeled through an ever-decreasing number of public access points.

Not only can open space resources be found in the mountains of the Wasatch, but private and public open space is also found in the valleys in the form of farms, developed and natural parks, golf courses, water features and vacant land. In many instances, these resources may receive more intensive use than those found in the adjacent mountains. Recently, because of the rapid growth in the area, citizens as well as state and local political leaders have become concerned about the relatively rapid loss of private open space resources, such as farmland and vacant land. Urban growth has put considerable pressure on the farmlands that can still be found in, or adjacent to, the urbanized areas. Some individuals and lawmakers value farmlands and would like to see some of them preserved for future generations. Management and development of open space has many questions – how, where, and to what degree will these lands be preserved?

Some agricultural lands are receiving state designation as farmland preserves through the use of conservation easements and favorable tax treatments. These designations assist farmers in preserving their lands for future agricultural use and provide aesthetically pleasing open space today. However, as development pressure and property values increase, it may become increasingly difficult to keep many agricultural lands in agriculture preserves.

Policy decisions relative to open space will affect land use and development patterns, and, as a consequence, will also affect long range plans for the region's transportation systems.

O. Hazardous Waste Sites

Morgan County does not have any hazardous waste sites.

P. Sensitive Species

Sensitive species are plants and animals, which are considered threatened or endangered relative to extinction. There are currently 21 species in Morgan County that fall into the sensitive species category. The most notable of these are the peregrine falcon, bald eagle, and Ute ladies tresses which are all on the federal list of endangered and threatened species. Both peregrine falcon and bald eagle sightings have been reported over the past few years on a fairly regular basis. Some examples of other less notable sensitive species, which are known to inhabit certain areas of Morgan County, include the spotted frog, least chub, western burrowing owl, ferruginous hawk, white faced ibis, Bonneville cutthroat trout, pocket gopher and others. The likelihood of these and other sensitive species being present in the region will depend on whether or not suitable habitats exist.

Q. Ground Water

Much of the water flowing in streams and interfluvial areas seeps into the ground. The foothills and the base of the mountains are the locations where much of this water seeps into the ground.

These locations are referred to as aquifer recharge areas. Water is stored in aquifers of various types. Morgan County has several aquifer recharge areas, a significant portion of the water utilized by residents comes from these aquifers, which can be tapped through wells or natural artesian springs.

R. Historical Development Layout

Historically, development has occurred according to the "Plat of Zion." Many of the areas along the Wasatch Front have street layouts based on the "Plat of Zion", implemented by Brigham Young when the Mormon Pioneers permanently settled the area beginning in1847. This concept is based on a grid of 10-acre blocks with wide streets. While the concept is apparent in central city areas, the suburbs deviate. Historically, the street network and connecting highways served the local areas. Intercity travel was via the Bamberger Railroad, which ran passenger service from Salt Lake City to Ogden from 1891 to 1952. In the 1950's, the federal government instituted the Interstate Highway System. Interstate 15 linked Salt Lake City, Ogden and Provo together with points north and south while Interstate 80 linked the area with points east and west.

Development has also followed along Interstate 15, Highway 89, and major collectors. Interstate 15 continues north through Davis County joining Interstate 84 in Weber County. Interstate 84 continues from Weber County east through Morgan County as the major transportation route through the county. Trappers Loop Road (SR 167), North Morgan Valley Drive, Old Highway Road and East Canyon Road (SR 66) are also major transportation routes in the county. Historic development has followed the geographic constraints particularly in transportation.

S. Transportation

The growth and distribution of population and employment in Morgan County will have a significant impact on the transportation demands in the year 2030. Transportation accessibility is one of the major, if not the most important determining factor, where people live and work. To a large extent, people will live and work where transportation exists. Future development patterns will influence and be influenced by transportation. It is better planning to first conceptually plan for major transportation requirements.

Air quality is an influence on transportation. Greater awareness and concern for the air quality has resulted in tighter air quality standards and decreased transportation emissions. As Morgan County continues to grow, the interrelationships among development and transportation will continue to increase.

The growth and distribution of the Morgan County population and employment will continue to have a significant impact on the transportation needs of the future. Increases in regional population and employment translate into a growing demand for travel. In addition, the number of miles driven continues to increase. The amount and distribution of growth provide insights into the type, size and location of new transportation facilities required to meet present and future travel demand, including new highway projects, transit improvements, and transportation facilities for bicycles and pedestrians.

T. Household Size

Even with relatively large families, Utah is following the national downward trend in household size. As the population ages, birthrates fall and the household size decreases. There is no reason to believe that Morgan County will continue steady growth over the next several decades. There are some areas in the county that will experience a slowing of population growth due to falling household sizes, while others will increase due to neighborhood recycling, where young families with children move into a neighborhood as the aging population dies. Certain areas of the county will remain undeveloped into the future even with projected high growth.

U. Technology

As technology develops, its influence on community development touches every aspect dramatically. Technological influences are significant. This report will only very briefly mention a few. Technology advances in communications have made it possible for telecommuting, reduced the requirement of a daily commute to a workplace; increased availability of reliable public transportation has changed where people live and work; advances in agriculture have allowed more food to be produced on less land; and technological advances allow developments on marginal sites. Currently Morgan County does not have any public transportation service. As population growth continues, public transportation service may expand into the Morgan valley.

V. Reclamation of Industrial Land

Much public and private land will remain undeveloped because of specific environmental constraints, such as steep slopes, prime wetlands, or hazardous substances. However, other environmentally challenging properties are now developable due to advances in technology. Some areas historically used for industrial or mining activity are planned to be reclaimed for other uses.

W. Employment Trends

In the past 30 years, Morgan County's economy has diversified, resulting in more widespread development. The county's economy was once heavily dependent on a limited number of industrial sectors, primarily mining and government/military.

No longer dependent on a limited number of sectors, the county's economy is now based on the service sector and other industries, such as health care, education, and local government. Agriculture continues to decline in importance in the county. The distribution of commercial and industrial development will remain much as it is today. Morgan County has experienced minimal employment changes, up or down, during the past decade. Overall, large employment gains are occurring in suburban areas.

X. Public Policy

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. Projections for the Wasatch Urban Area Long Range Transportation Plan: 2007-2030 is based on individual city and county land use assumptions. A majority of the region is expected to be developed for residential uses. These local master plans call for relatively low-density residential and non-residential development patterns, with some pockets of denser activity.

The Utah Quality Growth Act of 1999 created the Utah Quality Growth Commission to address the challenges and opportunities that growth brings to Utah. In addition, several public and private partnership planning efforts involved in smart growth initiatives have developed land use alternatives and growth scenarios. Envision Utah's outreach presentations provided local public officials and the general public the opportunity to examine the future consequences of various land use decisions. The growth scenarios ranged from the status quo land use planning to a demonstration of much greater density. These planning exercises and demonstrations proved beneficial in educating participants about development options and their anticipated consequences.

Public policy is the greatest contributing factor in development. This report has briefly mentioned the general development trends in the region and county as well as the contributing and limiting influences on development. Ultimately, the many development constraints and influences are measured, weighed, compared, and balanced in public policy.

Development public policy is articulated in Master Plans (sometimes referred to as General Plans, Land Use Management Codes, and other planning documents).

Master Plans and Land Use Management Codes are formally adopted by city or county councils whereas other planning documents may not receive formal adoption. All Region counties continue to update their Master Plans and Land Use Management Codes. The counties have cooperated in producing the Wasatch Front Regional Open Space Plan. This Plan gives each county guidelines for preserving and developing open space. Utah is partially State supported to advocate smart growth. Envision Utah defines "smart growth" as growth that requires minimal infrastructure and maximizes environmental and human benefits.

IX. Capabilities Assessment

This assessment analyzes current capacity to mitigate the effects of natural hazards and emphasizes the positive capabilities that should be continued. Morgan County has limited resources to accomplish hazard mitigation.

The following areas were assessed to determine mitigation capabilities:

- Staff and Organization
- Technical
- Fiscal
- Policies and Programs
- Legal Authority
- Political Willpower

A. Staff and Organization

The assessment found that Morgan County and Morgan City have limited capabilities to conduct mitigation projects, and are already protecting their citizens from natural hazards under at least one department within their governmental structure.

1. City and County Elected Officials
   Morgan County has an elected county council consisting of seven members governing the county. Morgan City has a five member city council and a mayor governing the municipality. These elected officials have the responsibility of adopting mitigation policies. All cities and counties receive their legal authority to govern from the State of Utah.

2. County General Capabilities
   Listed below is a general organizational list of county/city governmental administrative areas involved in pre-disaster mitigation:

   a. Elected Officials
   b. City Manager
   c. County and City Attorneys
   d. County Assessor
   e. County Clerk
   f. Human Services
   g. County and City Treasurers/ Finance
   h. Public Works Departments
   i. Weber-Morgan Health Department
   j. Sheriff's Office
   k. Fire Departments
   l. County Emergency Management
   m. Special Improvement Districts

3. Emergency Management
   Morgan County Emergency Management is organized within Morgan County Public Safety. The Public Safety Director is the designated emergency manager for the County and is responsible for natural and man-made hazard mitigation, preparedness, response and recovery operations.

4. Local Emergency Planning Committee (LEPC)
   The mission of LEPC is to coordinate emergency preparedness for hazardous materials between all public and private emergency task disciplines. The Morgan County LEPC has expanded its mandated hazardous materials function to include all hazards. The Morgan County LEPC is chaired by the emergency management director and is comprised of elected officials; law enforcement, emergency management, firefighting, emergency medical services, health, local environmental, hospital and transportation personnel; broadcast and print media; community groups; and owners and operators of hazardous chemical facilities that are required by federal law to have hazardous chemical emergency planning.

5. Fire/Emergency Medical Services
   Morgan County Emergency Services include the fire department, ambulance/EMS, and emergency management.

6. Public Works
   Morgan County Public Works includes road maintenance, snow removal, tree ordinance, and weed control, storm water management sections, and watershed management.

7. Health Care
   Morgan County does not have a hospital. However the Weber-Morgan Health Department provides medical emergency preparedness and response at a clinic located in Morgan. Weber-Morgan Health organizes, coordinates, and directs emergency medical and health services. The health department assesses health hazards caused by damage to sewer, water, food supplies or other environmental systems. It also provides safety information, assesses disaster related mental health needs and services, and provides crisis counseling for emergency workers. Short of a pandemic disease outbreak, the health department will likely continue to adequately staff, train and fund Health Department missions.

8. School District
   The Morgan County School District administrators work closely with local public safety officials including law enforcement, fire emergency medical services, and public health to help to ensure that schools are well prepared for any kind of emergency.

9. Special Service Districts
   There are more than 65 Special Service Districts (SSD) in Morgan County. The large majority of these SSD's provide the delivery of irrigation water to shareholders. For the purposes of this Plan, SSD's are defined as quasi-governmental agencies having taxing authority, providing a specific public service that may include; public transportation, fire, water, wastewater and sewer. SSD’s work closely with local public safety officials to ensure that these Districts are well prepared for any kind of emergency. Occasionally, the districts participate in the county or city emergency preparedness committee for emergency coordination, planning and response.

B. Technical Capability

Throughout the plan update process, planners consulted with and utilized the technical expertise from a wide variety of resources listed below:

1. Jurisdiction Technical Expertise
   Morgan County has a full-time community development planner, a part-time emergency manager, building inspectors, and engineers on staff.

2. Geographic Information Systems (GIS)
   Staff experience with GIS varies within Morgan County. There is at least some staff to coordinate data processing and computer capabilities for GIS. GIS is a geo-referenced set of hardware and software tools that are used to collect, manage and analyze spatial data. (GIS capabilities are often found in other departments such as public works or information technology.) GIS is most beneficial when data from all departments and planning jurisdictions is inputted for analysis.

3. Public Safety Communications (PSC)
   Morgan County public safety communications is connected through the Weber County State Public Safety Dispatch Center in Ogden. The Sheriff's Office also has an internal dispatch capability. Public safety networks assure emergency communications through radio, microwave, telephone, satellite, internet, e-mail, fax and amateur radio. One of the most beneficial capabilities of PSC is providing cross communication between equipment and frequencies. PSC coordinates dissemination of emergency information to the media, the public and emergency personnel; activates internal information systems; acts as a liaison to elected officials; assists in the provision of emergency information and document the impact.

4. Public Works
   Morgan County and Morgan City each has public works departments that generally provide engineering, transportation, GIS, water, wastewater, sanitation expertise and capability. As a team, public works personnel identify critical infrastructure and plan and prepare for emergency mitigation.

C. Other Technical Capabilities

1. Utah Division of Emergency Management (Utah DEM)
   Utah DEM assists Morgan County in providing information on preparing for and responding to emergencies. DEM serves as the liaison between local, state and federal emergency assistance. DEM provides information, planning and training on a variety natural and technological hazards.

2. Utah State University(USU) Cooperative Extension
   The USU Extension Service assisted with family and community data in putting research-based knowledge to work. Many of the programs and informational courses improve pre-disaster mitigation.

3. University of Utah
   The University of Utah was utilized as a technical resource for academic mitigation research and demographic data.

4. Wasatch Front Regional Council (WFRC)
   WFRC is a valuable cooperative planning organization between Davis, Morgan, Salt Lake, Tooele and Weber Counties. WFRC is a resource for coordination, communication and planning expertise.

D. Fiscal Capability

Morgan County has limited fiscal capabilities to implement mitigation actions. It's likely that the County can only fund a limited amount of the local fiscal match for existing federal mitigation programs. Utah State Code; Section 17-50-501 classifies counties into six categories based on population. The State of Utah grants graduated autonomy to counties according to class size. Morgan is a Class 5 County which is defined by having a population of 3,500-10,000. Morgan's current projected population is 10,173.

E. Policies and Programs

Connecting local land use management with natural hazard planning is an effective way to mitigate a community's risk. Many communities have plans, ordinances, agreements, maps, training, warning systems, etc. in place that help them to become more disaster resistant. One of the goals of this Plan is for communities to coordinate existing activities so that individual objectives become part of an overall plan of action.

F. Land Use Management Tools

1. Ordinances
   - **Zoning ordinances** designate the use of land and structures for the purpose of protecting the health, safety and welfare of residents and businesses. A zoning ordinance divides all land within a jurisdiction into zones or related uses. The zoning ordinance is comprised of two parts; the text and maps.
     Specific zones are usually created for residential, commercial, industrial and government uses. The map defines the boundaries of these zones and the text provides the regulations for uses that are permitted to exist in each of the zones.
   - **Subdivision ordinances** regulate all divisions and improvements of property including the division of land involving the dedications of new or changes of existing streets/roads.
   - **Design controls** regulate building and landscaping. Such controls can be tailored to require that new developments meet the specific needs of the area. For example, requiring flame resistant roofs in urban-rural wildland fire interface zones or requiring that trees and vegetation are planted on steep slopes to help mitigate landslide hazards.

- **Floodplain ordinances** prevent building in special flood hazard areas and provide flood loss reduction measures to new and existing development. Floodplain management ordinances help to provide insurance to homes and businesses through the National Flood Insurance Program (NFIP). The NFIP's Community Rating System was implemented to encourage cities to manage floodplain activities that exceed the minimum NFIP standards. A community participating in the system will receive reductions in insurance premiums.
- **Building codes** require certain standards of practice.

2. Easements
   Easements can be a cost effective way to control development in hazard prone areas. Various land trusts can help secure easements that can then be conserved or preserved.

3. Planning
   - **General plans** serve as a guide for decision-making on rezoning and other planning proposals and as the goals and policies of municipalities attempting to guide land use in local jurisdictions. Each plan is recommended to include land use, transportation, environment, public service and facilities, rehabilitation, redevelopment, conservation, and economics. Also recommended are implementing recommendations including the use of zoning ordinances, subdivision ordinances, capital improvement plans, and other suitable actions that the municipality deems appropriate. General plans articulate the jurisdiction's vision while land use management codes implement that vision. General plans and land use management codes are being consulted, reviewed, and changed as necessary.
   - **Emergency Operations Plans (EOPs)** identify specific emergency actions undertaken by a jurisdiction to protect lives and property immediately before, during, and following an emergency. The county EOP was reviewed as part of this planning process.
   - **Floodplain Management Plans** identify steps and implementation strategies to effectively deal with floodplains. FEMA uses a scoring system is used to rate communities. Those with higher scores will receive higher discounts (in 5% increments) on flood insurance.
   - **Stormwater Management Plans** identify water policies for an entire watershed. Such policies can include: preservation of habitats, water quality and supply, open space development, land preservation, pollution prevention and construction regulations.
   - **Environmental reviews** explain how development affects the land and its resources.
   - **Capital Improvement Plans**. Cities plan for costs related to infrastructure, public facilities, and public safety. These plans identify projects, prioritize them and identify ways of funding them. Such plans can include disaster reduction costs or mitigation measures in flood-prone areas or retrofitting buildings for seismic strengthening.

Morgan County strategies would incorporate various mitigation measures. The following table identifies Morgan County existing land use ordinances, management practices and plans currently in place.

MORGAN COUNTY AND CITY		
	Morgan City	**Unincorporated County**
Avalanches	N	Y
Earthquakes, Faults, Geologic Hazards	Y	Y
Floodplains	Y	Y
Foothills & Canyons	Y	Y
Groundwater	Y	Y
Habitat	Y	Y
Lakes, Streams, Riparian Areas	Y	Y
Landslides	Y	n/a
Mountains & Forest Zones	Y	n/a
Pollution & Air Quality (General Plan)	N	Y
Prime Agricultural Lands	Y	Y
Ridgelines	Y	N
Steep Slopes	Y	n/a
Watersheds	Y	Y
Wetlands (work with Army Corps)	Y	Y
Wildland Fire	Y	Y
Sensitive Lands	Y	Y
Emergency Management Plan	Y	Y
Stormwater Management Plan	Y	N
Growth Management Plan	Y	Y
Community Rating System Classification	N	N
General Plan Land Use Update	-	2010
General Plan Transportation Update	-	2016
General Plan Housing Update	-	2010

Natural Hazard and Environmental Planning, Morgan County

4. Building Codes

International and national building codes have been adopted by all jurisdictions in the region. These codes are constantly in review for reasonable preparedness for disasters. Locally, building officials lobby for additions or exceptions to international and/or national building codes according to local conditions. Most insurance policies rely on the international and national building code standards for assurance.

The Insurance Services Office, Inc. manages the Building Code Effectiveness Grading System (BCEGS). This program was implemented in 1995 and assesses the building codes in effect in a particular community as well as how well the community enforces its building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with 1 showing exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory credits, and related underwriting information.

Communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. FEMA also uses these scores in their competitive grant programs, giving a higher ranking to those projects with lower scores. The following table highlights the BCEGS scores for Morgan County.

Morgan County and City BCEGS Classification			
	Residential	**Commercial**	**Date**
Morgan	4	3	2007
Morgan County	4	4	2006

Building Code Effectiveness Grading Reports, Morgan County

G. Legal Authority

Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In Morgan County/City, the local executives responsible for implementing plans and policies are the county council and the city mayor/council.

Local governments must be prepared to participate in the post-disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document. Cities and counties in Utah have the authority, through policing, to protect the health, welfare, and safety of their residents.

H. Political Willpower

Morgan County public officials have shown support for pre-disaster planning in the following ways:

1. Community Development Documents
   Elected officials have adopted updated community development documents to reduce the risk of emergencies and disasters. Morgan County/City have updated Emergency Operation Plans, Land Use Management Codes, International Building Codes, and General Plans that include pre-disaster planning. In addition, there is support from residents for the Wasatch Front Regional Council's recently adopted Wasatch Front Regional Open Space Plan. In the Wasatch Front Regional Open Space Plan, property with higher probability for disaster is recommended for open space or lower intensity uses.

2. Emergency Planning Training Courses
   Morgan County residents have supported emergency planning training sponsored by DEM and local governments such as: Community Emergency Response Team (CERT), Local Emergency Planning Committees (LEPC), Hazardous Materials (HAZMAT), Site Plans and Ordinances, Real Estate Requirements, and Hazard Mitigation.

X. Risk Assessment

A. Hazard Identification

The first step in risk assessment is identifying the hazards that could impact Morgan County. Hazard identification addresses the geographic extent, the intensity/magnitude of a hazard and the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Working Groups
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Division of Emergency Management
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in the table on the next page have the potential of affecting Morgan County. The identification process for each county and participating jurisdictions utilized those natural hazards that consistently affected the county prior to and during the planning process based on history of occurrences, future probability, and risk.

Morgan County, with help from local officials, created maps that identified the location of critical facilities and the municipalities affected by each identified hazard. Initial data from this study was also used to determine hazards that presented the greatest risk the County. The geographic extent of each hazard is identified through maps. The hazard intensity/magnitude and probability profiles are also shown.

County jurisdictions contributed to the risk assessment analyses performed for the county when located within an identified hazard boundary.

Hazard	How Identified	Why Identified
Earthquake	• Review County Emergency Operations Plan • Input from County Emergency Manager, USGS, UGS, DEM, and community members	• Utah has a 1/5 chance, of experiencing a large earthquake within the next fifty years. • Numerous faults throughout Utah including the Intermountain Seismic Zone. • Yearly, Utah averages approximately 13 earthquakes having a magnitude 3.0 or greater. • Earthquakes can create fire, flooding, hazardous materials incident, transportation, and communication limitations. • The Wasatch Front has recorded large earthquakes in the past and can be expected to experience significant earthquakes in the future.
Landslide	• Input from County Emergency Manager, USGS, UGS, NCDC, DEM, and community members	• Has caused damage in the past to residential and commercial infrastructure. • Can be life threatening. • Generally, occur in known historic locations therefore risks exist throughout much of the Wasatch Front. • To increase community awareness.
Wildland Fire	• Review County Emergency Operations Plan • Review Community Wildfire Plans • Input from County Emergency Managers, DEM, Utah FFSL, Utah FS, NWS, FEMA, and local community members	• Serious threat to life and property. • Increasing threat due to urban growth in WUI areas. • Secondary threat associated with flooding, drought, and earthquake. • Most of Morgan County is at risk including the growing neighborhoods in the Cottonwoods, Mountain Green, and Rollins Ranch Developments. • Additional funding and resources offered by local and state agencies to reduce risk. • To increase community awareness.
Problem Soils	• Review County Emergency Operations Plan • Input from community members, DEM, and UGS • Research historical data	• Related to subsequent effects from earthquakes. • Have affected infrastructure and local economy in the past.

Dam Failure	• Review County Emergency Operations Plan • Input from community members, - Utah DWS, Dam Safety Section, DEM • Review inundation maps	• Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc. • There are several reservoirs located Morgan County. • Morgan County is downstream from four large reservoirs (East Canyon, Lost Creek, Echo, and Wanship). • Threat to downhill communities. • Subsequent effects include flooding, fire, and debris flows. • To increase community awareness. • To incorporate mitigation measures into existing plans to help serve local residents.
Flood	• Morgan County experienced a flood disaster in 2011 • Input from County Emergency Manager, Utah DWS, UGS, Utah Army Corps of Engineers, DEM, and community members • Review Flood Insurance Studies, Floodplain maps, and Flood Insurance Rate Maps	• Several incidents have caused severe damage and loss of life. • Many of the rivers and streams are located near neighborhoods. • Many neighborhoods are located on floodplains, alluvial fans. • Topography and climate lead to cloudburst storms and heavy precipitation can result in flash flooding throughout the county.
Severe Weather	• Review County Emergency Operations Plan • Review past disaster declarations • Input from County Emergency Manager, Utah Avalanche, Forecast Center, Utah Department of Transportation, and community members	• Damage to communities, homes, infrastructure, roads, ski areas, and residents. • Can cause property damage and loss of life. • Results in economic loss. • Lightning is number one cause of natural hazard death in Utah. • Can be costly to recover from. • Affects the young and old more severely.

Morgan County Hazards Identification

The hazard identification process was aided through the use of FEMA How to Guidance documents, FEMA 386-1,2,3,7 FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12, Disaster Mitigation Act of 2000, 44 CFR Parts 201 and 206, Interim Final Rule, and FEMA Region VIII Crosswalk. The risk assessment process also utilized assistance from local Wasatch Front region GIS departments using the best available data.

B. Hazard Profile

This section describes the causes and characteristics of each identified hazard, including its *severity* or *magnitude* (as it relates to the percentage of the jurisdiction that can be affected), *probability*, conditions that make the area prone to the hazard, hazard history, and maps of the hazard's geographic location or extent.

The hazards were profiled based on history of occurrence, local input, county emergency operations plan, and county master or general plans, scientific reports, historical evidence, and hazard analysis plans. A risk assessment "Hazard Profile" table was created that highlights the above mentioned materials in the Morgan County plan introducing each identified hazard. The probability of a hazard event was determined through the amount of risk to the county.

In determining hazard magnitude, a scale was used to identify the level of damage on a countywide basis from Catastrophic to Negligible.

