2017 Update to Pre-Disaster Mitigation Plan

Missoula County, City of Missoula

March 2017

TETRA TECH

2017 UPDATE TO
PRE-DISASTER MITIGATION PLAN

FOR

MISSOULA COUNTY, MONTANA
AND
CITY OF MISSOULA

***Prepared for*:**

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March 2017

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LIST OF ACRONYMS

BLM	Bureau of Land Management
BCA	Benefit Cost Analysis
BPA	Bonneville Power Administration
CAIC	Colorado Avalanche Information Center
CAPS	Community and Planning Services
CDBG	Community Development Block Grant
CDC	Centers for Disease Control
CDP	Census Designated Place
CEIC	Census and Economic Information Center
cfs	Cubic Feet Per Second
CPAW	Community Planning Assistance for Wildfire
CPRI	Calculated Priority Risk Index
CRC	Clearwater Resource Council
CRP	Conservation Reserve Program
CRS	Community Rating System
CSKT	Confederated Salish and Kootenai Tribes
CWPP	Community Wildfire Protection Plan
DES	Disaster and Emergency Services
DFIRM	Digital Flood Insurance Rate Map
DMA	Department of Military Affairs
DMA	Disaster Mitigation Act
DNRC	MT Department of Natural Resources and Conservation
DOI	U.S. Department of Interior
DPHHS	MT Department of Health and Human Services
EAP	Emergency Action Plan
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
EQIP	Environmental Quality Incentives Program
ERC	Energy Release Component
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FP&S	Fire Protection and Safety
FSA	Fire Service Area
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information Systems
HAZUS	Hazards of the United States
HMGP	Hazard Mitigation Grants Program
IBC	International Building Code
IDSA	Infectious Disease Society of America

LIST OF ACRONYMS

IRC	International Residential Code
LEPC	Local Emergency Planning Committee
LiDar	Light Detection and Ranging
LOMAR	Letter of Map Revision
MBMG	Montana Bureau of Mines and Geology
MCFPA	Missoula County Fire Protection Association
MDOR	Montana Department of Revenue
MDT	Montana Department of Transportation
MEC	Missoula Electric Cooperative
MRL	Montana Rail Link
NCDC	National Climatic Data Center
NDRP	National Drought Resilience Partnership
NFIP	National Flood Insurance Program
NFP	National Fire Plan
NFPA	National Fire Protection Association
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NRIS	Natural Resource Information System
NTSB	National Transportation Safety Board
NWS	National Weather Service
OEM	Office of Emergency Management
PDM	Pre-Disaster Mitigation
PDMC	Pre-Disaster Mitigation Competitive (grants program)
PGA	Peak Ground Acceleration
RC&D	Resource Conservation and Development
RFA	Rural Fire Assistance
RLP	Repetitive Loss Property
RFD	Rural Fire District
SHELDUS	Spatial Hazard Events and Losses Database for the United States
STD	Sexually Transmitted Disease
TRI	Toxic Release Inventory
UCF	Urban and Community Forestry
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geologic Survey
WHO	World Health Organization
WRN	Weather Ready Nation
WUI	Wildland Urban Interface
YPL	Yellowstone Pipe Line

SECTION 1. INTRODUCTION

1.1 Background

In response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Missoula County and the City of Missoula, have developed this Multi-Jurisdictional Pre-Disaster Mitigation (PDM) Plan. DMA 2000 amends the Stafford Act and is designed to improve planning for, response to, and recovery from, disasters by requiring State and local entities to implement pre-disaster mitigation planning and develop PDM Plans. The Federal Emergency Management Agency (FEMA) has issued guidelines for development of PDM Plans. The Montana Disaster and Emergency Services (DES) supports plan development for jurisdictions in the State of Montana.

> ***Hazard Mitigation*** is any sustained action taken to reduce or eliminate the long term risk and effects that can result from specific hazards.
>
> FEMA defines a ***Hazard Mitigation Plan*** as the documentation of a state or local government evaluation of natural hazards and the strategies to mitigate

Missoula County completed and adopted a PDM Plan in 2005, which was updated in 2011, to help guide and focus hazard mitigation activities. The County, working together with Tetra Tech Inc., has prepared this 2017 update to their PDM Plan to satisfy the requirement that PDM Plans be updated every five years. The 2017 Missoula County PDM Plan profiles significant hazards to the community and identifies mitigation projects that can reduce those impacts. The purpose of the updated PDM Plan is to promote sound public policy designed to protect residents, critical facilities, infrastructure, private property, and the environment from natural and man-made hazards. The updated Missoula County PDM Plan includes resources and information to assist residents, organizations, local government, and others interested in participating in planning for natural and man-made hazards. This 2017 updated PDM Plan supersedes the 2005 and 2011 PDM Plans.

1.2 Authority

The Missoula County PDM Plan update has been developed pursuant to the requirements in the Interim Final Rule for hazard mitigation planning and the guidance in the State and Local Plan Interim Criteria under DMA 2000. The Plan also meets guidance developed by FEMA in June of 2008 for Multi-Jurisdictional Mitigation Planning.

The Missoula County Board of County Commissioners have adopted this PDM Plan. Also adopting the Plan is the City of Missoula. These governing bodies have the authority to promote sound public policy regarding natural and man-made hazards in their jurisdictions. Copies of the signed resolutions are included as **Appendix A** to this plan. The PDM Plan was adopted at the regularly scheduled County Commission and City Council meetings, which were open to the public and advertised through the typical process the jurisdictions use for publicizing meetings.

Missoula County will be responsible for submitting the adopted PDM Plan to FEMA for review. Upon acceptance by FEMA, Missoula County and the City of Missoula will remain eligible for mitigation project grants and post-disaster hazard mitigation grant projects.

1.3 Acknowledgements

Many groups and individuals have contributed to development of the Missoula County PDM Plan. The Missoula County Office of Emergency Management (OEM) provided support for all aspects of plan development including providing digital locations and insurance values for the critical facilities and infrastructure used in the PDM analysis. The PDM Planning Team, comprised of various members of the Missoula County Disaster Planning Committee, met on a regular basis to guide the project, identify the hazards most threatening to the County, develop and prioritize mitigation projects, review draft deliverables and attend the public meetings. The local communities participated in the planning process by attending public meetings and contributed to plan development by reviewing and commenting on the draft plan.

1.4 Scope and Plan Organization

The process followed to prepare the 2017 Missoula County PDM Plan update included the following:

- Review and prioritize disaster events that are most probable and destructive,
- Update and identify new critical facilities,
- Review and update areas within the community that are most vulnerable,
- Update and identify new goals for reducing the effects of a disaster event,
- Review and identify new projects to be implemented for each goal,
- Review and identify new procedures for monitoring progress and updating the PDM Plan,
- Review the draft PDM Plan, and
- Adopt the updated PDM Plan.

The PDM Plan is organized into sections that describe the planning process (Section 2), community profile (Section 3), risk assessment (Section 4), mitigation strategies (Section 5) and plan maintenance (Section 6). Appendices containing supporting information are included at the end of the plan.

SECTION 2. PLANNING PROCESS

The updated Missoula County PDM Plan is the result of a collaborative effort between Missoula County and the City of Missoula, utilities, local agencies, non-profit organizations, businesses, and regional, state and federal agencies. The planning effort was facilitated by the contractor, Tetra Tech. Public participation played a key role in development of goals and mitigation projects, as outlined below. For the purposes of this planning effort, the public is defined as residents of Missoula County, local departments, state and federal agencies that support activities in the county, neighboring communities and local partners.

2.1 PDM Planning Team

The Missoula County OEM director requested various members of the Disaster Planning Committee serve as the PDM Planning Team for the purposes of updating the PDM Plan. These individuals are listed in **Appendix B**. The affiliation of these participants are presented in **Table 2.1-1.**

Table 2.1-1. Agencies Represented on the PDM Planning Team

Organization / Position	Type of Organization
City of Missoula Fire Department	City Government
City of Missoula Police Department	City Government
Missoula Aging Services	City-County Government
Missoula City-County Health Department	City-County Government
Missoula Water Quality Protection District	City-County Government
Missoula County Community and Planning Services	County Government
Missoula County Office of Emergency Management	County Government
National Weather Service / Warning Coordinator	Federal Government
Clark Fork Coalition	Local Organization
Local Emergency Planning Committee / Citizen Representative	Local Organization
Providence Saint Patrick Hospital	Medical Organization
Missoula County Public Works	County Government

Responsibilities of the Planning Team included attending conference calls to discuss update of the Plan, providing data for analysis in the risk assessment, attending public meetings, providing input and feedback on mitigation strategies, review of the draft plan document, and supporting the plan throughout the adoption process. The PDM Planning Team will assist the Missoula County OEM in updating the Plan in the future.

The Planning Team met several times over the course of the project; once to rank the hazards, and two other times to update the mitigation strategy. Conference calls were held on September 28th, October 19th and November 9th, 2016. In advance of each conference call, an agenda and/or materials to be discussed (i.e. hazard maps, hazard ranking matrices, example mitigation strategies, etc.) were sent to meeting participants. Planning Team meeting minutes are presented in **Appendix B**.

2.2 Project Stakeholders

The planning process was initiated by preparing a stakeholders list of individuals whose input was needed to help prepare the PDM Plan. Planning partners on the stakeholders list received a variety of information during the project including meeting notices, documents for review, and the draft mitigation strategy. **Appendix B** presents the stakeholders list for this project.

On the County level, project stakeholders included the County Commissioners, County Attorney, Office of Emergency Management, Community and Planning Services, Floodplain Administrator, Sheriff's Office, Public Information Officer, Director of Technology, Health Department, Public Works Department, GIS, School Districts, Missoula Aging Services, and Rural Fire District. These entities participated in the planning process by either providing data, attending public meetings, participating on the PDM Planning Team, and/or reviewing the draft PDM Plan.

Stakeholders from the City of Missoula included: the Chief Executive, Mayor, City Council Members, Police Department, Development Services, Floodplain Administrator, City Engineer, School Districts, GIS Coordinator and Fire Department. These entities participated in the planning process by either providing data, attending public meetings, participating on the PDM Planning Team, and/or reviewing the draft PDM Plan.

Stakeholders from federal agencies included representatives from: the National Weather Service (NWS), U.S. Forest Service, and U.S. Bureau of Land Management (BLM). These agencies were provided information on plan development, participating on the PDM Planning Team, attended public meetings, and/or reviewed the draft PDM Plan.

Stakeholders from state agencies included representatives from: the Montana Department of Natural Resources and Conservation (DNRC), University of Montana, District #1 Representative from Montana DES, and State Hazard Mitigation Officer. These entities participated in the planning process by providing data for the plan, attending the public meetings and/or reviewing the draft PDM Plan.

Non-governmental stakeholders (non-profits, local organizations, utilities, businesses) included: the American Red Cross, Team Rubicon and United Way; the Missoula Chamber of Commerce, Missoula Downtown, Missoula Conservation District, Bitter Root Resource Conservation and Development (RC&D), and Missoula Avalanche; KVGO radio and Missoulian newspaper; Providence Saint Patrick Hospital and Community Medical Center; Riverside Senior Center; Mountain Water, NorthWestern Energy, and Missoula Electric Coop; and, Montana Rail Link, Phillips 66, and Cenex-Harvest States. Some of these entities provided information for plan development, attended the public meetings, participated on the PDM Planning Team, and/or reviewed the draft PDM Plan update.

Planning partners from adjoining jurisdictions included: the Ravalli, Mineral, Granite, Powell, Sanders, Lincoln, and Lake County OEM Directors and the DES Coordinator for the Confederated Salish and Kootenai Tribes. These entities did not offer input on update of the Missoula County PDM Plan.

2.3 Review of Existing Plans and Studies

At the initiation of the project, planning documents and studies completed for Missoula County were obtained from relevant websites and reviewed in order to determine how mitigation could be integrated into this planning process and future local planning mechanisms and programs. Contributing plans/ordinances reviewed by the contractor included:

DAMS

- Emergency Action Plan, Isaac Creek Dam
- Emergency Action Plan, Spartan/Playfair Park Retention Basins

EMERGENCY OPERATIONS

- Missoula County Emergency Operations Plan

FLOODING

- Missoula County Flood Insurance Study, 2015

GROWTH POLICIES, ORDINANCES, REGULATIONS

- Missoula County Growth Policy, 2016
- Missoula County Shoreline Regulations, 2015
- Missoula County Subdivision Regulations, 2016
- Missoula County Zoning Ordinance, 2001
- Missoula County Floodplain Regulations, 2015
- Missoula County Regional Land Use Guide, 2002
- Lolo Regional Plan, 2002
- Seeley Lake Regional Plan, 2010
- Swan Valley-Condon Comprehensive Plan Amendment, 1996
- Wye-Mullan West Area Comprehensive Plan, 2005
- City of Missoula Growth Policy, 2015
- City of Missoula Floodplain Regulations, 2004
- City of Missoula Subdivision Regulations, 2010
- City of Missoula Zoning Ordinance, 2016
- City-County Urban Fringe Yearbook, 2012
- Butler Creek Area Comprehensive Plan Amendment, 1996
- Grant Creek Area Plan, 1980
- Historic Southside Neighborhood Plan, 1991
- Miller Creek Plan, 1997
- Northside-Westside Neighborhood Plan, 2006
- Rattlesnake Valley Comprehensive Plan Amendment, 1995
- Reserve Street Area Plan, 1995
- South Hills Comprehensive Plan, 1986
- Southside Riverfront Area Comprehensive Plan Amendment, 2000

HAZARD MITIGATION

- Missoula County Pre-Disaster Mitigation Plan, 2011
- Missoula County Community Wildfire Protection Plan, 2005
- Seeley Swan Fire Plan, 2013

OTHER

- Missoula Urban Area Open Space Plan, 2006
- Missoula Downtown Riverfront Plan, 1990
- Farviews Pattee Canyon Parks Study, 2008
- Rattlesnake Valley Transportation Summit Study, 2011
- Fort Missoula Regional Park Plan, 2010
- Missoula Active Transportation Plan, 2011

The data obtained from the plan and regulation review was incorporated into various sections of the PDM Plan. A summary of land use implementation tools is presented in *Section 3.7.1*. *Section 4.0* contains reference to the plans and ordinances affecting management of the hazard. *Section 7.3* includes a discussion on how mitigation can be implemented through existing programs.

2.4 Project Website

A website was set up at the start of the project to provide information to project stakeholders and the citizens of Missoula County. The project website can be viewed at: www.countypdm.com/ (password: Missoula). The website remained active during the course of the project through adoption of the plan.

The website contained a Home page and pages for: Contacts, Planning Team, Meetings, Draft PDM Plan, Maps, and References. The Home page contained a letter inviting participation in development of the Plan. The Contacts page contained information on Tetra Tech and County personnel involved in management of the project. The Planning Team page contained the meeting schedule, agendas, handouts, and notes from the Planning Team conference calls. The Meetings page contained the public meeting schedule, notes, handouts and presentations from the public meetings. The Draft PDM Plan page contained sections from the draft plan for stakeholder review. The Maps page contained draft versions of the critical facility and hazard maps prepared for the project. The References page contained the 2011 Missoula County PDM Plan, FEMA guidance on preparing multi-jurisdictional hazard mitigation plans, the FEMA Region 8 Plan Review Guidance dated September 2011, FEMA Planning Process Bulletin dated July 2016, FEMA Risk Assessment Bulletin dated June 2016, and links to the State of Montana PDM Plan and FEMA websites.

2.5 Public Meetings

Two public meetings were conducted during development of the PDM Plan. The first public meeting was held to kick-off the project. At this meeting, the 2011 PDM plan was reviewed and hazard events over the past five years discussed. The second public meeting was held to review the draft risk assessment and mitigation strategy and to kick-off the public review period for the draft PDM Plan. Sign-in sheets, handouts, presentations, and meeting notes are contained in **Appendix B** and posted on the project website.

The first public meeting was held on September 14, 2015 at the Missoula County Courthouse Annex first floor meeting room in Missoula. The September 14, 2016 edition of the Missoulian newspaper published an article on the PDM Update project which advertised the public meeting. The public meeting was also advertised on the county website and via social media (Facebook). A meeting notice was sent via e-mail to all project stakeholders and the meeting details was posted on the project website. Media documentation is presented in **Appendix B**.

During the first public meeting, Tetra Tech made a presentation which reviewed and analyzed each section of the 2011 mitigation plan, outlined the background and rationale for updating the PDM Plan, the process and methodology for the plan update, and the project schedule. **Table 2.5-1** describes the outcome of the 2011 PDM Plan review.

Table 2.5-1. Review and Analysis of 2011 Pre-Disaster Mitigation Plan

2011 PDM Sections	How Reviewed and Analyzed
Section 1 – Introduction	Reviewed existing section through discussion at public meeting. No analysis needed.
Section 2 - Planning Process and Public Involvement	Reviewed and analyzed existing section through discussion at public meeting. Planning process expanded by utilizing project website and scoring hazards using Calculated Priority Risk Index.
Section 3 – Inventory of Community Assets	Reviewed and analyzed existing section through discussion at public meeting. Reviewed and updated list of critical facilities. Developed critical facility maps and obtained values for PDM analysis.
Section 4 – Missoula County Hazard Assessment	Reviewed and analyzed existing section through discussion during public meeting and Planning Team conference calls. Reviewed and updated existing hazard profiles and developed profiles for new hazards to be included in PDM Plan. Enhanced profiles with climate change discussion.
Section 5 - Mitigation Strategy	Reviewed by Planning Team during conference calls and public meetings. New projects developed, existing projects re-worded and/or deleted, completed projects documented. Capability assessment updated.
Section 6 – Implementation and Plan Maintenance	Reviewed and analyzed existing section through discussion during Planning Team conference calls. Determined that plan maintenance procedures outlined in previous plan were implemented but not documented.

Tetra Tech made a presentation at the meeting which reviewed each section of the 2011 mitigation plan, outlined the background and rationale for updating the PDM Plan, the process and methodology for the plan update, and the project schedule. The meeting presentation was placed on the project website for stakeholders who could not attend the meeting (**Appendix B**). Approximately 18 individuals participated in the meeting including representatives from Missoula County OEM, the City Police and Fire Departments, County Public Health Department, County Community Development and Planning Services, City Development Services, City and County GIS Coordinators, the National Weather Service, Team Rubicon, Missoula Aging Services, St. Patrick's Hospital, and the Missoula Chamber of Commerce.

A second public meeting to review the draft PDM Plan was held on December 13, 2016 at the Missoula County Courthouse Annex first floor meeting room in Missoula. The public meeting was held at the beginning of the draft Plan public review period. A notice of the meeting was sent via email to the project stakeholders, advertised on the Missoula County website, via social media (Facebook), and on the project website. Tetra Tech presented results of the PDM risk assessment at the meeting as

well as the updated mitigation strategy. Eleven (11) individuals attended the public meeting including representatives from the Missoula County OEM, County Health Dept., Water Quality District, Community and Planning Services, Missoula Aging Services, Partnership Health Center, Montana Dept. Natural Resources and Conservation, Providence Health Center, and Montana Rail Link. Public meeting attendees networked before and after the meeting, listened to the presentation, and asked questions.

2.6 Plan Review

The planning process for the PDM Plan began on August 4, 2016 and lasted approximately nine months. The public was provided at least two opportunities for comment prior to adoption of the plan. The first opportunity was during the drafting process. A notice was placed in the newspaper, on the county website, and via social media regarding availability of the draft PDM Plan and that review copies were available in hard copy, electronically on compact disk (CD) upon request, or available on the project website. A hard copy of the draft Plan was available for review at the Missoula County Office of Emergency Management. An email announcement was sent to the project stakeholders indicating the draft PDM Plan was available for review with instructions on how to comment.

The draft document was produced with line numbers to aid in the review process. Reviewers were asked to submit their comments on the draft plan to the Missoula County OEM office after a review period of approximately 80-days (December 13, 2016 to February 28, 2017). The Missoula County OEM Director reviewed the comments and in consultation with the Planning Team submitted a consolidated list of comments to the contractor and a plan revision was completed.

The final draft plan was posted on the project website and stakeholders were notified of its availability via an e-mail message and social media. At this point a second opportunity was provided to the public to comment on the PDM Plan. The final draft plan was available for a second review from March 15 to April 30, 2017, an approximate 45-day review period.

Concurrent with the second public review period, the draft PDM Plan was submitted to the State Hazard Mitigation Officer and FEMA for compliance with the Region 8 Plan Review Guidance. The final draft Plan was placed on the project website and stakeholders were notified via email regarding its availability. Comments received from Montana DES and FEMA, along with comments received from the second public review of the final draft, were addressed in a second plan revision.

The final Plan was provided to the Missoula County Board of County Commissioners and the Missoula City Council for adoption. After adoption, copies of the final Plan were submitted to Missoula County, the City of Missoula, Montana DES and FEMA.

Future comments on the PDM Plan should be addressed to:

Missoula County Office of Emergency Management
200 W. Broadway, Missoula, Montana 59802
(406) 258-3632

SECTION 3. COMMUNITY PROFILE

This section of the PDM Plan presents an overview of Missoula County and the City of Missoula, the jurisdictions which comprise this plan. Information provided in this section on the characteristics of the county, the economy and land use patterns presents the backdrop for this mitigation planning process.

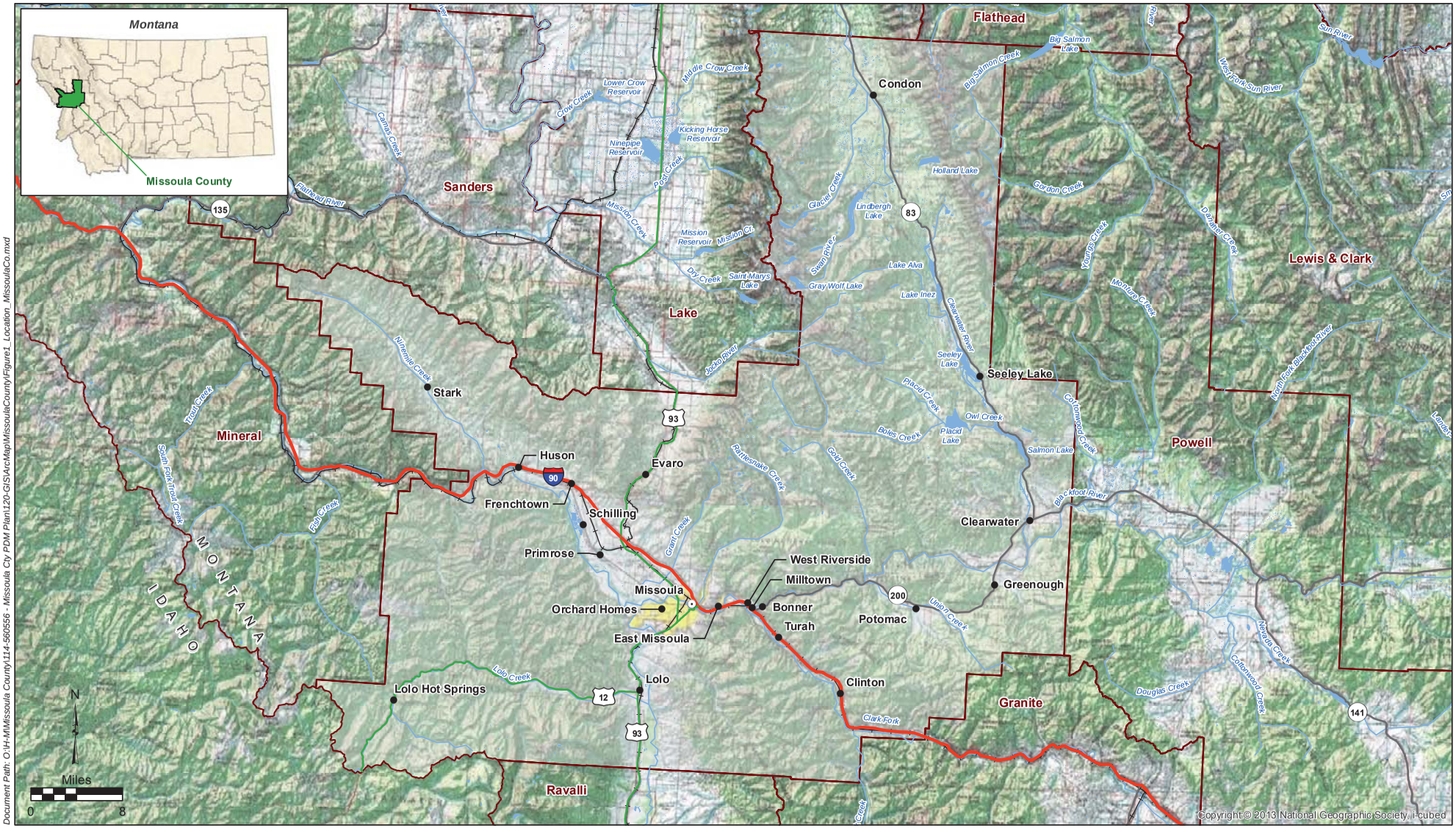
3.1 Physical Setting

Missoula County is located in western Montana (**Figure 1**) and is the second most populous county in the State of Montana. The County has a population of 114,181 (2015 U.S. Census estimate) and an area of 2,593 square miles. The City of Missoula is the only incorporated city and serves as the county seat. Unincorporated places in Missoula County include: Bonner-West Riverside, Clinton, Condon, East Missoula, Evaro, Frenchtown, Greenough, Huson, Lolo, Milltown, Orchard Homes, Potomac, Seeley Lake, Swan Valley, Turah, and Wye. Land in the north-central portion of the county is occupied by the Flathead Reservation which is home to the Confederated Salish and Kootenai Tribes (CSKT).

The forested mountains that frame the valleys and the open spaces that blanket the valley floors are iconic of Missoula County. Over 1,975 miles of rivers, streams and named tributaries crisscross the valleys. The City of Missoula is located at the base of Mount Sentinel at the hub of five valleys (the Hellgate and Blackfoot Valleys to the east, the Missoula Valley to the west, the Flathead-Jocko Valley to the north, and the Bitterroot Valley to the south) and three rivers (the Blackfoot, the Bitterroot, and the Clark Fork). The Seeley Lake area is located in the Clearwater River watershed, with forested mountain ranges on either side and rivers, streams, and a chain of lakes running through the valley.

Almost 62 percent of the land in Missoula County is managed by state, federal and local governments, with tribal lands accounting for an additional 5.8 percent. The U.S. Forest Service is the largest landowner, with 50.8 percent of the Missoula County land area, followed by the State of Montana at 9.4 percent. Private land ownership in the county has decreased from 736,648 acres in 2005 to 526,635 acres in 2015 and is at approximately 31.4 percent of the county land area. This is largely a result of a transfer of Plum Creek Timber Company (now Weyerhaeuser) land to the U.S. Forest Service, State of Montana, City of Missoula, The Nature Conservancy, and other private owners via the Montana Legacy Project and the Clearwater-Blackfoot Project. The mix of land ownership is still in transition. Approximately 19.5 percent of the county land area can be considered private and non-corporate (Missoula County Growth Policy, 2016).

Population density in Missoula County is 42.1 persons per square mile compared to the average 6.8 persons per square mile for the State of Montana. In the City of Missoula, population density is 2,427.6 persons per square mile (Census Quick Facts, 2016). **Figure 2** presents landownership and population density in Missoula County.



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Legend

- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

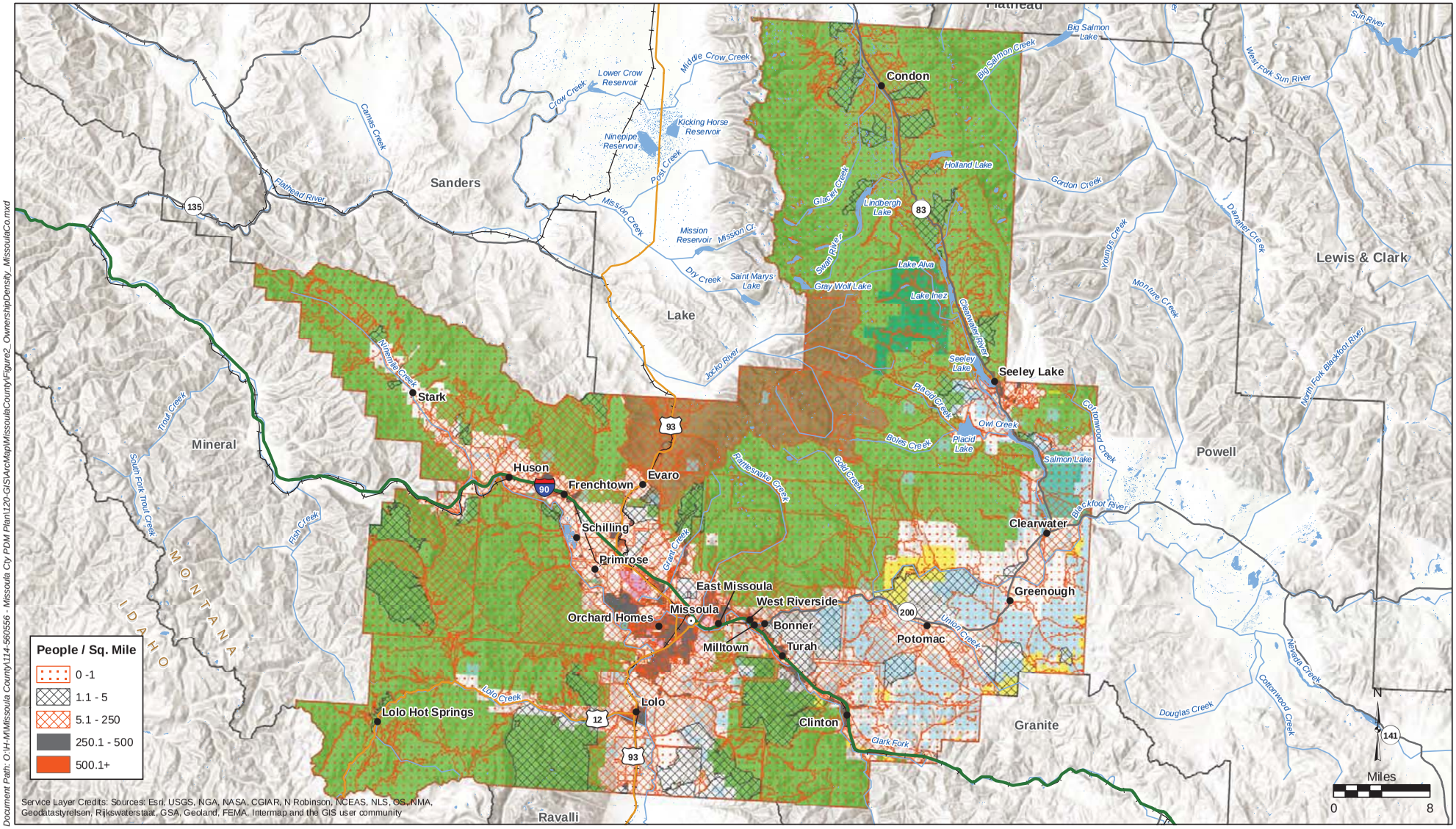
Date: 12/1/2016

Figure 1

Location Map

Missoula County, Montana

Pre-Disaster Mitigation Plan



Date: 12/6/2016

Legend

- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary
- City Government
- County Government
- State
- Montana Fish, Wildlife, and Parks
- Bureau of Land Management
- Forest Service
- Confederated Salish & Kootenai Tribes

Figure 2
Land Ownership & Population Density
Missoula County, Montana
Pre-Disaster Mitigation Plan

3.2 Climate

Missoula's climate is semiarid. Twelve to fifteen inches of annual precipitation are spread fairly evenly throughout the year with the heaviest amount occurring in May and June. Summers are warm and sunny with cool evenings while winters are moderately cold with extended periods of cloud cover. The growing season is May through September. Occasional artic air masses spill over the continental divide from the east in winter filling the valley with subzero air temperatures for short periods. The valley also experiences stagnant air inversions in winter and wildfire smoke events in summer which often have negative effects on air quality and health. **Table 3.2-1** presents climate statistics for Missoula.

Table 3.2-1. Missoula County Climate Statistics – Missoula

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High (^{0}F)	33	39	50	58	67	75	86	85	73	58	42	31
Average low (^{0}F)	18	21	28	33	40	47	51	50	42	32	25	17
Avg. Precipitation (Inches)	0.87	0.71	0.98	1.22	2.01	2.09	0.98	1.18	1.18	0.87	1.02	1.02
Average Snowfall (Inches)	8	6	5	1	0	0	0	0	0	1	5	11

Source: http://www.usclimatedata.com/climate/missoula/montana/united-states/usmt0231

For the purposes of this mitigation plan, weather is of interest when it threatens property or life and thus becomes a hazard. The National Weather Service provides short-term forecasts of hazardous weather to the public and also records weather and climatic data. Further information on NWS weather warning criteria is presented in the individual hazard profiles in *Section 4.*

Climate Change

Climate change will affect the people, property, economy and ecosystems of Missoula County in a variety of ways. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

A climate change study by the University of Montana predicts warmer temperatures and associated drought over the course of the next century with annual temperatures projected to warm 3.6 to 7.2 degrees. Winters will be shorter and summers will be longer with spring snowmelt occurring four to six weeks earlier and summer drought periods lasting six to eight weeks longer.

Climate change indicators provide useful information about what is occurring in complex systems. These indicators include temperature and growing season, rainfall intensity, snowpack, streamflow, stream temperature, wildland fire occurrence, plants live cycle events, and forest health. The hazard profiles in *Section 4* provide climate change implications as they relate to the specific hazards.

3.3 Critical Facilities and Infrastructure

Critical facilities are of particular concern because they provide essential products and services that are necessary to preserve the welfare and quality of life and fulfill important public safety, emergency response, and/or disaster recovery functions. Critical facilities include: the 911 emergency call

center, emergency operations centers, police and fire stations, public works facilities, sewer and water facilities, hospitals and shelters; and facilities that, if damaged, could cause serious secondary impacts (i.e., hazardous material facilities). Critical facilities also include those facilities that are vital to the continued delivery of community services or have large vulnerable populations. These facilities may include: buildings such as the jail, law enforcement center, public services buildings, senior centers, community corrections center, the courthouse, and juvenile services building and other public facilities such as hospitals, nursing homes and schools.

Critical facilities in Missoula County are identified in **Appendix C.** Replacement values were collected where readily available; however, time and resource constraints prohibited the collection of values for all structures. A GIS layer of the critical facilities was used in the hazard risk assessment. This GIS layer should be updated on a regular basis for use in future analysis. Further details on the county's critical facilities and infrastructure from the Missoula County Growth Policy (2016) and the City of Missoula Growth Policy (2015), are presented below.

3.3.1 Water and Wastewater Services

Drinking water for 80 percent of Missoula County residents is supplied by the Missoula Valley aquifer. Mountain Water Company currently serves the majority of the urban area and East Missoula, although the city is in the process of taking over the system. The water system relies on 37 wells drawing from the aquifer. Rattlesnake Creek serves as an emergency backup supply and future resource if needed.

Most residences in unincorporated Missoula County have individual wells. The few exceptions include the El Mar, Lolo and Sunset West water systems, which are managed by the Missoula County Public Works Department. Also, the Seeley Lake Water District serves a portion of the Seeley Lake community and a few private parties maintain several multi-user water systems throughout the county. The CSKT maintain three community water systems in Missoula County. The Lolo Municipal Water System is comprised of four water wells located within the aquifers of the Bitterroot River and Lolo Creek and three storage reservoirs on the hill in Lolo that provide gravity flow to the community.

The City of Missoula municipal wastewater treatment system operates in the urban area with planned expansions in the Rattlesnake Valley, the Wye, McCauley Butte, west of Reserve Street, and south of the Clark Fork River. A study is underway for the development of sewer service in the Bonner/ Milltown/ West Riverside areas. The City of Missoula operates a stormwater system that serves the urban area.

Individual wastewater treatment systems (septic system) are the most common method of wastewater disposal outside of the Missoula urban area. The Missoula County Public Works Department operates the Lolo and Lewis & Clark (Clinton) sewer systems. The Lolo facility has approximately 1,100 connections. The Lewis & Clark District has 42 connections and will require an update sometime between 2015 and 2020. The Lolo Wastewater Treatment Plant is close to the 100-year floodplain and floodway fringe of the Bitterroot River. The Seeley Lake District is planning a centralized wastewater project.

Stormwater drainage is most often addressed by landowners (including Missoula County) attempting to keep runoff on their properties and in drainage swales along public and private roads.

Missoula County does not operate a storm sewer system, but manages roadway stormwater runoff through roadside ditches, culverts and retention systems. As part of this, the county maintains approximately 528 sumps and more than 100 culverts.

3.3.2 Utilities

NorthWestern Energy and Missoula Electric Cooperative (MEC) provide most of the electric service in the county. Mission Valley Power serves the area of the county within the Flathead Reservation. MEC serves most of North Bitterroot Valley and the Lolo Creek Valley extending to the Idaho border. NorthWestern Energy provides natural gas service and is generally less available outside the city. Many rural residents also rely on propane.

Several transmission lines and gas pipelines cross the county. Bonneville Power Administration (BPA) operates a high voltage 500 kV transmission line that crosses the Lolo area. NorthWestern Energy operates an eight-inch underground high-pressure natural gas line in the foothills east of the Bitterroot River. Twenty-nine (29) miles of the Yellowstone Pipeline Company petroleum pipeline run through the county.

Numerous local and national companies provide cellular, landline, and/or internet telecommunication services within the county. Broadband internet is generally available to residents throughout Missoula County. The main line from Seattle/Chicago/Denver/Salt Lake City runs through Missoula and into the Swan Valley, Seeley Lake, Potomac, and Greenough. Due to terrain, there are areas that experience problems with these services.

3.3.3 Transportation

Missoula County has approximately 1,500 miles of public roadway. The County Road Department is responsible for maintenance activities on approximately 474 miles of road. Of these 474 miles, approximately 232 miles are paved and 242 miles are gravel. The county is also responsible for all bridges in the county that are not part of the state highway system.

The City of Missoula has approximately 338 total miles of local streets and highways. Montana Department of Transportation (MDT) roads include 191 miles of interstate, highway, and urban roads. About 10 miles of tribal residential and forest roads are within the Flathead Reservation in Missoula County as are over 2,400 miles of U.S. Forest Service roads.

The Missoula Urban Transportation District, or Mountain Line, operates 17 fixed-route buses operating on 12 routes in the Missoula area. Several other local organization provide on-demand service to the elderly and people with disabilities.

The Missoula County Airport Authority operates the Missoula International Airport west of Missoula. The airport averages 155 landings and takeoffs per day. Four air carrier and commuter airlines and several all- cargo airlines serve the airport. The Aerial Fire Depot, Intermountain Fire Sciences Laboratory, and the Missoula Technology Development Center use the airport. Other airports in Missoula County include the Seeley Lake Airport, the Rock Creek Airport and U.S. Forest Service landing strips in Condon, Missoula (Johnson Bell Field), Ninemile, and Seeley Lake.

Montana Rail Link move freight through Missoula. According to Montana Rail Link, about 16 to 20 freight trains pass through Missoula daily. The Bitterroot Railroad Line operates on an infrequent basis. Passenger rail service is not available in Missoula.

3.3.4 Law Enforcement and Emergency Services

The Missoula County Sheriff's Office and the Missoula City Police Department are the primary law enforcement agencies within the county. The Montana Highway Patrol maintains traffic enforcement and crash investigation on State highways and areas outside the city limits. On the Flathead Reservation, Tribal Police have law enforcement authority. Other agencies with law enforcement roles in Missoula County are Montana Fish, Wildlife and Parks, the U.S. Forest Service, U.S. Bureau of Land Management (BLM), and the U.S. Fish and Wildlife Service.

Fire Services

Rural Fire Districts as well as county, city, state, federal, and tribal agencies provide fire protection services in Missoula County. These agencies plan and provide for their own infrastructure needs and generate funds necessary to develop facilities and obtain new equipment. The Missoula County Fire Protection Association is a voluntary non-profit association of city, rural, state and federal fire professionals, emergency responders, and others who work together to address issues in common.

Several agencies respond to fire and medical emergencies throughout the county. The agency having jurisdiction responds. The City Fire Department and the Missoula Rural Fire District provide emergency medical services in most of the urban area. Other fire organizations in the County include: Arlee Rural Fire District (RFD) covering south of Arlee; Clinton RFD covering Clinton and Lower Rock Creek; East Missoula RFD covering East Missoula; Florence RFD covering north of Florence; Frenchtown RFD covering Evaro, Frenchtown, Huson/Ninemile, Petty Creek, and the Wye; Greenough-Potomac Fire Service Area (FSA) covering Greenough and Potomac; Missoula City Fire Department covering Missoula; Missoula RFD covering Blackfoot/Turah, Grant Creek/Rattlesnake, Pattee Canyon, Lolo/Miller Creek, and Target Range/Big Flat; Seeley Lake RFD covering Seeley Lake; and Swan Valley Fire Service Area covering Condon. The fire districts and fire service fee areas are staffed by volunteers. There are areas without designated fire services. The Lolo, Flathead, and Bitterroot National Forests; BLM; Montana DNRC; and CSKT also provide fire protection in Missoula County.

Mutual Aid Agreements exist between all the fire service agencies. Under such agreements, a member agency may request and receive assistance at an emergency that exceeds or might exceed the requesting agency's available resources. However, the assisting agency takes into account the need to provide services within its own jurisdiction.

Office of Emergency Management

The mission of the Missoula County OEM is to protect lives, property, and the environment through preparedness, response, recovery, and mitigation planning and activities. The OEM provides the following services: plans, organizes, and manages the County's Emergency Preparedness Program; evaluates, improves, and promotes comprehensive disaster planning efforts; organizes and facilitates effective operations of multi-jurisdiction, multi-discipline work groups and task forces;

promotes interagency coordination; and, develops and reviews polices, contracts, and interagency agreements. These efforts are designed to enhance the capacity of the local government to plan for, respond to, and mitigate the consequences of threats and disasters using an all-hazards framework. Overall, OEM emphasizes preparedness in addressing potential natural threats (wildfires, flooding). OEM maintains and delivers information to the public in coordination with fire protection agencies, law enforcement, and other emergency response providers.