	Jurisdiction Affected	Risk
Catastrophic	More than 50%	Extreme or High
Critical	25-50 %	Moderate
Limited	10-25%	Moderate
Negligible	Less than 10%	Low

FEMA Hazard Profile

The probability of a hazard event was determined through the amount of risk to the county. The probability or likelihood of an occurrence is categorized into four categories: Highly Likely, Likely, Possible, and Unlikely.

The geographical extent or location of the community that would be affected has been identified in the mapping portion of each county where geographic data was available. A Morgan County hazard history is provided. The hazard history was taken from the Spatial Hazard Events and Losses Database for the United States (SHELDUS). The history was condensed into charts, tables and graphs in the hazard profile section.

Maps were created using GIS software to identify the location and extent of each identified hazard area. Hazard maps were created for every identified hazard within the county. The following risk assessment maps were created for the county:

- Dam/Reservoir Sites
- Earthquake Epicenters and Fault Zones
- Flood Zones
- Ground-shaking Potential
- Landslide Susceptibility
- Liquefaction Potential
- Problem Soils
- Wildfire
- Combined Structural Hazards

C. Vulnerability Analysis

The vulnerability analysis is based on asset identification and potential loss estimates for those jurisdictions located within identified hazard areas. The information sources used to complete the vulnerability assessment portion of this Plan include; Utah DEM, County GIS department, county Assessor's Office, HAZUS-MH data, and the Utah Automated Geographic Reference Center (AGRC). This data was compiled into GIS layers that were used as overlays to identify critical facilities, municipality, roads, and residents. The assets that have been identified are based on the best available data during the development of this Plan in GIS form.

1. Asset Identification
   The vulnerability analysis combines the data from each of the hazard profiles and merges it with community asset information to analyze and quantify potential damages from future hazard events. The asset inventory identifies buildings, roads, and critical facilities that can be damaged or affected by the hazard events. Critical facilities are of particular concern because of the essential products and services to the general public they provide. These critical facilities can also fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in this plan include hospitals, police and fire stations, schools, communication facilities, utility companies, water and wastewater treatment plants. In order to assess where and to what extent the identified hazards will affect the assets of Morgan County, the locations of assets were identified and overlaid with the mapped hazards using GIS software.

2. Potential Loss Estimates
   Potential dollar loss estimates were identified using this same method; therefore estimates were completed for existing infrastructure only. When data permitted, structure, content, and function of the identified vulnerable infrastructure was incorporated into the vulnerability assessments. Describing the vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets.

   Future planned development was not analyzed due to the lack of data available in GIS format. However, countywide development trends have been identified and are addressed within this chapter. The core planning team and local planning team members estimated potential losses for the identified hazards by using the methodology explained in the FEMA document titled, Understanding Your Risks: Identifying Hazards and Estimating Losses, Utah DEM historical data and GIS data.

D. Methodology

Geographic Information System (GIS) software was used as the basic analysis tool to complete the hazard analysis for the Morgan County Natural Hazards Pre-Disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and Transportation Analysis Zone (TAZ) demographic information.

Statewide digital data was obtained from Utah Automated Geographic Reference Center (AGRC) for problem soils only. The vulnerability assessment for each county estimates the number of homes, business, infrastructure and population vulnerable to each hazard and assigns a replacement dollar value to residential structures and infrastructure in each hazard area. The value of residential housing was calculated using estimated average residential housing values for Morgan County, as census estimates were unavailable. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

The methodology used to determine vulnerability for all hazards was identical. The number of households and population vulnerable to each hazard was determined using WFRC Transportation Analysis Zone (TAZ) data and Block Data from the 2010 Census data. The Block Data from the 2010 Census database, or TAZ data, was intersected with each of the mapped hazard layers in order to determine the number and location of residential housing units and population at risk from hazards.

The methodology used assumes an even distribution of residential housing units and population across each census block. Point data from HAZUS-MH, which is shorthand for Hazards United States - Multihazards. The HAZUS-MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The HAZUS-MH model for Morgan County was updated in 2015. This data was used to determine the number of businesses, and the annual sales of each business in each hazard area.

The number of acres for all hazards was determined for each city and the unincorporated county. Once an acre total was identified it was overlaid on the Census Block data or TAZ data to determine the total number of homes impacted. The number of homes impacted was then multiplied by the average housing value to determine the total value of potential loss. 2010 U.S. Census Bureau average house values for Morgan County was multiplied by the rate of increase for Morgan County. This produced an average house value of $223,000 for Morgan County. Content values are not included, which would raise the potential loss numbers for housing by approximately 50%.

In addition to the above methodology, earthquake was profiled using HAZUS-MH. The methodology deals with nearly all aspects of the built environment and a wide range of different types of losses. Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS-MH methodology and software are flexible enough that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy. 2010 TAZ data was aggregated to census blocks to update population data within HAZUS-MH.

Uncertainties are inherent in any loss estimation methodology, which arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities.

Uncertainties also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS-MH Earthquake Model, possibly at best a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS-MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model does not perform as well in estimating more detailed results, such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

The HAZUS-MH Model estimates building losses, numbers of shelters required for displaced households, amounts of debris generated, and numbers of casualties. A HAZUS-MH report was last completed for Morgan County in 2006.

The potential impact of natural hazards on transportation and utilities was determined in a similar method as described above. Roads and utilities were overlaid on the hazard areas and the impacted utility and road segments were inventoried. Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS-MH.

In addition to the linear features, point data for critical facilities, dams, care facilities, schools, power generation facilities and substations were analyzed to determine if the feature was within a hazard area.

Limited availability of digital data presented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, flood, landslides, dam failure, problem soils and wildfires in this Plan. Additional limitations to the above described analysis method include:

- Assuming random distribution
- Limited data sets for water, gas, electrical, resulting in incomplete numbers for these features
- Lack of digital parcels data for Morgan County
- Relied on state wide data not intended for manipulation at the scale it was used
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data
- Meta data was lacking on some of the used data sets

In this document, simple maps were created to provide a graphical illustration of location. These maps are done at a scale, which allows them to fit on a standard letter sized page.

Data manipulation and maps were created as a planning tool, to be used as a visual representation of the data. This information should not take the place of accurate field verified mapping from which ordinances need to be based.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available, but this data does not necessarily indicate which areas will be developed and which will not.

E. Mitigation Strategies, Objectives, Actions

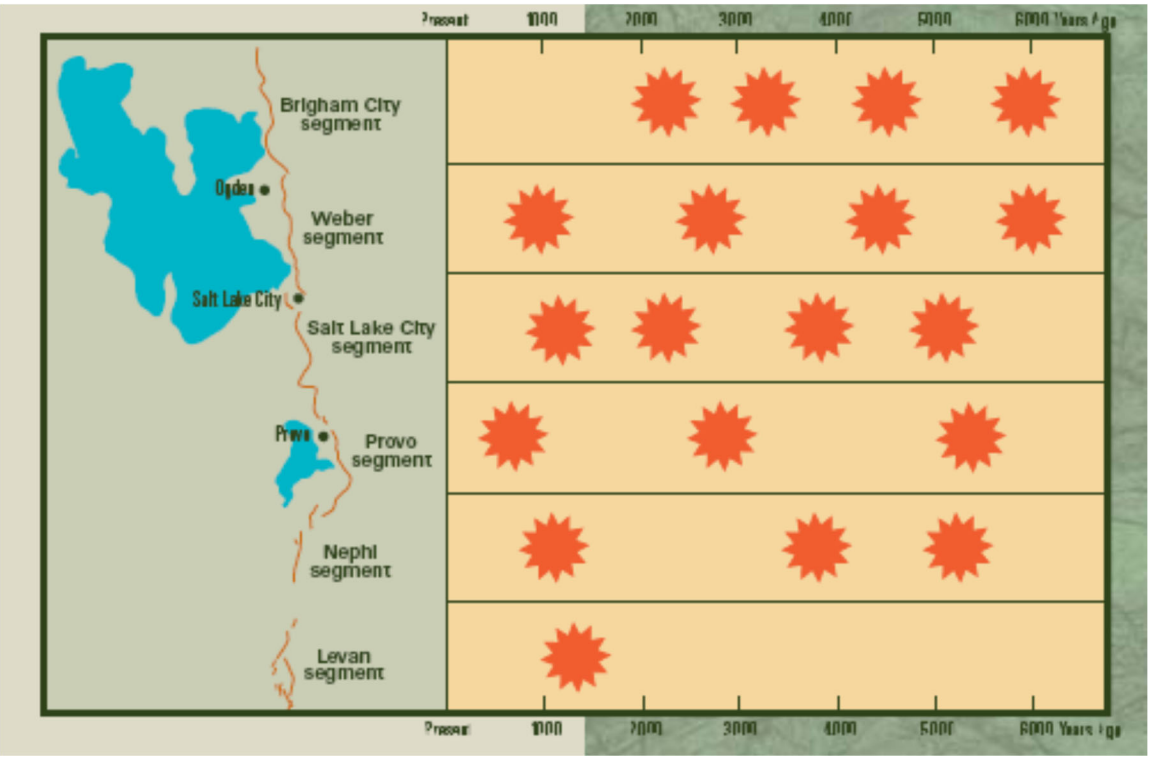
Using the findings from the risk assessment and the capabilities assessment as a guide, several mitigation strategies and implementing actions were identified that would benefit each jurisdiction. Each action has been formalized and placed into this Plan in the county mitigation section.

These actions were identified in the planning group meetings which included input from the core planning team, local planning team, state and local agencies, county government, and city and county residents. Goals and objectives were developed in a working session between the above-mentioned groups with a period provided for comment and revision.

Morgan County identified mitigation actions based on the identified goals and objectives. These actions are included in this Plan. These mitigation actions identify the responsible agency, the funding source, timeline, background, and their priority. Actions were selected using the information obtained from the capabilities assessment, which identified existing programs and shortfalls related to mitigation activities. The actions were prioritized based on the Social, Technical, Administrative, Political, Legal, Economic, Environmental (STAPLEE) method identified in the FEMA How-To Guides. The STAPLEE method of prioritization emphasizes the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each action is judged and ranked against these criteria and assigned the priority of High, Medium, or Low.

F. Hazard Description

Each of the natural hazards that could affect the county have been described. These are general descriptions about each hazard to give an idea of what, why, when, and how the hazards occur.



Wasatch Fault Segments and Timeline of Major Ruptures (Source: "The Wasatch Fault," Utah Geological Survey)

1. Earthquake

The Utah Geologic Survey defines an earthquake as the result of "…sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface" (UDCEM 1991). The energy that is released is abrupt shaking, trembling or sudden motion in the earth and rocks that break along faults or zone of weakness along which the rocks slip. Seismic waves are then transmitted outward and also produce ground shaking or vibrations in the earth. The Richter scale measures the magnitude of earthquakes on a seismograph. A Richter magnitude 6 earthquake is 30 times more powerful than a Richter magnitude 5. A Richter magnitude 7 is 1000 times more powerful than a Richter magnitude 5.

Utah experiences approximately 700 earthquakes each year, and approximately six of those have a magnitude 3.0 or greater. On average, a magnitude 5.5 or greater earthquake occurs in Utah every 10 years.

Generally, in order for humans to feel an earthquake it needs to be at least a magnitude 2.0. In order for significant damage to occur, an earthquake needs to be at least a magnitude of 5.5 or greater. The amount of damage that occurs from an earthquake depends on soil type, rock type, ground-water depth and topography. Other factors include the type of construction in an area and the population density.

Locations and Activity: Faulting can be evident on the earth's surface or not evident at all, therefore earthquakes are believed to be able to occur anywhere in Utah (UDCEM 1991).

The earthquake history of the Wasatch Fault is complicated by the fact that there has not been a large earthquake since the first pioneers first arrived in the valley in 1847. The last major earthquake in the Wasatch Front was approximately 1,350 years before present. Yet, when looking at the region, the potential for a large earthquake exists considering that "since 1850 at least 16 earthquakes (excluding aftershocks) of magnitude 6.0 or greater have occurred within the Intermountain Seismic Belt (ISB)" (UDCEM 1991).

On average, Utah experiences a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) every 7 years. The history of seismic activity in Utah and along the Wasatch Front suggests that it is not a matter of "if" but when an earthquake will occur.

Secondary Hazards: Associated earthquake hazards include ground shaking, surface fault rupture and tectonic subsidence, soil liquefaction, flooding, avalanches, dam failure, fire, and slope failure.

Ground Shaking: Ground shaking is caused by the passage of seismic waves generated by an earthquake. Shaking can vary in intensity but is the greatest secondary hazard because it affects large areas and stimulates many of the other hazards associated with earthquakes. The waves move the earth's surface laterally and horizontally and vary in frequency and amplitude.

High frequency, small amplitude waves cause more damage to short, stiff buildings. Low frequency, large amplitude waves have a greater effect on high-rise buildings. The intensity depends on geologic features such as bedrock and rock type, topography, and the location and magnitude of the earthquake. Other significant factors include ground water depth, basin shape, thickness of sediment, and the degree of sediment consolidation. Moderate to large earthquake events generally produce trembling for about 10 to 30 seconds. Aftershocks can occur erratically for weeks or even months after the main earthquake event. (UDEM 2014)

	Wasatch Front	**Utah**
Magnitude	***Frequency***	***Frequency***
≥3.0	3 per year	6 per year
≥4.0	1 every 2 years	1 per year
≥5.0	1 every 10 years	1 every 4 years
≥5.5	1 every 20 years	1 every 10 years
≥6.0	1 every 50 years	1 every 20 years
≥6.5	1 every 120 years	1 every 50 years
≥7.0	1 every 330 years	1 every 150 years

*Average Earthquake Frequency (Source: UUSS) unpublished data in UGS PI-38 1996) *excludes foreshocks, aftershocks and human-triggered seismic events*

Surface Fault Rupture and Tectonic Subsidence**:** Surface fault rupture or down dropping and tilting associated with tectonic subsidence can rupture the ground surface and in Utah the result is the formation of scarps or steep breaks in the slope. The 1934 Hansel Valley earthquake resulted in a surface displacement of approximately 1.6 feet. The highest potential for surface faulting exists in the central segments of the Wasatch Fault. Also, earthquakes having a magnitude of 6.5 or greater could result in surface faulting of 16 to 20 feet high and 12 to 44 mile long break segments. Surface displacement generally occurs over a zone of hundreds of feet wide called the zone of deformation. Tectonic subsidence generally depends on the amount of surface fault displacement. The greatest amount of subsidence will be in the fault zone and will gradually diminish out into the valley (UDEM 2014).

Soil Liquefaction**:** Liquefaction occurs when there is a sudden large decrease in shear strength of sandy soils. It is caused by the collapse of the soils structure in which the soil loses its bearing capacity, and also by a temporary increase in pore-water pressure, or water saturation during earthquake ground shaking. Liquefaction is common in areas of shallow ground water and sandy or silty sediments. Two conditions must be met in order for soils to liquefy; 1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) and 2) ground shaking must be strong enough to cause susceptible soils to liquefy (UGS 2015). The result is soils that will flow even on the gentlest of slopes.

Lateral spreading is a type of failure that results in surficial soil layers breaking up and moving, up to 3 feet or more, independently over the liquefied layer. On slopes more than 5 percent, flow failures can move several miles at speeds up to 10s of miles per hour. On slopes less than 0.5 percent the bearing capacity will lessen and can cause buildings to settle or tip. No matter the slope percent, ground cracking and differential settlement will occur. Liquefaction can also cause foundation materials to liquefy and fail and/or cause sand boils. Sand boils are deposits of sandy sediment ejected to the surface during an earthquake along fissures. Liquefaction can occur during earthquakes of magnitude 5.0 or greater. (UDEM 2014)

Slope Failure**:** Ground shaking can cause rock falls and landslides in mountainous or canyon areas. Rock falls are the most common slope failure and can occur up to 50 miles away from a 6.0 magnitude earthquake. Landslides occur along benches in wet unconsolidated materials. During a 6.0 magnitude earthquake, landslides may occur within 25 miles of the source. (UDEM 2014)

Flooding: "Flooding can happen due to tectonic subsidence and tilting, dam failure, seiches (waves generated in standing bodies of water) in lakes and reservoirs, surface-water diversion or disruption, and increased ground-water discharge." (UDEM 2014)

Avalanches: Avalanches could be triggered because of the associated ground movement. The most vulnerable areas include those that have steep terrain, high precipitation, high earthquake potential, and high population density. The Wasatch Range in Morgan County typically experiences several avalanches each winter (UDEM 2014).

Sensitive Clays: Sensitive clays are a soil type that loose strength when disturbed and result in liquefaction or collapse. The resulting type of ground failure is similar to liquefaction (UDEM 2014).

Subsidence: A settling or sinking of the earth's crust in loose granular materials such as gravel that do not contain clay. Western Utah is subject to this type of ground settlement (UDEM 2014).

2. Flood

Flooding is a natural event for rivers and streams. Flood is defined as the overflow of water onto land that is normally dry. Floods are related to an excess of snowmelt, rainfall, or failure of natural or engineered impoundments onto the banks and adjacent floodplains. Floodplains are lowland areas near river, lakes, reservoirs, oceans, and low terrain urban areas that are subject to recurring floods.

Flooding occurs when the peak discharge, or rate of flow in cubic feet per second, is larger than the channel of the river or the storm sewer capacity in a city. The peak discharge for a stream is associated with a probability of occurrence. The probability of occurrence can be stated in terms of recurrence intervals or return periods. For example, a probability of occurrence of 10 percent would be a flood expected to occur once in 10 years or 10 times in a 100 years. Flooding damage includes saturation of land and property, erosion from water, deposition of mud and debris, and the fast flowing waters from the flood itself. Most injuries and deaths occur from the fast moving floodwaters and most of the property damage results from the inundation by sediment-filled water. Flash flood conditions result from intense rainfall over a short period of time (USFMA 2015).

Snowmelt floods occur from the rapid snowmelt in the mountains. These floods generally happen in April, May and June. Warm air masses with mostly sunny skies melt the mountain watershed snowpack. The large accumulations of water generally last several days and the magnitude depends on the amount of snowpack and the warm weather. Snowmelt flood risk is reduced when the snowpack is below normal and/or the weather changes from winter to spring and summer gradually without an abrupt warming trend (USFMA 2015).

Rainfall floods result from large amounts of precipitation. Short duration local storms such as cloudburst or thunderstorms with a high intensity rainfall as well as the general storms that last several days with a less intense rainfall can produce a flooding event (USFMA 2015).

Areas prone to flooding, according to the Utah Natural Hazards Handbook, include lake and reservoir shorelines which may flood when the flow of water into the lakes or reservoirs is greater than the outflow capacity. The Great Basin has several terminal lakes, such as the Great Salt Lake and Sevier Lake, which mean there is no outlet to the sea. These types of lakes are subject to considerable variations in water levels because the only outflow is by evaporation. Successive wet or dry periods lasting several years can result in a large change in size of terminal lakes. Development near this type of lake during a dry period is risky and certain to get flooded during wet periods (USFMA 2015).

River and creek floodplain areas range from narrow zones to extensive lowlands extending great distances from a natural drainage area. Construction in floodplains is also dangerous because of the high flood risk.

Urban areas are also prone to flooding because of the decrease in vegetation of the natural watershed. Houses, driveways, parking lots, buildings, and streets are all replacing the vegetative cover that is so important in lessening the potential for flood. This type of development prevents water infiltration into the soil and greatly increases the runoff. In some areas undersized piping and channels are used which may cause flooding. Manmade drainage channels can also play a role in flooding. Trash and debris can obstruct passageways (USFMA 2015).

3. Landslide

Utah ranked third in the nation in terms of largest total landslide damage cost and cost per person between 1973 and 1983.

Morgan County's Mountain Green area has experienced damaging landslides in the recent past. Utah's landslide hazard rating is "severe", the highest level of five hazard classes given by the U. S. Geological Survey. The three main contributing factors to slope failure include areas with moderate to steep slopes, conductive geology, and high precipitation. The main elements that cause slope failure include precipitation events, topography and vegetation (UDEM 2015). Landslide distribution in Utah is associated with topography and physiographic provinces. The two physiographic regions that are conducive to landslides in Utah are the Middle Rocky Mountains province, and the High Plateaus subdivision of the Colorado Plateau physiographic province. Landslides are also known as slope failure and are classified according to the type of movement and the material involved. The five types of movement include falls, topples, slides, lateral spreads, and flows. The types of materials include rocks, debris (course-grained soil), and earth (fine-grained soil). Slope failure types are identified as rock falls, rock topples, rock slides, debris flows, debris topples, debris slides, slumps, and earth flows (UDEM 2015).

Rock Falls and Rock Topples occur when loosened blocks or boulders from an area of bedrock move down slope. Rock falls and topples generally occur along steep canyons, cliffs, and steep road cuts. Rock fall damage usually affects roads, railroad tracks, and utilities.

Debris Slides and Debris Flows generally occur in mountainous areas and involve the relatively rapid, viscous flow of course-grained soil, rock, and other surficial materials, and are considered a flow rather than a slide because of the high water content coupled with the debris. Debris flows are typically more dangerous because of the high speeds under which they travel, and generally remain in stream channels, however, they can flow from canyon mouths, out to a considerable distance. Debris flows and slides can damage anything in their path, including buildings, roads, railroad tracks, life lines/utilities, and reservoirs.

Slumps are common along road embankments and river terraces. Slumps slip or slide along a curved failure plane away from the upper part of a slope leaving a scarp (a relatively steeper slope separating two more gentle slopes). Slumps generally do not move very far from the source area.

Earth Flows are slumps with the addition of water that slump away from the top or upper part of a slope, leaving a scarp. These can range in size from very small to flows involving hundreds of tons of material and result in a bulging toe that can block streams and cause flooding, and damage buildings or other structures.

Causes of landslides are the result of hillside instability. Slope makeup, slope gradient, and slope weight all play a role. Other important factors of slope instability include rock type and structure, topography, water content, vegetative cover, and slope aspect. Debris flows, for example, occur when these elements are modified by natural processes or by human created processes.

Natural processes that can induce slope failure include ground shaking, wind and water weathering and erosion.

Human created processes such as lawn watering and irrigation may place excess water on already unstable ground by adding water weight to the material. This action raises the pore pressure, leading to a loss of shear strength. Water can also change the consistency of the slope material reducing cohesion leading to an unstable mixture.

Rock types containing clay, mudstone, shale, or weakly cemented units, which, are strongly affected by weathering and erosion, are particularly prone to landslides because of expansive and lubricating properties. Other processes include the removal or addition of slope materials during construction. Vegetation is very important in the stabilization of slopes because it prevents rainfall from impacting the soil directly and helps protect from erosion by retaining water and decreasing surface runoff. The roots systems serve as slope-stabilizing elements by binding the soil together or binding the soil to the bedrock. Increase in slope gradient such as placing heavy loads at the top of a slope and /or the removal of material at the toe of a slope all affect the equilibrium and result in slope failure because of slope instability.

4. Wildfire

The Wildland-Urban Interface (WUI) area, or I-Zone, is where residential areas meet wildland areas. It is known as the interface zone and presents a serious fire threat to people and property. The urban aspect includes homes, schools, storage areas, recreational facilities, transmission lines and commercial buildings. Wildland refers to unincorporated areas including hills, benches, plateaus, and forests. Homes are built on the benches adjacent to wildland areas. Wildfires remove vegetation which results in slope failure, erosion, water runoff and depletion of wildlife resources. The three conditions that affect fire behavior are topography, vegetation and weather (UDEM 2008).

Topography includes such factors as slope, aspect, and elevation. Fires spread faster upslope because the fuels are closer to the flames on the upslope. The heat from a fire moves uphill and dries fuels in front of the fire allowing for easier ignition. The aspect of slope dictates moisture content. In other words, the sun dries out fuels on south and west facing slopes more than on north and east facing slopes. Elevation and weather are interrelated because, generally, higher elevations result in cooler temperatures and a higher relative humidity. Elevation also determines the types of vegetation present (UDEM 2008).

Vegetation plays a major role in the speed of a fire. Light grasses burn rapidly and heavy dense fuels burn slowly but with a greater intensity. The five major fuel types in Utah's vegetation include grass/sagebrush, pinion-juniper, mountain bush, hardwoods, and softwoods. The grass/sagebrush area poses a serious threat because people under estimate the danger of wildfires in this area. These fires burn across thousands of acres rapidly and pose a serious threat to not only property but also life. Pinion-juniper fuel does not normally burn much, except when conditions are hot, dry and windy. When a fire does occur here, it will burn intensely and spread rapidly.

Mountain brush is commonly found in Utah's foothills and if moderate to extreme fire conditions are present. This type of fuel will burn hot and fast. Hardwood-forest and softwood (deciduous) fuel types are generally less risky (UDEM 2008).

Size, continuity and compactness all affect the fuel's rate of spread. Large fuels do not burn as readily as smaller fuels and need more heat to ignite. Small fuels on the other hand ignite easier, and a fire will spread more rapidly through them. Continuity is described by how fuel is arranged horizontally. Fuels that are broken up burn unevenly and slower than uniform fuels. Compactness is how fuel is arranged vertically.

Tall, deep fuels have more oxygen available so they burn more rapidly. Less oxygen is available to compact fuels such as leaf litter and stacked logs, therefore they burn slower (UDEM 2008). Weather factors include temperature, humidity, precipitation, and wind. Weather affects the ease with which a fuel ignites, the intensity at which it burns, and how easy or difficult fire control may be.

High temperatures increase fire danger because it heats fuels and reduces water content, which increases flammability. Humidity influences fuel ignition and how intensely fuel burns. A decrease in relative humidity causes fuels to dry, promoting easier ignition and more intense burning. Wind speed can increase burning intensity and the direction that the fire moves. Wind carries heat from a fire into unburned fuels drying them out and causing them to ignite easier. The wind may also blow burning embers into unburned areas well ahead of the main fires starting spot fires (UDEM 2008).

Fire protection in these areas is difficult because the tactics used for wildland fire suppression cannot be used for structure protection and suppression. The energy that is emitted from a wildland fire is very dangerous to firefighters and homeowners and makes protection of homes almost impossible. One third of all firefighter deaths occur fighting wildfires. Many believe that WUI areas increase the risks to firefighters significantly. Legally, federal wildland protection agencies seldom have the responsibility to protect structures. The legal responsibility for protecting structures on non-federal wildlands varies widely among state forestry agencies (UDEM 2008).

5. Dam Failure

Dams and associated water delivery systems serve various functions and are built by different agencies and entities including; the Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, cities, counties, and private irrigation companies. Dams are built for hydroelectric power generation, flood control, recreation, water storage for irrigation, as well as municipal and industrial uses. Utah's dry climate makes it critical for the storage of the winter snowmelt runoff for uses all year round. 84% of Utah's stored water is behind federal dams, while 650 non-federal dams hold more than 1.2 million acre-feet of water. Dam placement is important and needs to be in an area where it can collect and distribute the greatest amount of water. Dam sites with strong impermeable bedrock are the best in terms of strength. Many materials can be used to construct a dam such as earthen fill, concrete, roller compacted concrete, and rocks and mine tailings. Other dams are created by the enlargement or addition of existing lakes (UDEM 2008).

Rainy Day failures occur when floodwaters overstress the dam, spillway, and outlet capacities. The floodwater flows over the top of the dam and eventually erodes the structure from the top down.

At this point the floodwater meets with the floodwaters from the rainstorm and a very destructive, powerful flood is created (UDEM 2008).

Sunny Day failures are the most dangerous because they happen without any warning. Downstream residents or inhabitants have little or no time to prepare or even evacuate the area; the results are generally catastrophic. Sunny day failures occur from seepage or erosion inside the dam. This erosion removes fine materials creating a large void that can cause the dam to collapse, or overtop and wash away. Earthquake ground shaking or liquefaction can also create structural problems with dams. Ground shaking will cause the dam to start piping, slumping, settling, or experience a slope failure similar to a landslide. The dam then fails internally or overtops and washes away. Other sunny day failures occur when vegetation or rodents get into a dam and leave holes or tunnels that can lead to failure. Not all dam failures are catastrophic; sometimes a dam can fail and be drained and repaired without a damaging flow of floodwaters (UDEM 2008).

The Quail Creek Lake dike in Washington County experienced a sunny-day failure in 1989. Following its dedication in 1985, leakage in the dike was a problem. On December 31, 1988, those problems increased dramatically. Just after midnight on January 1, 1989, the 1,820 foot long Quail Lake Dike collapsed and a 200-foot break occurred. More than 25,000 acre-feet of water released into the Virgin River Channel. That flood damaged 50 to 60 homes and 100 apartment units, forcing 1,500 people from their residences. Bridges, roads, farms, and other property were damaged and the reservoir was rendered useless for several months. The ensuing flood from the Quail Lake dike failure was one of the worst disasters in southern Utah history, causing more than $12 million in damage, yet, miraculously, no lives were lost. (WCHS 2015)

"Hazard ratings are determined by downstream uses, size, height, volume and incremental risk/damage assessments. The hazard ratings are: Low- insignificant property loss; Moderate- significant property loss; and High- possible loss of life" (UDEM 2008). Over two hundred Utah dams are rated as high-hazard dams. In Morgan County, East Canyon, Echo, Wanship, and Lost Creek Dams are classified as high hazard dams.

6. Severe Weather

Winter Storms

Winter storms gain energy from the collisions of two air masses. In North America, a winter storm is usually generated when a cold air mass from dry Canadian air moves south and interacts with a northward moving warm moist air mass from the Gulf of Mexico. The position where a warm and a cold air mass meet is called a front. If cold air is advancing and pushing away the warm air, the front is known as a cold front. If warm air is advancing, it will ride up over the cold air mass and the front is known as a warm front. A winter storm will typically begin under what is known as a stationary front. A stationary front is when neither air mass is advancing.

The atmosphere will try to even out the pressure difference by generating an area of lower pressure; this creates wind that blows from high pressure towards a low-pressure area.

As the air travels toward the center of the low-pressure area, it is pushed up into the colder regions of the upper atmosphere because it has nowhere else to go. This causes the water vapor to condense as snow in the northern areas because of the colder temperatures. In the south, if the temperatures are warm enough the water vapor will fall as heavy rain in thunderstorms.

Because of the easterlies in Northern America, the winter storm moves quickly over the area and generally does not last longer than a day in one area. However, in Utah, because of the Great Salt Lake "lake-effect", snowstorms can last for many days. This is because of the amount of moisture from an unfrozen body of water. When a strong cold wind blows over a larger area of water, the air can attain a substantial amount of moisture; this moisture turns into heavy snow when it reaches land causing a lake effect snowstorm (Scholastic 2008).

Ice Accumulations

Ice accumulations can bring down electrical wires, telephone poles and lines, trees, and communication towers. Ice can also cause extreme hazards to motorists and pedestrians. Bridges and overpasses are likely to freeze first. (UDEM 2008).

Heavy Snow

Heavy snow will sometimes "immobilize a region by stranding commuters, stopping the flow of supplies, disrupting emergency and medical services, close infrastructure and services" (UDEM 2008). When heavy snow occurs with high winds, blowing snow or blizzard conditions may exist. (UDEM 2008).

Avalanche

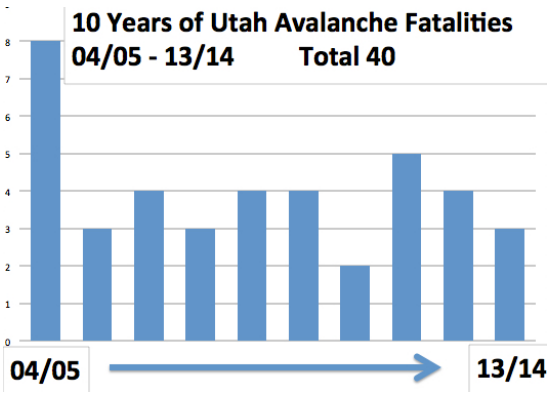
The Utah Division of Emergency Management defines an avalanche as a mass of snow sliding down a mountainside. Avalanches occur when stresses (driving forces), such as the pulling of snow downhill by gravity, exceeds the strength (resisting forces) such as the bonds between snow grains.

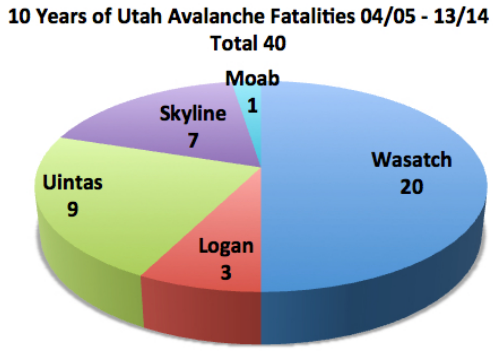
Four ingredients are needed to produce an avalanche:

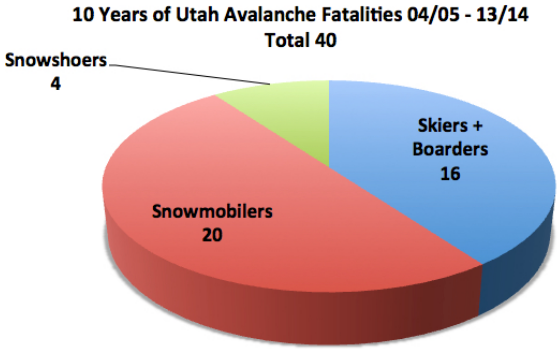
1. Snow
2. Weak layer in the snow cover
3. Steep slope
4. A trigger

About 90% of all avalanches start on slopes of 30 - 45 degrees; about 98% of all avalanches occur on slopes of 25 - 50 degrees. Avalanches release most often on slopes above timberline that face away from prevailing winds (leeward slopes collect snow blowing from the windward sides of ridges.) Avalanches can run, however, on small slopes well below timberline, such as gullies, road cuts, and small openings in the trees. Dense trees can anchor the snow to steep slopes and prevent avalanches from starting; however, avalanches can release and travel through a moderately dense forest.

Avalanche victims are primarily backcountry recreationists: snowmobilers, climbers, snowboarders, skiers, and hikers. In 90% of avalanche incidents, the victim or someone in the victim's party triggers the avalanche. (UDEM 2015)







10 Years of Utah Avalanche Fatalities 2004-2014 (UDEM 2015)

An avalanche consists of a starting zone, a track, and a runout zone. The starting zone is where the ice or snow breaks loose and starts to slide; this zone can be triggered by human and/ or natural activities. Human induced avalanches can result from snowmobilers, backcountry skiers, or other outdoor recreationalists causing ground shaking. The two main natural factors that affect avalanche activity include weather and terrain and large, frequent storms combined with steep slopes. Other factors that contribute to the stability of the snowpack include the amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. The track is the grade or channel down which an avalanche travels. The runout zone is where an avalanche stops and deposits the snow. For large avalanches, the runout zone can include a powder, or windblast zone that extends far beyond the area of snow deposition. In Utah, avalanches annually kill more people than any other natural hazard, and ironically, are often triggered by the victim. Each winter an average of four people dies in Utah due to avalanche activity (UDEM 2015).

Weather and terrain conditions affect avalanche conditions. The weather controls the durations and the extent of an avalanche while terrain is the element that determines where, why, and how an avalanche occurred. In Utah, the months of January through April pose the greatest avalanche potential.

Weather related aspects that affect the snowpack stability include rate of accumulation, amount of snowfall, moisture content, wind speed and direction, and snow crystal type. Wind can deposit snow 10 times faster than snow falling from a storm without accompanying wind. This affects avalanche potential because the underlying weak layer of snow cannot adjust to the new load. Rain and the melting of snow can almost instantly cause an avalanche because of the added weight (UDEM 2015).

Terrain includes such variables as slope, aspect, elevation, roughness and angle. The slope is important in understanding where an avalanche will occur. Slopes greater than 45 degrees are too steep because the snow continually sloughs off; however slopes greater than 20 degrees can produce avalanches. Optimum slope degree is between 30 to 45 degrees, which is also the optimum angle for backcountry skiers. This slope angle is where approximately 99.9 percent of avalanches occur. The slope aspect and elevation affect the snow depth, temperature, and moisture characteristics of the snowpack. Slope aspect, such as north facing or shady slopes usually produce more avalanches and more persistent avalanche hazards occur during mid winter months. In the spring, the strong sun on south facing slopes produce more wet avalanches (UAC 2015).

Slope shape and roughness correlate with snowpack stability. Roughness identifies boulders, shrubs, and trees that can help slow, or reduce avalanche speed and impact. A bowl shaped slope is more prone to an avalanche than a ridge or cliff.

Dry-slab avalanche is when a cohesive slab of snow that fractures as a unit slides on top of weaker snow and breaks apart as it slides. Dry-slab avalanches occur usually because too much additional weight has been added too quickly, which overloads the buried weak layer. Even the weight of a person can add a tremendous stress to a buried weak layer. Dry-slab avalanches usually travel between 60-80 miles per hour within 5 seconds of the fracture and are the deadliest form of avalanche (UAC 2015).

Wet-slab avalanches occur for the opposite reason of dry avalanches; percolating water dissolves the bonds between the snow grains on the pre-existing snow, which decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour (UAC 2015).

Avalanches can result in loss of life as well as economic losses. At risk are some communities, individual structures, roads, ski areas, snowmobilers, backcountry skiers, snowshoers, snowboarders, and climbers. One of the major consequences of avalanches is the burial of structures, roads, vehicles, and people in the runout zone where tens of feet of debris and snow can be deposited (UAC 2015).

Between 1958 and 2015, there was one Morgan County avalanche fatality listed on the Utah Avalanche Center website. In 2010, a snowmobiler was killed in the Francis Peak Ridgeline area. (UAC 2015)

Ground shaking, sound, or a person treading in an avalanche area can trigger a slide that can cover a wide area or can be concentrated to a smaller more narrow path. According to the Utah Avalanche Center, "a snow avalanche is the rapid down-slope movement of snow, ice, and debris. Snow avalanches occur in the mountains of Utah as the result of snow accumulation and unstable snowpack conditions" (UDEM 2015).

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Weather and terrain conditions affect avalanche conditions. The weather controls the durations and the extent of an avalanche while terrain is the element that determines where, why, and how an avalanche occurred. In Utah, the months of January through April pose the greatest avalanche potential. Weather related aspects that affect the snowpack stability include rate of accumulation, amount of snowfall, moisture content, wind speed and direction, and snow crystal type. Wind can deposit snow 10 times faster than snow falling from a storm without accompanying wind. This affects avalanche potential because the underlying weak layer of snow cannot adjust to the new load. Rain and the melting of snow can almost instantly cause an avalanche because of the added weight (UDEM 2015).

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Severe Thunderstorms usually last around 30 minutes and are typically only 15 miles in diameter (UDEM 2008), but all produce lightning, the “number one weather-related killer” in Utah (UDEM 2008). Thunderstorms can also lead to flash flooding from heavy rainfall, strong winds, hail and tornadoes or waterspouts (UDEM 2008).

Extreme Heat kills more people in the United States each year than any other weather-related hazard (NOAA 2008). Extreme heat is defined as “summertime weather that is substantially hotter and/or more humid than average for a location at that time of year” (EPA 2006). Extreme heat poses multiple threats to persons and infrastructure. Not only may personal health be affected through heat cramps, heat exhaustion or heat stroke (EPA 2006), but power grids are substantially burdened through the increased use of air conditioning, potentially resulting in brownouts or blackouts.

Certain populations are especially vulnerable during these events. These include the very young and elderly, the poor and homeless, reclusive persons, persons with physical or mental impairment, persons using specific medications, illicit drugs or alcohol, or persons strenuously working or playing outdoors (EPA 2006).

Extreme Cold

Prolonged exposure to the cold can cause frostbite or hypothermia and can become life threatening (UDEM 2008). Increasing winds can increase the risk to this hazard.

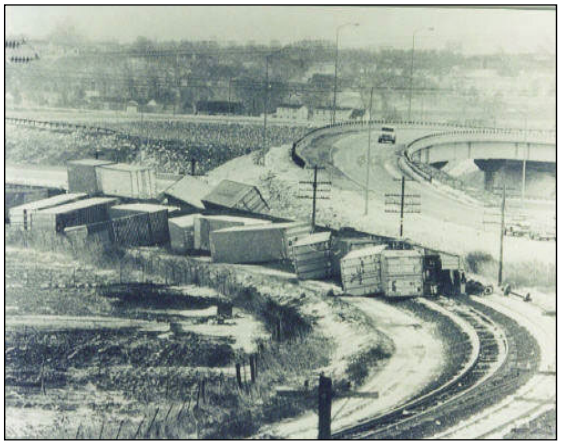
A. Severe Weather Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***	***X***	***Highly Likely***
		Critical (25-50%)			***Likely***
	X	***Limited (10-25%)***			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Occur in localized areas throughout the county. Although many severe weather phenomena generally have recognizable patterns of recurrence, it is difficult to identify exactly when and where the next event will take place.				
Seasonal Pattern	Year round				
Conditions	Vary based on latitude, elevation, aspect and land forms				
Duration	Severe weather hazards generally last hours and can persist for days.				
Secondary Hazards	Wildfire, flooding				
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah DEM, local input, and review of historic events and scientific records.				

Description of Location and Extent

1. High Winds

High winds can occur with or without the presence of a storm and are unpredictable in regards to time and place. Morgan County has experienced high winds in the past and can expect future high wind events.



Wasatch Front, April 4-6, 1983 – 70 mph "East Winds" derailed this train in the Lagoon area. Peak gusts were recorded at 104 mph. (Source: Utah's Weather and Climate, Photo: Ogden Standard Examiner)

Canyon winds can bring wind gusts greater than 100 mph through the canyon mouths into the populated areas of the Wasatch Front. Winds are usually strongest near the mouths of canyons and have resulted in the loss of power and the inability to heat homes and businesses. Winds have also damaged roofs, destroyed and knocked down large trees and fences, overturned tractor trailers and railroad cars, and downed small airplanes. Generally, strong east canyon winds do not impact Morgan County.

2. Severe Weather

Severe weather includes thunderstorms, lightning, hail, heavy snow or rain, and extreme cold. Severe Weather is generally related to high precipitation events during the summer and winter months and can happen anywhere in the county. Damage can be extensive especially for agriculture, farming, and transportation systems; they can also disrupt business due to power outages.

3. Thunderstorms

Strong, rising air currents bring warm, moist air from the surface into the upper atmosphere where it condenses forming heavy rains, hail, strong winds and lightning. Based on historical evidence thunderstorms can strike anywhere in the region, mainly during the spring and summer months.

Salt Lake Valley, September 3rd, 1983 - Thunderstorms produce 0.5" – 1.5" hail (Source: Utah's Weather and Climate, Photo: National Weather Service)

4. Hail

Hail occurs when freezing water (in thunderstorm clouds) accumulates in layers around an icy core generally during the warmer months of May through September. Hail causes damage by battering crops, structures and automobiles. When hailstorms are large, damage can be extensive (especially when combined with high winds).

Lewis Peak, North Ogden, Utah, August 8th, 2003 – Lightning (Source: Utah's Weather and Climate, Photo by Gene Poncelet)

5. Lightning

Lightning is the electric discharge between clouds or from a cloud to the earth. In Utah, lightning causes the highest number of weather-related fatalities (UDEM 2008). Lightning casualties occur most frequently during the summer monsoonal flow in July and August. Lightning is also the primary cause of wildland fires in Utah (UDEM 2008), which could cause casualties or be disruptive to the economy. There has been documented one lightning caused fatality in Morgan County, and two injured from lightning between 1958 - 2007. (NWS 2008).

6. Heavy Precipitation

Heavy amounts of precipitation from rain or snow can result in flash flood events. Morgan County has been susceptible to these types of storms because of close proximity to the mountain ranges. Major winter storms can produce five to ten times the amount of snow in the mountains than in the valley locations. Heavy snow can cause a secondary hazard in avalanches.

During heavy rain events, water and debris collects in stream channels causing water to overflow its banks, resulting in damaged residential, commercial property and infrastructure.

7. Extreme Temperatures

Temperatures in Morgan County can reach the extreme ends of the thermometer. Sub-zero temperatures are common during winter months, while summer temperatures regularly reach into the nineties with a few days above 100 degrees Fahrenheit.

Prolonged periods of extreme cold weather are infrequent, and January is generally the coldest month of the year. Historically, extreme cold in the county has disrupted agriculture and farming activities. Especially vulnerable to extreme cold are the young, elderly, homeless, and animals. Wind chill can further the effects of extreme cold.

Extreme heat not only causes discomfort, but can lead to heat exhaustion or heat stroke. Extreme heat also places severe strain on electrical systems due to the widespread use of evaporative coolers and air conditioners. This strain can lead to brownouts or blackouts leaving many without electrical power.

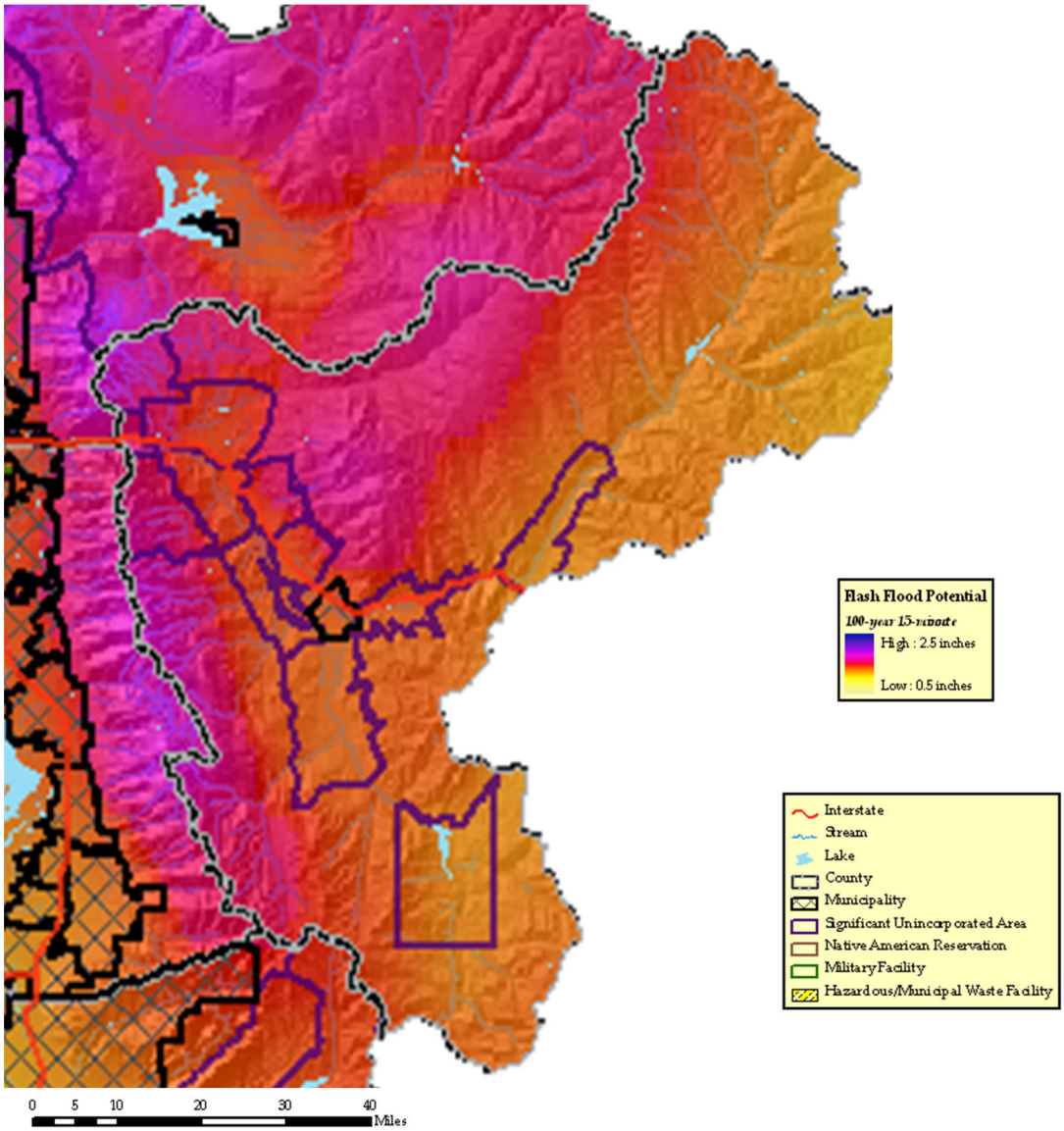
White Pine, Little Cottonwood Canyon, December 23rd, 1988 – two to three feet of snow deposited in the mountains causes many avalanches (Source: Utah's Weather and Climate, Photos: National Weather Service)

8. Avalanche

Heavy snows, high winds, extreme temperatures and steep mountain slopes combine to form avalanche hazards in the foothills and mountainous areas of the region. Even though most avalanches occur in wildland areas, recreational endeavors – hiking, hunting, mountain climbing, skiing, snowboarding, snowmobiling and other wintertime activities – bring the population into contact with avalanche-prone areas. Due to the immense popularity of these activities, avalanches are actively mitigated within well-traveled areas. Persons venturing into the backcountry are more at risk. Homes and businesses along the foothills and in mountain areas have been damaged from avalanches.

The majority of avalanches occur on slopes between 30 and 50 degrees and with terrain barren of vegetation. Types of avalanches include wet and dry slab. *Wet-slab avalanches* occur most often in warming conditions on southerly-facing slopes.

Dry-slab avalanches occur mostly on northerly facing slopes in mid-winter. Wind can accelerate snow deposition leading to larger and/or more frequent avalanches (UAC 2008). Morgan County has only recorded one avalanche related death. However, Snow Basin expansion plans may place residents closer to potential avalanche areas.



Morgan County Flash Flood Hazard (Source: NWS Hydrometeorological Design Studies Center)

B. Earthquake Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)		***X***	***Likely***
	X	***Limited (10-25%)***			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Dependent on vegetation and climate preference of individual insect species				
Seasonal Pattern	Typically spring and summer months				
Conditions	Varies with insect species				
Duration	Months, years				
Secondary Hazards	Wildfire, dust storms, landslides due to dead vegetation				
Analysis Used	Utah Department of Agriculture and Food (UDAF), United States Forest Service (USFS), Utah Division of Forest, Fire, and State Lands (UDFFSL)				

Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years (UGS 2002). Morgan County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment.