Missoula County OEM operates from the basement of the Courthouse Annex which also serves as the local Emergency Operations Center (EOC) in the event of an emergency. The EOC is a designated area established for facilitating the overall management of an emergency. The EOC provides a multi-agency coordination center where elected officials and senior agency representatives gather to: manage coordination, communications, data and information collection; design and disseminate public information; engage in strategic senior decision-making processes; and, provide the primary link to state and federal agencies.

3.4 Population Trends

According to the 2015 U.S. Census estimates, Missoula County is the 2nd most populous in Montana with a population of 114,181. This represents a 4.5 percent increase since the 2010 census. **Table 3.4-1** illustrates the change in population in Missoula County compared to the U.S. and Montana since 1970.

Table 3.4-1. County, State and National Population Trends

Year	Missoula Co. Population	% change from previous census	State of Montana Population	% change from previous census	United States Population	% change from previous census
2015	114,181	4.47%	1,032,949	4.40%	321,418,820	4.10%
2010	109,299	14.09%	989,415	9.67%	308,745,538	9.71%
2000	95,802	21.75%	902,190	12.91%	281,424,602	13.15%
1990	78,687	3.51%	799,065	1.57%	248,709,873	9.79%
1980	76,016	30.47%	786,690	13.29%	226,542,199	11.43%
1970	58,263	30.45%	694,409	2.91%	203,302,031	13.37%

Source: U.S. Census Bureau

Table 3.4-2 presents population statistics for the City of Missoula as well as other unincorporated communities within Missoula County.

Table 3.4-2. Missoula County and Community Population Trends

Census Designated Place (CDP)	1980	% Change Since Last Census	1990	% Change Since Last Census	2000	% Change Since Last Census	2010	% Change Since Last Census	2015	% Change Since Last Census
City of Missoula	33,351	13.07%	42,918	28.69%	57,053	32.93%	66,788	17.06%	71,022	6.34%
Bonner-W. Riverside CDP	--	--	1,669	--	1,693	1.44%	1,663	-1.77%	--	--
Carlton CDP	--	--	--	--	--	--	694	--	--	--
Clinton CDP	--	--	--	--	549	--.	1,052	91.62%	--	--
Condon CDP	--	--	--	--	--	--	343	--	--	--
East Missoula CDP	--	--	--	--	2,070	--	2,157	4.20%	--	--
Evaro CDP	--	--	--	--	329	--	322	-2.13%	--	--
Frenchtown CDP	--	--	--	--	883	--	1,825	106.68%	--	--
Huson CDP	--	--	--	--	--	--	210	--	--	--

Table 3.4-2. Missoula County and Community Population Trends

Census Designated Place (CDP)	1980	% Change Since Last Census	1990	% Change Since Last Census	2000	% Change Since Last Census	2010	% Change Since Last Census	2015	% Change Since Last Census
Lolo CDP	--	--	2,746	--	3,388	23.38%	3892	14.88%	--	--
Orchard Homes CDP	--	--	10,317	--	5,199	49.61%	5,197	-0.04%	--	--
Piltzville CDP	--	--	--	--	--	--	395	--	--	--
Seeley Lake CDP	--	--	--	--	1,436	--	1,659	15.53%	--	--
Wye CDP	--	--	--	--	381	--	511	34.12%	--	--

Source: U.S. Census Bureau. Notes: CDP – Census Designated Place; "—" = not available

According to the Missoula County Growth Policy (2016), the county population is expected to grow significantly and is projected to have a population of 137,055 in 2035. Based on current population distribution, 65 to 70 percent of new residents will locate within the Missoula city limits and 30 to 35 percent will locate within the unincorporated areas. In Missoula County, even more so than the rest of the United States, the population is aging.

3.5 Housing Stock

The U.S. Census estimates in their *2010-2014 American Community Survey* that Missoula County had 50,740 housing units with a median value of $237,300. Of those, 31,387 or 62 percent are located within the Missoula city limits. A further breakdown of the housing units from the census is presented in **Table 3.5-1.**

Table 3.5-1. U.S. Census Housing Data; Missoula County

Category		Missoula County	City of Missoula
Total Number of Housing Units		50,740	31,387
Median Value Housing Units (2010-2014)		$237,300	$236,800
Year Structure Built			
	2010 or later	595	440
	2000 to 2009	9,435	5,455
	1990 to 1999	8,325	4,144
	1980 to 1989	5,209	2,611
	1970 to 1979	9,919	5,583
	1960 to 1969	5,161	3,391
	1950 to 1959	4,437	3,526
	1940 to 1949	2,016	1,707
	1939 or earlier	5,653	4,530

Source: U.S. Census Bureau, 2010-2014 American Community Survey

According to the Missoula County Growth Policy (2016), Missoula County (outside of the City) will need between 2,740 and 3,220 new housing units by 2035. These estimates are due in part to the aging population and family decisions to have fewer children. Efforts to provide smaller and senior friendly housing within and around the communities will be important to meet the expected demand.

3.6 Economy and Socioeconomics

The City of Missoula is the economic center for not only the County, but also the region. There were more than 76,000 jobs in Missoula County in 2013, but less than 6,000 jobs were located outside of

the city. In addition, almost 3,000 people work out of their homes running trucking, construction, and professional services firms. These businesses supplement the traditional "brick-and-mortar" establishments such as restaurants, gas stations and stores, providing the communities with vital and diverse economic activity. The University of Montana, regional medical centers, government, and retail industries, as well as existing and new non-profit organizations have become the strongest economic drivers in Missoula.

Agriculture contributes to the more than $38 million in wages paid by the agriculture and related services, forestry, fishing, and hunting industries in the county. Although the industry is now far less dominant, it still plays an important role and Missoula County has timber resources that can provide an economic base. Timber is harvested on private, state, and federal lands and processed at the Pyramid Mill in Seeley Lake and Roseburg Mill in Missoula. In 2013, the industry paid more than $34 million in wages and employed almost 700 workers in forestry, logging, support activities, and wood products manufacturing. The largest agricultural sales within Missoula County are cattle and calves ($8,148,000); nursery and greenhouse sales ($1,945,000); and crops and hay ($1,593,000).

The top private employers in 2012 in Missoula County reported by the Montana Department of Labor and Industry are: Community Medical Center and St. Patrick Hospital (1,000+ employees); DirecTV Customer Service, Express Employment Professionals, and Wal-Mart (500 to 999 employees); Albertsons, Opportunity Resources, Inc., Village Health Care Center, Western Montana Clinic, and Western Montana Mental Health Center (250 to 499 employees); and, Allegiance Benefits, Costco, Good Food Store, Jim Palmer Trucking, Missoula Developmental Service, North West Home Care, Inc., Progressive Personal Care, Safeway, Town Pump, and YMCA (100 to 249 employees). **Table 3.6-1** presents economic indicators for Missoula County and the City of Missoula, from 2010 to 2014.

Table 3.6-1. Economic & Socioeconomic Data; Missoula County

Indicator	State of Montana	Missoula County	Missoula, City
Per capita income	$25,373	$26,559	$25,275
Median household income	$46,230	$47,029	$41,968
Persons living below poverty level	15.2%	16.0%	19.8%

Source: U.S. Census Bureau, 2010-2014 American Community Survey

3.7 Land Use and Future Development

Land use patterns in Missoula are stable but slowly and constantly evolving in response to changes in demographics, economics, technology, culture, climate, and other factors over time. In little more than a century Missoula progressed from frontier trade hub to a diverse regional economic community built upon decades of varied economic forces led by forest and mining resources, a growing university, regional retail services, and increasingly a center of state-of the-art medical services. Over the decades, Missoula has been carefully crafting policy to plan for change and growth within Missoula's valley.

Land use patterns have generally resulted in the development of commercial businesses along traffic corridors and industrial lands along the river, interstate and railway corridors. Residential development occurs within the core of the community and then extends to the north in Grant Creek and the Rattlesnake, to the south with the Lewis and Clark, South Hills, and Linda Vista areas, and to

the west with the Target Range and Mullan Road areas. The historic downtown mixes uses and anchors the community.

Growth of the County during the recent decades has extended subdivisions and development into the forest and also onto much of the agricultural land base, resulting in challenges related to public safety, cost of providing services, and long term agricultural production. A description of land use and future development potential in the various regions within Missoula County is presented below (Missoula County Regional Land Use Guide):

Clark Fork River Valley Area - The Clark Fork River Valley, from where it enters Missoula County until it reaches the City of Missoula, is characterized by a narrow valley shared by two railroad mainlines, Interstate-90, frontage roads, the Clark Fork River, several transmission lines, a pipeline, and scattered agricultural and residential development. The area has developed as a utility-transportation corridor with many adverse effects on the prior land uses. However, the region does have attraction for urban development due to the ease of access to Missoula and the high amenity value which still exists, despite the crowded utility and transportation facilities traversing the area. This is due to the presence of the high mountains lining the narrow valley which minimize the present adverse impacts. Much of this mountainous area is in public ownership and will be exempt from urban development, thus providing the main counterbalance to development on the valley floor.

Evaro Area - The presence of the Flathead Indian Reservation has significant influence on the future development planning. The present jurisdictional problems between the county, state, federal and tribal governments have slowed the process of effectively dealing with land use controls.

Frenchtown-Nine Mile Area - In recent years the foothills at the lower end of the Missoula Valley have seen increased large tract development. There are presently over 5,000 acres divided for residential development. Much of this land has not been developed and the full impact to the area has not been felt. Due to the large extent of the present divided, but undeveloped areas, no new development has been designated until the existing area has been built up and the impact on the community adequately assessed.

Hellgate Area - The Hellgate area borders the urban area, and this has been the cause of some pressure for development. However, this portion of the valley contains some of the best agricultural land within Missoula County.

Potomac-Greenough Area - The Potomac and Greenough areas include several large ranches in a relatively stable agricultural area. A large portion of the former Plum Creek Timber land in the area has been transferred through the Montana Legacy Program to federal, state and private ownership. The area has a very limited tax base, with agricultural uses providing a large share of the support for public services. The citizens of the area have indicated a reluctance to encourage further residential development.

Seeley Lake Area - The Seeley Lake area has many natural amenities and more water surface with its many lakes than elsewhere in the county. The area has very few small private ownerships compared to the total acreage. A large portion of the small private ownership has been platted for development.

The following sections provide details on the planning tools used by Missoula County to manage growth.

3.7.1 Land Use Implementation Tools

Industrial, commercial and residential land use is managed with zoning ordinances and subdivision regulations in accordance with guidelines set forth in the county and city growth policies. Building codes also play an important role to ensure structures are constructed to safety standards.

Growth Policies

A growth policy is a guide for decision making as well as a road map that articulates what a community would like to become and how it intends to get there. Growth policies can be used to identify community priorities. A growth policy is a guidance document, not a regulatory document, and it does not necessarily require regulations to be adopted. However, growth policies provide the legal framework and philosophical foundation upon which future plans and regulations are based. In addition, growth policies are used as the basis for updating or adopting land use regulations and are used as a resource when evaluating development applications.

Goal 11 of the Missoula County Growth Policy (2016) supports hazard mitigation. This goal, its objectives, and actions are listed below.

Goal - Reduce the safety risks and costs associated with wildland fire, flooding, and other hazards.

- Discourage development in hazardous areas and areas where public and emergency responder safety is compromised.
  - ✓ Identify hazardous areas, including mapping of wildfire and floodplain risks.
  - ✓ Provide mapping and other information to the public about local hazards in an easily accessible format.
  - ✓ Explore zoning regulations to guide growth to appropriate locations (outside of hazard areas).
  - ✓ Complete channel migration zone mapping to identify historical river and stream movement and model future movement.
- When development in hazardous areas does occur, take appropriate measures to limit safety risks and ensure emergency personnel have sufficient resources to respond safely and effectively.
  - ✓ Work with public safety and resource agencies to identify and mitigate risks and provide appropriate resources for public and responder safety.
  - ✓ Adopt development regulations that require the best possible hazardous mitigation techniques, including Firewise construction, multiple accesses, etc.
  - ✓ Provide information to landowners regarding development in hazardous areas (evacuation plans, Firewise development practices, etc.). Explore the possibility of providing risk disclosure statements.
  - ✓ Support efforts such as cost sharing to help landowners reduce fuels and take measures to make their properties more resilient to hazards.

Missoula County has used land use designation mapping since 1975. Land use designations and mapping are intended to reflect the desired future land use and development pattern for local communities and the county as a whole. The Land Use Designation Map provides an over-arching

guide for any regulations that address land use and/or development patterns such as zoning and subdivision regulations. They are used to prevent development in high risk and hazardous areas. The City of Missoula has been using land use designation maps in their Growth Policy to plan for growth since the mid-1960s.

The City of Missoula Growth Policy (2015) has three goals that support hazard mitigation, as follows:

- Establish Wildland-Urban Interface (WUI) standards including limiting development in fire-prone areas in order to protect human life and property.
- Acquire, restore and protect river and stream corridors and floodplains as open space whenever possible including corridors outside urban service areas.
- Support delineation and protection of floodplains and wetlands to reduce peak flood flows, decrease risks to live/property and encourage groundwater infiltration to help sustain late summer flows.

The Seeley Lake Regional Plan (2010) presents various goals and action strategies for wildfire, flooding, hillsides, and shorelines. For wildfire, it is recognized that some areas are a significant wildfire risk due to the slope of the landscape, human population densities adjacent or within forests, overall fuel hazards, and the accessibility of evacuation routes. The Plan discourages expansion of the WUI and encourages development to occur within the area where it already exists. Expanding the WUI causes concerns about providing adequate fire and emergency services to residences in the area. The wildfire goal and action strategies for the Seeley Lake area are presented below.

- Reduce risks to human life and property from wild fire impacts.
  - ✓ Discourage new development that would expand the WUI.
  - ✓ Adopt rural development standards to implement appropriate measures to reduce the risk of wildfire impacts.
  - ✓ Provide information to landowners about fuel mitigation.

The Seeley Lake Plan also includes action strategies to address natural stream functioning and floodplain hazards through setbacks, land use designations, limits on development, design requirements, and stream restoration, as presented below.

- Protect development and public infrastructure from flood hazards.
  - ✓ Do not allow new development of homes, commercial, or industrial buildings in the 100-year floodplain.
  - ✓ Where not accurately mapped, require that developers conduct detailed analyses to determine actual flood elevations and flood hazards before development is permitted in or near the designated 100-year or other flood hazard area.
  - ✓ Require that all lots in new subdivisions have a buildable area and road access that are naturally outside flood hazard areas, unless mitigation is approved.
  - ✓ Require that landowners demonstrate that proposed development will be free from high groundwater hazards.
- Protect and conserve natural waterways and shorelines.
  - ✓ Explore the need for additional shoreline protection measures or setbacks.
  - ✓ Require that public infrastructure minimally impacts streams and floodplains.

The Lolo Regional Plan (2002) discusses policies to mitigate wildfire and flooding hazards. The Plan discourages development in Wildland Residential Interface areas but acknowledges that if development occurs, the Missoula County Subdivision Regulations have standards that include access suitable for emergency equipment and a water source. They do recommend however, that landowners use Class A or B fire-rated roofing materials, clear a defensible space around dwellings, and select landscaping plants that limit or retard fire spread.

The Lolo Plan recognizes that floods are inevitable and that homes, businesses and public infrastructure should be built in locations ensuring that neither property nor human health will be damaged. Any alterations to floodplains must not endanger nearby properties, nor harm natural stream functions. Some zoned land in Lolo is located in the floodplain. A goal of their Plan is that no new development occurs in flood hazard areas and to allow transfer of density to areas more suitable for development. Policies and implementation strategies to mitigate the flood hazard are described below.

- Preserve the floodplain for flood attenuation, aquifer recharge, fish and wildlife habitat, and a buffer for pollutants.
  - ✓ Require that developers conduct detailed analyses to determine actual flood elevations and flood hazards before development occurs in or near the designated 100-year or 500-year floodplain or other flood hazard area.
  - ✓ Require that all lots in new subdivisions have a buildable area and road access that are naturally outside flood hazard areas, unless mitigation is approved.
  - ✓ Do not allow new development of homes, commercial, or industrial buildings in the 100-year floodplain unless improving or replacing an existing structure.
  - ✓ Establish a mechanism to allow transfer of development density from flood hazard areas to sites outside flood hazard areas.
- Protect development and public infrastructure from flood hazards.
  - ✓ Require that landowners demonstrate that proposed development will be free from high groundwater hazards.
  - ✓ Complete the Lakes Neighborhood Flood Damage Control Plan and implement recommended measures. Incorporate elements of the Flood Damage Control Plan into new development proposals.
  - ✓ Require that public infrastructure minimally impacts streams and floodplains.

The Wye-Mullan West Area Comprehensive Plan (2005) discusses mitigation for flood hazards. Objectives and strategies to mitigate these hazards are outlined below.

- Ensure that new development is placed an adequate distance from watercourses to protect each watercourse and improve and maintain its associated habitats.
  - ✓ Keep new development outside the identified 100-year floodplains.
  - ✓ Establish specific setbacks for development from creeks and drainages.
  - ✓ Support and implement the Grant Creek Restoration Project.
  - ✓ Evaluate proposed development within 300 feet of the ordinary high water mark of the Clark Fork River to address potential development impacts to water quality, flood risk, bank stability, riparian habitat, wildlife habitat or corridors, social, cultural, and recreational

values. These factors will be utilized in defining specific setbacks and identifying other possible restrictions.

- Preserve the floodplain for flood attenuation, aquifer recharge, and natural filtration while protecting development from flooding and bank erosion.
  - ✓ Establish a mechanism to allow transfer of development rights from flood hazard areas to sites outside flood hazard areas.
  - ✓ Limit new development of homes, commercial, or industrial buildings in the 100-year floodplain to improving or replacing existing structures according to Missoula County Floodplain Regulations.
  - ✓ Require that all lots in new subdivisions have a buildable area and road access located naturally outside flood hazard areas.
  - ✓ Require detailed analyses to determine actual flood elevations and flood hazards before development is approved in or near the designated 100-year or 500-year floodplain, or other flood hazard area.
  - ✓ Require that proposed development will be free from high groundwater hazards.
  - ✓ Require that public infrastructure minimally impacts streams and floodplains.

Growth Policies could be strengthened by acknowledging mitigation strategies in the County's PDM Plan.

Zoning Ordinances

Zoning is a tool used by local government to control and direct land use in communities, in order to protect the public health, safety and welfare. Zoning ordinances regulate where future growth should or should not be allowed (e.g., which areas of the county are most suitable for development as well as least suitable due to issues such as floodplains, seasonal high groundwater, steep slopes and WUI areas).

Zoning regulates the density and types of land uses that are permitted on a property. About 7 percent of land outside of the City of Missoula is currently zoned. Within the city, 96 percent of the land is zoned. Missoula County first adopted a zoning resolution in 1976. Missoula County planners intend to update the zoning resolution to address several of the goals and objectives in the growth policy, as well as to generally modernize the document.

Subdivision Regulations

Missoula County controls development through the use of subdivision regulations. The regulations ensure that all subdivisions are designed so that potentially significant adverse impacts to public health and safety can be avoided or mitigated including impacts from: flooding, improper drainage, slopes of 25 percent or more, snow avalanches, rock falls, landslides, high potential for wildfire, high water table, severe toxic or hazardous waste exposure, and others.

Floodway provisions in the subdivision regulations stipulate the land located in the floodway of a 100-year flood shall not be developed for building purposes. If any potion of a proposed subdivision is within 2,000 horizontal feet and less than 20 vertical feet of a live stream and there are no floodplain maps available, survey data must be provided and the Montana DNRC will determine whether a flood hazard exists.

Areas rated as WUI must comply with special design standards including:

- Roof Coverings - must be Class A or B fire-rated roofing materials;
- Access and Evacuation – Roadside vegetation must be maintain so roads will service as escape routes and fire breaks. There must be a minimum of two approach routes to ensure one than one escape route and access routes by emergency vehicles.
- Vegetation Management - A vegetation management plan is required that will reduce fuel loading and hazard rating and provide continuous maintenance of the fuel load. The plan must include guidelines for defensible space, fuel breaks and greenbelts, and a plan for continuous maintenance.
- Water Supply – A fire-fighting water source and access to that source must exist and be maintained as defensible space. Requirements for water supply systems are stipulated and may include fire hydrants or storage tanks. Residential fire sprinkler systems are required.
- Fire Protection Covenants are required stipulating that property owners must maintain fire protection water supplies and fire protection systems (defensible spaces, driveway routes, fuel breaks) in perpetuity.

The subdivision regulations require an Environmental Assessment be completed to evaluate the potential impacts the subdivision would have on:

- Public health and safety (including flooding, earthquake, steep slopes/unstable soils/slides, high water tables, high fire hazard or designated WUI area);
- Surface water (including areas subject to the flood hazard); and
- Topography, geology and soils (including unstable and excessive slopes).

Mitigation measures may be required prior to approval of the subdivision.

Building Codes

Building codes are also a tool to control future development. The main purpose of building codes are to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures. They comprise a set of rules that specify the minimum acceptable level of safety for buildings and often contain requirements for snow and wind loads, roof construction, and seismic risk. Building codes are generally intended to be applied by architects and engineers, but are also used by building inspectors. Missoula County and the City of Missoula have adopted and enforce the state building codes which include the International Building Code, International Residential Code and International Existing Building Code.