The combined average repeat time for large earthquakes on any of the five central segments (Brigham City, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years (McCalpin and Nishenko 1996 in UGS 2002). The average repeat time on any single segment ranges from about 1,200-2,600 years. Major earthquakes on the five central segments occurred 250 to 2,900 years ago (Lund 2005). The Weber Segment of the Wasatch Fault runs from North Salt Lake to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years (McCalpin and Nishenko 1996, in UGS 2002), making it one of the most active fault segments. The Salt Lake Segment underlies the Salt Lake valley. Smaller fault zones also pose a threat to Morgan County; include the Morgan, East Canyon, and Saleratus Creek fault zones (UGS 2002). The best data thus far is from the Morgan Fault which has a maximum potential of a 6.5-7.0 Richter magnitude fault rupture (Hecker 1993 in UGS 2002).

The recent historical record of earthquakes in Morgan County shows no events greater than Richter magnitude 4.0. Map 10-2 illustrates the locations of earthquakes epicenters in Morgan County since 1962, along with approximate Richter magnitude. Fault groups are provided to show relative locations of epicenters to faults located within the county.

A 0.2-second spectral acceleration map was created due to the predominance of one- and two-story buildings in the County. This frequency of ground shaking causes the greatest amount of damage in these structures (UGS 2008).

The mapped values indicate the maximum probable force (as a percentage of gravity) a one-to-two-story building would experience during a 2,500-year event (2% probability of exceedance in 50 years), which corresponds roughly to a Richter magnitude 7.1 event along the Wasatch Fault. For example, Morgan City would likely experience around 1g of lateral force during the event. Poorly constructed buildings will likely experience damage at around 0.1g (10% of gravity) (FEMA 1995). Local geologic structure and shaking duration are not accounted for in this map, and will likely cause significant variability in damages during an actual event.

Name	Fault Type	Length (km)	Time of most recent deformation	Recurrence Interval
East Canyon (East Side) fault	Unknown	24	<1.6 million years ago	Unknown
East Canyon fault, Northern section	Normal	25.9	<1.6 million years ago	Unknown
East Canyon fault, Southern section	Normal	25.9	<750,000 years ago	Unknown
Morgan fault, Central section	Normal	16.6	<8320±100 14C yr B.P.	25,000-100,000 years
Morgan fault, Northern section	Normal	16.6	<750,000 years ago	Unknown
Morgan fault, Southern section	Normal	16.6	<750,000 years ago	Unknown
Saleratus Creek fault	Normal	38	<750,000 years ago	Unknown

Active Faults in Morgan County (UGS 2002, Lund 2005) 14C yr B.P.=Radiocarbon 14 years before present

Liquefaction hazard for Morgan County is low. The river valleys have a minimal risk. This does not minimize the effect that an earthquake will have on the county as the ground shaking risk remains high.

Vulnerability Analysis

A vulnerability analysis was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH. The following numbers were based on a probabilistic 2,500-year event with a Richter magnitude of 7.1. An arbitrary 5.9 event located in close proximity to the County's most populated areas was also modeled. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH, please see Part VII or the HAZUS-MH Technical Manual (Earthquake Model) at www.fema.gov/hazus).*

Building Damage

HAZUS-MH classifies building damage into five states: none, slight, moderate, extensive and complete. The following table lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage. Also listed are the estimated monetary losses to structures, contents/inventory and income.

Category	Number of Structures with > 50% Damage		Category	Estimated Losses	
	Morgan M5.9	2500-yr M7.1		Morgan M5.9	2500-yr M7.1
Residential	80	P 2992 S 282	**Structural Losses**	$1,023,000	$11,772,580
Commercial	4	45	**Non-Structural Losses**	$3,600,000	$37,701,470
Industrial	1	8	**Content Losses**	$1,439,000	$12,760,820
Government	1	9	**Inventory Losses**	$76,000	$717,160
Education	0	1	**Income & Relocation Losses**	$909,000	$10,179,540
Totals	**86**	**800**	**Totals**	**$7,047,000**	**$72,414,410**

Building Damage Counts and Estimated Losses, 2006

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in the table below. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage >50%		Estimated Losses	
		Morgan M5.9	2500-yr M7.1	Morgan M5.9	2500-yr M7.1
Waste Water Facilities	2	1	2	$16,313,000	$36,722,000
Waste Water Pipelines	735 km	38 leaks/breaks	801 leaks/breaks	$137,000	$2,886,000
Potable Water Pipelines	1,225 km	48 leaks/breaks	1,014 leaks/breaks	$173,000	$3,649,000
Natural Gas Pipelines	490 km	41 leaks/breaks	857 leaks/breaks	$146,000	$3,085,000
Highway Bridges	80	13	31	$1,419,000	$10,842,000
Railway Bridges	1	0	0	$0	$4,000
Airport Facilities	1	0	1	$1,273,000	$2,157,000
Total Losses				**$19,461,000**	**$59,345,000**

Damage to Transportation and Utilities, 2006

Debris Removal

The following table shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	Morgan M5.9	2500-yr M7.1
Brick, Wood & Others	1,000 tons / 40 loads	12,000 tons / 480 loads
Concrete & Steel	2,000 tons / 80 loads	27,000 tons / 1,080 loads

Debris Generated/Number of Loads, 2006

Fire Following

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. The table below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Morgan M5.9	**2500-yr M7.1**
Ignitions	0	0
Persons Exposed	0	0
Value Exposed	$0	$0

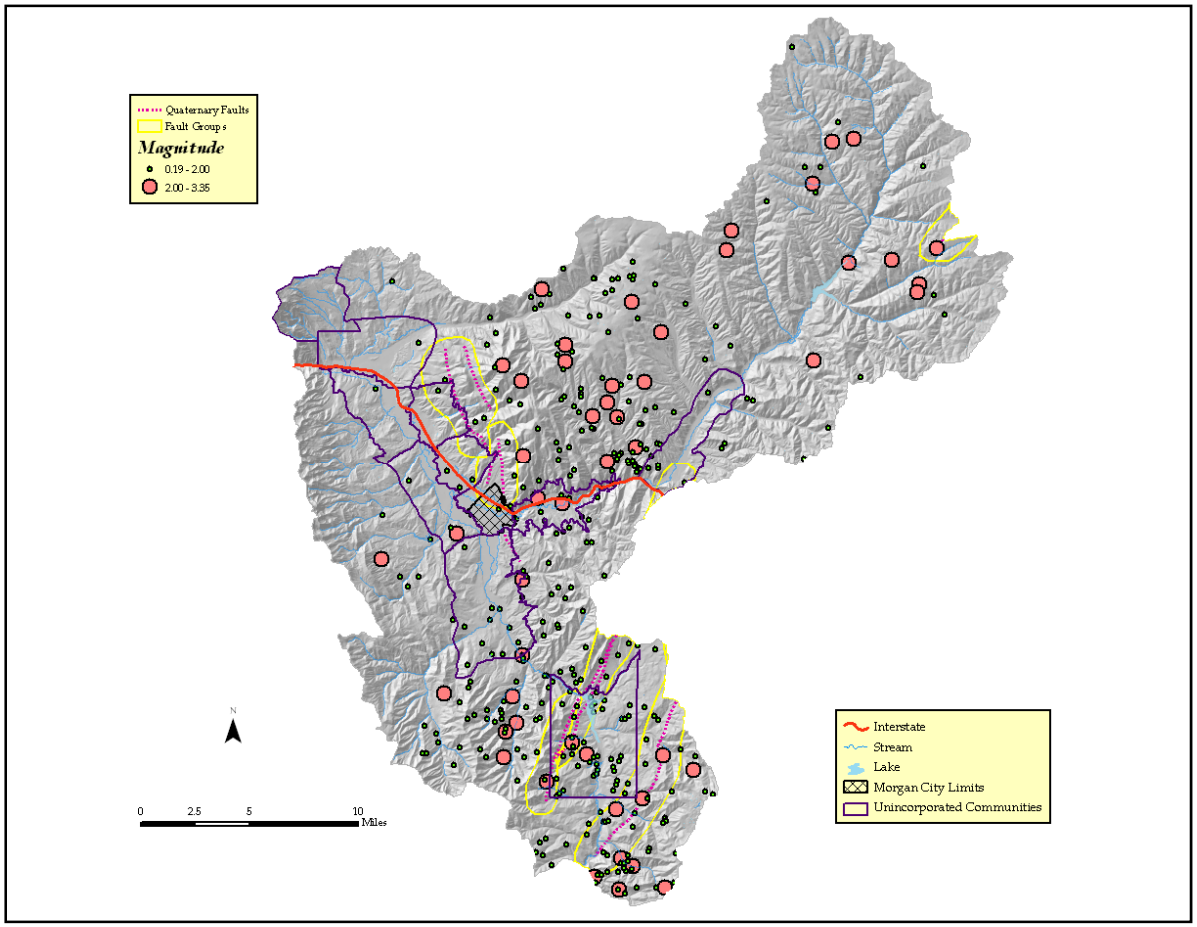
Fire Following Event, Population Exposed, and Building Stock Exposed, 2006

Casualties

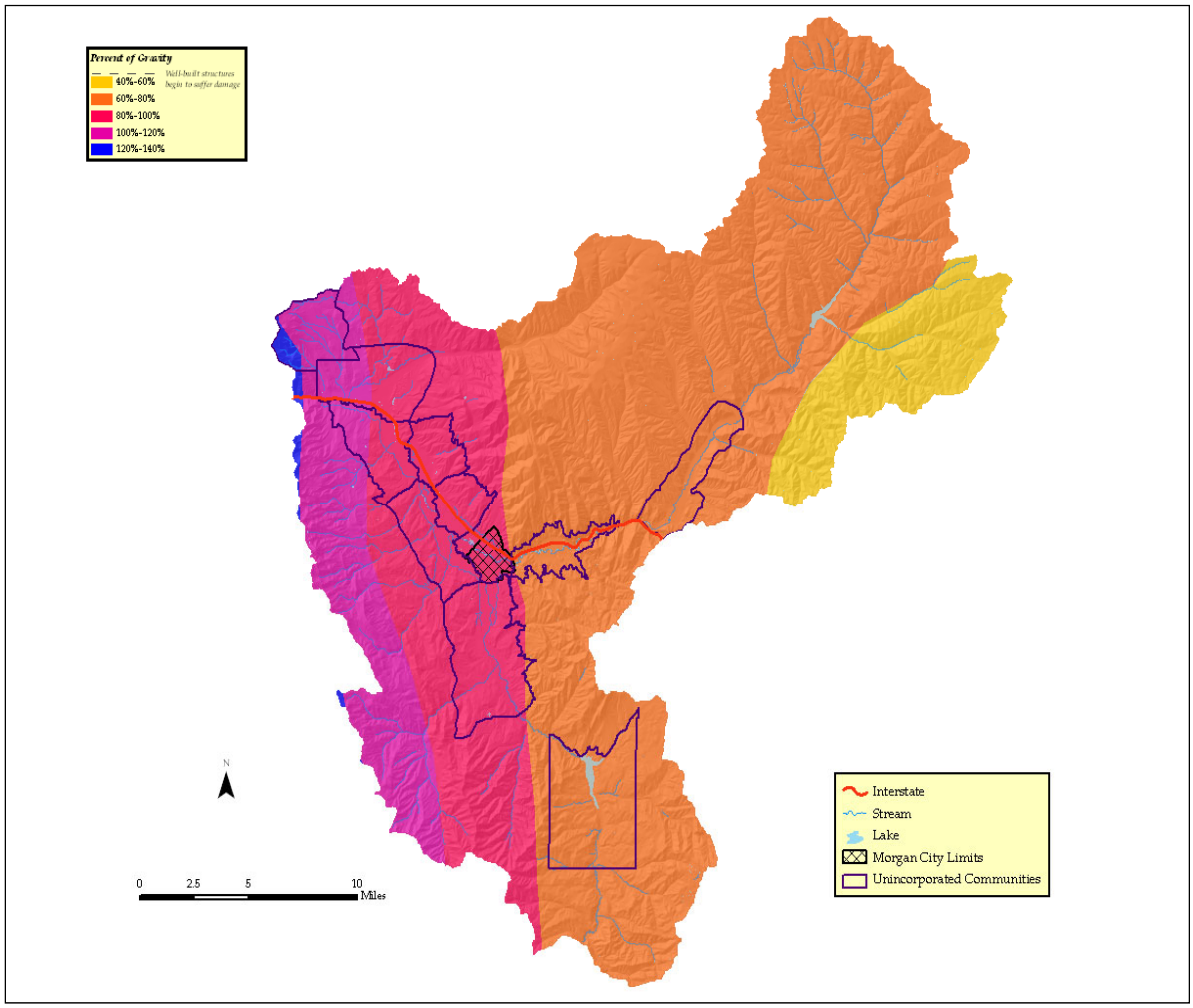
The following table estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons. The daytime scenario (2 p.m. local time) assumes a commercial concentration. The commute scenario (5 pm. local time) assumes a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major) and fatalities.

Night Event	Morgan M5.9	2500-yr M7.1	Day Event	Morgan M5.9	2500-yr M7.1	Commute Event	Morgan M5.9	2500-yr M7.1
Minor	2	30	**Minor**	2	42	**Minor**	2	35
Major	0	8	**Major**	0	14	**Major**	0	10
Fatalities	0	2	**Fatalities**	0	4	**Fatalities**	0	3

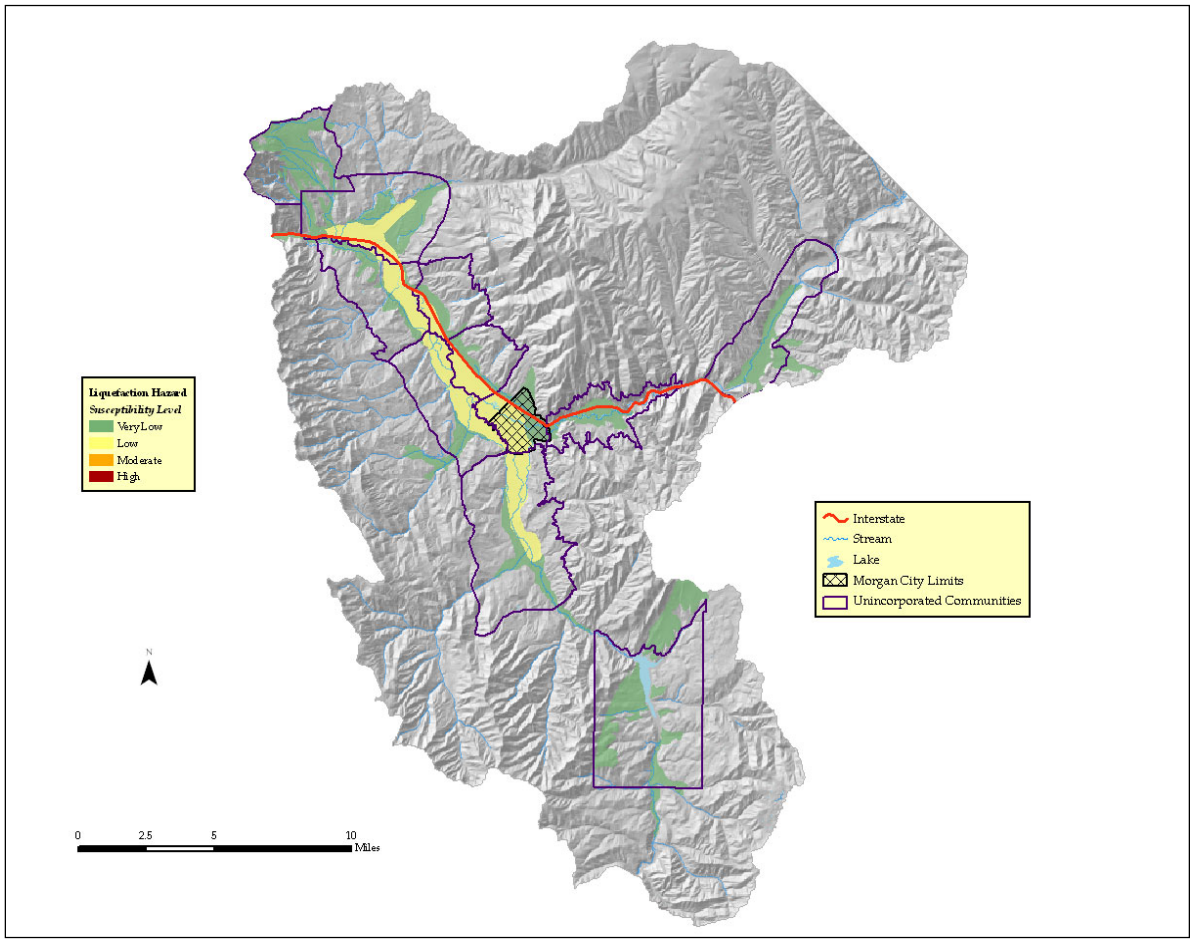
Casualties, 2006



Historical Earthquake Epicenters and Faults, Morgan County 1900-2007 (UUSS 2007)



Ground Shaking Hazard Map, Morgan County (NSHMP 2002)



Liquefaction Hazard Map, Morgan County (Solomon, et. al 2004)

C. Flood Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)		***X***	***Likely***
	X	***Limited (10-25%)***			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Weber River and its tributaries.				
Seasonal Pattern	Spring, late summer.				
Conditions	Cloudburst Storms and Heavy Snowfall Runoff.				
Duration	Flooding can last anywhere from hours to days and even months.				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills.				
Analysis Used	Review of FIS, FIRM, HAZUS-MS.				

Description of Location and Extent

Flooding may be largely associated with heavy rainfall from cloudburst storms or may occur as a result of heavy snowpack melt and runoff. Historical events suggest flooding poses the most significant reoccurring threat in the county. Flooding events can also cause in mud and debris flows.
The Weber River and its tributaries (East Canyon Creek, Lost Creek, Hardscrabble, Deep Creek and Peterson Creek) pose the most significant flood threat. Lost Creek has experienced flooding because bridges at the confluence of the Weber River become obstructed with debris acting as a dam. Gordon Creek has also flooded in the past due to a perched channel. Sewer and water lines cross the Weber River and the spring flooding of 1983 caused a sewer line to break. This sewer line is now encased with concrete so should no longer pose a problem. Another flood event similar to those of 1952 and 1983-1984 could cause the Como Bridge to fail due to age. A 100-year flood event would cause Deep Creek to experience overbank flooding. Agricultural flooding is also of concern because of the amount of farmlands and irrigation canals. Island Road along East Canyon Creek through Richville, as well as the Highlands and Mountain Green between I-84 and the old highway could experience residential and commercial flooding. Morgan High, Middle, and Morgan County Elementary Schools are all located in the floodplain, as is the entire city of Morgan.

In 2011, Morgan County experienced significant flooding as a result of heavy rainfall. A detailed report of this incident is found on page 36 of this Plan.

Vulnerability Assessment

The vulnerability assessment for flooding in Morgan County was obtained from HAZUS-MH**. Vulnerability was assessed for both 100-year (NFIP Zone A) and 500-year (NFIP Zone B or Zone X (shaded)) flood events. Total monetary losses include structures, contents and business interruption. Analysis was completed using Flood Insurance Rate Maps (FIRM). Only streams which contained detailed flood cross-section data could be used. Consequently, the results should be considered conservative. (**For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the HAZUS-MH Technical Manual (Flood Model) at www.fema.gov/hazus)

	Acres Flooded	**Population Displaced**	**Number of Structures with at Least Moderate Damage**	
			Residential Units (Total Losses)	**Commercial/Industrial Units (Total Losses)**
100-year Flood	3019.72	539	*117* **$6,370,000**	**$2,850,000**
500-year Flood	3259.56	595	*130* **$8,050,000**	**$3,480,000**

Morgan County Flood Hazard, 2006

Agricultural Losses

Agricultural losses are listed in the table on the following page. Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$23,375	$31,167	$24,332	$32,442

Agricultural Losses, April 15 Scenario, 2006

Vehicle Losses

The following table contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$416,921	$518,385
Nighttime Scenario	$521,329	$637,730

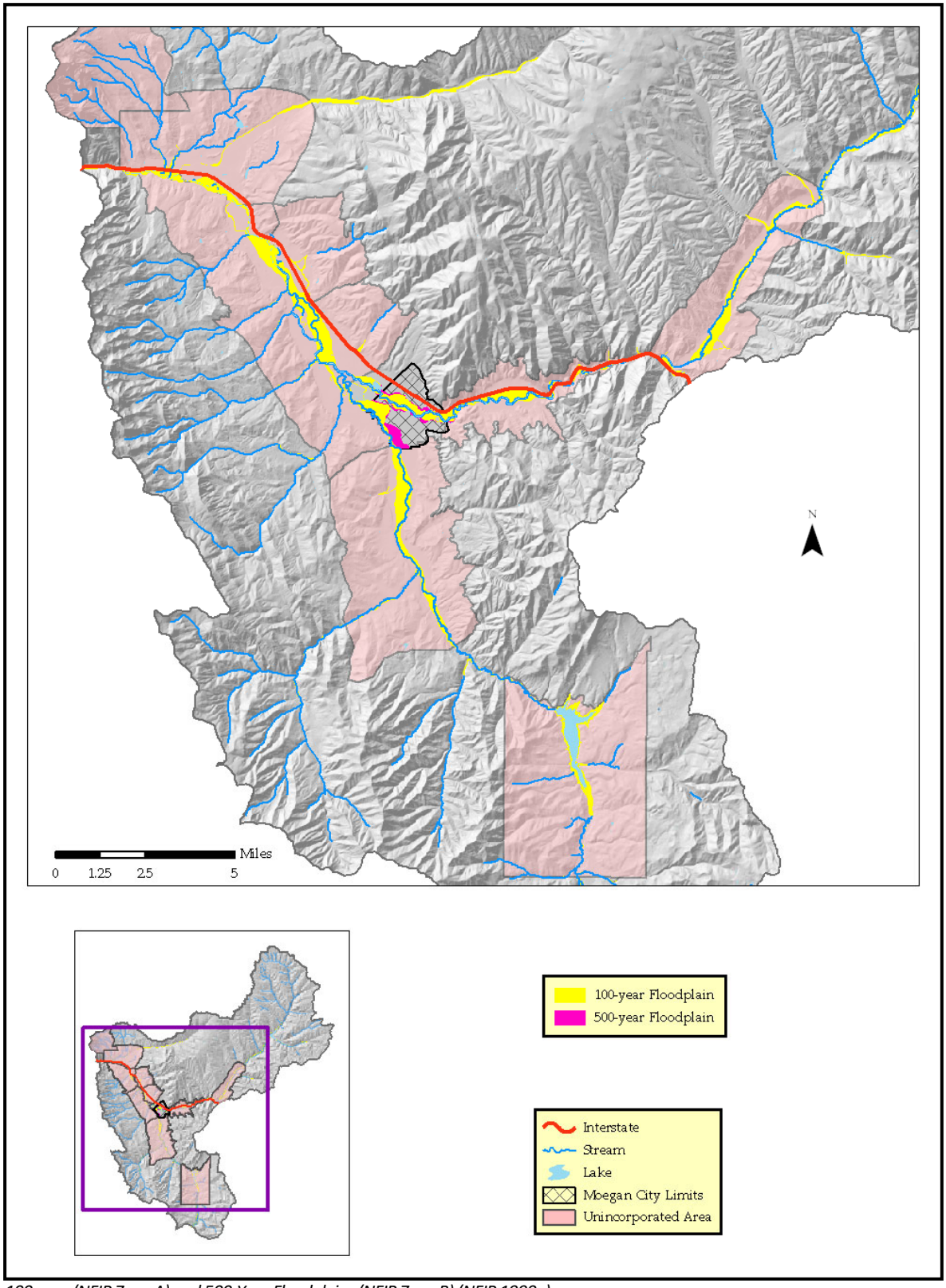
Vehicle Losses, 2006

Debris Removal

The table below shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	759 tons/31 loads	940 tons/38 loads
Structures	110 tons/5 loads	124 tons/ 5 loads
Foundations	118 tons/5 loads	135 tons/6 loads
Totals	**987 tons/41 loads**	**1,199 tons/49 loads**

Debris Generation and Removal, 2006



100-year (NFIP Zone A) and 500-Year Floodplains (NFIP Zone B) (NFIP 1990a)

D. Slope Failure Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
	X	***Critical (25-50%)***		***X***	***Likely***
		Limited (10-25%)			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See Map on page 111				
Frequency	Spring and summer; after heavy or long-duration precipitation				
Conditions	Usually caused by the stress release of over-weighted soils, shallow groundwater in certain soils, or loosening of rock and debris.				
Duration	Hours to years				
Secondary Hazards	Flooding (natural dams), traffic accidents				
Analysis Used	Information and maps provided by UGS, DEM				

Description and Extent

Rock fall near Devil's Slide, March 2004 (UGS 2004)

Landslides have occurred in Morgan County due to the prevalence of clay soils and ample precipitation. Clay soils can hold much water. Morgan County's mountainous terrain allows for a substantial annual snowpack and high water table. This groundwater acts as an excellent lubricant allowing the soils to slide.