Floodplain Regulations

Instead of trying to control floods, Missoula County and the City of Missoula have adopted floodplain regulations designed to minimize flood damages. By recognizing that floods are inevitable, homes, businesses and public infrastructure can be built in locations and with designs meant to ensure that neither property nor human health is damaged, and that alterations to floodplains do not endanger

nearby properties or harm natural stream functions. It is in the public interest to manage regulation of flood prone lands and waters in a manner consistent with sound land and water use management practices which will prevent and alleviate flooding threats to life and health and reduce private and public economic losses.

Floodplain regulations are amended periodically to stay current with statutory requirements or other relevant changes. Floodplain regulations are enforced through the floodplain administrator in Missoula County and the City of Missoula. The County and City participate in the National Flood Insurance Program.

3.7.2 Future Development

Based on building permit data and population trends, the Missoula urban area will grow at an average rate between 1 and 2 percent per year. As a result, the Missoula Urban Service Area will have to accommodate approximately 15,000 new dwelling units by 2028 in accordance with adopted policies applicable to the areas. New construction on approved lots is expected to increase throughout the county. The Miller Creek/Linda Vista area in particular is expected to grow within the next 10-20 years as more than 1,200 residential lots have been preliminarily approved for development in that area (City-County Urban Fringe Yearbook, 2012).

Most of the subdivision and development activity in Missoula County has historically occurred in the valleys near existing communities, a pattern Missoula County seeks to continue in accommodating future growth. Depending on the availability and costs of housing in the City of Missoula, increased residential development pressure can be expected in other areas within commuting distance to the city such as Frenchtown, Huson, Lolo, Clinton and Turah. The second home market is also likely to pick up again in the Swan Valley and other areas near lakes, rivers, and natural amenities.

Areas of projected commercial and industrial development outside the Missoula urban service area include the following (Missoula County Regional Land Use Guide):

- Seeley Lake - The community activity center for Seeley Lake should be the site of additional local commercial development. The new commercial development should fill in the existing commercial areas to provide a convenient central shopping area for the community and its seasonal residents. Additional industrial uses should be developed within the industrial area of the present lumber mill site.
- Clark Fork River Valley - The community activity center for Clinton should be the site of additional convenience shopping to supplement expanded residential development. Also, an industrial base should be encouraged at this location.
- Frenchtown-Nine Mile - The Huson and Frenchtown activity centers should be the base to support convenience shopping. The area around the former Stone Container pulp mill and around the airport should be the sites of additional industrial expansion.

Section 4.10 presents a hazard analysis of proposed future development projects in Missoula County.

SECTION 4. RISK ASSESSMENT AND VULNERABILITY ANALYSIS

Missoula County is exposed to many hazards both natural and man-made. A risk assessment and vulnerability analysis was completed to help identify where mitigation measures could reduce loss of life or damage to property in the County and City of Missoula.

This section includes a description of the risk assessment methodology and a hazard profile for eight hazards organized from high to low by county priority: wildfire, hazardous material incidents including railroad derailments, flooding, severe weather and drought, communicable disease, avalanche, earthquake, and dam failure. This section is concluded with a risk assessment summary and discussion on what hazards future development projects may be exposed to. Supporting documentation is presented in **Appendix C**.

4.1 Risk Assessment Methodology

A risk assessment was conducted to address requirements of the DMA 2000 for evaluating the risk to Missoula County from natural and man-made hazards. DMA 2000 requires measuring potential losses to critical facilities and property resulting from natural hazards by assessing the vulnerability of these facilities to natural hazards. In addition to the requirements of DMA 2000, the risk assessment approach taken in this study evaluated risks to vulnerable populations and also examined the risk presented by several man-made hazards. The goal of the risk assessment process is to determine which hazards present the greatest risk and what areas are the most vulnerable to hazards.

The risk assessment approach used for this plan entailed using geographic information system (GIS) software and data to develop vulnerability models for people, structures, critical facilities, and evaluating those vulnerabilities in relation to hazard profiles that model where hazards exist. This type of approach to risk assessment is dependent on the detail and accuracy of the data used during the analysis. Additionally, some types of hazards are extremely difficult to model. Data limitations are described in *Section 4.1.7*.

4.1.1 Critical Facilities and Building Stock

Critical facilities were mapped using coordinates provided by Missoula County and the City of Missoula. Mapping of these facilities allowed for the comparison of their location to the hazard areas where such hazards are spatially recognized. Construction type of critical facilities (e.g. steel, wood, masonry, etc.) has not been compiled and was therefore, not considered in the analysis. This data should be collected for future updates of this plan. Critical facility values were obtained, where readily available, from municipal departments. Many values were estimated based on similar structures in other counties where values were available.

Infrastructure, including bridges, water and wastewater facilities, and communication sites had digital mapping available and was therefore included in the analysis. Bridge data was obtained from the Montana Natural Resource Information System (NRIS) (which comes from MDT) and the National Bridge Inventory, while other data was obtained from the County. Replacement values of critical

facilities were used in the risk assessment where this information was readily available from the County, City, and Montana Cadastral Mapping Program. **Figures 3 through 3D** present the location of critical facilities in Missoula County, the City of Missoula, and several unincorporated communities. Bridge replacement values were extrapolated using unit costs (developed by Lewis and Clark County) for span length and width. **Figure 4** presents the bridge locations in Missoula County. The **Appendix C** presents a key to the bridge inventory. Missoula County may wish to enhance the bridge data for the 2022 PDM Plan update by adding the major culverts in the county.

Building stock data was obtained from the Montana Department of Revenue's (MDOR) cadastral mapping program. This system spatially recognizes land parcels within the County with a distinction between residential and other properties. Appraised building values are available on the parcel level and were used to determine exposure. The "other" building type includes all properties not designated as residential which consists of commercial, agricultural and industrial properties. The MDOR cadastral database does not spatially locate structures within each parcel. To reconcile this limitation for the flood analysis, the NRIS structures shapefile, which provides spatial locations of structures within each parcel, was linked to the MDOR cadastral database to obtain building values. Building exposure in the risk assessment is presented for Missoula County and the City of Missoula.

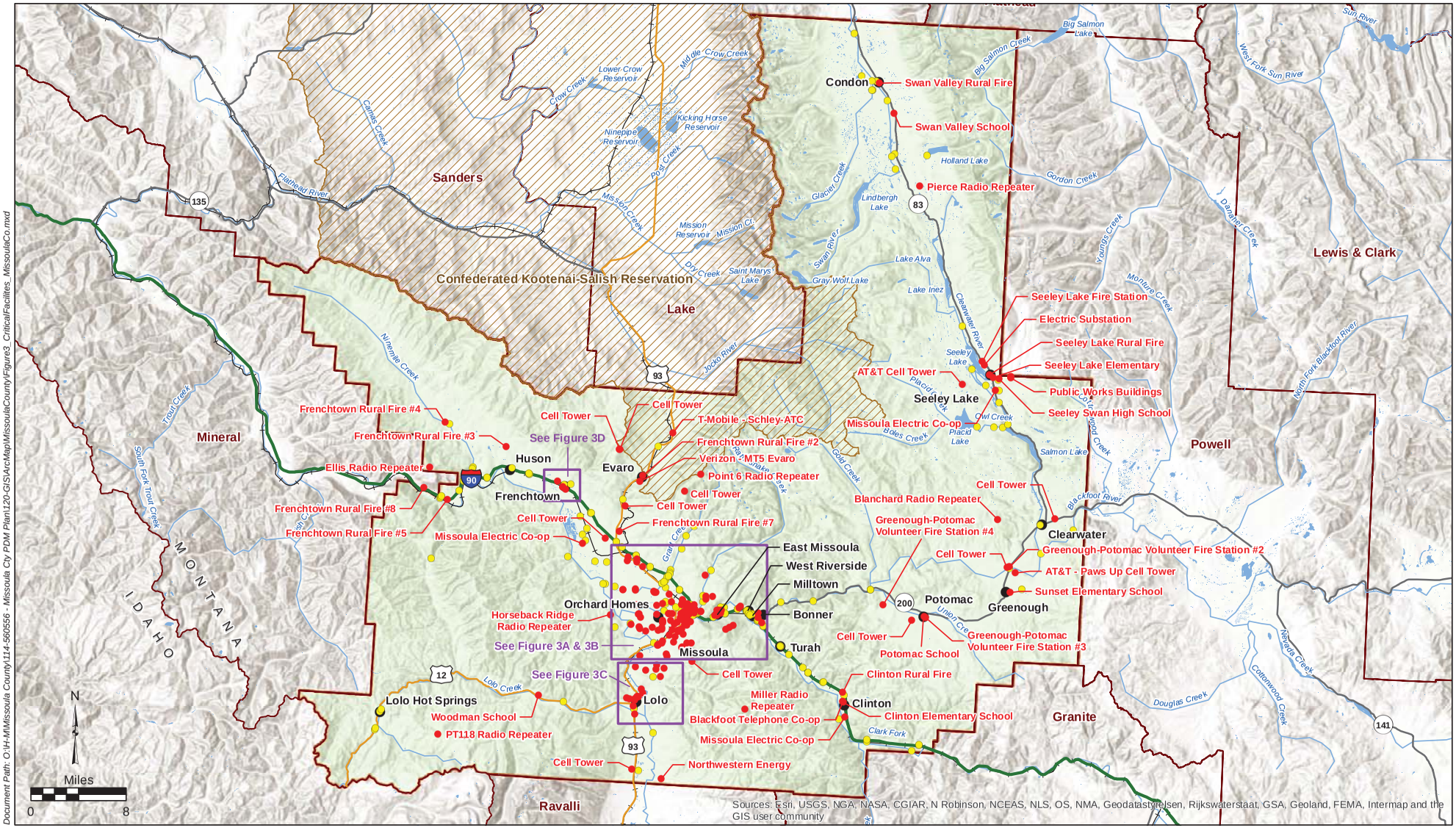
4.1.2 Vulnerable Population

Data from the 2010 census was used in the analysis to determine vulnerable populations at risk in the hazard areas, as available. Census data was downloaded from the U. S. Census Bureau's website. Downloaded data included total population (by census block) and number of individuals under the age of 18 for Missoula County and the City of Missoula. Vulnerable population was calculated based on the population in each census block intersected by the hazard area. Where hazard areas are restricted to discrete areas, such as for flooding, this approach may over report at-risk population. To reconcile this limitation, vulnerable population was calculated by intersecting the flood hazard area with the NRIS structures shapefile and estimates by the U.S. Census that 2.35 individuals reside in each structure, 22.5 percent of whom are under age 18.

4.1.3 Hazard Identification

The 2011 Missoula County PDM Plan (Atkins, 2011) identified six natural hazards affecting Missoula County and the City of Missoula (earthquakes, flooding, landslides, volcanic ash, weather, and wildfire). These hazards were reviewed for the 2017 PDM Plan update by the Planning Team who considered what other natural and manmade hazards might be of consequence since development of the original PDM Plan. Planning Team meeting notes in **Appendix B** describe the wide range of hazards considered for the PDM Plan.

Hazards profiled in the 2017 update include wildfire, flooding (including dam failure), severe weather, and earthquake from the 2011 PDM Plan with the addition of: hazardous material incidents including railroad derailments, drought, communicable disease, and avalanche. The Planning Team decided that two hazards profiled in the 2011 PDM Plan should be de-emphasized in the 2017 update because they either effect only a small segment of the population and/or occur infrequently with little damage, including; landslides and volcanic ash.



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure3_CriticalFacilities_MissoulaCo.mxd

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary
- Confederated Kootenai-Salish Reservation

Date: 12/6/2016

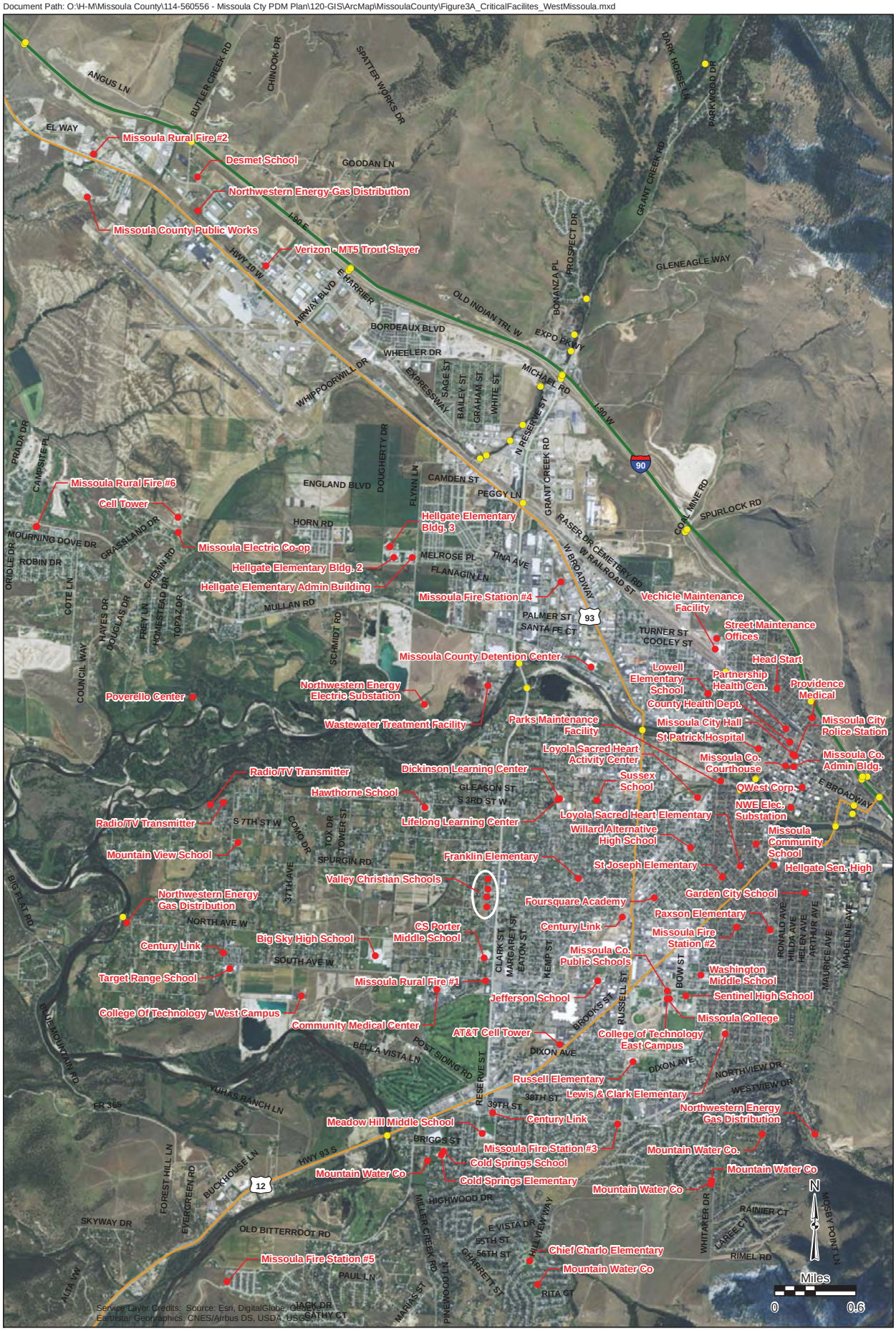
Figure 3

Critical Facilities

Missoula County, Montana

Pre-Disaster Mitigation Plan

Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure3A_CriticalFacilites_WestMissoula.mxd



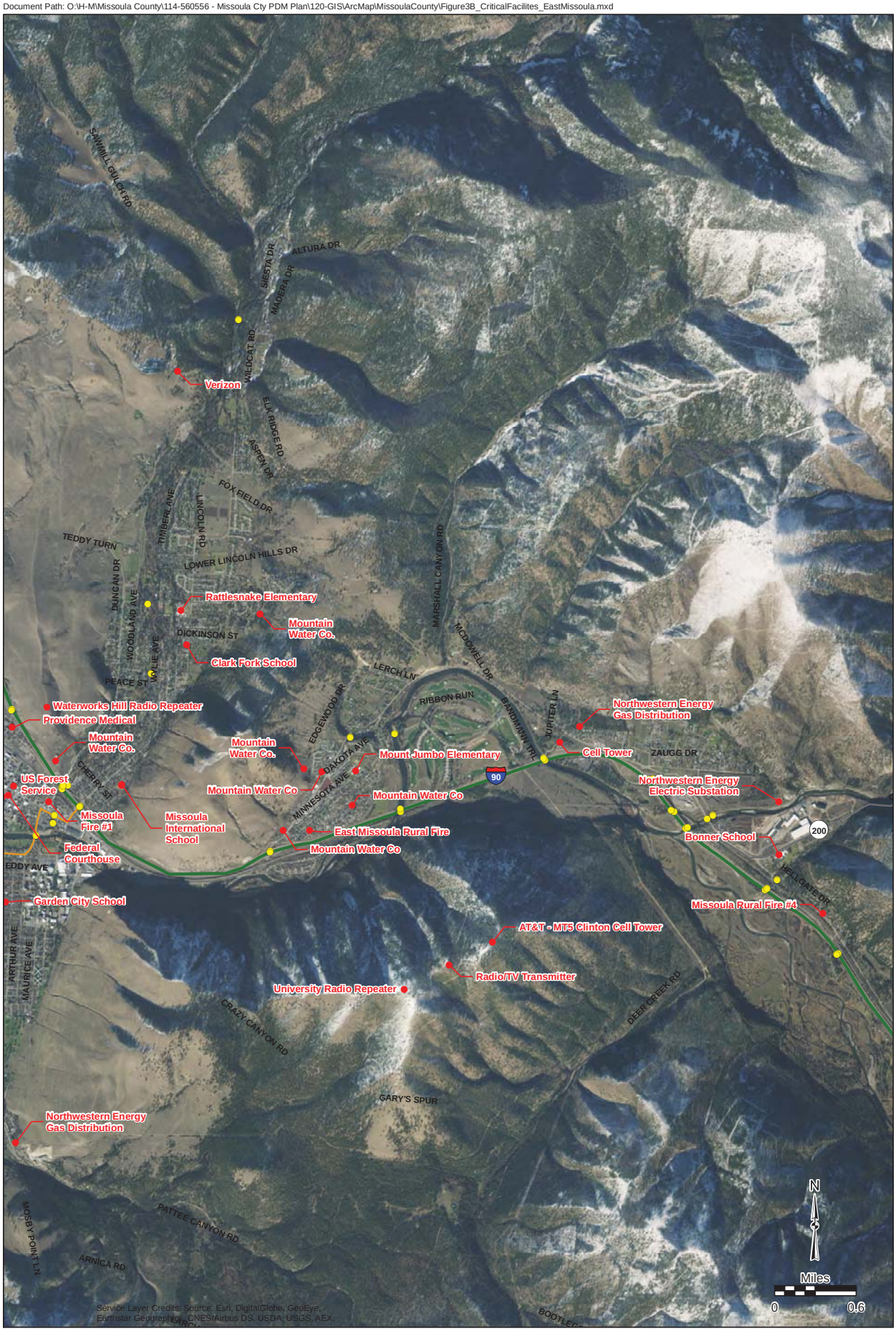
Date: 11/29/2016

Legend

- Critical Facility
- Bridge

Figure 3A
Critical Facilities
West Missoula
Missoula County, Montana
Pre-Disaster Mitigation Plan

Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure3B_CriticalFacilites_EastMissoula.mxd



Date: 11/23/2016

Legend

- Critical Facility
- Bridge

Figure 3B
Critical Facilities
East Missoula
Missoula County, Montana
Pre-Disaster Mitigation Plan

Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure3C_CriticalFacilites_Lolo.mxd

Date: 11/23/2016

Legend

- Critical Facility
- Bridge

Figure 3C
Critical Facilities
South Missoula & Lolo
Missoula County, Montana
Pre-Disaster Mitigation Plan

Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure3D_CriticalFacilites_Frenchtown.mxd

Date: 11/23/2016

Legend

- Critical Facility
- Bridge

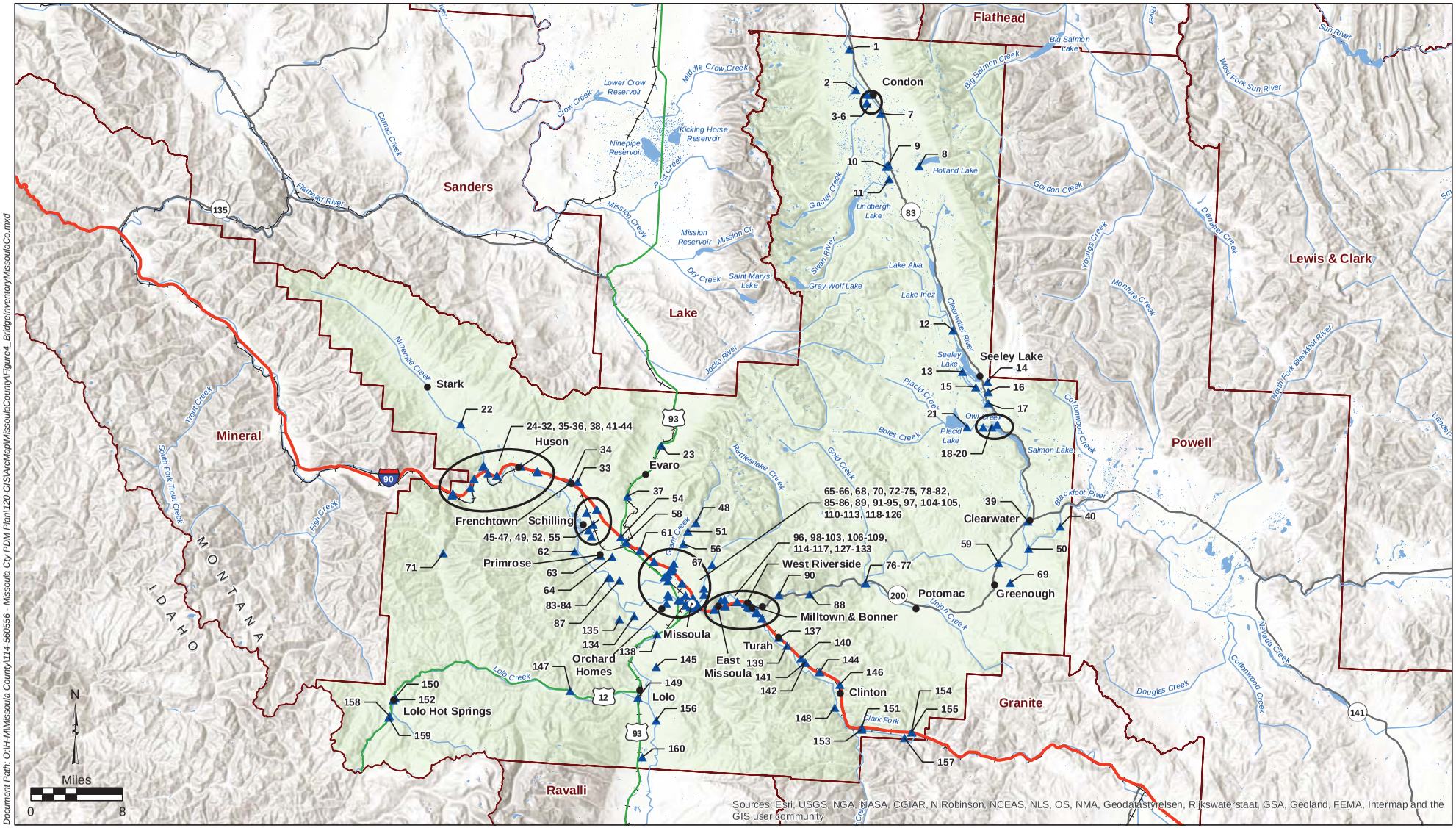
Figure 3D

Critical Facilities

Frenchtown

Missoula County, Montana

Pre-Disaster Mitigation Plan



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure4_BridgeInventoryMissoulaCo.mxd

Bridge data source is the Montana Dept. of Transportation

Legend

- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Date: 11/23/2016

Figure 4

Bridge Inventory

Missoula County, Montana

Pre-Disaster Mitigation Plan

4.1.4 Hazard Profiles

Hazard profiles were prepared for each of the identified hazards and are presented within this section according to their prioritized rank (see *Section 4.1.6*). The level of detail for each hazard is generally limited by the amount of data available.