With increasing residential development, many prime building sites are now located on top of these soils, especially in the Mountain Green and Peterson areas. Notable active landslides are found along Creekside Drive in Mountain Green. Slides occurred in 2001 and 2005-2006 causing over $1 million dollars in damages to homes, roads and utilities in the latter event (Elliot 2007b).

Another slope failure hazard in Morgan County is rock fall. The freezing and thawing of water trapped between cracks in rock formations can cause the rock to break apart. Gravity then takes over causing the rocks to fall downhill. This occurred in March of 2004, near Devil's Slide, when a large boulder dislodged from a high cliff breaking into several pieces. The largest of these weighed close to 250 tons and rolled down the hill nearly half mile before coming to rest (Elliot 2007b).

Vulnerability Assessment

The table below estimates infrastructure vulnerable to landslides in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. The following tables estimate the total area, population, and buildings vulnerable to landslides for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City. Major repair or replacement of Weber Basin Water Conservancy District (WBWCD) water distribution infrastructure would likely cost several millions of dollars in excess of that listed below.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	16.5 miles	$89,387,083
Highway Bridges	39 bridges	$43,348,782
Railway Segments	4.92 miles	$5,652,768
Railway Bridges	0 bridges	$0
Water Distribution Lines	904.90 miles	$18,099,375
Gas Lines	224.87 miles	$7,239,760
Sewer Lines	337.34 miles	$10,859,637
Total Estimated Infrastructure Replacement Cost		**$174,587,405**

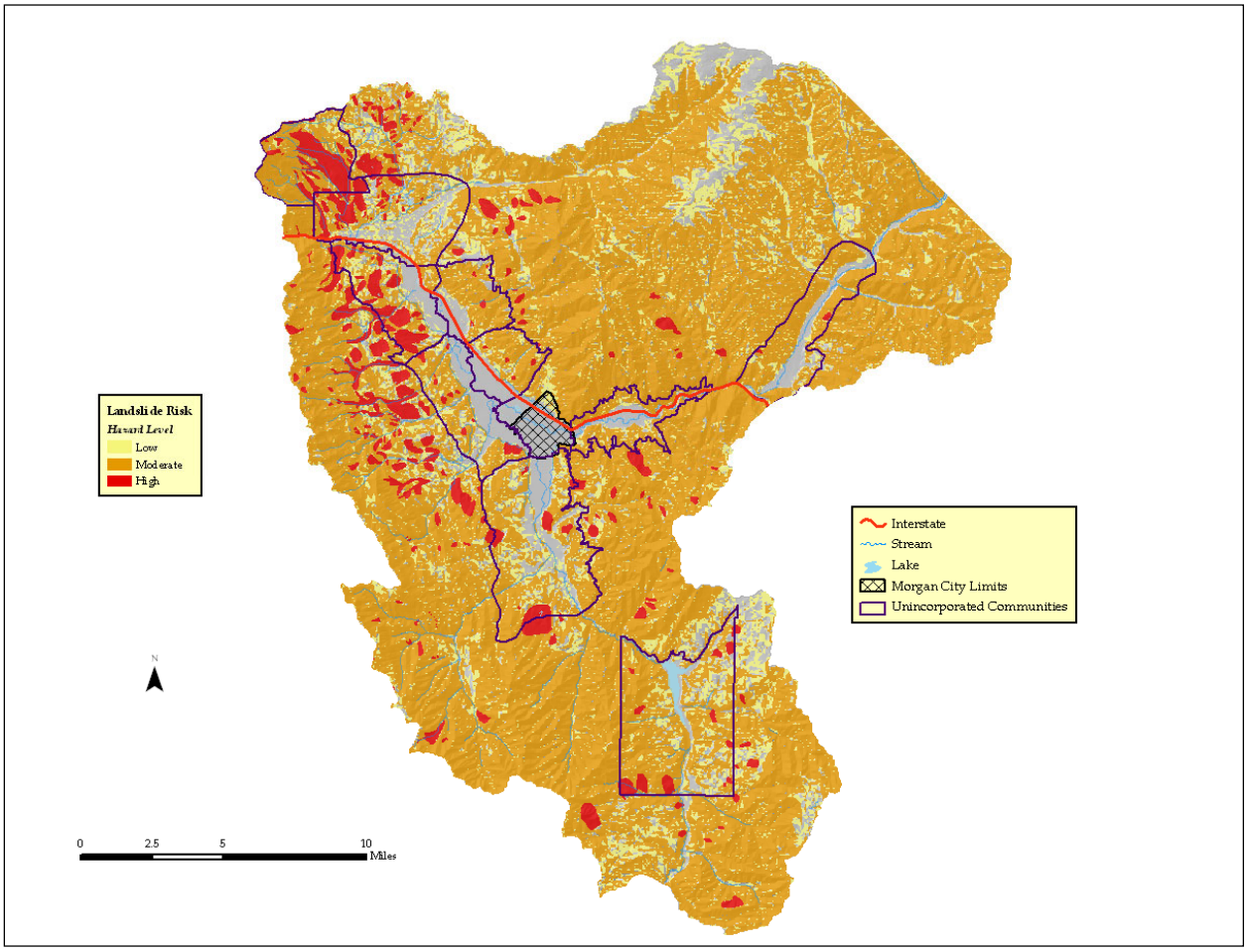
Infrastructure Vulnerable to Landslides, Morgan County, 2006

Incorporated	Acres in Hazard Area	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan City	74	231	73 $14,819,000	0

Unincorporated	Acres in Hazard Area	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Croydon	4,298.0	84	28 $5,684,000	3 $467,080
East Canyon Resort	9,216.1	0	0	0
Enterprise	2,355.9	209	69 $14,007,000	1 $5,301
Milton	2,822.5	690	230 $46,690,000	1 $12,489
Mountain Green	4,166.3	1,267	401 $81,403,000	18 $4,060,753
Peterson	3,658.3	440	156 $31,668,000	2 $1,798,602

Porterville/Richville	6,753.2	694	226 $45,878,000	4 $376,274
Round Valley	2,248.3	213	79 $16,037,000	3 $1,103,913
Snow Basin Resort	5,189.5	0	0	0
Stoddard	1,767.9	188	61 $12,383,000	1 $448,400

Morgan County Landslide Vulnerability, 2006



Morgan County Landslide Hazard (Giraud and Shaw 2007)

E. Wildland Fire Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
	X	***Critical (25-50%)***		***X***	***Likely***
		Limited (10-25%)			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Wildland-Urban Interface (WUI) areas near the foothills and in forested areas				
Frequency	Summer months				
Conditions	Areas affected by drought and/ or heavily overgrown with dry brush and debris Lightning and human triggers				
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire				
Secondary Hazards	Landslides, debris flows, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DEM				

Description of Location and Extent

According to the Northern Utah Regional Wildfire Protection Plan, Morgan County experienced 444 fires during the period from 1973 to 2005 (UDFFSL 2007). Many of these fires occur in wildland areas. The threat of wildfires is steadily increasing in Morgan County.

The wildfire threat has had a significant effect on the County watersheds, including landslides, debris flows and other forms of erosion. Federal, state and local agencies have worked together to enforce ordinances and other programs to protect watersheds.

Wildland fire risk is found on page 114. The map layers were provided by the Utah Division of Forestry, Fire and State Lands and show four categories of wildfire risk (extreme, high, moderate, and low). These ratings cover all of Morgan County and are based on the type and density of vegetation in each area as well as the vulnerable population. Additional factors that influence fires (weather conditions, wind speed and direction) are not considered in this risk assessment.

Large areas of the County is at moderate or greater wildland fire risk. Morgan City has a low risk within most of its boundaries. A small area in the northern part of the city has extreme wildland fire risk. Unincorporated areas primarily affected include Enterprise, Milton, Mountain Green, Peterson, Snow Basin Resort and Stoddard. Development has been advancing further into WUI zones, with many of the most vulnerable homes also the most costly to replace. Without effective fuel reduction measures and sufficient defensible space, these areas may likely experience considerable losses.

Vulnerability Assessment

The data in the following table is an estimate of infrastructure vulnerable to wildland fire in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	46.49 miles	$290,734,600
Highway Bridges	10 bridges	$2,878,644
Railway Segments	33.22 miles	$38,159,858
Railway Facilities	1 bridge	$44,100
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$331,817,202**

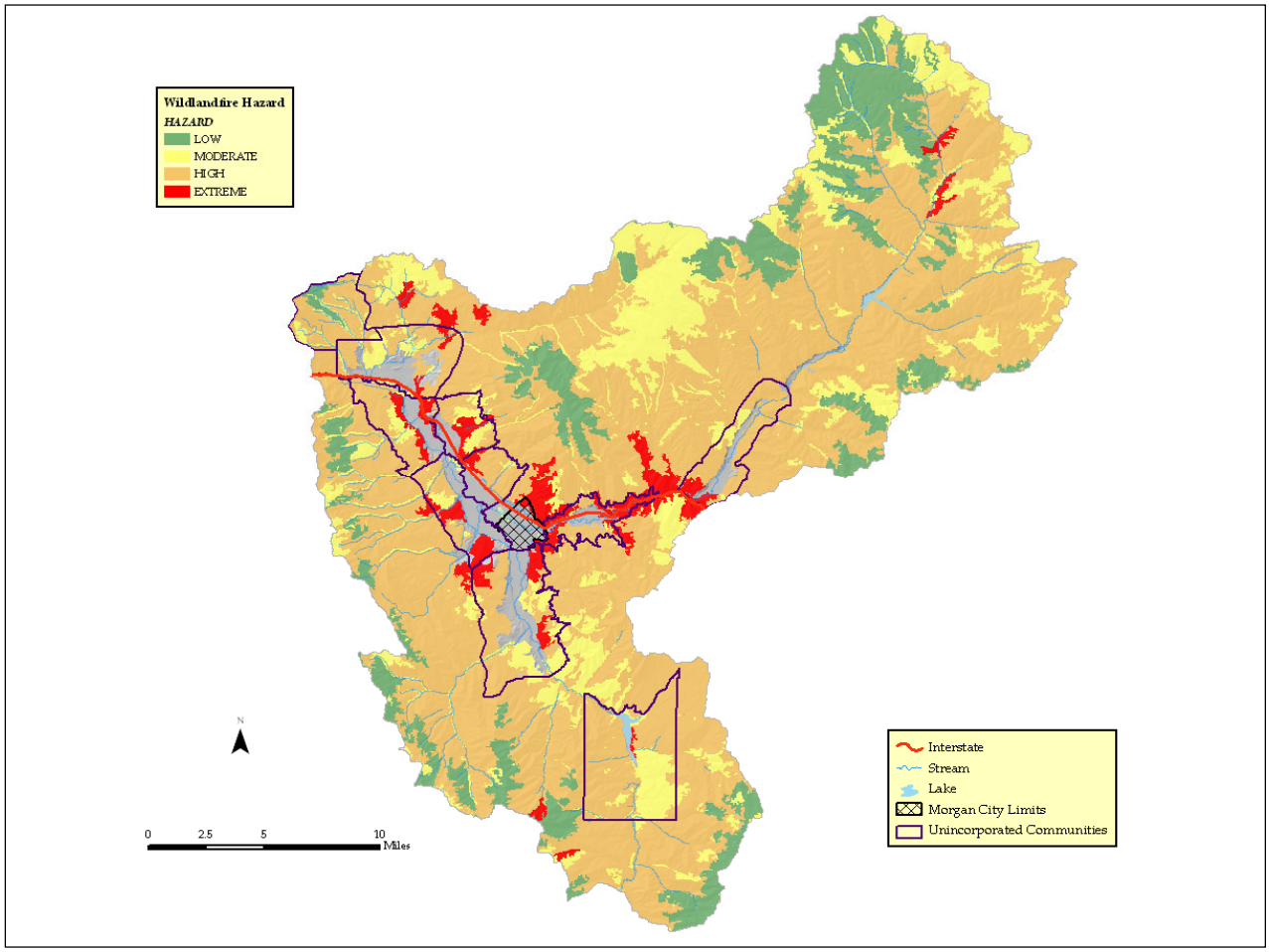
Infrastructure Vulnerable to Wildland Fire, Morgan County, 2006

The data in the table below is an estimate of the total area, population and buildings vulnerable to wildland fire for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

Incorporated	City Area (Acres)	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan City	1,934.8	39	30 $10,781,000	1 $450,948
Unincorporated	**Acres in Hazard Area**	**Population in Hazard Area**	**Structures in Areas of Moderate or Greater Hazard**	
			Residential Units (Replacement Cost)	**Commercial Units (Annual Sales)**
Croydon	6,622.0	83	27 $5,481,000	3 $467,080
East Canyon Resort	13,462.3	0	118 $23,954,000	1 $80,217
Enterprise	3696.7	28	10 $2,885,000	5 $344,367
Milton	5,912.7	628	196 $39,642,500	3 $132,465
Mountain Green	8,206.1	2,003	625 $126,250,000	5 $1,774,996
Peterson	5,935.1	542	169 $34,138,000	8 $1,951,788
Porterville/Richville	12,164.2	175	55 $11,110,000	2 $874,405
Round Valley	3,812.4	34	10 $2,205,000	4 $1,421,129

Snow Basin Resort	5,643.5	0	0	0
Stoddard	3,309	43	14 $2,828,000	3 $308,477

Morgan County Wildland Fire Vulnerability, 2006



Wildfire Hazard Map, Morgan County (UDFFSL 2007)

F. Problem Soils Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
	X	***Limited (10-25%)***		***X***	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See map on page 118				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Problem soils pose a significant threat to Morgan County. Expansive soils not only contribute to the landslide hazard, but may also cause subsidence or upheaval under building foundations, pipes and roads (Kaliser 1972). Limestone can erode into karst structures leaving a subsurface cavity vulnerable to collapse.

The primary type of expansive soil in Morgan County is clay. This soil can absorb significant quantities of water. When a home or road is placed over top of these soils, normal evaporation cannot take place. The clay begins to absorb more water than is evaporated and begins to expand causing heaving. During especially dry periods, these soils can contract significantly causing subsidence and ground cracking. Residents already living in these areas should avoid excessive watering, make sure sufficient water drainage is in place around the home, and plumbing and irrigation piping and fixtures are well protected from breakage or leaks (Kaliser 1972).

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way casing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Fortunately, many of the karst structures are located in undeveloped areas.

Vulnerability Assessment

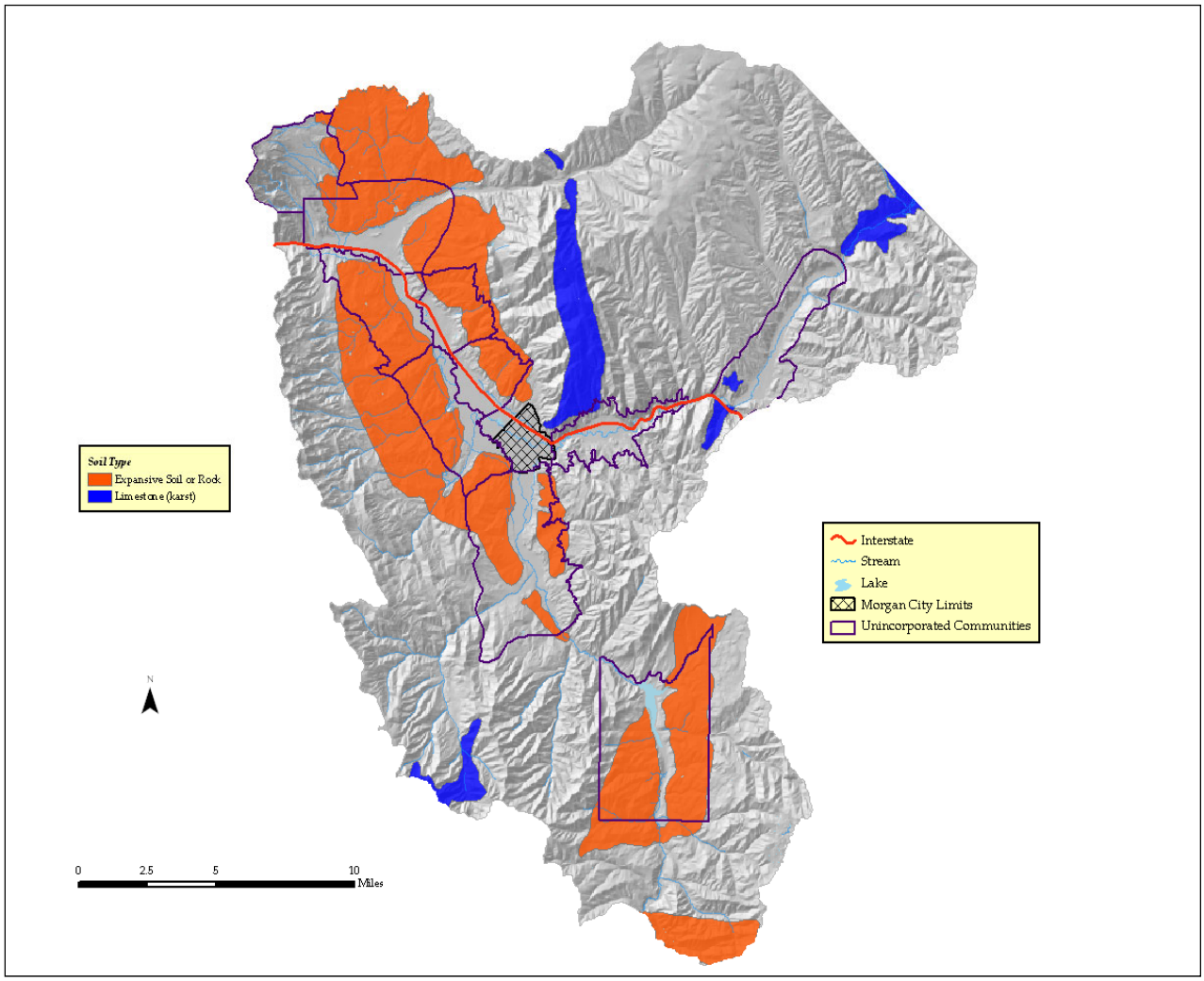
The table on page 116 estimates infrastructure vulnerable to problem soils in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. The second table on page 116 estimates the total area, population and buildings vulnerable to landslides for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	9.93 miles	$45,758,668
Highway Bridges	7 bridges	$3,974,239
Railway Segments	0.39 miles	$446,720
Railway Bridges	0 bridges	$0
Water Distribution Lines	153.02 miles	$4,925,119
Gas Lines	61.21 miles	$1,970,050
Sewer Lines	91.81 miles	$2,955,075
Total Estimated Infrastructure Replacement Cost		**$60,029,871**

Infrastructure Vulnerable to Problem Soils, Morgan County, 2006

Incorporated	**Acres in Hazard Area**	**Population in Hazard Area**	**Number of Structures in Hazard Area**	
			Residential Units (Replacement Cost)	**Commercial Units (Annual Sales)**
Morgan	1	4	4 $812,000	0
Unincorporated	**Acres in Hazard Area**	**Population in Hazard Area**	**Number of Structures in Hazard Area**	
			Residential Units (Replacement Cost)	**Commercial Units (Annual Sales)**
Croydon	4,298	0	0	3 $467,080
East Canyon Resort	19,342	0	15 $3,045,000	0
Enterprise	9,479	148	52 $10,556,000	1 $5,301
Milton	26,440	767	258 $52,374,000	1 $12,489
Mountain Green	20,801	751	235 $47,705,000	18 $4,060,753
Peterson	20,616	376	130 $26,390,000	2 $1,798,602
Porterville/Richville	6,753	694	226 $45,878,000	4 $376,274
Round Valley	2,317	12	3 $609,000	3 $1,103,913
Snow Basin Resort	12,457	0	0	0
Stoddard	4,020	123	41 $8,323,000	1 $448,400

Problem Soils Vulnerability, Morgan County, 2006



Problem Soils Hazard, Morgan County (Mulvey 1992)

G. Dam Failure Hazard Profile

Potential Magnitude	***X***	***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
		Limited (10-25%)		***X***	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See map on page 122				
Frequency	Rainy Day Failure: Spring, Late Summer Sunny Day Failure: Anytime				
Conditions	Rainy-day failure happens mainly during heavy precipitation events, can have some warning time. Sunny day failure happens without warning, usually resulting from sudden structural failure				
Duration	Hours to days				
Analysis Used	Review of BOR inundation maps and plans, FIS, Utah Division of Water Rights.				

Description of Location and Extent

There are twenty-seven dams and irrigation impoundments located in Morgan County. Four of these dams are listed as a high hazard threat, meaning if they fail, they have a high probability of causing loss of life and extensive economic loss. Three dams have a moderate hazard threat. If they fail they have a low probability of causing loss of life, but would cause appreciable property damage. Mitigation efforts should be developed and pursued for these dams. Fifteen dams have a low hazard threat. If they were to fail there would be minimal threat to life and economic losses would be minor and damages would be limited to the owner of the dam. These dams should still be monitored. No hazard rating is provided for five dams. Additionally, there are 2 other major dams on the Weber River upstream from Morgan County in Summit County (Echo and Wanship) that pose a significant threat to county residents should either experience a catastrophic failure. Should any of these high hazard dams fail, the possible dam failure inundation flood area would potentially be 62.5 square miles or approximately 10% of the county land area. The average daytime population within high hazard dam failure inundation areas is approximately 100 residents. There are approximately 60 structures within the dam failure inundation area with a projected loss of $57,467,639.

It should be noted that Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure. For a list of high and moderate rated dams in Morgan County, please see table below. Dam locations can be found on page 122.

Name/Owner	Hazard Rating
Northwest	High
Silver Leaf	High
BOR East Canyon	High
BOR Lost Creek	High
BOR Echo	High
BOR Wanship	High
Wardell Reservoir	Mod
Peterson Creek – Left Fork (Bohman Dam)	Mod
Morgan Secondary Water Assoc.	Mod

High and Moderate Hazard Dams, Morgan County (Source: Utah Division of Water Rights), 2006

Bureau of Reclamation Dam Information

Lost Creek

Lost Creek Dam is on Lost Creek, 12 miles upstream from its confluence with the Weber River. It impounds a reservoir with a total capacity of 22,510 acre-feet covering a surface area of 365 acres. A zoned earthfill structure 248 feet high with a crest length of 1,078 feet, the dam has a volume of 1,831,820 cubic yards. The uncontrolled spillway on the right abutment has a concrete-lined chute with a capacity of 2,455 cubic feet per second. The outlet works, with a capacity of 805 cubic feet per second, consists of an intake structure at the right abutment, a concrete-lined tunnel, a gate chamber for two 2.25-foot-square high-pressure gates, a concrete tunnel, and stilling basin.

East Canyon

East Canyon Dam is a concrete thin-arch structure, 10 miles southeast of Morgan on East Canyon Creek. The new dam, with a height of 260 feet, a top thickness of 7 feet, crest length of 436 feet, and a volume of 35,716 cubic yards, replaces an old concrete arch dam and increases the reservoir capacity from 29,000 to 51,200 acre-feet, covering a surface area of 684 acres. The uncontrolled spillway is on the left end of the dam and has a 6,200-cubic-foot-per-second capacity; the outlet through the dam has a capacity of 710 cubic feet per second.

Echo Dam

Echo Dam is a zoned earthfill structure, one mile upstream from the town of Echo and about six miles north of Coalville. Echo was built by the U.S. Bureau of Reclamation (BOR)in the late 1920s and early 1930s as a single-purpose irrigation project. The dam is located approximately 13 miles southeast of Morgan City. It has a structural height of 158 feet and contains 1,540,000 cubic yards of materials. The spillway has a capacity of 15,000 cubic feet per second. The outlet conduit is a concrete-lined horseshoe tunnel to the gatehouse, from which two steel pipes pass through a tunnel to the valve house. The outlet works has a capacity of 2,100 cubic feet per second.

Beginning in 2012, the BOR conducted a seismic overhaul of Echo Dam. It was the largest federal project of its kind ever in Utah, representing a four-year, $50 million effort. When it was completed in late 2014, the earthquake safety modifications on Echo Dam met or exceed federal standards, and the BOR stated that one less dam in the state is at risk of catastrophic failure. Crews removed approximately 665,000 cubic yards of dirt down to bedrock at the downstream slope of the dam, using heavy equipment to gouge out a massive hole. A safety analysis of the 85 year-old dam found that dirt at its foundation and underneath the spillway controls could liquefy in an earthquake. Loosely deposited soils could liquefy, losing strength. As a result, the top of the dam may have dropped, leading to a catastrophic failure. A seismic analysis shows a fault plane between Henefer and East Canyon Dam to the west that is capable of a 6.5-magnitude earthquake. A collapse of the dam would have imperiled all the communities downstream — Henefer, Morgan, Peterson, Stoddard, Uintah and South Weber. Flood waters would reach the flatlands of Plain City — more than 50 miles away in Weber County.

An estimated 1.2 million cubic yards of that new fill material was used. Contractors constructed an earthen stability berm designed to buttress the dam. Another upstream berm was also constructed and compacted to further minimize the risk of any catastrophic failure. The BOR has developed comprehensive dam safety plans for all of these impoundments and conducts annual dam failure exercises with all the downstream jurisdictions.

Wanship Dam

Located 1.5 miles south of Wanship on the Weber River, the Wanship Dam impounds Rockport Lake. Wanship is approximately 28 miles southeast of Morgan City. The lake has 62,100 acre-feet total capacity, and a surface area of 1,080 acres. The dam, a zoned earthfill structure, is 156 feet high, has a crest length of 2,010 feet, and contains 3,183,000 cubic yards of material.

The spillway is an uncontrolled open concrete chute with a capacity of 10,800 cubic feet per second. The outlet works tunnel provides for releases to the power plant or to the river. The outlet works has a capacity of 1,000 cubic feet per second.

Vulnerability Assessment

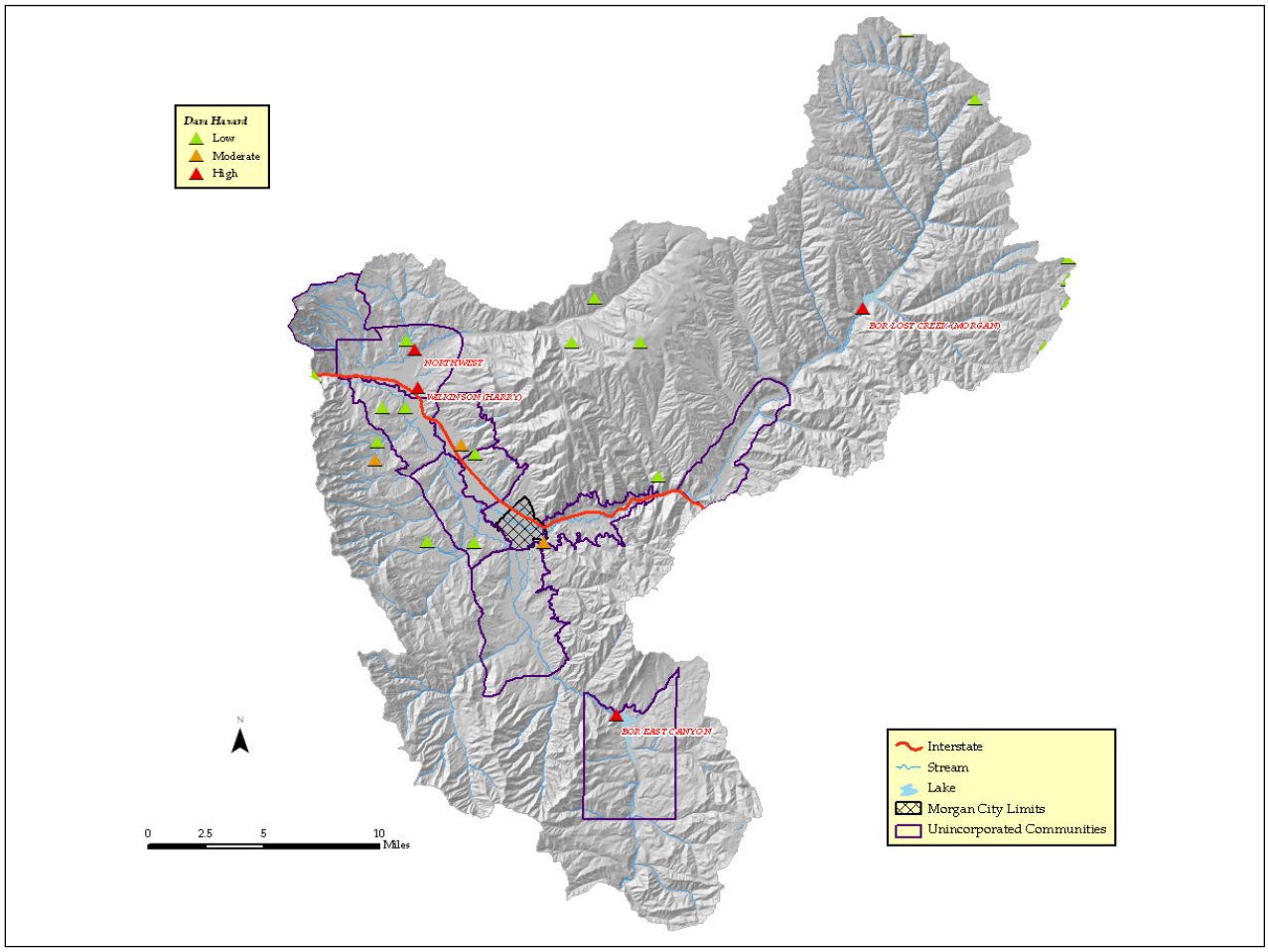
The following table estimates infrastructure vulnerable to dam failure in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. The following table estimates the total area, population and buildings vulnerable to dam failure for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

Highways/Interstates	1.16 miles	$9,985,771
Highway Bridges	3 bridges	$629,324
Railway Segments	1.13 miles	$1,300,443
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$11,915,538**

Infrastructure Vulnerable to Dam Failure, Morgan County, 2006

	Acres in Hazard Area	Population in Hazard Area	Number of Structures in Inundation Area	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Incorporated				
Morgan	74	231	73 $14,819,000	0
Unincorporated				
Croydon	4,298	84	28 $5,684,000	3 $467,080
East Canyon Resort	0	0	0	0
Enterprise	2,355	209	69 $14,007,000	1 $5,301
Milton	2,822	690	230 $46,690,000	1 $12,489
Mountain Green	4,166	1,267	401 $81,403,000	18 $4,060,753
Peterson	3,658	440	156 $31,668,000	2 $1,798,602
Porterville/Richville	6,753	694	226 $45,878,000	4 $376,274
Round Valley	2,248	213	79 $16,037,000	3 $1,103,913
Snow Basin Resort	0	0	0	0
Stoddard	1,767	188	61 $12,383,000	1 $448,400

Dam Failure Vulnerability, Morgan County, 2006



Dam Hazard Map, Morgan County (Utah Division of Water Rights 2014)

Morgan County Hazards and Future Development

Morgan County Projected Growth						
Population Projections						
2010	**2015**	**2020**	**2030**	**Absolute Change 2010-2030**	**% Change 2010-2030**	**AARC 2010-2030**
9,183	11,621	16,756	24,478	15,295	37%	2%
Household Projections						
2010	**2015**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
2,839	3,370	3,735	4,826	5,780	6,742	4.2%

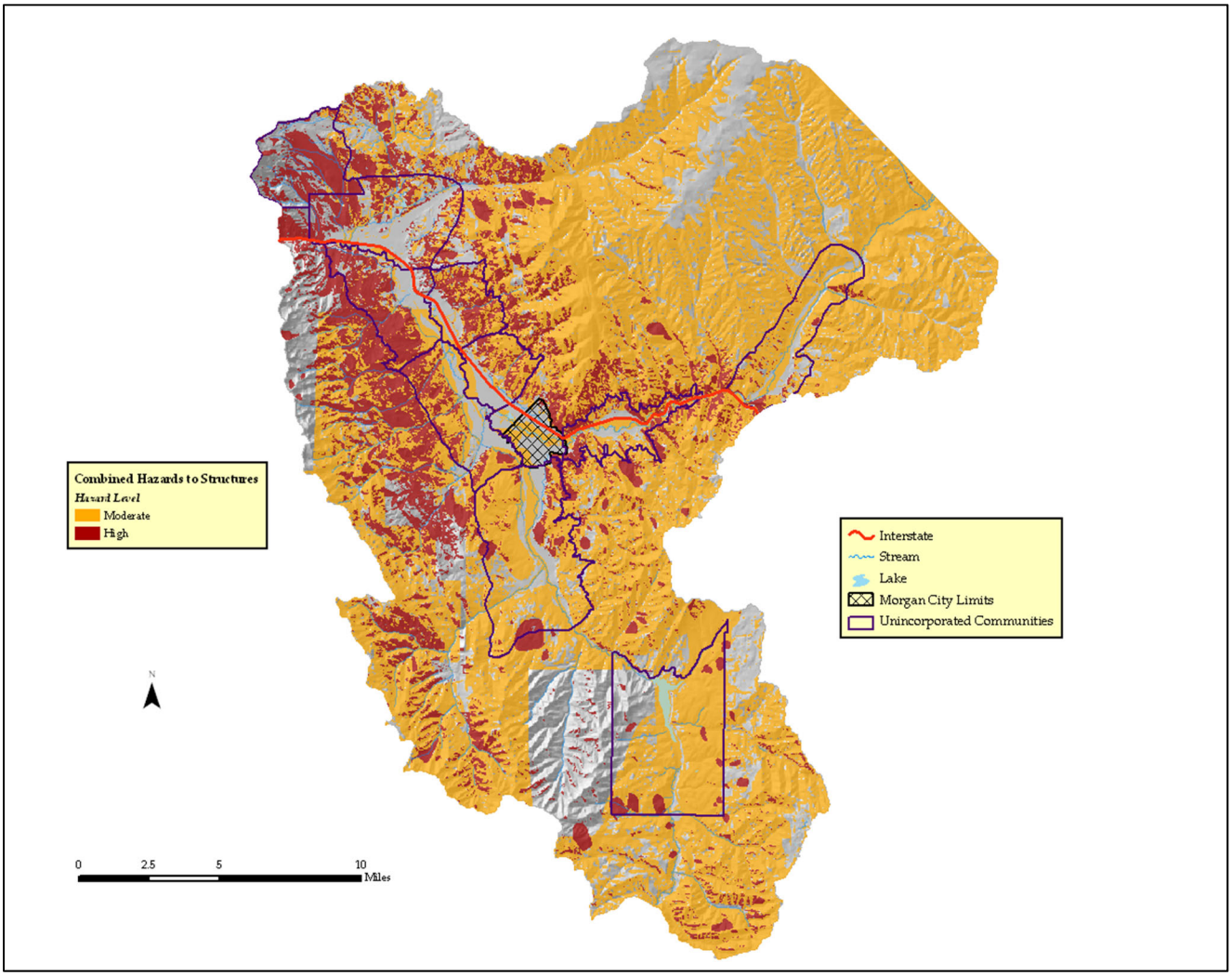
Morgan County Final General Plan, 2010: Morgan County Planning and Development; Governor's Office of Management Budget: 2012 Baseline Projections, Population and Households by Area, gomb.utah.gov (accessed June, 2016)
AARC = Average Annual Rate of Change

Morgan County is experiencing rapid residential development. Since 2000, Morgan County has seen a 28% increase in residential housing (American FactFinder 2015). Many have been built in extremely hazardous areas for wildland fire and some are vulnerable to landslide.

To assist its citizens in becoming less vulnerable to the landslide hazard, Morgan County enacted an ordinance requiring geotechnical studies to be performed prior to new construction. The County's General Plan restricts construction on slopes greater than 25 percent and requires grading standards for hillside development.

With the adoption of the 2006 Utah Wildland-Urban Interface Code, Morgan County is now better prepared to mitigate the potential for wildland fires affecting development within the County. The new codes give more power to building code enforcement to ensure necessary provisions are made for access, water supply and defensible space in the event of an actual fire. In some instances, the code enforcement officials have the authority to require fire protection plans to ensure property owners are sufficiently prepared.

The map on the following page shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, wildland fire, and severe weather) in Morgan County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development is encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Combined Hazards to Structures, Morgan County

XI. Specialized Local Districts

Utah State Code, Annotated, Section 17B-1-102, defines Specialized Local Districts (SLD) as a local district that is a cemetery maintenance district, a drainage district, a fire protection district, an improvement district, an irrigation district, a metropolitan water district, a mosquito abatement district, a public transit district, a service area or a water conservancy district. An SLD is a body corporate with perpetual succession, a quasi-municipal corporation, and is a political subdivision of the state.
SLD's may be created to provide services consisting of: airport operations; cemetery operations; fire, paramedic, and emergency services; garbage collection and disposal; health care including health department or hospital service; library operations; abatement or control of mosquitoes and other insects; park or recreation facilities or services; sewage system operations; street lighting; construction and maintenance of curb, gutter and sidewalk; transportation, including public transit and providing streets and roads; water system operations, including the collection, storage, retention, control, conservation, treatment, supplying, distribution, or reclamation of water, including storm, flood, sewage, irrigation, and culinary water, whether the system is operated on a wholesale or retail level or both.

Because SLD's are defined as quasi-municipal, they may be eligible for FEMA disaster funding reimbursement under the Stafford Act. Most of the SLD's have jurisdictional boundaries within a specific county. Others, such as the Utah Transit Authority (UTA), have jurisdictional boundaries that include multiple counties.

Specialized local districts identified in the WFRC Region are listed below. There may be others not identified here which will be included as they adopt this plan.

Morgan School District
P.O. Box 530
240 East Young St.
Morgan, UT 84050
(801) 829-0589

Mountain Green Fire
Protection District
5593 Park View Drive
Mountain Green, UT 84050
(801) 876-2277

Mountain Green Sewer
Improvement District
4274 Blue Jay Circle
Morgan, UT 84050
(801) 876-2287

There are more than 50 irrigation companies in Morgan County all primarily sourcing their water from the Weber River, groundwater or springs. The water is primarily used for agricultural purposes. A complete list of water companies operating in Morgan County is listed on the following page.

Morgan County Secondary Water Providers 2016			
Anderson Bowman Ditch	H.L.J. Ditch Company (Heiner-Lowe-Johnson) Mutual association	Old Fort Ditch Company Mutual Association	Settlement Ditch Mutual Association
Blue Horizons LLC	Heiner Morris Ditch Mutual Association	Pentz & Smith Ditch Company Mutual Association	Smith Creek Irrigation Company Mutual Association
Central Enterprise Water Association	Heiner Pump	Peterson Creek Ditch	South Line Creek Ditch
Cottonwood Mutual Water Company	Highlands Water Company Inc.	Peterson Irrigation Company on only Dalton Creek	South Morgan Water Ditch Company
Creechley Mickesell Ditch	Line Creek Irrigation Co.	Preese-Poulsen-Baird Ditch	South Round Valley Canal Co.
Croydon Irrigation Company	Littleton and Milton Irrigation Company	Richard Ditch Irrigation Company	Spendlove Ditch
Davis and Weber Counties Canal Company	Madsen Olsen Ditch Mutual Association	Richville Irrigation and Canal Company	Weber Basin Water Conservancy District
Deep Creek Ditch Company	Meacham-Nelson-Madsen Ditch Company	Richville Pipeline Company	Weber Canal Company
Deep Creek Garden Ditch Mutual Association	Monte Verde Water Association	Old Fort Ditch Company mutual association	Weber River Water Users` Association
East Porterville Canal Co.	Mountain Green Subdivision Water Association	Pentz & Smith Ditch Company Mutual Association	Welch Field Ditch Irrigation Company
East Richville Ditch Company	Musser Irrigation	Peterson Creek Ditch	West Enterprise Water Association
Enterprise and Stoddard Irrigation Company ("Bench Canal Stock")	North Bench Canal Company Mutual Association	Peterson Irrigation Company on only Dalton Creek	West Porterville Canal Company
Enterprise and Stoddard Irrigation Company ("Field Ditch Stock")	North Morgan Extension Ditch Company Mutual Association	Preese-Poulsen-Baird Ditch	West Porterville Irrigation Company
Enterprise Water System	North Morgan Irrigation Company	Richard Ditch Irrigation Company	West Porterville Pipe Line Company
	North Round Valley Canal Company	Richville Irrigation and Canal Company	Woods Creek Ditch & Reservoir Company
	Northwest Irrigation Company	Richville Pipeline Company	Wooley Ditch

Source: http://www.waterrights.utah.gov/forms/waterCompanies.asp; accessed January 2016

Specialized Local Districts (SLD) are subject to the same hazards as the local jurisdictions in which they are located. The following general mitigation objectives have been developed for SLD's.

Problem Identification: Infrastructure vulnerability – Special Local Districts

1. **Objective**: Assess the vulnerability of critical facilities owned outside Morgan County that can impact service delivery inside Morgan County.

2. **Objective**: Retrofit or replace critical lifeline facilities and or their backup facilities that are shown to be vulnerable to damage in natural disasters

3. **Objective**: Conduct comprehensive programs to identify and mitigate problems with facility contents, architectural components, and equipment that will prevent critical buildings from being functional after major natural disasters

4. **Objective**: Develop and maintain a system of interoperable communications for first responders from cities, counties, special service districts, local school districts, state and federal agencies.

5. **Objective**: Identify and undertake cost effective retrofit measures on critical facilities when these buildings undergo major renovations.

6. **Objective**: Engage in, support and or encourage research by others on measures to further strengthen transportation, water, sewer, and power systems so that they are less vulnerable to damage in natural disasters.

7. **Objective**: Encourage a higher priority for funding seismic retrofit of existing transportation and infrastructure systems.

Problem Identification: Vulnerability of critical educational facilities

1. **Objective**: Retrofit or replace critical education facilities that are shown to be vulnerable to damage in natural disasters,

2. **Objective**: Conduct comprehensive programs to identify and mitigate problems with facility contents, architectural components, and equipment that will prevent critical buildings from being functional after major natural disasters

3. **Objective**: Identify and undertake cost effective retrofit measures on critical facilities when these buildings undergo major renovations

4. **Objective**: Develop and maintain a system of interoperable communications for first responders from cities, counties, special service districts, local school districts, state and federal agencies.

5. **Objective**: As a secondary focus, assess the vulnerability of non-critical educational facilities to damage in natural disasters based on occupancy and structural type, make recommendations on priorities for structural improvements or occupancy reductions, and identify potential funding mechanisms.

XII. Plan Maintenance and Implementation

Monitoring, Evaluating and Updating the Plan

Periodic monitoring and updates of this Plan are required to ensure that the goals and objectives for the region are kept current and that local mitigation strategies are being carried out. This Plan has been designed to be user-friendly in terms of maintenance and implementation.

Annual Review Procedures

Morgan County shall annually review this Plan or as situations dictate such as following a disaster declaration. If Morgan County or DEM determines that a modification of the Plan is warranted, an amendment to the Plan may be initiated.

Revisions and Updates

The County Emergency Manager will regularly monitor and annually review the Plan and is responsible to make revisions and updates. An annual review is recommended to ensure that the goals and objectives for the County are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates. The Plan will also be revised to reflect lessons learned or to address specific hazard incidents arising out of a disaster.

Five Year Plan Review

The entire Plan including any background studies and analysis shall be revised and updated every five years to determine if there have been any significant changes in the region that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the Plan.

The Natural Hazard Pre-Disaster Mitigation Planning Committees and Local Working Groups, with a potential membership representing every jurisdiction in the county will be reconstituted for the five year review/update process. Typically, the same process that was used to create the original Plan will be used to prepare the update. If Morgan County or DEM determine that the recommendations warrant modification to the Plan, an amendment may be initiated as described below.

Plan Amendments

The Utah DEM State Hazard Mitigation Officer, County Mitigation Committee, or Mayor/City Manager of an affected community, will initiate amendments and updates to the Plan. Upon initiation of an amendment to the Plan, DEM will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full planning committee may be reconstituted. At a minimum, the information will be made available through public notice in a newspaper of general circulation or on the DEM website at dem.utah.gov. The review and comment period for the proposed Plan amendment will last for not less than forty-five (45) days.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to participating jurisdictions for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. DEM will review the proposed amendment along with comments received from other parties and submit a recommendation to FEMA within sixty (60) days.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or
2. New issues or needs have been identified which were not adequately addressed in the Plan; and/or
3. There has been a change in information, data or assumptions from those on which the Plan was based.
4. The nature or magnitude of risks has changed.
5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of DEM, a public hearing will be held. DEM will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, DEM will take one of the following actions:

1. Adopt the proposed amendment as presented.
2. Adopt the proposed amendment with modifications.
3. Defer the amendment request for further consideration and/or hearing.
4. Reject the amendment request.

Implementation through Existing Programs

Once the Plan is promulgated, Morgan County will be able to include this Plan's information in existing programs and plans. These could include the General or Master Plan, Capital Improvements Plan, Emergency Operations Plan, State Mitigation Plan, City Mitigation Plans. Many of the mitigation actions developed by the cities and counties have elements of mitigation implementation including the National Flood Insurance Program (NFIP), the Utah Wildland-Urban Interface Code, the Building Code Effectiveness Grading System (BCEGS), and Community Rating System (CRS), all of which have been implemented.

Process

It will be the responsibility of the County Commission or the Morgan City Mayor and Council to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. Morgan County shall continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the Plan identifies the primary Federal and State grant programs for jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal Programs

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property. The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local Natural Hazard Pre-Disaster Mitigation Planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations.

These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure.

The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: Small Business Administration (SBA) Disaster Assistance Program
Agency: U.S. SBA

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration.

The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration.
Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

State Programs

Local
Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

Non-Governmental
Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the American Red Cross, hospitals, land trusts and other non-profit organizations. Paramount to having a Plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this Plan.

Continued Public Involvement
Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. The Plan will be available on the WFRC and Utah DEM website's to provide opportunities for public participation and comment. The Plan will also be available for review at the offices of the Wasatch Front Regional Council.

Morgan County Emergency Management is the lead agency in preparing and submitting the Morgan County Natural Hazards Pre-Disaster Mitigation Plan, which includes coverage for Morgan County. The strategy of the county in preparing the Plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility.

In addition, the county has reached out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the Plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the Plan. This being the case, the county has established the following course of action:

STEP 1. The county will publicly advertise all hearings, requests for input and meetings directly related to the Natural Hazard Pre-Disaster Mitigation Planning process. Meetings of the Morgan County Council where Plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all.

Advertisement will be done according to the pattern set in previous years, i.e. the county will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the Ogden Standard Examiner. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The county has established a mailing list of many local agencies and individuals that may have an interest in the Natural Hazard Pre-Disaster Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the Plan; however, the county reserves the right to limit comments that are excessively long due to the size of the Plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the county will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The following policies will guide county staff in making access and input to the Natural Hazard Pre-Disaster Mitigation Plan as open and convenient as possible:

A. Participation
   All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The county will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings
Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information
Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Natural Hazards Pre-Disaster Mitigation Plan, and/or any other documents prepared for distribution by the county that may be adopted as part of the Plan by reference. The county may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance
Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. County staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The county will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings
The county will plan and conduct public hearings according to the following priorities:

1. Hearings will be conveniently timed for people who might benefit most from mitigation programs.
2. Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy).
3. Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: Identify and profile hazards, Develop mitigation strategies, and Review Plan goals, performance and future Plans.

F. Future Revisions:
Future revisions of the Plan shall include:

1. Expanded vulnerability assessments to include flood and dam failure inundation.
2. Continue the search for more specific mitigation actions.
3. An analysis of progress of the Plan as it is revised.
4. Expanded look into how the identified natural hazards will affect certain populations including the young and elderly.

Appendix A. Environmental Considerations

Natural disasters are naturally occurring phenomena. They play an integral part in maintaining balance in our world. Meteorological, geological, or hydrological processes have shaped Utah for millions of years and will continue to shape the valley for millions more. These unique phenomena only cause disasters when they affect humans and their structure. Modern engineering has made it possible to prevent damage from natural hazards. However, the economic and environmental costs can be rather high. Tampering with natural systems can also create an imbalance in the natural environment. The effects of many of these imbalances are still unknown. It is better to live with a small amount of risk, respecting natural processes where appropriate, than to construct mitigation at every chance. Nature provides its own mitigation and measures the need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation measures, all applicable city/county ordinances and state/federal laws pertaining to the environment must be followed. The majority of the proposed mitigation programs in this Plan will be funded through federal programs, and thus tied to federal funding.

"44 CFR 10.8(d)(2)(iii) excludes this rule from the preparation of an environmental assessment or environmental impact statement, where the rule relates to actions that qualify for categorical exclusions under 44 CFR 10.8(d)(2)(iii), such as the development of plans under this section" (United States 2002).

The following acts will be taken into consideration and will be incorporated when needed while organizing and implementing the PDM Plan: Clean Air Act, Clean Water Act, Endangered Species Act, Floodplain Management, National Historic Preservation Act.

Clean Air Act (CAA) 1970: The Clean Air Act is the comprehensive Federal Law that covers the entire country under the Environmental Policy Act regulating air emissions from area, stationary, and mobile sources. This law sets limits or National Ambient Air Quality Standards (NAAQS), on how much of a pollutant can be in the air anywhere in the United States and the emissions of air pollutants. These limits ensure that all Americans have the same basic health and environmental protections. Maximum pollutant standards were set, though states may have stronger pollution controls than the national standards. Each state explains how it will do its job under the Clean Air Act by developing a mandated "state implementation plan" (SIP) that must be approved by the Environmental Protection Agency (EPA). The 1977 amendment set new dates for areas of the country that failed to meet the initial deadlines for achieving NAAQS. The 1990 amendments addressed problems such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxins. This act required facilities with large amounts of certain hazardous chemicals to have a special emergency planning requirement. Based on a facilities potential threat or risk from chemical spills, fires, explosions, etc., facilities prepare a Risk Management Plan (RMP) that includes hazard identification, assessments, design and maintenance of a safe facility, necessary steps to prevent releases and ways to minimize the consequences from an accidental release (United States 1970).