Each hazard profile contains a description of the hazard and the history of occurrence, the vulnerability and area of impact, the probability and magnitude of future events, an evaluation of how future development is being managed to reduce risk, and implications of climate change. The methodology used to analyze each of these topics is further described below.

Description and History

A number of databases were used to describe and compile the history of hazard events profiled in this plan. This data was supplemented by input from the public, local officials, newspaper accounts, and internet research. The two primary databases used included the National Climatic Data Center (NCDC) Storm Events Database and Spatial Hazard Events and Losses Database for the United States (SHELDUS).

The NCDC Storm Events database receives Storm Data from the National Weather Service. The NWS receives their information from a variety of sources, including county, state and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public. Storm Data is an official publication of the National Oceanic and Atmospheric Administration (NOAA) which documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce.

SHELDUS is a county-level hazard data set for the United States for 18 different natural hazard event types. For each event, the database includes the date, location, property losses, crop losses, injuries, and fatalities that affected each county. The database includes every loss-causing and/or deadly event between 1960 through 1975 and from 1995 onward. Between 1976 and 1995, SHELDUS reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.

Vulnerability and Area of Impact

Vulnerabilities are described in terms of critical facilities, structures, population, and socioeconomic values that can be affected by the hazard event. Hazard impact areas describe the geographic extent to which a hazard can impact a jurisdiction and are uniquely defined on a hazard-by-hazard basis. Mapping of the hazards, where spatial differences exist, allows for hazard analysis by geographic location. Some hazards can have varying levels of risk based on location. Other hazards cover larger geographic areas and affect the area uniformly.

Probability and Magnitude

Probability of a hazard event occurring in the future was assessed based on hazard frequency over a 100 year period. Hazard frequency was based on the number of times the hazard event occurred divided by the period of record. If the hazard lacked a definitive historical record, the probability

was assessed qualitatively based on regional history and other contributing factors. Probability was broken down as follows:

- Highly Likely – greater than 1 event per year (frequency greater than 1).
- Likely – less than 1 event per year but greater than 1 event every 10 years (frequency greater than 0.1 but less than 1).
- Possible – less than 1 event every 10 years but greater than 1 event every 100 years (frequency greater than 0. 01 but less than 0.1).
- Unlikely – less than 1 event every 100 years (frequency less than 0.01)

The magnitude or severity of potential hazard events was evaluated for each hazard. Magnitude is a measure of the strength of a hazard event and is usually determined using technical measures specific to the hazard. Magnitude was calculated for each hazard where property damage data was available. Magnitude is expressed as a percentage according to the following formula:

- (Property Damage / Number of Incidents) / $ of Building Stock Exposure

Future Development

The impact to future development was assessed based on potential opportunities to limit or regulate development in hazardous areas such as zoning and subdivision regulations. The impacts were assessed through a narrative on how future development could be impacted by the hazard. Plans, ordinances and/or codes currently in place were identified that could be revised to better protect future development in Missoula County from damage caused by natural and man-made hazards.

Climate Change

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every 5 years for the past 100 years, then it can be expected to continue to flood an average of once every 5 years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be a 100-year flood might strike more often, leaving many communities at greater risk. The risks of severe storms, extreme heat and wildfire are all affected by climate patterns as well. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis.

At the end of each hazard profile is a discussion on climate change. The information provides insight on how the hazard may be impacted by climate change and how these impacts may alter current exposure and vulnerability for people, property, and critical facilities.

4.1.5 Hazard Ranking and Priorities

In ranking the hazards, the Planning Team completed a Calculated Priority Risk Index (CPRI) work sheet. The CPRI examines four criteria for each hazard (probability, magnitude/severity, warning time, and duration); the risk index for each according to four levels, then applies a weighting factor (**Table 4.1-1**). The result is a score that has been used to rank the hazards. Each hazard profile presents its CPRI score with a cumulative score sheet included in **Appendix C**. **Table 4.1-2** presents the results of the CPRI scoring for all hazards.

Table 4.1-1. Calculated Priority Risk Index

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	▪ Rare with no documented history of occurrences or events. ▪ Annual probability of less than 0.01.	1	45%
	Possibly	▪ Infrequent occurrences with at least one documented or anecdotal historic event. ▪ Annual probability that is between 0.1 and 0.01.	2	
	Likely	▪ Frequent occurrences with at least two or more documented historic events. ▪ Annual probability that is between 1 and 0.1.	3	
	Highly Likely	▪ Common events with a well documented history of occurrence. ▪ Annual probability that is greater than 1.	4	
Magnitude/ Severity	Negligible	▪ Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses are treatable with first aid and there are no deaths. ▪ Negligible quality of life lost. ▪ Shut down of critical facilities for less than 24 hours.	1	30%
	Limited	▪ Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses do not result in permanent disability and there are no deaths. ▪ Moderate quality of life lost. ▪ Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	▪ Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses result in permanent disability and at least one death. ▪ Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	▪ Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses result in permanent disability and multiple deaths. ▪ Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self explanatory.	4	15%
	6 to 12 hours	Self explanatory.	3	
	12 to 24 hours	Self explanatory.	2	
	More than 24 hours	Self explanatory.	1	
Duration	Less than 6 hours	Self explanatory.	1	10%
	Less than 24 hours	Self explanatory.	2	
	Less than one week	Self explanatory.	3	
	More than one week	Self explanatory.	4	

Table 4.1-2. Calculated Priority Ranking Index Summary; Missoula County

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Hazardous Material Incidents	Highly Likely	Limited	<6 hours	<24 hours	3.20
Structure Fire	Highly Likely	Limited	<6 hours	<6 hours	3.10
Mass Casualty Transportation Accidents	Likely	Critical	<6 hours	<24 hours	3.05
Severe Winter Weather	Highly Likely	Limited	>24 hours	<24 hours	2.75
Severe Summer Weather	Likely	Limited	<6 hours	<6 hours	2.65
Communicable Disease	Likely	Critical	>24 hours	>1week	2.80
Landslide	Likely	Limited	<6 hours	<6 hours	2.65
Flooding	Likely	Limited	12-24 hours	>1week	2.65
Interface Wildfires	Likely	Limited	6-12 hours	<24 hours	2.60
Railroad Derailments	Possibly	Critical	<6 hours	<24 hours	2.60
Dam Failure	Unlikely	Catastrophic	<6 hours	<1week	2.55
Drought	Likely	Limited	>24 hours	>1week	2.50
Avalanche	Possibly	Critical	<6 hours	<6 hours	2.50
Terrorism	Unlikely	Catastrophic	<6 hours	<6 hours	2.35
Volcanic Ash	Possibly	Limited	6-12 hours	<1week	2.25
Violence, Civil Unrest	Unlikely	Critical	<6 hours	<1week	2.25
Earthquake	Unlikely	Critical	<6 hours	<6 hours	2.05

The Calculated Priority Risk Index scoring method has a range from 0 to 4. "0" being the least hazardous and "4" being the most hazardous situation.

The Planning Team felt that the CPRI ranking did not accurately represent Missoula County's priorities; therefore, the list of hazards was re-prioritized and several hazards were combined into one profile, as shown below. The remainder of this section contains the hazard profiles in this order.

1 – Wildfire (*Section 4.2*)
2 – Hazardous Material Incidents and Railroad Derailments (*Section 4.3)*
3 – Flooding (*Section 4.4*)
4 – Severe Weather and Drought (*Section 4.5*)
5 – Communicable Disease (*Section 4.6*)
6 – Avalanche (*Section 4.7*)
7 – Earthquake (*Section 4.8*)
8 –Dam Failure (*Section 4.9*)

Profiles for two low priority hazards (Landslide, Volcanic Ash) are included in **Appendix C**.

4.1.6 Assessing Vulnerability – Estimating Potential Losses

The methodology used in the vulnerability analysis presents a quantitative assessment of the building stock, population, and critical facility exposure to the individual hazards. Building stock data, available from the MDOR cadastral mapping program was used in the analysis. This data spatially recognizes land parcels along with the appraised value of building stock. Using GIS, hazard risk areas were intersected with the building stock data to identify the number of structures and exposure due to each hazard. Using GIS, hazard risk areas were also intersected with critical facility data to determine the number and exposure of critical facilities to each hazard. Various infrastructure (e.g. water systems, wastewater systems) were analyzed as part of the critical facility vulnerability analysis. A separate analysis was completed for Missoula County's bridges.

Population exposure was computed using data from the 2010 census and the percentage of the census blocks located in each hazard area. Population exposure is reported according to total population living in the hazard area and a subset of this data, individuals under the age of 18 years. Using GIS, total population for the census blocks was intersected with the hazard maps to determine population at risk.

For hazards that are uniform across the jurisdiction (i.e. severe summer weather and severe winter weather) the methodology presented below was used to determine annualized property loss.

- Exposure x Frequency x Magnitude

Where:

- Exposure = building stock, vulnerable population, or critical facilities at risk
- Frequency = annual number of events determined by calculating the number of hazard events / period of record
- Magnitude = percent of damage expected calculated by: (property damage/# incidents)/ building stock or critical facility exposure

For hazards that are not uniform across the jurisdiction and instead occur in specific areas (e.g. flooding, wildfire, hazardous material incidents, dam failure, etc.) the localized hazard area factored into the vulnerability assessment.

For hazards without documented property damage, magnitude could not be calculated and therefore, only the exposure of the building stock or population was computed. Annualized loss estimates cannot be calculated without property damage using this risk assessment approach.

4.1.7 Data Limitations

Risk assessment results are only a general representation of potential vulnerabilities and many inherent inaccuracies exist with the risk assessment methodology used. Output is only as good as data sources used and Missoula County may wish to use alternate data for future PDM Plan updates.

The methodology used for the risk assessment has inherent limitations. Hazard layers were intersected with MDOR parcel data. The MDOR data does not locate structures within the parcel; therefore, any structures within a parcel "clipped" by the hazard layer were assumed to be vulnerable. Where parcels are large in size, it may be inaccurate to assume that all structures are actually within the hazard area. Therefore, exposure data for some hazards may over-report the number and value of structures at risk. This limitation was rectified for the flood analysis, where most evident, by using the NRIS structures shapefile, which spatially locates structures within each parcel, and linking this shapefile to the MDOR parcel database for building values.

There is also a limitation using census block data to estimate vulnerable population. Where census blocks are large, using a percentage of census block population to estimate number of individuals living in the hazard area may include more persons than actually reside in the hazard area where census blocks are large. This limitation was rectified for the flood analysis, where advanced GIS analysis was conducted using the NRIS structures shapefile, which precisely locates structures within

each parcel, and estimates by the U.S. Census that 2.35 individuals reside in each structure, 22.5 percent of whom are under age 18.

The remainder of this section presents hazard profiles organized by County priority followed by a risk assessment summary. Loss estimates, where applicable, are summarized at the end of this section.

4.2 Wildfire

CPRI SCORE = 2.6

Description and History

A wildfire is an unplanned fire, a term which includes grass fires, forest fires and scrub fires, both man-caused and natural in origin. Severe wildfire conditions have historically represented a threat of potential destruction within the region. Negative impacts of wildfire include loss of life, property and resource damage or destruction, severe emotional crisis, widespread economic impact, disrupted and fiscally impacted government services, and environmental degradation.

Wildfire risk is the potential for a wildfire to adversely affect things that residents value - lives, homes, or ecological functions and attributes. Wildfire risk in a particular area is a combination of the chance that a wildfire will start in or reach that area and the potential loss of human values if it does. Human activities, weather patterns, wildfire fuels, values potentially threatened by fire, and the availability (or lack) of resources to suppress a fire all contribute to wildfire risk. Fire season is the result of low rainfall, high temperatures, low humidity, and thunderstorms, high winds and lightning. Varied topography, semi-arid climate, and numerous human-related sources of ignition make this possible.

Roughly two-thirds of the fire starts in Missoula County are lightning caused. On average, there are 3,000 to 4,000 strikes a year, which equate to one strike for every 1.3 square miles. People also cause wildfires; burning yard waste where fire escape its boundaries, children playing with fireworks, campfire neglect, careless smokers, or heated catalytic converters in dry grass. Only a fraction of fire starts are arson (Missoula Co. CWPP, 2005).

Major wildfires can occur at any time of year. **Table 4.2-1** presents warning and advisory criteria for wildfire and a description of prohibitions that land management agencies can put into effect to reduce fire risk and prevent wildfires during periods of high to extreme danger.

Table 4.2-1. Warning, Advisories and Restrictions for Wildfire

Warning/Advisory/ Restriction	Description
Fire Weather Watch	A fire weather watch is issued when Red Flag conditions (see Red Flag Warning) are expected in the next 24 to 72 hours.
Red Flag Warning	A red flag warning is issued when Red Flag criteria are expected within the next 12 to 24 hours. A Red Flag event is defined as weather conditions that could sustain extensive wildfire activity and meet one or more of the following criteria in conjunction with "Very High" or "Extreme" fire danger: • Sustained surface winds, or frequent gusts, of 25 mph or higher; • Unusually hot, dry conditions (relative humidities less than 20%); • Dry thunderstorm activity forecast during an extremely dry period; • Anytime the forecaster foresees a change in weather that would result in a significant increase in fire danger. For example, very strong winds associated with a cold front even though the fire danger is below the "Very High" threshold.
Fire Warning	A fire warning may be issued by local officials when a spreading wildfire or structure fire threat ens a populated area. Information in the warning may include a call to evacuate areas in the fire's path as recommended by officials according to state law or local ordinance.
Dense Smoke Advisory	Dense smoke advisories are issued when the widespread visibilities are expected at a ¼ mile or less for a few hours or more due to smoke.

Table 4.2-1. Warning, Advisories and Restrictions for Wildfire

Warning/Advisory/ Restriction	Description
Stage 1 Fire Restriction	No building, maintaining, attending, or using a fire, campfire, or stove fire without a permit except in Forest Service developed camp or picnic grounds. No smoking unless in an enclosed vehicle or building, a developed recreation site, or while stopped in an area at least three feet in diameter that is barren or cleared of all flammable material. No operation of welding, acetylene, or other torch with an open flame. No operation or using any internal or external combustion engine without a spark arresting device properly installed, maintained and in effective working order.
Stage 2 Fire Restriction	No building, maintaining, attending or using open fire campfires or stove fires. No smoking unless in an enclosed vehicle or building, a developed recreation site, or within a three foot diameter cleared to mineral soil. No operation of welding, acetylene, or other torch with an open flame. No operation or using any internal or external combustion engine without a spark arresting devise properly installed, maintained and in effective working order.

Source: NWS, 2016; National Interagency Fire Center; (gacc.nifc.gov/.../r2ftc/documents/Fire_Restriction_Chart.pdf)

Missoula County has witnessed a number of wildfires that have destroyed property and affected wildlife habitat, scenic resources, and air quality. **Table 4.2-2** presents data from the Montana DNRC on wildfires over 100 acres with statistics on structures lost and suppression cost where available. This data indicates that in the past 30 years, 22 large wildfires have burned over 87,000 acres costing over $73 million to suppress with four residences and 11 outbuildings lost. In 1977, six homes were lost on the southeastern edge of Missoula during the Pattee Canyon Fire (Missoula Co. CWPP, 2005).

Table 4.2-2. DNRC Wildfire Listings >100 Acres in Missoula County

Date	Name	Acres	Cause	Structures Lost	Suppression Cost
7/15/1987	Ninemile	355	Miscellaneous	-	-
10/5/1991	Rifle Range	375	Arson	-	-
10/12/1991	Game Range	7,628	Arson	-	-
8/13/1992	Deer Creek #3	175	Arson	0	$549,524
7/29/1994	Black Mountain	100	Lightning	3 R	$672,352
8/25/1996	Telephone Butte #2	140	Equipment	0	$687,837
8/18/2001	Lower Fawn Creek	185	Lightning	0	$1,024,419
8/2/2003	Crazy Horse	6,215	Lightning	0	$8,010,788
8/6/2003	Mineral/Primm	13,947	Lightning	0	$9,742,407
8/9/2003	Boles Meadow	1,288	Lightning	0	$7,796,622
8/9/2003	Dirty Ike	850	Lightning	0	$2,065.606
8/9/2003	Black Mountain #2	95	Lightning	3 R	$187,667
7/4/2006	Mount Jumbo	333	Fireworks	0	$139,566
7/25/2006	Woodchuck	1,060	Miscellaneous	2 OB	$2,198,756
8/8/2006	Lolo Steakhouse	108	Lightning	0	$421,209
7/28/2007	MM 124	6,098	Miscellaneous	0	$3,335,203
8/3/2007	Jocko lakes	32,557	Lightning	1 R, 7 OB	$26,076,455
8/14/2007	Black Cat	10,766	Miscellaneous	2 OB	$6,394,793
7/9/2008	Mount Sentinel	390	Children	0	$150,033
7/20/2008	Indreland	107	Railroad	0	$5,952
8/22/2011	West Riverside	3,800	Miscellaneous	0	$6,008,754
7/25/2013	Mill Creek	707	Equipment	0	$697,292
8/2013	Lolo Complex	10,902	Lightning	5 R, 4 OB	$11,347,474
TOTAL		**98,181**		**12 R, 15 OB**	**$85,449,169**

Source: DNRC, 2016; Missoula CWPP, 2005. Notes: "--" indicates no data available; R = Residence: OB = Outbuilding.

The U.S. Forest Service provided data on wildfires over 100 acres on the Lolo National Forest from 1987 to 2012. Statistics on move recent wildfires were obtained from the Missoula Interagency Dispatch. **Table 4.2-3** presents this data. The data indicates that from 1986 to 2016, over 50 wildfires have burned more than 359,573 acres costing over $151 million to suppress. There is some duplication between the DNRC and U.S. Forest Service wildfire data that may represent the acres suppressed by each agency through mutual aid agreements.