Clean Water Act (CWA): The Federal Water Pollution Control Act Amendments of 1972 came about because of the growing awareness for the need to control water pollution. As amended in 1977, this law became known as the Clean Water Act, whose mission is to establish the basic structure for regulating discharges of pollutants into the waters of the United States, and to reduce and maintain the chemical, biological, and physical veracity. The act gave the EPA the authority to set wastewater standards for industry. The act also requires that each state adopt water quality standards, act to protect wetlands, and limit industrial and municipal discharges into navigable waters unless permitted. It funded the construction of wastewater treatment plants for nearly every city in the United States through construction grant programs from the EPA and recognized the need for planning for future threats from nonpoint source pollution. (United States 1977a)

Clean Water Act, Section 404 – Wetland Preservation: This section regulates activities in wetland areas and authorizes the EPA to restrict or prohibit the use of an area as a disposal site for dredged or fill material if the discharge will have adverse affects on municipal water supplies, shellfish beds and fishery areas, wildlife or recreational areas. A permit must be issued that is based on regulatory guidelines developed in conjunction with the U.S. Army Corps of Engineers and the EPA. (United States 1977a)

Endangered Species Act of 1973: This act provides a plan for the protection of threatened or endangered plants and animals and the habitats in which they are found. Congress declared that various species of fish, wildlife, and plants in the United States have been caused to become extinct, or are so depleted in numbers they are in danger of becoming extinct as a result of economic development and expansion without adequate concern for conservation. Aesthetic, ecological, educational, historical, recreational, and scientific importance come from these species and are a value to our nation and its people. The U.S. will conserve, to a practicable extent, the species that face extinction and will encourage the States through federal assistance to develop and maintain conservation programs. The reason for the Act is to provide a means by which ecosystems with endangered and threatened species will be conserved. It is also declared that all state and local agencies resolve water resource issues in connection with conservation of endangered species (United States 1973).

Floodplain Management Policy: The main points of this policy are to reduce the loss of life and property and the disruption of societal and economic pursuits caused by flooding or facility operations as well as to restore, sustain and enhance the natural resources, ecosystems and other functions of the floodplains. Activities will search for a balance between the sometimes competing uses of floodplains in a way that provides the most benefit to society. Activities will pursue and encourage the appropriate use of floodplains, avoid long and short term negative impacts associated with the development and modification of floodplains, and avoid direct and indirect support of floodplain development whenever there is a practicable alternative. **"**Functions of floodplains include natural moderation of floods; fish, wildlife, and plant resources and habitat; groundwater recharge; and water quality maintenance. Uses of floodplains include storm water management, erosion control, open space, natural beauty, opportunity for scientific study, outdoor education, recreation, and cultural preservation, and compatible economic utilization of floodplain resources by human society." (United States 1977b).

National Historic Preservation Act of 1966 (NHPA): This act was enacted by Congress because "the spirit and direction of the Nation are founded upon and reflected in its historic heritage…the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people." Another main point of the act mandates the awareness of historic properties that are being lost or substantially altered. The preservation will continue a legacy of cultural, educational, aesthetic, inspirational, economic and energy benefits for future generations. The knowledge of historic resources and the encouragement of their preservations will improve the planning and execution of Federal and federally-assisted projects and will assist economic growth and development. The act uses measures that will foster conditions in which historic resources can exist in productive harmony with present and future generations (United States 2000).

Section 106 of NHPA "requires all Federal agencies to take into account the effects of their actions on historic properties, and provide ACHP with a reasonable opportunity to comment on those actions and the manner in which Federal agencies are taking historic properties into account in their decisions" beginning at the early stages of planning to mitigate any adverse effects on historic properties (United States 2000).

Appendix B. General Mitigation Strategies

For the purpose of this Mitigation Plan, mitigation strategies will be divided into one of five categories according to how they accomplish mitigation. The six categories include:

- Emergency Services
- Natural Resource Protection
- Prevention
- Property Protection
- Public Information and Involvement
- Structural Protection

Emergency Service: Emergency Services protect people during and after a disaster. Examples include:

- Mutual aid agreements
- Protection of critical facilities
- Health and safety maintenances
- Inventory of assets
- EMS/Police/Fire response and skill

Natural Resource Protection: Natural Resource Protection includes strategies that preserve or restore natural areas or the natural function that an area provides. Examples include:

- Wetlands protection
- Pollution reduction
- Erosion and sediment control
- Fuels reduction
- Watershed maintenance

Prevention: Prevention measures are intended to prevent the problem from occurring and/or keep it from getting worse. Examples include:

- Planning, zoning, and ordinance regulations
- Open space preservation
- Floodplain and wetland development regulations
- Storm water management
- Minimum set back requirements
- Evacuation plans

Property Protection: Property protection measures are used to modify buildings within high-risk areas in an attempt to reduce damage.

For the most part property protection measures do not affect a buildings appearance or use making them less expensive and particularly suitable for historical sites and landmarks. Examples include:

- Utility relocation
- Burying or flood proofing
- Non-structural earthquake mitigation
- Backup protections
- Insurance and other financial loss minimization actions
- Technical evaluations and mapping

Public Information and Involvement: Public information and involvement activities are intended to advise property owners, potential property owners, and visitors about the particular hazards associated with a property and ways to protect people and property from these hazards. Examples include:

- Education
  - NFIP
  - URWIN areas
  - Hazard Identification
- Maps with high hazard locations identified
- Informational mailings
- Workshops
- Real estate disclosures for natural hazards
- Real estate insurance

Structural Protection/Projects: These are man-made structures, which prevent damage from impacting property. Examples include:

- Detention/retention basins
- Larger culverts
- Elevated seismic design
- Floodwalls
- Debris basins
- Landslide stabilization and levees

1. Flood/ Riverine Mitigation

Generic Mitigation

The following are generic mitigation strategies appropriate for addressing the hazard of flooding. Many of these strategies are expanded upon in the text that follows.

- Avoidance, land-use planning and zoning ordinances
- Better flood routing through communities

- Annual warning of risk information on how to protect property and lives
- Flood insurance awareness, emphasis, and marketing
- Projects such as levees/dams
- Funding by a stormwater tax in cooperation with Federal and State programs
- Additional SNOTEL sites and enhanced instrumentation
- Protection of roads and bridges
- Greater reservoir capacities
- Curtail development in flood-prone areas
- General infrastructure protection
- Develop river corridor parkways
- Protection of wastewater treatment facilities from excessive inflows
- Protection of drinking water supply systems
- Gather hazard and risk data/information
- Development of improved mitigation techniques
- Education of local officials, developers, and citizens
- Protecting natural floodplain resources
- Good watershed management

A. Emergency Services

Flood Warning: Warning systems designed to alert residence of rising floodwaters. Warning systems can disseminate the information through a number of means such as sirens, radio, television, mobile public address system, emergency notification system, or door-to-door contact. Multiple or redundant warning systems are most effective, giving people more than one opportunity to be warned.

Flood Response: Flood response refers to the actions that are taken to prevent or reduce damage once a flood starts. An example of flood response is the turning of Salt Lake City's State Street into a river during the 1983 flood event. Many of the below actions should be part of an Emergency Operations Plan (EOP) developed in coordination with the agencies that share responsibilities. The EOP once developed should be exercised and continually evaluated so when the Plan is needed key players know what to do. Flood response actions might include:

- Activation of the emergency operations center
- Sandbagging designated areas
- Closing streets and bridges
- Shutting off power to threatened areas
- Protective actions for children in schools
- Ordering an evacuation
- Opening evacuation shelters

Critical Facilities Protection: Protecting critical facilities is vital, yet this protection draws workers and resources away from protecting other parts of a town or county. For this reason listed below are vital facilities and facilities with the potential of causing a secondary disaster if destroyed. It is important to keep these locations in mind when considering potential mitigation projects.

Facilities or locations vital to flood response efforts:

- Emergency operations centers
- Police and fire stations
- Hospitals
- Highway garages
- Selected roads and bridges
- Evacuation routes

Facilities and locations which, if flooded would create a secondary disaster:

- Facilities housing hazardous materials
- Wastewater treatment plants
- Schools
- Nursing homes

Health and Safety Maintenance: Response to floods or other natural disasters should include measures to prevent damage to health and safety such as:

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Vaccinating residents for tetanus
- Clearing streets
- Cleaning up debris

Many of these recommendations should be integrated into a public information program to educate citizens on the benefits of health and safety precautions.

B. Natural Resource Protection

Wetlands Protection: Wetlands are capable of storing large amounts of floodwater, slowing and reducing downstream flows, and filtering the water. Any development that is proposed in a wetland is regulated by either federal and/or state agencies. Mitigation techniques are often employed, which might consist of creating a wetland on another site to replace what would be lost through the development. This is not an ideal practice, however, since it takes many years for a new wetland to achieve the same level of quality as an existing one.

Erosion and Sedimentation Control: Controlling erosion and sediment runoff during construction and on farmland is important, since eroding soil will typically end up in downstream waterways. Sediment tends to settle where the water flow is slower. It will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. Sediment and erosion control have two principal components: minimize erosion with vegetation and capture sediment before it leaves the site.

Slowing runoff increases infiltration into the soil, thereby controlling the loss of topsoil from erosion and the resulting sedimentation. Runoff and erosion control can be done through vegetation, terraces, contour strip farming, no-till farm practices and impoundments.

C. Prevention Measures

Planning and Zoning: Land use plans are put in place to guide future development, recommending where development should or should not take place. Sensitive and vulnerable lands can be designated for uses that would be compatible with occasional flood events. Zoning ordinances can regulate development in these sensitive areas by limiting or preventing some or all development.

Open Space Preservation: Preserving open space is the best way to prevent flooding and flood damage. Open space preservation should not be limited to the flood plain. Other areas within the watershed may contribute to controlling the runoff that exacerbates flooding.

Floodplain Development Regulations: Floodplain development regulations typically do not prohibit development in the special flood hazard areas, but they do impose construction standards on what is built there. The intent is to protect roads and structures from flood damage and to prevent the development from aggravating the flood potential. Floodplain development regulations are generally incorporated into subdivision regulations, building codes, and/or floodplain ordinances.

Subdivision regulations: These regulations govern how land will be divided into separate lots or sites. In some Utah cities these are known as Site Based Ordinances.

Building Codes: Standards can be incorporated into building codes that address flood proofing all new improved or repaired buildings.

Floodplain Ordinances: Communities that participate in the National Flood Insurance Program (NFIP) are required to adopt the minimum floodplain management regulations, as developed by FEMA. The regulations set minimum standards for subdivision regulations and building codes. Communities may adopt more stringent standards than those set forth by FEMA.

Storm Water Management: Development outside of a floodplain can contribute significantly to flooding by covering impervious surfaces, which increase storm water runoff. Storm water management is usually addressed in subdivision regulations. Developers are typically required to build retention or detention basins to minimize any increase in runoff caused by new or expanded impervious surfaces, or new drainage systems.

Most larger cities and counties within Utah enforce an ordinance prohibiting storm water from leaving a site at a rate higher than it did before the development.

Drainage System Maintenance: Ongoing maintenance of channel and detention basins is necessary if these facilities are to function effectively and efficiently over time. A maintenance program should include regulations that prevent dumping in or altering watercourses or storage basins; grading and filling should also be regulated.

D. Property Protection

Relocation: Moving structures out of the floodplain is the surest and safest way to protect against damage. Relocation is expensive, so this approach will probably not be used except in extreme circumstances.

Acquisition: Acquisition by governmental entity of land in a floodplain serves two main purposes: it ensures that the problem structure is addressed; and it has the potential to convert problem areas into community assets

Building Elevation: Elevation of a building above the base flood elevation is the best on-site protection strategy. The building could be raised to allow water to run underneath it, or fill could be brought in to elevate the site on which the building sits.

Insurance: Above and beyond standard homeowners insurance, there is other coverage a homeowner can purchase to protect against flood hazard. Although this doesn't mitigate the problem it does allow the homeowner to shift the financial loss/risk to another party. Two of the most common insurances offered against flood loss are:

- National Flood Insurance: When a community participates in the NFIP, any local insurance agent is able to sell separate flood insurance policies under rules and rates set by FEMA. Rates do not change after claims are paid because they are set on a national basis.
- Basement Backup Insurance: National Flood Insurance offers an additional deductible for seepage and sewer backup, provided there is a general condition of flooding in the area that was the proximate cause of the basement getting wet.

E. Public Information and Involvement

Outreach Programs: Outreach projects are proactive; giving the public information even if they have not asked for it. Outreach projects should be designed to encourage people to seek out more information and take steps to protect themselves and their properties. Examples include:

- Mass mailing or newsletters to all residents
- Notices directed to high risk area residents
- Displays in public buildings

- Newspaper articles and special sections
- Radio and TV news releases and interviews
- A detailed property owners handbook tailored for local conditions
- Presentations at public meetings and neighborhood groups

Real Estate Disclosure: Disclosure of information regarding flood or hazard prone properties is important if potential buyers are to be in a position to mitigate damage. Federally regulated lending institutions are required to advise applicants that a property is in the floodplain.
However, this requirement needs to be met only five days prior to closing, and by that time the applicant is typically committed to the purchase. This only includes flood prone areas, at the exclusion of other hazards.

Map Information: Flood plain maps developed by FEMA outline the boundaries of the flood hazard areas. These maps can be used by anyone interested in a particular property to determine if it is in the floodplain. These maps are available from FEMA, the Utah Division of Emergency Services, and at many city and county planning offices. In addition the Utah Geologic Survey creates and maintains maps illustrating geologic hazards. These maps are available for sale at the Division of Natural Resources books store.

F. Structural Projects

The intent behind structural projects for flood mitigation is to prevent floodwaters from reaching properties. The shortcomings of almost all structural mitigation projects are that:

- They can be very expensive
- They disturb the land, disrupt natural water flows, and destroy natural habitats.
- They are built to an anticipated flood event, and may be exceeded by a greater than expected flood.
- They can create a false sense of security

Reservoirs: Reservoirs control flooding by holding water behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate the river downstream can handle. Reservoirs are expensive to build, occupy large tracts of land, require maintenance, and, if they fail, often result in greater downstream flooding than would occur during a natural flooding event.

Levees/Floodwalls: One of the best-known structural flood control measures, levees and floodwalls are earthen, steel or concrete structures placed between the watercourse and the land.

Diversions: A diversion is simply a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversion structures can consist of surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel but during flooding events floodwaters spill over into the diversion channel.

Channel Modifications: Channel modifications include making a channel wider, deeper, smoother, or straighter. Common channel modifications include:

- Dredging: Dredging is often cost-prohibitive because the dredged material must be disposed of somewhere else, and dredged streams usually fill back in with sediment.
- Drainage Modifications: These include man-made ditches and storm sewers that help drain areas where the surface drainage system is inadequate or where underground drainage ways may be safer or more attractive.

Storm Water Management: Mitigation techniques for managing storm water include installing storm water systems, enlarging pipes, and street improvements in existing storm water systems.

2. Earthquake

Generic Mitigation

Below is a list of generic earthquake mitigation strategies pertaining to secondary threats often associated with earthquakes.

Generic Ground Shaking Mitigation

- Understand peak horizontal acceleration and recurrence interval
- Design appropriately
- Zoning ordinances and building codes

Generic Liquefaction Mitigation

- Move soil out
- Densify soils in place
- Remove ground water
- Structural design

Generic Surface Fault Rupture Mitigation

- Avoidance
- Zoning ordinances
- Earthquake resistant building design codes
- Retrofitting of critical facilities and supporting equipment
- Retrofitting under-designed buildings
- Annual warning of risk/info on how to protect property and lives
- Projects to seismically upgrade critical public facilities/utilities and shelters

- Gather hazard and risk data/information
- Protection of roads and bridges
- General infrastructure protection
- Development of improved mitigation techniques
- Education of local officials, developers, and citizens

A. Emergency Services

Emergency Operations Planning: Maintain an earthquake response plan to account for secondary problems, such as fire and hazardous material spills.

Critical Facilities Protection: Protecting critical facilities are vital as the facilities play an important role in coordinating response and recovery following an earthquake. For this reason listed below are vital facilities and facilities with the potential of causing a secondary disaster if destroyed.

- Facilities or locations vital to earthquake response efforts
- Emergency operations centers
- Sheriff's Office and Fire Stations
- Hospitals
- Highway garages
- Selected roads and bridges
- Evacuation routes

Facilities and locations, which if destroyed would create a secondary disaster:

- Facilities housing hazardous materials
- Wastewater treatment plants
- Schools
- Nursing homes

B. Natural Resource Protection

- Design of pipelines
- Land-use planning
- Community master plans and zoning ordinances

C. Prevention

While earthquakes are not preventable proper planning, zoning, and building codes can prevent much of the damage common with earthquakes. Planning, zoning, and building codes should address minimums setbacks, critical faculty locations, steep slopes, areas with liquefiable soils, and insure high factor of safety ratings for critical facilities. Community master plans and zoning ordinances define hazard areas and require developers to show that any existing hazards have been investigated and new construction will not be exposed to unacceptable risk.

D. Property Protection

Nonstructural Mitigation: Nonstructural mitigation consist of mitigation measures that don't affect the overall look or purpose of the building yet prevent damage to no structural aspects and reduce the loss of life. In addition buildings with non-structural mitigation are frequently usable after an event.

- Tie downs
- Flexible utility connections
- Mylar film on windows to prevent the glass from shattering
- Added bracing

Retrofitting: Retrofitting upgrades the seismic safety of a building through structural and nonstructural mitigation techniques.

Insurance: Above and beyond standard homeowners insurance, there is other coverage a homeowner can purchase to protect against earthquake hazard, something not covered under most homeowner's insurance plans. Although this doesn't mitigate the problem it does allow the homeowner to shift the financial loss/risk onto another party.

E. Public Information and Involvement

Public information and involvement for earthquakes is similar to the mitigation strategies outlined in the flood and riverine section mentioned above.

Real Estate Disclosure: Disclosure of information regarding earthquakes and hazard prone properties are important if potential buyers are in a position to mitigate damage. Unlike floodplains there are no federal laws, which require disclosure of earthquakes.

F. Structural Protection/Projects

Mitigation measures can be any type of activity that reduces the likelihood or modifies what is at risk from the hazard. Earthquake mitigation can be accomplished through building codes that ensure safe and adequate construction including earthquake resistant designs and construction. Older building should be retrofitted to comply with the codes.

3. Dam Failure

Generic Mitigation

- Proper floodplain maps, including dam breach flood potential
- Public knowledge of floodplains for the general public and emergency managers
- Updated Emergency Operation Plans (EOP) integration with GIS Systems
- Maintain proper floodplain/ wetland geometry and vegetation for flood routing
- Floodplain usage compatible with floodplain needs

- More debris dams; they help to maintain flooding, debris, and mud
- Flood control pool in existing dams
- Protection of roads and bridges
- General infrastructure protection
- More authority to help with snowmelt floods/runoff- releases, better forecasting
- Gather hazard and risk data/information
- Development of improved mitigation techniques
- Education of local officials, developers, and citizens

A. Emergency Service

- Good emergency management and emergency action plans
- Dam conditioning monitoring
- Warning system and monitoring
- Understand standard operating procedures

B. Natural Resource Protection

- Zoning of downstream usage
- Risk assessment
- Good watershed management

C. Prevention

- Dam failure inundation maps
- Planning/zoning/open space preservation to keep downs stream areas clear
- Building codes with flood elevations based on dam failure
- Dam safety inspections
- Draining the reservoir when conditions appear unsafe

D. Property Protection

- Acquisition of building in the path of a dam breach flood
- Flood insurance

E. Public Information and Involvement

- Communication and education of dam owners
- Communication and education with the public
- Evacuation procedures

F. Structural Protection/Projects

- Dam improvements
- Spillway enlargements
- Remove unsafe dams
- Design and construction review
- Direction for consulting engineers
- Instrumentations and monitoring of dams
- Remedial repair procedures
- Incremental damage assessment

4. Wildfire

Generic Wildfire Mitigation

- Avoidance
- Define, create, and maintain a defensible space
- Plant drought and fire resistant vegetation
- Ordinances
- Modification of fuel loading in high hazard interface areas
- Wildland fire training and experience for fire department personnel
- Public education effort for people living in the interface
- Additional suppression equipment needs of fire departments and the Utah Division of Forestry, Fire, and State Lands
- Fuel modification in moderate hazard interface areas
- Protection of roads and bridges
- Annual warning of risk/info on how to protect life and property
- Gather hazard and risk data/information
- General infrastructure protection
- Development of improved mitigation techniques
- Education of local officials, developers, and citizens
- Protection of drinking water supply systems

A. Emergency Service

- Fire fighting

B. Natural Resource Protection

- Prohibit development in high-risk areas.
- Vegetation control

C. Prevention

- Zoning ordinances to reflect fire risk zones
- Planning and zoning to restrict development in areas near fire protection and water resources
- Requiring new subdivisions to space buildings, provide firebreaks, on-site water storage, wide roads and multiple accesses
- Building code standards for roof materials, spark arrestors
- Maintenance programs to clear dead and dry bush trees
- Regulations on open fires

D. Property Protection

- Retrofitting of roofs and adding spark arrestors
- Landscaping to keep bushes and trees away from structures
- Insurance rates based on distance from fire protection
- Planning how to deal with WUI fires before they occur
- Good visibility

E. Public Information and Involvement

- Educating homeowners and future homeowners about risk
- Planning how to deal with WUI fires before they occur
- Emergency warning system, action plan
- Communication tree between fire departments and homeowners
- Community actions
- Adequate water supply and systems

F. Structural Protection/Projects

- Building and property assessments
- Use appropriate construction materials
- Adequate access to buildings

5. Landslides

Generic Mitigation

- Avoidance
- Recognize landslide area
- Zoning ordinances
- Remove landslide materials
- Drain subsurface materials

- Install surface drains
- Remove materials for the head of the landslide
- Re-grade
- Build buttress or retaining wall at the toe of the slope
- Install soil nails and rock anchors
- Maintain natural vegetation
- Improved geologic mapping to identify potential landslide problems
- Zoning ordinances prohibiting construction in or adjacent to areas with high landslide potential
- Soil moisture sensors at SNOTEL sites
- Gather hazard and risk data/information
- Protection of roads and bridges
- Development of improved mitigation techniques
- Education of local officials, developers, and citizens
- Protection of drinking water supply systems
- Generic Rock Fall Mitigation
- Avoidance
- Stabilize rocks
- Prerelease
- Build berms or benches
- Build structures to stop rocks

A. Emergency Services

- Warning systems
- Hazard identification and areas at risk

B. Natural Resource Protection

C. Prevention

- Land use planning ordinances
- Identify old landslides
  - Old landslides: irregular or subdued hill-like topography
  - Younger or more recently occurring landslides: hummocky terrain, scarps, inclined trees, ground cracks, sharp vegetation differences, and numerous depressions or ponds
- Identify unstable slopes
- Identify areas that could be affected by slope failures
  - Potential rock falls: steep cliff areas or where bedrock crops out onto mountain slopes

D. Property Protection

- Good land-use practices
- Avoid slope-irrigation, undercutting, and over-steepening

E. Public Information and Involvement

- Communications systems
- Proper property assessments of slope conditions

F. Structural Protection/Projects

- Proper assessments of slope conditions
- Grading or removing the material from the top and placing it at the toe of a slope can lessen the slope gradient
- Subsurface drainage control used to dewater and stabilize slopes
- Retaining structures
  - Concrete block walls or large masses of compacted earth
- Constructing debris basins
- Building deflection walls upslope of structures
- Avoiding ground level windows that face upslope
- Catchment fences
- Tieback walls
- Rock bolts
- Cut benches and berms

6. Severe Weather

A. Emergency Services

- Early warning systems
- Communication systems

B. Natural Resource Protection

C. Prevention

- Building code standards for light frame construction
- Ordinances that include weather resistant designs

D. Property Protection

E. Public Information and Involvement

- Listen to a weather radio
- Watch and listen to weather forecasts and warnings
- Develop a plan so you know where to take your family for shelter
- Understand risk and identify ways of reducing the impacts

F. Structural Protection/Projects

- Strengthen un-reinforced masonry

7. Problem Soils

Generic Problem Soil Mitigation

- Avoidance
- Presoak and Compact
- Remove problem soil
- Landscape so that runoff moves away from foundations

A. Emergency Service

B. Natural Resource Protection

- Soil awareness

C. Prevention

- Landscaping with vegetation that does not concentrate or draw large amounts of water from the soil near foundations
- Insulating floors or walls near heating or cooling units to prevent evaporation that could cause local changes in soil moisture
- Avoid areas underlain by limestone and dolomite to prevent ground water contamination and foundation problems in karst terrain
- Use soil tests to find gypsum; do not plant high level of water plants near the house
- Reduce piping damage by limiting construction that disturbs natural drainage
- Peat deposits should be removed or avoided at construction sites
- Avoid abandoned mine areas
- Sands, and calcareous loamy soils are highly erodible

D. Property Protection

- Special foundation designs
- Installing gutters and downspouts that direct water at least 10 feet away from foundation slabs
- Landscape with vegetation that does not concentrate or draw large amounts of water from the soil near foundations

E. Public Information and Involvement

F. Structural Protection

- Special foundation designs
- Installing gutters and downspouts
- Proper drainage along roads and around structures

Appendix C. Hazard Histories

Morgan County

	Injuries	% of Total Injuries	Fatalities	% of Total Fatalities	Property Damage	% of Total Property Damage	Crop Damage	% of Total Crop Damage
1960s*	2.9	3%	0.07	2%	$2,093,847	6%	$117,817	2%
1970s	**31.5**	**36%**	0.43	12%	$4,484,717	14%	**$1,941,634**	**28%**
1980s	0.2	0%	0.24	7%	$7,457,690	22%	**$4,668,534**	**67%**
1990s	**41.0**	**47%**	**1.77**	**48%**	**$17,893,11**	**54%**	$126,446	2%
2000s*	11.8	14%	**1.15**	**31%**	$1,266,907	4%	$63,857	1%
TOTAL	87.4	100%	3.66	100%	$33,196,27	100%	$6,918,288	100%
Major Disaster Decadal Statistics 1962-2005, Morgan County (2005 dollars) *Not entire decade (HVRI 2007)								

	Injuries	% of Total Injuries	Fatalities	% of Total Fatalities	Property Damage	% of Total Property Damage	Crop Damage	% of Total Crop Damage
Avalanche	0.4	1.0%	**0.5**	**12.1%**	$60,387	0.6%	$0.00	0.0%
Extreme Cold	0.2	0.5%	0.0	0.7%	**$297,071**	**3.1%**	**$1,406,087**	**22.9%**
Flooding	0.0	0.0%	0.2	5.8%	**$4,876,500**	**51.3%**	**$4,674,203**	**76.0%**
Fog	**1.8**	**4.9%**	**0.4**	**9.7%**	$7,174	0.1%	$0	0.0%
Heavy Snow	**31.5**	**86.2%**	**2.8**	**69.1%**	**$2,706,577**	**28.5%**	**$65,358**	**1.1%**
Lightning	0.0	0.0%	0.0	0.0%	$37,078	0.4%	$0	0.0%
Wind	**2.7**	**7.3%**	0.1	2.5%	**$ 1,512,166**	**15.9%**	$5,469	0.1%
TOTAL	36.5	100.0%	4.1	100.0%	$9,496,952	100.0%	$6,151,118	100.0%
Major Disaster Statistics 1962-2005, Morgan County (2005 dollars) (HVRI 2007)								

	Number of Events	Events Per Year	Injuries Per Event	Fatalities Per Event	Property Damage Per Event	Crop Damage Per Event	Total Monetary Loss Per Event	Total Annualized Losses
Avalanche	4	0.1	**0.10**	**0.13**	$15,097	$0	$15,097	$1,372
Extreme Cold	**7**	**0.2**	0.02	0.00	**$42,439**	**$200,870**	**$243,308**	**$38,708**
Flooding	5	0.1	0.00	**0.05**	**$975,300**	**$934,841**	**$1,910,141**	**$217,061**
Fog	1	0.0	**1.80**	**0.40**	$7,174	$0	$7,174	$163
Heavy Snow0	**75**	**1.7**	**0.42**	**0.04**	$36,088	**$871**	$36,959	**$62,999**
Lightning	1	0.0	0.00	0.00	$37,078	$0	$37,078	$843
Major Disaster Per Event and Annual Statistics 1962-2005, Morgan County (2005 dollars) (HVRI 2007)								

Appendix D. Critical Facilities

The following identifies an inventory of all the critical facilities within each county. Critical facilities are of particular concern because of the essential products and services to the general public they provide. These critical facilities can also fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in this Plan include amateur radio repeaters, emergency operations centers, electric and oil facilities, hospitals, fire and police stations, schools, water and wastewater treatment plants. (Mod = Moderate)

Morgan County Amateur Radio Resources 2016

Call Sign (Location, Frequency)	*Dam Failure*	*Flood*	*Ground Shaking*	*Liquefaction*	*Problem Soils*	*Slope Failure*	*Wildfire*	*Severe Weather*
KB7ZCL (Morgan, 147.100)	Low	Low	High	Low	Low	Low	Mod	High
WA7GIE (Lewis Peak, 147.360)	Low	Low	High	Low	Low	Low	Mod	High
K7MLA (Francis Peak, 146.960)	Low	Low	High	Low	Low	Low	Mod	High
W7SU (Mt. Ogden, 146.900)	Low	Low	High	Low	Low	Low	Mod	High
W7SP (Farnsworth Peak, 146.620)	Low	Low	High	Low	Low	Low	Mod	High
K7DAV (Antelope Island, 147.040)	Low	Low	High	Low	Low	Low	Mod	High
AC7O (Promontory, 147.260)	Low	Low	High	Low	Low	Low	Mod	High
W7SU (Mt. Ogden, 448.600)	Low	Low	High	Low	Low	Low	Mod	High
N7TOP (Powder Mountain, 447.750)	Low	Low	High	Low	Low	Low	Mod	High

Name	*Dam Failure*	*Flood*	*Ground Shaking*	*Hail*	*Lightning*	*Liquefaction*	*Problem Soils*	*Radon*	*Slope Failure*	*Tornado*	*Wildfire*	*Wind*
Weber Power Plant (PacifiCorp)	High	High	High	Low	Low	Low	Low	High	Mod	Low	High	High
Electric Generation Facility Vulnerability, Morgan County												

	Emergency Operations Centers											
Name	***Dam Failure***	***Flood***	***Ground Shaking***	***Hail***	***Lightning***	***Liquefaction***	***Problem Soils***	***Radon***	***Slope Failure***	***Tornado***	***Wildfire***	***Wind***
Morgan Fire Station	High	Low	High	Low	Low	Low	Low	Mod	Low	Low	Low	High
Morgan Search and Rescue	Low	Low	High	Low	Low	Low	Low	Mod	Low	Low	High	High
Emergency Operation Center Vulnerability, Morgan County												

	Fire Stations											
Name	***Dam Failure***	***Flood***	***Ground Shaking***	***Hail***	***Lightning***	***Liquefaction***	***Problem Soils***	***Radon***	***Slope Failure***	***Tornado***	***Wildfire***	***Wind***
Power Department Shed	High	High	High	Low	Low	Low	Low	Mod	Low	Low	Mod	High
Morgan County Fire	High	Low	High	Low	Low	Low	Low	Mod	Low	Low	Low	High
Mountain Green Fire	High	Low	High	Low	Low	Low	Low	Mod	Low	Low	Mod	High
Fire Station Vulnerability, Morgan County												

	Police Stations											
Name	***Dam Failure***	***Flood***	***Ground Shaking***	***Hail***	***Lightning***	***Liquefaction***	***Problem Soils***	***Radon***	***Slope Failure***	***Tornado***	***Wildfire***	***Wind***
Morgan County Sheriff	High	Low	High	Low	Low	Low	Low	Mod	Low	Low	Low	High
Law Enforcement Vulnerability, Morgan County												

	Schools							
Name	***Dam Failure***	***Flood***	***Ground Shaking***	***Liquefaction***	***Problem Soils***	***Slope Failure***	***Wildfire***	***Severe Weather***
Morgan Elementary	High	High	High	Low	Low	Low	Low	High
Morgan High	High	Low	High	Low	Low	Low	Low	High
Morgan Middle	High	High	High	Low	Low	Low	Low	High
Mountain Green Elementary	Low	Low	High	Low	Low	Low	Low	High

School Vulnerability, Morgan County

Appendix E. Glossary of Terms

Abutment (dam) – the valley side against which a dam is constructed.
Acre-foot of water – approximately 326,000 gallons of water, or approximately a football field covered by one foot of water.
Active Faults – An active fault is defined as a fault displaying evidence of displacement along one or more of its traces during Holocene time (about the last 11,000 years).
Aftershocks – earthquakes during the seconds, hours, days to months following a larger earthquake (main shock) in the same general region.
Alluvial fan – a cone-shaped deposit of stream sediments, generally deposited at the base of a mountain where a stream encounters flatter terrain.
Amplitude (seismic waves) - the maximum height of a wave crest or depth of a trough. Amount the ground moves as a seismic wave passes, as measured from a seismogram.
ATV – All Terrain Vehicle
Avalanche path – the area in which a snow avalanche runs; generally divided into starting zone, track, and runout zone.
Basin and Range physiographic province – consists of north-south-trending mountain ranges separated by valleys, bounded by the Rocky Mountains and the Colorado Plateau to the east and the Sierra-Cascade Mountains to the west (includes western Utah).
Bearing capacity – the load per unit area, which the ground can safely support without excessive yield.
Bedrock – solid in-place rock, sometimes exposed and sometimes concealed beneath the soil.
Block faulting – see **normal fault**
Collapsible soil (hydrocompaction) – loose, dry, low-density soil that decreases in volume or collapses when saturated for the first time following deposition.
Critical Areas – Environmentally sensitive areas which include wetlands fish and wildlife habitat conservation areas; geologically hazardous areas; areas with a critical recharging effect on aquifers used for potable water; and frequently flooded areas. Critical areas have measurable characteristics which, when combined, create a value for or potential risk to public health, safety and welfare.
Critical/Essential Facilities – Structures meeting one or more of the following criteria:

- Fire stations, police stations, storage facilities for vehicles/equipment needed after a hazard event, and emergency operation centers.
- Hospitals, nursing homes, and housing which is likely to contain occupants who may not be sufficiently mobile to avoid injury or death as a result of a hazardous event
- Public and private utility facilities, which are vital to maintaining or restoring normal services to, damaged areas after a hazardous event.
- Structures or facilities that produce, store, or use highly flammable, explosive, volatile, toxic and/or water reactive materials

Debris flow – involves the relatively rapid, viscous flow of surficial material that is predominantly coarse grained.
Debris slide – involves predominantly coarse-grained material moving mainly along a planar surface.
Drought (Agricultural) – lack of water for crop production in a given area
Drought (Hydrologic) – lack of water in the entire water supply for a given area.

Drought (Meteorological) – lack of precipitation compared to an area's normal
Drought (Socioeconomic) – lack of water sufficient to support an area's population
Earth flow – Involves fine-grained material that slumps away from the top or upper part of a slope, leaving a scarp, and flows down to form a bulging toe.
Earthquake – a sudden motion or trembling in the earth as fracture and movement of rocks along a fault release stored elastic energy.
Earthquake fault zone – earthquake fault zones are regulatory zones around active faults. The zones are used to prohibit the location of critical facilities and structures designed for human occupancy from being built astride an active fault. Earthquake Fault Zones are plotted on topographic maps at a scale of 1-inch equals 2,000 feet. The zones vary in width, but average about one-quarter mile wide.
Earthquake-induced seiche – Earthquake generated water waves causing inundation around shores or lakes and reservoirs.
Epicenter – the point on the earth's surface directly above the focus of an earthquake.
Epoch – geologic time unit lasting more than an age but shorter than a period (Epoch 2008).
Erosion – the removal of earth or rock material by many types of processes, for example, water, wind, or ice action.
Expansive soil and rock – soil and rock which contain clay minerals that expand and contract with changes in moisture content.
Fault – a break in the earth along which movement occurs.
Fault segment – section of a fault that behaves independently from adjacent sections.
Fault zone – an area containing numerous faults.
Federal Emergency Management Agency (FEMA) – authorized under Section 404 of the Stanford Act. Provides funding for hazard mitigation projects that are cost-effective and comply with existing post-disaster mitigation programs and activities. These projects cannot be funded through other programs to be eligible.
Fill – material used to raise the surface of the land generally in a low area.
Fire-resistant vegetation – plants that do not readily ignite and burn when subjected to fire because of inherent physiological characteristics of the species such as moisture content, fuel loading, and fuel arrangement.
Floodplain – an area adjoining a body of water or natural stream that has been or may be covered by floodwater.
Floodplain (100-year/500-year) – Floodplains that have the potential to flood once every 100 or 500 years or that has a 1% (100-year) or 0.2% (500-year) chance of flooding equal to or in excess of that in any given year.
Floodway – An area of land immediately adjacent to a stream or river channel that, in times of flooding, becomes an enlarged stream or river channel and carries the floodwater with the highest velocity.
Fluvial – concerning or pertaining to rivers or streams.
Focus – the point of origin of an earthquake within the earth, and the origin of the earthquake's seismic waves.
Formation (geologic) – a mappable rock unit consisting of distinctive features/rock types separate from units above and below.

Frequency (seismic waves) – the number of complete cycles of a seismic wave passing a point during one second.
Fuel (fire) – vegetation, building material, debris, and other substances that will support combustion.
Fuel break – a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located strip of land to reduce or hinder the rate of fire spread.
Fuel type – a category of vegetation used to indicate the predominate cover of an area.
Glacial moraine – debris (sand to boulders) transported and deposited by glacial ice along a glacier's sides or terminus.
Graben – a block of earth down dropped between two faults.
Gradient (slope) – a measure of the slope of the land surface.
Ground failure – a general term referring to any type of ground cracking or subsidence, including landslides and liquefaction-induced cracks.
Ground shaking – the shaking or vibration of the ground during an earthquake.
Ground water – that portion of subsurface water which is in the zone of saturation.
Gypsiferous deposits – soil or rock containing gypsum, which can be subject to dissolution.
Gypsum – a mineral composed of hydrated calcium sulfate. A common mineral of evaporites.
Hazard Mitigation Plan – The Plan resulting from a systematic evaluation of the nature and extent of vulnerabilities posed by a hazard present in society that includes the strategies needed to minimize future vulnerability to hazards.
Hazard Mitigation – Any action taken to reduce or permanently eliminate the long-term risk to human life and property and the environment posed by a hazard.
HAZUS-MH – Hazards United States – Multihazards; Earthquake loss estimation software using GIS databases developed by FEMA.
Head (landslide) – the upper parts of the slide material along the contact between the disturbed material and the main scarp.
Holocene – geologic epoch covering the last 10,000 years (after the last Ice Age).
Igneous rocks – rocks formed by cooling and hardening of hot liquid material (magma), including rocks cooled within the earth (for example, granite) and those that cooled at the ground surface as lavas (such as basalt).
Impermeable – materials having a texture that does not permit water to move through.
Interfluve – land between two streams in the same drainage basin (Interfluve 2004)
Intermountain Seismic Belt (ISB) – zone of pronounced seismicity, up to 120 miles wide and 800 miles long, extending from Arizona through central Utah to northwestern Montana.
Lacustrine – concerning or pertaining to lakes.
Lake Bonneville – a large, ancient lake that existed 30,000 to 12,000 years ago and covered nearly 20,000 square miles in Utah, Idaho, and Nevada. The lake covered many of Utah's valleys, and was almost 1,000 feet deep in the area of the present Great Salt Lake.
Lake Bonneville sediments – sediments deposited by Lake Bonneville, found in the valleys, which range from gravels and sands to clays.
Landslide – a general term for a mass of earth or rock, which moves down slope by flowing, spreading, sliding, toppling, or falling (see slope failure).

Lateral spread – lateral down slope displacement of soil layers, generally several feet or more, above a liquefied layer.
Levee (flood) – a berm or dike used to contain or direct water, usually without an outlet or spillway.
Liquefaction – sudden large decrease in shear strength of a cohesionless soil (generally sand or silt) caused by collapse of soil structure and temporary increase in pore-water pressure during earthquake ground shaking.
Magnitude (earthquake) – a quantity characteristic of the amplitude of the ground motion of an earthquake. The most commonly used measurement is the Richter magnitude scale; a logarithmic scale based on the motion that would be measured by a standard type of seismograph 60 miles from the earthquake's epicenter.
Metamorphic rocks – rocks formed by high temperatures and/or pressures (for example, quartzite formed from sandstone).
Mitigation – the act of reducing or preventing hazards which affect society or those things deemed important to society
Modified Mercalli Intensity (MMI) – the most commonly used intensity scale in the U.S.; it is a measure of the severity of earthquake shaking at a particular site as determined from its effect on the earth's surface, man, and man's structures.
Montmorillonite – a clay mineral characterized by expansion upon wetting and shrinking upon drying.
Natural vegetation – native plant life existing on a piece of land before any form of development.
Normal fault (block faulting) – fault caused by crustal extension in which relative movement on opposite sides is primarily vertical; for example, the Wasatch fault.
Oolite – spherical grains of carbonate sand with a brine shrimp fecal pellet nucleus.
Outlet (dam) - a conduit through which controlled releases can be made from the reservoir.
Palmer Drought Severity Index (PDSI) – developed by Wayne Palmer in the 1965; measures drought severity using temperature, precipitation and soil moisture (Utah Division of Water Resources 2007)
Peat – unconsolidated surficial deposit of partially decomposed plant remains.
Period (geologic) – a standard (world-wide) geologic time unit.
Permeability – the capacity of a porous rock or soil for transmitting a fluid.
Physiographic province – a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.
Piping (problem soil and rock) – a weak incoherent layer in unconsolidated deposits that acts as a channel directing the movement of water. As the layer becomes saturated it conducts water to a free face (cliff or stream bank for example) that intersects the layer, and material exits out a "pipe" formed in the free face. Piping can occur in a dam as the result of progressive development of internal erosion by seepage.
Pore space – the open spaces in a rock or soil between solid grains. The spaces may be filled with gas (usually air) or liquid (usually water).
Porosity – the ratio of the volume of pore space in rock or soil to the volume of its mass, expressed as percentage.
Probable Maximum Flood (PMF) – a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in a region.

Probable Maximum Precipitation (PMP) – the maximum amount and duration of precipitation that can be expected to occur on a drainage basin.
Problem soil and rock – geologic materials that are susceptible to volumetric changes, collapse, subsidence, or other engineering geologic problems.
Project Impact – An initiative of the Federal Emergency Management Agency intended to modify the way in which the United States handles natural disasters. The Goal of Project Impact from a Federal Government perspective is to reduce the personal and economic costs of hazard events by bringing together the private and public sector to better enable the citizens of a community to protect themselves from natural hazards.
Quaternary – a geologic time period covering the last 1.6 million years.
Recurrence interval – the length of time between occurrences of a particular event (an earthquake, for example).
Rock fall – abrupt free fall or down slope movement, such as rolling or sliding, of loosened blocks or boulders from an area of bedrock. The rock-fall runout zone is the area below a rock-fall source which is at risk from falling rocks.
Rock topple – forward rotation movement of a rock unit(s) about some pivot point.
Runout zone (avalanche) – where a snow avalanche slows down and comes to rest (deposition zone). For large avalanches, the runout zone can include a powder- or wind-blast zone that extends far beyond the area of snow deposition.
Sand blow (earthquake) – deposit of sandy sediment ejected as water and sand to the surface, formed when ground shaking has caused liquefaction at depth.
Scarp – a relatively steeper slope separating two more gentle slopes. Scarps can form as result of earthquake faulting.
Sediment – material that is in suspension, is being transported, or has been moved from its site of origin by water, ice, or wind, and has come to rest on the earth's surface either above or below the sea level.
Sedimentary rocks – rocks formed from loose sediment such as sand, mud, or gravel deposited by water, ice, or wind, and then hardened into rock (for example, sandstone); or formed by dissolved minerals precipitating out of solution to form rock (for example, tufa).
Seiche – a standing wave generated in a closed body of water such as a lake or reservoir. Ground shaking, tectonic tilting, sub aqueous fault rupture, or landsliding into water can all generate a seiche.
Seismic waves – vibrations in the earth produced during earthquakes.
Seismicity – seismic or earthquake activity.
Sensitive clay – clay soil that experiences a particularly large loss of strength when disturbed. Deposits of sensitive clay are subject to failure during earthquake ground shaking.
Shear strength – the internal resistance that tends to prevent adjacent parts of a solid from "shearing" or sliding past one another parallel to the plane of contact. It is measured by the maximum shear stress that can be sustained without failure.
Shear stress - a stress causing adjacent parts of a solid to slide past one another parallel to the plane of contact.
Slope failure – a general term referring to any type of natural ground movement on a sloping surface (see landslide).

Slump – a slope failure that slides along a concave rupture surface. Generally slumps do not move very far from the source area.
Snow avalanche – a rapid down slope movement of a mass of snow, ice, and debris.
Spectral Acceleration – measurement for approximate horizontal force experienced in a model earthquake. Measurements are specific to the frequency of shaking found to affect buildings during and earthquake. A 0.2-second period affects primarily one- and two-story buildings while 1.0- second period of spectral acceleration affects buildings approximately 10 stories in height.
Stafford Act – Robert T. Stafford Disaster Relief and emergency Assistance Act, PL 100-707, signed into law November 23 1988: amended the Disaster Relief Act of 1974, PL 93-288
Starting zone (avalanche) – where the unstable snow or ice breaks loose and starts to slide.
Subsidence – a settling or sinking of the earth's crust.
Sunny-day failure –
Surface fault rupture (surface faulting) – propagation of an earthquake-generated fault rupture to the ground surface, displacing the surface and forming a scarp.
Tectonic subsidence – subsidence (down dropping) and tilting of a basin on the down dropped side of a fault during an earthquake.
Toe (landslide) – the margin of disturbed material most distant from the main scarp.
Track (avalanche) – the slope or channel down which a snow avalanche moves at a fairly uniform speed.
Unconsolidated basin fill – un-cemented and non-indurated sediment, chiefly clay, silt, sand, and gravel, deposited in basins.
Urban area – a geographical area, usually of incorporated land, covered predominately by engineered structures including homes, schools, commercial buildings, service facilities, and recreational facilities.
Velocity (ground motion) – the rate of displacement of an earth particle caused by passage of a seismic wave.
Wasatch fault – a normal fault that extends over 200 miles from Malad City, Idaho to Fayette, Utah, and trends along the western front of the Wasatch Range.
Watershed – the area of land above a reference point on a stream or river, which contributes runoff to that stream.
Weathering – a group of processes (such as the chemical action of air, rain water, plants, and bacteria and the mechanical action of temperature changes) whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.
Wildfire – uncontrolled fire burning in vegetation.
Wildland area – a geographical area of unincorporated land covered predominately by natural vegetation.
Wildland Urban Interface (WUI) – Wildland vegetation and forested areas adjacent to or intermingled with residential developments.
Zone of deformation (earthquake) – the width of the area of surface faulting over which earth materials have been disturbed by fault rupture, tilting, or subsidence.

List of Acronyms and Recognized Abbreviations

AARC	Average Annual Rate of Change
AGRC	Automated Geographic Reference Center
APHIS	Animal and Plant Health Inspection Service
AOG	Association of Governments
BCEGS	Building Code Effectiveness Grading System
BOR	Bureau of Reclamation
cal yr B.P.	Calendar Years Before Present
CDBG	Community Development Block Grant
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERT	Certified Emergency Response Team
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CRS	Community Rating System
DB	Detention Basin
DFIRM	Digital Flood Insurance Rate Map
DEM	Utah Division of Emergency Management
DMA 2000	Disaster Mitigation Act of 2000
EAP	Emergency Action Plan
EGSLFZ	East Great Salt Lake Fault Zone
EM	Emergency Management/Manager
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
G	Gravity
GIS	Geographic Information Systems
GOPB	Governor's Office of Planning and Budget
GPS	Geographic Positioning System
GSL	Great Salt Lake
HAM	Handheld Amateur Radio
HAZMAT	Hazardous Materials
HAZUS-MH	Hazards United States – Multi-Hazards
HGMP	Hazard Mitigation Grant Program
LEPC	Local Emergency Planning Committee
LUST	Leaking Underground Storage Tank
M	Magnitude
MSL	Mean Sea Level

MOU	Memoranda Of Understanding
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NWS	National Weather Service
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
piC/L	picoCuries per Liter
PL	Public Law
PSC	Public Safety Communications
RCRA	Resource Conservation and Recovery Act
SA	Spectral Acceleration
SBA	Small Business Administration
SHELDUS	Spatial Hazard Events and Losses Database for the United States
SLC	Salt Lake City
SPI	Standardized Precipitation Index
SR	State Route
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, Environmental
SWSI	Surface Water Supply Index
TAZ	Transportation Analysis Zone
TRAX	Transit Express
TRI	Toxic Release Inventory
UCAN	Utah Communication Agency Networks
UDAF	Utah Department of Agriculture and Food
UDOT	Utah Department of Transportation
UEDV	Utah Economic Data Viewer
UFFSL	Utah Division of Forestry, Fire, and State Lands
UGS	Utah Geological Survey
USGS	United States Geological Survey
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USFS	United States Forestry Service
USU	Utah State University
UUSS	University of Utah Seismic Stations
WFRC	Wasatch Front Regional Council
WFZ	Wasatch Fault Zone
WUI	Wildland-Urban Interface

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