Table 4.2-3. USFS Wildfire Listings >100 Acres in Missoula, Ninemile & Seeley Lake Ranger Districts

Date	Name	Cause	Acres	Suppression Costs
Missoula Ranger District				
5/8/1987	-	Lightning	315	$317,000
9/22/1987	-	Lightning	100	$124,700
8/25/1988	Lolo Creek	Lightning	2,230	$1,087,700
8/25/1996	Telephone Butte	Other	140	$223,700
8/21/1998	Gilbert Cr	Lightning	1,750	$1,500,000
9/1/1998	Boulder Lake	Lightning	245	$44,000
8/24/2000	Alder	Lightning	5,500	$1,500,000
8/8/2003	North Howard	Lightning	2,843	$1,477,000
8/8/2003	Black Mtn #2	Lightning	7,061	$13,300,000
8/8/2003	Mineral/Primm	Lightning	25,202	$22,900,000
8/8/2003	Sally Ridge #2	Lightning	119	$30,000
8/8/2003	Strawberry	Lightning	1,021	$1,900,000
7/13/2007	Wyman #2	Lightning	36,045	$10,715,500
7/13/2007	Fisher Point	Lightning	18,222	$5,417,000
7/13/2007	Sawmill	Lightning	14,233	$4,231,300
6/22/2010	Alder Creek	Lightning	871	$1,300,000
7/21/2010	Packer Meadows	Lightning	135	$750,000
8/22/2011	West Riverside	Playing with Matches	3,800	$5,500,000
07/15/13	Gold Creek	Lightning	171	--
08/18/13	West Fork 2	Lightning	6,000	--
08/18/13	Schoolhouse	Lightning	4,902	--
08/27/13	Harry's Flat	Lightning	596	--
Ninemile Ranger District				
7/26/1988	Madison Gulch	Lightning	1,009	$500,000
5/17/1993	Little Paw	Other	134	$38,800
7/29/1994	Beaver Slough	Lightning	780	$1,900,000
8/3/2000	Upper Ninemile	Lightning	17,817	$13,870,000
8/3/2000	Alpine Divide	Lightning	3,713	$2,888,700
8/3/2000	S. Nemote #4	Lightning	1,434	$1,161,000
8/10/2000	Siamese Lake	Lightning	1,350	$12,600
8/8/2003	Fish Creek	Lightning	3,008	$13,000,000
8/8/2003	No Name Lake	Lightning	144	$0
8/8/2003	Thompson Creek	Lightning	33,948	$14,000,000
8/4/2005	Alberton East	Other	118	$105,020
8/4/2005	Fish	Other	145	$137,950
8/4/2005	West Mountain	Other	1,642	$1,461,380
8/4/2005	Tarkio	Other	9,082	$8,083,870
9/5/2011	Crater Creek	Lightning	200	$12,000
08/13/15	Wildhorse Point	Lightning	133	--
08/14/15	West Fork Fish Creek	Lightning	13,351	--

Table 4.2-3. USFS Wildfire Listings >100 Acres in Missoula, Ninemile & Seeley Lake Ranger Districts

Date	Name	Cause	Acres	Suppression Costs
Seeley Lake Ranger District				
8/11/1986	-	Lightning	520	$45,000
6/25/1988	Canyon Creek	Lightning	38,642	$0
8/31/1988	Canyon Creek	Lightning	35,358	$1,500,000
9/9/1988	-	Lightning	220	$330,000
7/13/2000	Monture Complex	Lightning	23,802	$8,271,000
7/26/2000	Spread Ridge	Lightning	3,731	$919,000
9/25/2001	Cabin Creek	Lightning	2,084	$232,000
8/8/2003	Boles Meadow	Lightning	4,490	$7,700,000
7/15/2007	Conger Creek	Lightning	25,150	$980
7/30/2012	Falls Point	Lightning	350	$1,000,000
8/8/2012	Meadow Creek	Lightning	224	$1,194,000
8/17/2012	Wedge Creek	Lightning	2,021	$350,000
07/30/12	Falls Point	Lightning	380	--
08/09/12	Meadow Creek	Lightning	224	--
08/18/12	Wedge Creek	Lightning	2,003	--
08/14/15	Richmond Ridge	Lightning	625	--
08/14/15	North Richmond	Lightning	240	--
TOTAL			**330,948**	**$151,031,200**

Source: U.S. Forest Service, 2013. Missoula Interagency Dispatch, 2016. Notes: "--" = not available

Missoula County was had several federal disaster declarations from wildfire. Major disaster declarations were issued in 1994 and 2000 as part of larger state-wide disaster declarations. Fire Management Assistance Declarations were issued in 2000 (Montana SW Zone 2 Fire Complex), in 2003 (Missoula/Mineral Fire Zone), in 2007 (Black Cat and Jocko Lakes Fires) and in 2013 (Lolo Creek Fire Complex). A description of several significant wildfires that occurred in Missoula County since the PDM Plan was last updated in 2011 are described below.

August, 2011 - Homes were threatened from West Riverside to Johnson Gulch on the lower Blackfoot River. Within an hour, the fire had raced across 150 acres and crested the ridgeline, while residents – some less than 100 yards below the fire's downslope edge – scrambled to remove personal belongings from homes. But with stout winds whipping up the mountainside, flames moved unabated northward and eastward, crowning through the trees, sending fiery debris tumbling down toward neighborhoods below, and spotting as far as half a mile ahead of the fire's eastern edge. Approximately 3,800 acres burned in the West Riverside Fire which started from children playing with matches. Suppression costs were over $6 million. (Missoulian, *Wildfire Races up West Riverside Mountain Burns 1,000 to 2,000 Acres*, August 22, 2011).

Flames light up the evening sky in West Riverside as wildfire burns through timber.
Source: Tom Bauer/Missoulian

August, 2013 - The Lolo Creek Complex, consisted of two fires; the Schoolhouse Fire and the West Fork II Fire, on both sides of Highway 12, eight miles southwest of the outskirts of Missoula and five miles west of Lolo. Extreme fire danger and Red Flag conditions hampered initial attack efforts and the fire experienced rapid growth, driven by winds of 40-50 mph. More than 500 fire personnel worked to keep the fire west of Sleeman Gulch and north of Highway 12, away from the 1,200 homes in the area. The fire burned over 9,500 acres and had five primary residences and four outbuildings lost. Wildfire Today, Montana: *Lolo Creek Complex Southwest of Missoula*, August 22, 2013).

Lolo Creek Complex as seen from Missoula, August 19, 2013.
Source: Wildfire Today

Missoula County has a non-regulatory Community Wildfire Protection Plan (CWPP) dated 2005. The Seeley-Swan Fire Plan was revised in 2013. **Appendix E** contains copies of these documents. The Missoula County CWPP seeks to reduce hazardous fuels and structure ignitability to protect communities from wildfire. The CWPP and the Seeley-Swan Fire Plan contain more detailed maps identifying areas of greater fire risk and where fire hazard reduction treatments should be prioritized. Mitigation projects identified in the fire plans are incorporated herein by reference. A new wildfire hazard risk mapping project is underway to help provide landowners, the public, and decision makers with additional information about wildfire hazards in Missoula County. The project will result in recommendations for possible firewise treatments and other land management options to reduce risks associated with wildfire.

In 2015, Missoula County was selected by the Community Planning Assistance for Wildfire Program (CPAW) as one of five jurisdictions in the nation to participate in a study of wildfire protection programs. Further details on the CPAW technical grant include:

- The project will bring national experts to join with local firefighters and community stakeholders to comprehensively evaluate and provide recommendations on existing and future wildfire risks and associated land use planning strategies within Missoula County. This effort will materialize in the development and publication of Missoula County's CWPP.
- Missoula County currently has a well-organized network focused on WUI mapping, fuel mitigation, wildfire education, and emergency response coordination.
- This project will look at additional land use planning tools that can enhance the effectiveness of these current activities.
- It will also explore other planning measures being used across the Mountain West to reduce the risk of wildfire to property owners living in the WUI and to firefighters tasked with protecting lives and properties in those areas.
- This project will help improve coordination between the County's wildfire mitigation efforts and its land-use decision making framework.
- This project will bring together a diverse team of public and private stakeholders from multiple departments and sectors.

- The program is funded by the U.S. Forest Service and private foundations. It is entirely voluntary and local jurisdictions retain all authority to implement any program recommendations.
- The program is co-managed by Wildfire Planning International and Headwaters Economics.

Vulnerability and Area of Impact

The WUI is a line, area or zone [MCA 76-13-102(16)] where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. A WUI exists anywhere that structures are located close to natural vegetation and where a fire can spread from vegetation to structures, or vice versa. The most extreme situation with respect to fuel conditions and values at risk occurs in rural areas where numerous high-value individual homes and subdivisions are located in the WUI in close proximity to or within the wildland boundary. A significant loss of life could occur to residents, firefighters, and others who are in the wildfire area and do not evacuate.

People and structures near wildfires are threatened unless adequately protected through evacuation or mitigation. Should fires occur, structures within the WUI are very vulnerable. Some areas are a significant wildfire risk due to the slope of the landscape, human population densities adjacent or within forests, overall fuel hazards, and the accessibility of evacuation routes. The increase in wildland fires near population centers over the past decade has increased the level of awareness and the need for mitigation in the WUI setting.

Regional electric infrastructure that pass through wildland and non-irrigated agricultural areas are vulnerable to wildfire. In particular, the electric substations, transmission lines, fuel tanks, and radio transmission towers are not often equipped to withstand the heat from a wildfire. A wildfire could disrupt electricity or communications should this infrastructure be damaged.

Another concern with wildfires is erosion and flash flooding in severely burned area. When moderate to heavy rains fall, an initial flush of ash can fill streams and rivers with ash and debris, which can adversely affect municipal water supplies as well as private domestic water supplies for subdivisions and private property owners.

Smoke from fires both within and outside of Missoula County can create poor air quality and can affect sensitive groups such as the elderly and asthmatics. A recent study by Harvard-Yale Universities predicts that most of the smoke generated by West coast fires will move towards western Montana as North America warms through the coming century. To identify the highest-risk areas, the team used a fire prediction model and advanced atmospheric modeling to separate pollution caused by wildfires from other pollution sources. They also tracked the likely movement of smoke, focusing on "smoke waves"– two or more consecutive days of unhealthy levels from fires. The study found that nationwide, the average length of the smoke-wave season is forecast to grow from 14 days a year to 29. Western Montana counties, however, could see smoke-wave seasons ranging from 25 to 69 days (Independent Record, *Wildfire Smoke Affecting Montana*, August 21, 2016).

The health effects associated with forest fire smoke exposure has been studied by the Centers for Disease Control (CDC). Researchers found the risk of hospital admission for respiratory and circulatory illness was greater during periods of heavy smoke associated with the Bitterroot forest fires in 2000 than the unexposed area (CDC, 2001).

Although the primary concern is to structures and the interface residents, most of the costs associated with fires, come from firefighting efforts. Wildfires can also have a significant impact on the regional economy with the loss of timber, natural resources, recreational opportunities, and tourism. Smoke also affects things like road safety, tourism, and property values.

Probability and Magnitude

The trend in climatic conditions in recent years has had major implications for wildland fire severity. A wildfire risk assessment, known as the West-Wide Wildfire Risk Assessment, was completed in 2013 for 17 western states including Montana (Sanborn, 2012). Missoula County is shown to have 1,605,418 wildland acres and 68,272 non-wildland acres. Data compiled for areas of wildfire risk was described, as follows.

- **Fire Risk Index** - Measure of overall wildfire risk. Data from the assessment showed that Missoula County has the highest Fire Risk Index rating of all Montana counties.
- **Fire Effects Index** - Identifies areas with important values affected by wildland fire and/or that are costly to suppress. Data from the assessment showed that Missoula County has the second highest Fire Effects Index rating of all Montana counties.
- **Wildland Development Areas** - Describes where people are living in wildland areas. Data from the assessment showed that Missoula County has the third highest Wildland Development Area rating of all Montana counties.

Property damage information is difficult to obtain for wildfires since it is typically the forest and agricultural resources that sustain most of the damage. As such, the magnitude of wildfire can be correlated with the acres burned and cost to suppress the fire by local, state, and federal agencies, as well as by the number of structures lost. **Tables 4.2-2 and 4.2-3** and research on Missoula County wildfires indicate that in the past 30 years there have been at least 60 fires over 100 acres in Missoula County that have burned over 446,700 acres. Suppression costs on these fires have amounted to over $200 million with at least 13 residences and 11 outbuildings lost.

Wildfire does not present a uniform risk across Missoula County. To perform the PDM analysis for the wildfire hazard, the WUI layer provided by the Missoula County's GIS Dept. was used. The method for developing the WUI was not determined. **Figure 5** presents the wildfire hazard map used for the PDM analysis.

To complete the vulnerability analysis for this project, GIS was used to intersect the WUI layer with both the critical facility and MDOR cadastral parcel datasets. Estimates of vulnerable population were calculated by determining the percent exposure in each census block for the hazard area. Exposure values are presented in **Table 4.2-4**. Building exposure reflects only the monetary structure value and does not account for improvements or personal effects that may be lost to wildfire.

Table 4.2-4. Missoula Co. Vulnerability Analysis; Wildfire (High and Very High WUI)

Category	Missoula County (balance)	City of Missoula	Missoula County Total
Residential Property Exposure $	$2,624,077,721	$2,919,107,711	$5,543,185,432
# Residences At Risk	14,349	16,514	30,863
Commercial, Industrial & Agricultural Property	$428,219,524	$1,687,426,720	$2,115,646,244
# Commercial, Industrial & Agricultural	1,221	2,940	4,161
Critical Facilities Exposure Risk $	$189,970,747	$869,202,523	$1,059,173,270

Table 4.2-4. Missoula Co. Vulnerability Analysis; Wildfire (High and Very High WUI)

Category	Missoula County (balance)	City of Missoula	Missoula County Total
# Critical Facilities At Risk	104	70	174
Bridge Exposure $	$150,997,489	$7,171,555	$158,169,044
# Bridges At Risk	127	33	160
Persons At Risk	35,080	73,210	108,290
Persons Under 18 At Risk	8,237	13,460	21,697

GIS analysis of the wildfire risk to Missoula County indicates that approximately 951,460 acres (56.7 percent) are within WUI areas. According to the vulnerability analysis, 30,863 residences, 4,161 commercial, industrial and agricultural buildings, and 174 critical facilities are located in the WUI areas. The Wildfire Section in **Appendix C** lists the critical facilities and bridges within the WUI.

Wildfires generally occur more than once per year in Missoula County and therefore, the probability of future events are rated as "highly likely". Missoula County's history with wildfires, the mountainous terrain, and areas of the county encompassed by public land has prompted the community to identify wildfires as a significant hazard. Other losses from severe wildfire include loss of jobs, loss of taxable value, and a loss of sense of safety. Post-fire effects include flash flooding and erosion. Smoke from local and regional forest fires create public health emergencies.

Future Development

Wildfire disasters can be mitigated through comprehensive land use planning that includes housing development design, fuels management, and public education. Regulations and ordinances addressing these issues in future development can play a significant role to minimize the danger posed by fire to residents, homes, and firefighters.

The Missoula County Subdivision Regulations contain requirements for subdivisions in the WUI that address defensible space for critical infrastructure, ingress and egress for lot owners and emergency responders, and water supply for fire suppression. Areas rated as WUI must comply with special design standards including:

- Roof Coverings - must be Class A or B fire-rated roofing materials;
- Access and Evacuation – Roadside vegetation must be maintain so roads will service as escape routes and fire breaks. There must be a minimum of two approach routes to ensure one than one escape route and access routes by emergency vehicles.
- Vegetation Management - A vegetation management plan is required that will reduce fuel loading and hazard rating and provide continuous maintenance of the fuel load. The plan must include guidelines for defensible space, fuel breaks and greenbelts, and a plan for continuous maintenance.
- Water Supply – A fire-fighting water source and access to that source must exist and be maintained as defensible space. Requirements for water supply systems are stipulated and may include fire hydrants or storage tanks. Residential fire sprinkler systems may be required.
- Fire Protection Covenants are required stipulating that property owners must maintain fire protection water supplies and fire protection systems (defensible spaces, driveway routes, fuel breaks) in perpetuity.

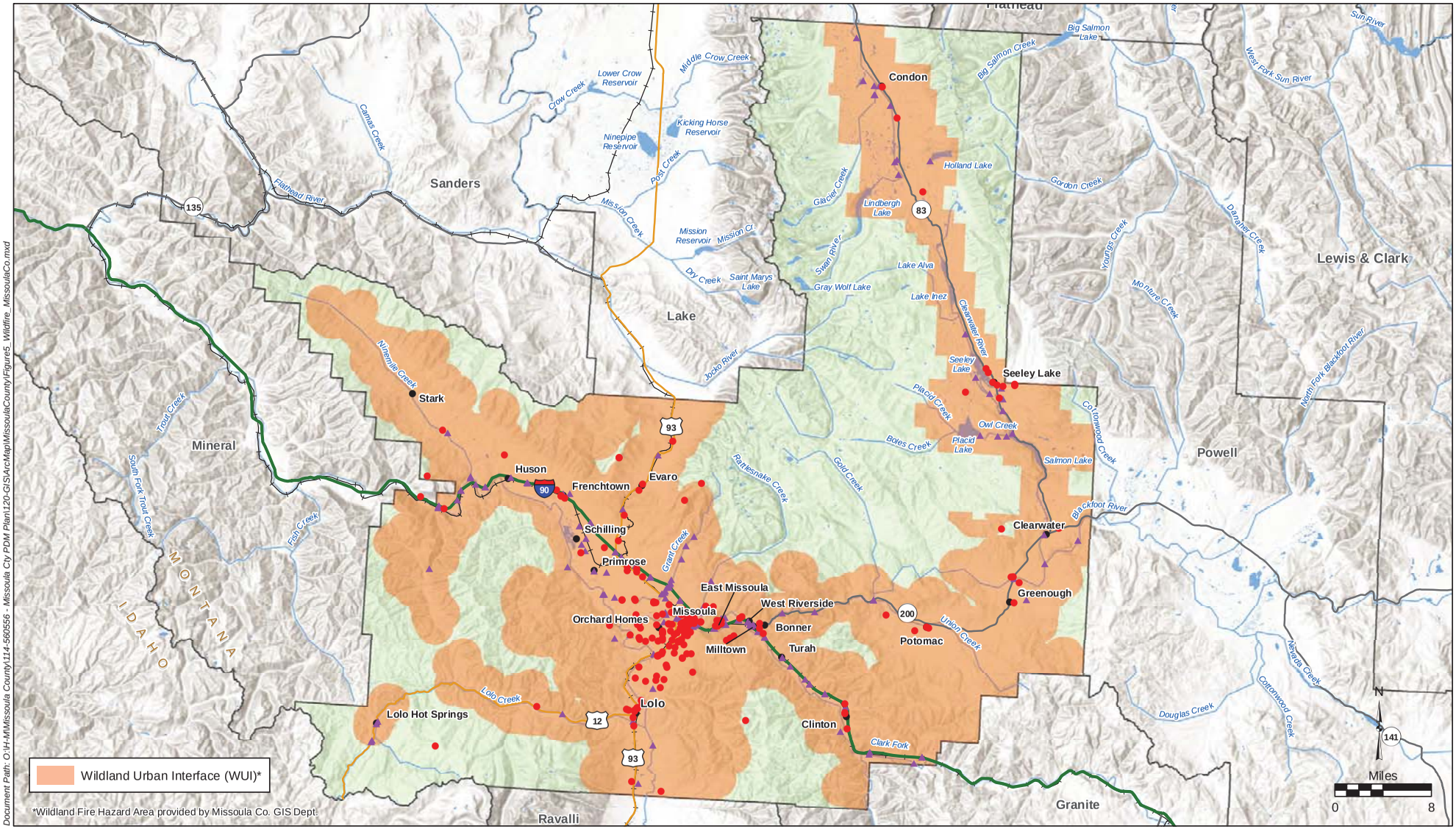
Both the Missoula County zoning ordinance and building codes may be updated or other measures developed to further protect life and property from the wildfire hazard (Missoula Co. Growth Policy, 2016). According to the Seeley-Swan Fire Plan (2013), additional development in WUI areas must be carefully considered to avoid creating unreasonable risks.

Climate Change

Wildfire is determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. Additionally, changes in climate patterns may impact the distribution and perseverance of insect outbreaks that create dead trees (increase fuel). When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

According to the Missoula County Growth Policy (2016), there is no doubt in the scientific community that climate change will bring increased fire danger to Missoula County. A combination of increased temperatures over extended periods of time will result in earlier snowmelt, lower humidity, drought, and decreased fuel moisture. The Forest Service has designed a series of measurements/calculations to represent fire danger both on a daily basis and into the future. The most important of these is the "Energy Release Component," the ERC. This is basically the intensity of the fire as it burns using a standard set of fuel characteristics. The higher the ERC, the greater the fire danger. A recent analysis from the Missoula Fire Science Laboratory indicates that the fire season over the next 95 years will increase by 17 days (32% increase); fire danger (ERC) will increase by around 15 percent; drought will increase by 16 percent; and fuel moistures will decrease by 16 percent. Larger, more severe, and more frequent fires may impact the people, property and critical facilities by increasing the risk from ignition from nearby fire sources.

Additionally, secondary impacts such as air quality concerns and public health issues from smoke may increase. Wildfire smoke generates a lot of particulate matter 2.5 microns or less in diameter, known as PM2.5. Those particles are so small, they easily bypass most of the human body's defenses and move directly from the lungs into the bloodstream. A recent study demonstrates that smoke waves are likely to be longer, more intense, and more frequent under climate change, which raises health, ecologic and economic concerns. Organizations like Climate Smart Missoula have been putting together ideas for dealing with smoke, like funding public places with air conditioners or filtered air when it gets bad.



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure5_Wildfire_MissoulaCo.mxd

Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Figure 5
Wildfire Risk
Missoula County, Montana
Pre-Disaster Mitigation Plan

4.3 Hazardous Material Incidents & Railroad Derailments

CPRI SCORES
HAZMAT INCIDENTS = 3.2
RAILROAD DERAILMENTS = 2.6

Description and History

A hazardous material release is the contamination of the environment (i.e. air, water, soil) by any material that because of its quantity, concentration, or physical or chemical characteristics threatens human health, the environment, or property. Hazardous materials, including petroleum products and industrial chemicals, are commonly stored and used in Missoula County and are regularly transported via the region's roadways, railroads, and pipelines. A release of hazardous materials from both fixed and transportation incidents pose possible threats involving emergency response. Hazards range from small spills on roadways to major transportation releases on railways or pipeline ruptures contaminating land and water.

Records of hazardous material events from 1990 to 2016, available from the National Response Center database, are summarized in **Table 4.3-1**. There have been no Presidential disaster declarations associated with the hazardous material incident hazard in Missoula County. However, the 1996 Alberton Chlorine Spill (described below) resulted in a State Emergency declaration. A regional hazardous-material team is located in Missoula.

Table 4.3-1. Missoula County Hazardous Material Incidents; 1990 – 2016

Incident Date	Type of Incident	Incident Cause	Location	Nearest Town	Suspected Responsible Party	Quantity Spilled/ Material Name
2/14/1990	Railroad	TA	US 93	Evaro	Montana Rail Link	500 Gallons Oil, Fuel: No. 2
3/1/1990	Mobile	TA	Kenova Loading Fac	Lolo	Green Diamond Logging	25 Gallons Hydraulic Oil
3/29/1990	Pipeline	EF	Unknown	Bonner	Champion International	30 Gallons Hydraulic Oil
9/8/1990	Fixed	EF	Unknown	Missoula	Stone Container	1 Pound Sulfur Dioxide
12/21/1990	Fixed	OE	3670 Grant Creek Rd	Missoula	Borden Inc.	1,000 Pds Formaldehyde Solution
3/6/1991	Fixed	OE	Unknown	Missoula	Stone Container	1,500 Pounds Sulfuric Acid
4/22/1991	Fixed	OE	1701 Brooks	Missoula	Superamerica Stores	11 Gallons Gasoline: Automotive
6/12/1991	Fixed	OE	403 Russell	Missoula	Superamerica Stores	5 Gallons Gasoline: Automotive
7/16/1991	Fixed	OE	3330 Raser Drive	Missoula	Conoco	30 Barrels Unleaded Gasoline
10/17/1991	Fixed	EF	14th & Catlin	Missoula	USDA- Forest Service	40 Gallons Pentachlorophenol
3/4/1992	Mobile	TA	806 Whitaker Dr.	Missoula	Food Services of America	40 Gallons Oil: Diesel
4/15/1992	Fixed	EF	3330 Raser Dr.	Missoula	Conoco Pipeline Co	70 Barrels Gasoline: Automotive
8/14/1992	Aircraft	OE	Continental Jetway	Missoula	Continental Airlines	75 Gallons Jet Fuel
10/8/1992	Fixed	Unknown	1515 South 14 West	Missoula	Us West	Gasoline: Automotive
1/28/1993	Fixed	TA	4570 N Reserve	Missoula	Cenex Ltd	408 Gallons Gasoline
3/12/1993	Fixed	Unknown	4570 N Reserve	Missoula	Cenex Ltd	Unknown Oil
5/30/1993	Railroad	Unknown	Unknown	Frenchtown	Montana Rail Link	Unknown Oil
6/2/1993	Fixed	EF	Waste Water Div.	Missoula	City Of Missoula	100 Pounds Chlorine
7/12/1993	Mobile	Other	I-90	Missoula	Arnold Bros Transport	20 Gal Creosol (Parts Cleaner)
1/2/1994	Mobile	Other	I-90 West at MP 143	Missoula	Kline Trucking	75 Gallons Oil: Diesel
3/4/1994	Mobile	Other	2701 Palmer Rd	Missoula	Frito Lay	10 Gallons Oil: Diesel
3/29/1994	Fixed	Dumping	1134 Long Staff	Missoula	Butch's Appliances	Freon
12/9/1994	Mobile	TA	1.5 Mi. W of Clinton	Clinton	Jgl Distributing	2200 Gallons Gasoline
2/2/1996	Fixed	NP	Drawer D	Missoula	Stone Container	1 Pound Sulfur Dioxide
3/24/1996	Fixed	EF	Mullan Road	Missoula	Stone Container	13 Pounds Chlorine
10/9/1996	Mobile	OE	US 93	Ronan	Wilbur-Ellis Co	Unknown

Table 4.3-1. Missoula County Hazardous Material Incidents; 1990 – 2016

Incident Date	Type of Incident	Incident Cause	Location	Nearest Town	Suspected Responsible Party	Quantity Spilled/ Material Name
11/1/1996	Pipeline	Other	8 Mi. W of Missoula	Missoula	Montana Power Company	Natural Gas
12/3/1996	Railroad	Unknown	E. Spruce St Crossing	Missoula	Burlington Northern	Ethylene Glycol
3/13/1997	Fixed	Other	Mullan Rd.	Missoula	Stone Container	10 Pounds Chlorine
7/6/1997	Fixed	EF	Stone Container	Missoula	Stone Container	300 Gallons Hydraulic Oil
9/4/1997	Fixed	EF	Mullan Road	Missoula	Stone Container	Sodium Hydroxide
12/4/1997	Fixed	Unknown	Mullan Road	Missoula	Stone Container	300 Gallons Ferric Sulfate
1/5/1998	Fixed	Unknown	Mullan Road	Missoula	Stone Container	35 Gallons Oil, Misc: Lubricating
8/13/1998	Fixed	Other	Mullan Road	Missoula	Stone Container	Chlorine
12/14/1998	Mobile	EF	Mullan Road	Missoula	Smurfit Stone Container	250 Gallons Hydraulic Oil
1/20/1999	Fixed	OE	Mullan Road	Missoula	Smurfit Stone Container	150 Gallons Sulfuric Acid
4/19/1999	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	500 Gallons Oil, Misc: Lubricating
7/9/1999	Fixed	Other	3300 Raser Dr.	Missoula	Louisiana Pacific	Lead Brick
8/2/1999	Fixed	Other	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	139 Pounds Formaldehyde
9/8/1999	Mobile	EF	500 West Front	Missoula	Unknown	200 Gallons Sodium Hypochlorite
12/23/1999	Fixed	Unknown	68 Valleyofthe Moon	Clinton	Thatcher Co Of Montana	3000 Pds Sodium Hypochlorite
6/10/2000	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	400 Gallons Hydraulic Oil
7/6/2000	Fixed	EF	5115 Sky View Drive	Missoula		35 Gallons Dielectric Oil
10/7/2002	Fixed	EF	Clark Fork River	Missoula	Layne Christensen	1 Pint Oil, Misc: Motor
2/25/2005	ST	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	400 Gallons Sulfuric Acid
10/13/2005	Fixed	Dumping	Norco Products	Missoula	Norco Products	Waste Oil
1/11/2006	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	205 Pounds Methyl Mercaptan
6/18/2006	Railroad	Unknown	101 Internatnl Way	Missoula	Montana Rail Link	Ethanol
8/8/2006	Fixed	NP	Unknown	Unknown	Northwestern Energy	150 Gal Oil, Misc: Transformer
1/17/2007	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	136 Pounds Methyl Mercaptan
10/11/2007	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	123 Pounds Methyl Mercaptan
6/16/2008	Fixed	OE	2600 Latimore	Missoula	Pacific Steel And Recycling	Oil, Misc: Motor
10/9/2008	ST	EF	3555 Mullan Rd.	Missoula	Walmart	10 Gallons Waste Cooking Oil
2/27/2009	Mobile	Other	Interstate 90	Missoula	John S Pocock LLC	114 Gallons Oil, Fuel: No. 1-D
4/16/2009	Fixed	EF	So Reserve & Mullan	Missoula	Town Pump	2 Gallons Oil: Diesel
7/2/2009	Fixed	Other	40060 Paws Up Rd	Greenough	Resort At Paws Up	Paint
12/6/2009	Fixed	EF	14377 Pulp Mill Rd.	Missoula	Smurfit Stone Container	102 Pounds Hydrogen Sulfide
5/1/2010	Fixed	OE	2106 Clements Road	Missoula	Dales Dairy	2000 Gal Gasoline: Automotive
10/7/2010	Fixed	Other	Unknown	Missoula	Unknown	Unknown Pesticides
8/3/2011	Fixed	Other	3602 Stevens Ave	Missoula	Unknown	30 Gallons Oil, Misc: Mineral
9/3/2012	Fixed	EF	704 SW Higgins	Missoula	Northwestern Energy	100 Gal Oil, Misc: Transformer
7/3/2014	Railroad	Derailment	Unknown	Missoula	Montana Railing	Denatured Alcohol
4/20/2016	Mobile	TA	State Hwy 10	Albertson	Tece Trucking	Gasoline: Automotive (Unleaded)
7/28/2016	Fixed	Dumping	1192 Airport Rd	Seeley Lake	Private Citizen	Oil, Misc: Motor

Source: National Response Center, 2016 (http://www.nrc.uscg.mil/).
Notes: EF = Equipment Failure; OE = Operator Error; ST = Storage Tank; TA = Transportation Accident; US = Unknown Sheen.

Montana Rail Link and Burlington Northern-Santa Fe provide rail service through Missoula County. According to Montana Rail Link, about 16 to 20 freight trains pass through Missoula daily, many of which contain hazardous materials. (Missoula County Growth Policy, 2016). **Table 4.3-2** lists railroad accidents in Missoula County with details on derailments containing hazardous materials.

Table 4.3-2. Missoula County Railroad Accidents; 1996 – 2016

Date	Nearest Town	Injuries	Fatalities	Cars Carrying Haz-Mat	Haz-Mat Cars Damaged	Comments
1/18/1996	Missoula	0	0	0	--	MRL – 8 cars derailed on mainline.
3/16/1996	Missoula	0	0	0	--	MRL – 3 cars derailed in yard
3/27/1996	Missoula	0	0	2	--	MRL – 2 cars derailed in yard
4/24/1996	Missoula	0	0	0	--	MRL – 3 cars derailed in yard
5/18/1996	Missoula	0	0	0	--	MRL – 2 cars derailed in yard
11/9/1996	Missoula	0	0	0	--	MRL – 2 cars derailed in yard
11/30/1996	Missoula	0	0	1	0	MRL – 7 cars derailed in yard
12/5/1996	Frenchtown	1	0	13	0	MRL incident on mainline
12/16/1996	Clinton	0	0	0	--	MRL – 2 cars derailed on mainline
12/23/1996	Missoula	0	0	0	--	MRL – 2 cars derailed in yard
3/13/1997	Missoula	0	0	10	0	MRL – 3 cars derailed in yard
3/26/1997	Missoula	0	0	0	--	MRL – 4 cars derailed in yard
6/14/1997	Missoula	0	0	8	1	MRL – 11 cars derailed on main. No haz-mat released
7/23/1997	Missoula	0	0	26	4	MRL – 4 cars derailed in yard. No haz-mat released.
8/4/1997	Missoula	0	0	0	--	MRL – 2 cars derailed in yard
9/14/1997	Evaro	0	0	0	--	MRL – 4 cars derailed on siding
10/7/1997	Bonner	0	0	0	--	MRL – 1 locomotive and 2 cars derailed on industry
11/17/1997	Clinton	0	0	15	10	MRL – 49 cars derailed on main. No haz-mat released
7/2/1998	Missoula	0	0	1	0	MRL – 2 cars derailed in yard
10/15/1998	Missoula	0	0	2	0	MRL – 4 cars derailed in yard
11/4/1998	Missoula	0	0	0	--	MRL – 3 cars derailed in yard
6/28/1999	Missoula	0	0	1	0	MRL – 4 cars derailed in yard.
7/28/1999	Nimrod	0	0	9	1	MRL – 7 cars derailed. No haz-mat released
2/20/2000	Lothrop	0	0	0	--	MRL – 12 cars derailed on mainline.
3/23/2000	Missoula	0	0	8	1	MRL – 2 cars derailed in yard. No haz-mat released.
7/19/2000	Lothrop	1	0	0	--	MRL – 1 car derailed on mainline.
8/13/2000	Missoula	0	0	0	--	MRL incident - 1 car derailed in yard.
8/29/2000	Evaro	0	0	0	--	MRL incident - 1 car derailed on mainline.
1/15/2001	Schilling	0	0	0	--	MRL – 5 cars derailed on industry spur
2/17/2001	Missoula	0	0	1	0	MRL collision – 2 locomotives derailed in yard
3/23/2001	Missoula	0	0	4	1	MRL incident – 2 cars derailed. No haz-mat released
6/20/2001	Missoula	0	0	29	1	MRL – 2 cars derailed in yard. No haz-mat released.
8/30/2001	Missoula	0	0	1	0	MRL – 7 cars derailed in yard
7/14/2002	Nimrod	0	0	0	--	MRL – 1 car derailed on mainline
10/2/2002	Missoula	0	0	3	3	MRL – 1 car derailed in yard. No haz-mat released.
1/22/2003	Missoula	0	0	0	--	MRL – 9 cars derailed on mainline
5/4/2003	Missoula	0	0	0	--	MRL collision – 3 cars derailed in yard
9/21/2003	Missoula	0	0	26	3	MRL – 1 cars derailed on mainline. No haz-mat release
12/4/2004	Missoula	0	0	0	--	MRL – 5 cars derailed in yard
5/2/2005	Missoula	0	0	0	--	MRL – 4 cars derailed in yard
1/15/2006	Missoula	0	0	0	--	MRL – 3 cars derailed in yard
2/27/2006	Missoula	0	0	0	--	MRL incident on industry spur
5/3/2006	Missoula	0	0	0	--	MRL collision in switching yard – 1 car derailed
6/18/2006	Missoula	0	0	29	3	MRL – 7 cars derailed in yard. 13,000 gal alcohol lost
2/1/2007	Missoula	0	0	0	--	MRL – 7 cars derailed in yard
10/27/2007	Bonner	0	0	0	--	MRL – 2 locomotives & 1 car derailed on industry spur
12/11/2007	Missoula	0	0	0	--	MRL collision in switching yard

Table 4.3-2. Missoula County Railroad Accidents; 1996 – 2016

Date	Nearest Town	Injuries	Fatalities	Cars Carrying Haz-Mat	Haz-Mat Cars Damaged	Comments
4/12/2008	Missoula	0	0	0	--	MRL – 5 cars derailed in yard
6/22/2008	Missoula	0	0	0	--	MRL – 7 cars derailed in yard
7/12/2008	Missoula	0	0	0	--	MRL collision in switching yard 1 locomotive derailed
7/15/2008	Missoula	0	0	6	0	MRL incident in switching yard – 5 cars derailed
11/30/2008	Missoula	0	0	0	--	MRL – 4 cars derailed in yard
3/25/2009	Missoula	0	0	0	--	MRL – 6 cars derailed at industry spur
1/7/2010	Missoula	0	0	0	--	MRL – 4 locomotives derailed in yard
8/10/2010	Missoula	0	0	0	--	MRL – 4 cars derailed in yard
9/4/2010	Missoula	0	0	0	--	MRL – 2 locomotives derailed in yard
12/16/2010	Missoula	0	0	0	--	MRL – 3 cars derailed in yard
8/18/2011	Missoula	0	0	0	--	MRL – 1 car derailed in yard
9/16/2011	Missoula	0	0	0	--	MRL – 3 cars derailed in yard.
11/23/2011	Missoula	0	0	0	--	MRL – 8 cars derailed in yard.
8/15/2012	Missoula	0	0	0	--	MRL incident in yard.
11/16/2012	Clinton	0	0	0	--	MRL – 1 car derailed on mainline.
3/5/2013	Missoula	0	0	0	--	MRL – 1 car derailed in yard
6/2/2013	Missoula	0	0	0	--	MRL – 2 cars derailed on mainline
12/19/2013	Missoula	0	0	0	--	MRL – 1 car derailed in yard
2/14/2014	Frenchtown	0	0	54	1	MRL – 1 car derailed. No haz-mat release
7/1/2014	Missoula	0	0	0	--	MRL collision
11/13/2014	Bonner	0	0	0	--	MRL collision; 3 locomotives, 11 car derailed
12/16/2014	Missoula	0	0	30	30	30 cars derailed in switching yard. No haz-mat release.
9/24/2015	Missoula	0	0	0	--	MRL incident in train yard
11/19/2015	Missoula	1	0	0	--	MRL – 13 cars derailed
4/4/2016	Missoula	0	0	0	--	MRL – Kubota on tracks causing accident
5/16/2016	Missoula	0	0	0	--	MRL – 2 car derailed
TOTAL		**3**	**0**	**279**	**59**	

Source: Federal Railroad Administration, 2016
http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Query/incabbr.aspx

One of the most significant hazardous material incidents in Montana history occurred in 1996 in Alberton, west of Missoula, and involved derailment of several railroad cars containing chlorine. A description of this and other hazardous material incidents, are presented below.

April 11, 1996 – Nineteen (19) cars from a Montana Rail Link (MRL) freight train derailed near Alberton, Montana. Six of the derailed cars contained hazardous materials. One derailed tank car containing chlorine (a poison gas) ruptured, releasing 130,000 pounds of chlorine into the atmosphere; another tank car containing potassium hydroxide solution (potassium cresylate, a corrosive liquid) lost 17,000 gallons of product; and a covered hopper car containing sodium chlorate (an oxidizer) spilled 85 dry gallons onto the ground. This chlorine spill is the second largest in U.S. history.

About 1,000 people from the surrounding area were evacuated. Approximately 350 people were treated for chlorine inhalation, 123 of whom sustained injury. Nine people, including both members of the train crew, were hospitalized. A transient riding the train died from acute chlorine toxicity.

U.S. Interstate Highway 90 (I-90) is roughly parallel and about 150 yards north of the MRL tracks at the accident site. The hazardous material cloud drifted across I-90 resulting in multiple highway traffic accidents. Several motorists were stranded in the cloud after these accidents. I-90 was closed requiring an 81-mile detour. Monetary damage was estimated to be $10 million.

Alberton, MT; KPAX TV video; Missoula, MT

The Governor of Montana declared a state of emergency in Missoula and Mineral Counties. On April 14, 1996 the evacuation area was reduced to 15 square miles; residents were temporarily escorted into the area to feed and water livestock animals, retrieve some personal possessions, and locate pets (NTSB, 1998).

June 12, 2013 – The Missoula Rural Fire Department and Missoula County's Haz-Mat team investigated a 5,000-gallon spill of diluted acids that flooded the floor of a Missoula manufacturer. The spill of citric, phosphoric and sulfuric acids occurred because a valve was left open overnight in a mix tank. The spill occurred at Spectrum Products, a manufacturer of pool products, located near the Missoula International Airport. The spill was contained to the building's interior using bentonite material. (Billings Gazette, 5,*000 Gallons of Acid Spill at Missoula Manufacturer*, June 12, 2013).

April 20, 2016 – A tanker spilled an estimated 2,200 gallons of gasoline west of Alberton. The tanker narrowly missed striking a power pole after detaching from the truck on Old Highway 10 about two miles west of Alberton. Crews safely moved the gas from the tanker to a second tanker, before it was towed away and removed soil were the gasoline spilled. The driver was not injured and no water resources were threatened by the spill (KPAX.com, *Cleanup Continues After Gasoline Tanker Crashes Near Alberton*, April 20, 2016). A PDM Planning Team member indicated that this spill didn't need to happen. The trucker was driving on a windy two-lane road instead of using the safer, more direct route of the interstate.

The Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted in 1986 to inform communities and citizens of chemical hazards in their areas. Sections 311 and 312 of EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires the U.S. Environmental Protection Agency (EPA) and the states to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public in the Toxics Release Inventory (TRI). In 1990 Congress passed the Pollution Prevention Act which required that additional data on waste management and source reduction activities be reported under TRI. The goal of TRI is to empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed. There are three active TRI facilities in Missoula County, as shown in **Table 4.3-4**.

Table 4.3-3 - Toxic Release Inventory – Total Aggregate Releases; 2011-2015

Facility/Year	Total On-Site Disposal or Other Releases	Total Off-Site Disposal or Other Releases	Total On- and Off-site Releases	Chemical
Hexion Inc., 3670 Grant Creek Road, Missoula, MT				
2015	16,865 pounds	11 pounds	16,876 pounds	Formaldehyde, formic acid, methanol, phenol
2014	16,299 pounds	11 pounds	16,310 pounds	
2013	16,219 pounds	6 pounds	16,225 pounds	
2012	15,957 pounds	6 pounds	15,964 pounds	
2011	14,925 pounds	6 pounds	14,932 pounds	
JTL Group Missoula (DBA Knife River-Missoula), 4800 Wilkie Ave., Missoula, MT				
2011	3 pounds	0	3 pounds	PAHs
Phillips 66 Missoula Products Terminal, 3330 Raser Drive., Missoula, MT				
2015	2,375 pounds	1 pound	2,376 pounds	1,2,4-trimethlbenzene, benzene, ethylbenzene, N-hexane, naphthalene, polycyclic aromatic compounds, toluene, xylene
2014	3,362 pounds	0	3,362 pounds	
2013	2,974 pounds	0	2,974 pounds	
2012	3,247 pounds	0	3,247 pounds	
2011	3,292 pounds	243 pounds	3,535 pounds	
Roseburg Forest Products Co. – Missoula Particleboard, 3330 Raser Road, Missoula, MT				
2015	110,800 pounds	60 pounds	110,860 pounds	Acetaldehyde, formaldehyde, lead compounds, methanol
2014	94,539 pounds	56 pounds	94,595 pounds	
2013	86,046 pounds	53 pounds	86,099 pounds	
2012	89,830 pounds	57 pounds	89,887 pounds	
2011	60,516 pounds	56 pounds	60,572 pounds	

Source: U.S. EPA, 2016; https://iaspub.epa.gov/triexplorer/tri_release.chemical

The Yellowstone Pipe Line (YPL) Company operates a 725-mile petroleum products pipeline system that originates from refineries in Billings and transports product to markets in Montana, northern Idaho and eastern Washington. The pipeline crosses through Missoula County and is related to the bulk storage facilities on the west side of Missoula. Other facilities maintaining bulk hazardous material storage consist of the various propane distributors found around the county.

Many facilities in Missoula County sell or use hazardous materials including the municipal water treatment facilities, industrial businesses, chemical dealers, and fuel distributors. Locations of facilities in Missoula County with Tier II reporting requirements are listed in **Table 4.3-4.**

Table 4.3-4. Missoula County Tier II Hazardous Material Reporters

Facility Name	Address	City
A & I Distributors Missoula	5649 Expressway	Missoula
American Welding & Gas	204 Commerce Street	Missoula
Amerigas (Charlo)	2610 Charlo street	Missoula
Amerigas (Raser RD)	2900 Raser Rd.	Missoula
Amerigas (Seeley)	2823 MT-83	Seeley lake
AT&T - MT3210	FT6W-HLNAMTMA	Potomac
AT&T - MT3260	7050 Grant Creek Rd	Missoula
AT&T Corp. - MTA027	2398 Coal Mine Road	Missoula
Bonneville Power Admin - Miller Peak	Closest town - Missoula	Missoula
Bresnan Communications, LLC	924 South 3rd Street West	Missoula
Bresnan Communications, LLC	Point Six Communications Site	Missoula
CHS Inc. - Missoula Propane Plant-Energy Partners	25 Raser Drive	Missoula
CHS Inc. - Seeley Lake Propane-Energy Partners	3240 Highway 83 N.	Seeley Lake

Table 4.3-4. Missoula County Tier II Hazardous Material Reporters

Facility Name	Address	City
CHS Inc. - Mountain West Cooperative - Missoula	4570 N. Reserve St.	Missoula
CHS, Inc. - Missoula Terminal	3576 Grant Creek Rd	Missoula
Coca-Cola High Country - Missoula	2010 S 3rd St W	Missoula
Costco Wholesale (67)	3220 North Reserve Street	Missoula
Daily's Premium Meats LLC	2900 Mullan Road	Missoula
DAL Global Services, LLC - MSO	5225 Highway 10 West	Missoula
Emerald Services, Inc. - Missoula	900 Phillips Street	Missoula
Everlast Climbing Industries, Inc. dba Spectrum Products	7100 Spectrum Ln	Missoula
Ferrellgas - Missoula	9201 Inspiration Dr.	Missoula
Frenchtown CenturyLink	16812 Mullan Rd	Frenchtown
Hexion Inc.	3670 Grant Creek	Missoula
Horizon Air - Missoula International Airport	5225 Hwy 10 West	Missoula
Knife River - Missoula	4800 Wilke Rd	Missoula
L. S. Jensen Construction & Ready Mix	4685 Mullan Road	Missoula
Lafarge Missoula Terminal	6529 Desmet Rd	Missoula
Lolo CenturyLink	11455 US Highway 93 S	Lolo
Lowe's Of Missoula, MT (Store #1682)	3100 North Reserve Street	Missoula
Missoula	3760 N. Reserve St.	Missoula
Missoula Bishops' Storehouse	6200 Industrial Way	Missoula
Missoula Main Central Office CenturyLink	201 N Pattee St.	Missoula
Missoula South CenturyLink	2430 39th St	Missoula
Mountain Water Company	1345 W Broadway	Missoula
National Weather Service	11098 Point Six Rd.	Missoula
Northern Energy (AmeriGas)	3301 Broadway	Missoula
NorthWestern Energy - Missoula Service Center	1801 S Russell	Missoula
Pacific Recycling - #5	2600 Latimer	Missoula
Pacific Steel - #7	2828 Palmer	Missoula
Phillips 66 Missoula Product Terminal	3330 Raser Drive	Missoula
Republic Services of Montana - Missoula Hauling	1501 Rodgers Street	Missoula
Republic Services of Montana.- Missoula Recycling Center	3207 West Broadway	Missoula
Roseburg Forest Products	3300 Raser Dr.	Missoula
Sprint Missoula, MT POP	2515 West Railroad Street	Missoula
TA Missoula	8018 U.S. Hwy 93 N.	Missoula
Thatcher Company of Montana	3200 Raser Drive	Missoula
The Home Depot Store #3102	2725 Radio Way	Missoula
United States Postal Service	1100 W Kent	Missoula
UPS Missoula	221 Expressway Lane	Missoula
Verizon Wireless East Missoula	1086 Tamarack Rd.	East Missoula
Verizon Wireless Linda Vista	2701 Loraine Drive	Missoula
Verizon Wireless Playfair	1101 W. South Ave.	Missoula
Verizon Wireless Seeley Lake	Section 35, T16N, R15W	Seeley Lake
Verizon Wireless UofM Grizzly	32 Campus Drive	Missoula
Zayo Missoula MT-MSS	215 Market St.	Missoula
Zayo Missoula MT-11E	110 E Broadway St.	Missoula

Source: Missoula County OEM, 2016

Vulnerability and Area of Impact

Transportation of hazardous materials through Missoula County on highways, pipelines, and by the railroads could result in an accident or derailment that would have the potential to impact Missoula County residents. Large quantities of industrial chemicals and petroleum products are stored in various locations throughout the county.

The volume and type of hazardous materials that flow into, are stored, and flow through communities will determine exposure to a potential release of hazardous materials. An accidental or intentional release of materials could produce a health hazard to those in the immediate area, downwind, and/or downstream. Some hazardous materials occur in the gaseous phase and are denser than air; therefore, having the potential to collect in low places. The Missoula Valley is subject to strong air inversions during the winter where air gets trapped and air pollution builds-up. Fumes from a hazardous material incident could impact air quality and public health for an extended period until the inversion lifts allowing gases to escape.

The Missoula aquifer is the sole source of drinking water for more than 40,000 households in the Missoula Valley. It runs from Milltown to Frenchtown and to Lolo and in some places it's no deeper than 40 feet below the surface. The shallow depth of the aquifer makes it very susceptible to contamination. As such, Missoula's drinking water supply is vulnerable from hazardous material spills.

The U.S. Department of Transportation issued an emergency restriction order on May 7, 2014 that requires railroad carriers to identify to the State Emergency Response Commission through which counties Bakken crude oil is being transported. The notification provides information regarding the estimated volumes and frequencies of train traffic per week and describes the petroleum crude oil expected to be transported and applicable emergency response information. MT DES forwards copies of the notifications to county emergency managers for their information and dissemination. There has been an increase in oil trains through Missoula County since the last PDM Plan was completed in 2011. However, MRL reports that there are only a few oil trains per month through Missoula now that Bakken oil production has slowed dramatically.

The Missoula County Health Department responds to hazardous materials incidents and other public/environmental health emergencies. At the PDM Public Meeting, they emphasized that limiting the speed of rail cars through vulnerable sections of the county (near water ways and dense populations) would decrease the community's risk to hazardous material disasters.

Probability and Magnitude

To model the spatial distribution of hazardous material incident risk a GIS data layer of transportation arteries was used, which included highways, major roadways, and railroads. TRI and Tier II facilities were added to this layer and it was then buffered by 0.25 miles. **Figures 6 and 6A** presents the hazardous material buffer in Missoula County and the City of Missoula, respectively, and show the vulnerability of critical facilities to hazardous material incidents. Building exposure was calculated by intersecting the hazardous material buffer with the MDOR parcel and critical facility GIS layers. Population exposure was calculated by intersecting the hazardous material buffer with census block data. **Table 4.3-5** presents the results of the vulnerability assessment.

Table 4.3-5. Missoula County Vulnerability Analysis; Hazardous Material Incidents & Railroad Derailments

Category	Missoula County (balance)	City of Missoula	Missoula County Total
Residential Property Exposure $	$738,180,278	$919,654,514	$1,657,834,792
# Residences At Risk	4,695	6,693	11,388
Commercial, Industrial & Agricultural Property	$345,246,995	$1,433,041,603	$1,778,288,598
# Commercial, Industrial & Agricultural	785	2,421	3,206
Critical Facilities Exposure Risk $	$77,310,241	$713,384,970	$790,695,211
# Critical Facilities At Risk	49	49	98
Bridge Exposure $	$90,617,975	$38,404,450	$129,022,425
# Bridges At Risk	83	29	112
Persons At Risk	22,597	43,480	66,077
Persons Under 18 At Risk	5,527	6,891	12,418

The GIS analysis indicates that there are over 80,562 acres in Missoula County in the hazardous material buffer (4.8 percent) including 11,388 residences, 3,206 commercial, industrial and agricultural buildings, and 98 critical facilities. The Hazardous Material Incident Section in **Appendix C** lists the critical facilities and bridges within the hazardous material transportation buffer.

According to the U.S. Department of Transportation, Office of Hazardous Materials Safety, Missoula County has had numerous hazardous material releases with reported damages in the past 25 years, as shown in **Table 4.3-6.**

Table 4.3-6. Missoula County Hazardous Material Incidents with Damages

Date	Location	Carrier	Quantity Released	Commodity Released	Damages	Mode of Transport
1/21/1991	Missoula	Van Waters & Rogers	0.12 gal	Tetrachloroethylene	$200	Highway
11/4/1991	Missoula	YRC Inc.	1 gal	Cleaning Liquid	$350	Highway
1/7/1993	Missoula	Consolidated Freightways	0.01 gal	Formaldehyde Solution	$10	Highway
2/17/1993	Missoula	Con-Way Properties Inc.	0.75 gal	Corrosive Liquids	$22	Highway
11/18/1994	Missoula	Roadway Express Inc.	0.50 gal	1 1 1-Trichloroethane	$32	Highway
12/9/1994	Clinton	JGL Distributing Inc.	3,700 gal	Gasoline	$49,700	Highway
4/19/1995	Missoula	YRC Inc.	40 gal	Cleaning Liquid	$2,400	Highway
10/16/1996	Missoula	Fleet Transport Co. Inc.	30 gal	Regulated Substance	$350	Highway
7/10/1997	Missoula	Arrow Transportation	15 gal	Sodium Hydroxide	$25	Highway
8/21/1997	Missoula	Nationsway Transport	5 gal	Corrosive Liquid	$600	Highway
6/22/1999	Missoula	Fedex Ground	0.25 gal	Hypochlorite Solution	$125	Highway
9/8/1999	Missoula	Thatcher Company	300 gal	Hypochlorite Solutions	$195	Highway
11/30/2000	Lolo	Rodney C Frank	1,500 gal	Liquefied Petroleum Gas	$1,202	Highway
4/21/2003	Missoula	Airborne Express	0.79 gal	Isopropyl Alcohol	$75	Highway
10/13/2003	Missoula	Fedex Ground	1 gal	Hydrochloric Acid	$525	Highway
10/20/2003	Missoula	Fedex Ground	1 gal	Hydrochloric Acid	$525	Highway
6/18/2006	Missoula	Montana Rail Link Inc.	13,063 gal	Alcohol	$414,858	Rail
7/18/2006	Missoula	Fedex Freight	0.50 gal	Paint Related Material	$1,531	Highway
8/10/2008	Milltown	XPO Enterprise Services	40 gal	Printing Ink	$6,000	Highway
11/17/2009	Missoula	USF Reddaway Inc.	10 gal	Corrosive Liquid	$570	Highway
6/9/2015	Missoula	Sorco Inc.	12 gal	Gasoline	$4,036	Highway
TOTAL					**$483,331**	

Source: U.S. Dept. Transportation, 2016; https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/IncrSearch.aspx
Notes: gal = gallon

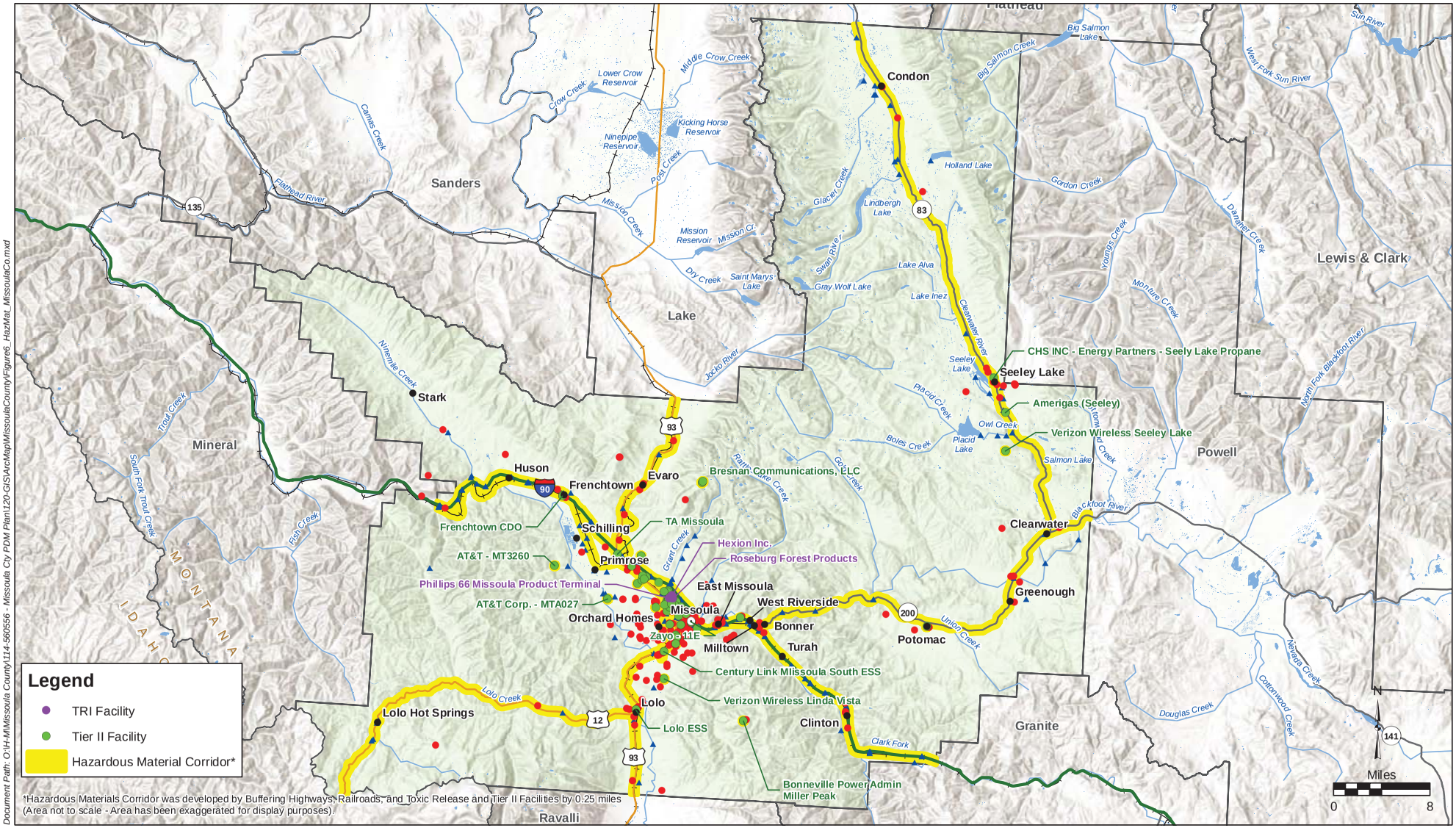
The history of hazardous material events in Missoula County indicates that over 70 incidents have occurred in the past 20 years. During this period, there were 22 railroad accidents involving 279 railcars carrying hazardous materials of which 59 were damaged during the derailment. Therefore, the probability of future events is rated as "highly likely". The magnitude of any hazardous material event would depend on the amount and material spilled.

Future Development

Missoula County has no land use regulations that specifically restricts building around industrial facilities or along transportation routes or in the vicinity of facilities that store large quantities of hazardous materials or petroleum products. However, impacts to public health and safety are considered for all new subdivisions.

Climate Change

Neither hazardous material incidents nor railroad derailments are expected to increase as a result of climate change. No increase in exposure or vulnerability to the population, property, or critical facilities are expected to occur.



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCountyFigure6_HazMat_MissoulaCo.mxd

Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Date: 12/3/2016

Legend

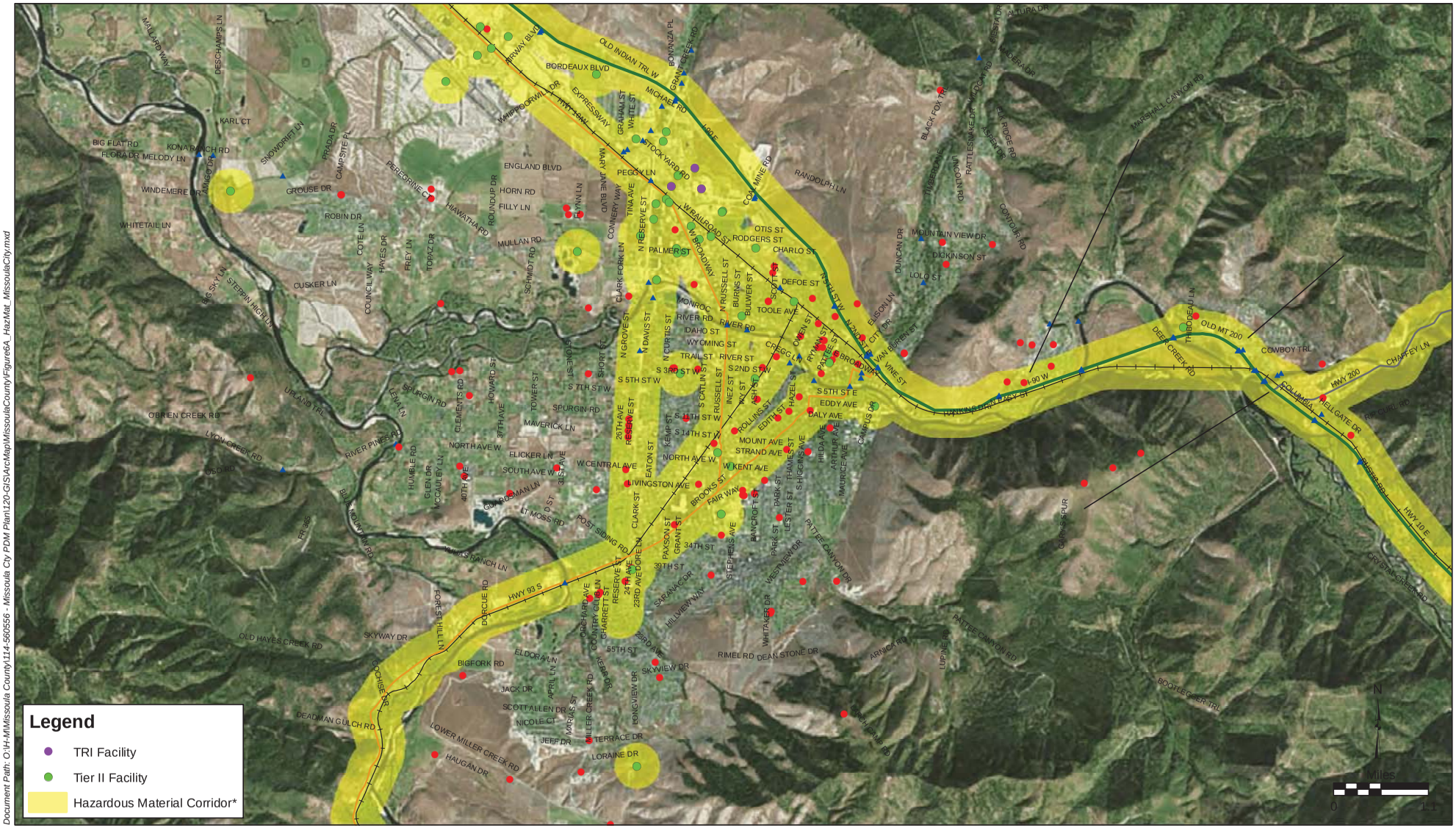
- Place
- County Seat
- Critical Facility
- Bridge
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Figure 6

Hazardous Material & Railroad Transportation Buffer

Missoula County, Montana

Pre-Disaster Mitigation Plan



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCountyFigure6A_HazMat_MissoulaCity.mxd

*Hazardous Materials Corridor was developed by Buffering Highways, Railroads, and Toxic Release and Tier II Facilities by 0.25 miles
(Area not to scale - Area has been exaggerated for display purposes).

Legend

- Critical Facility
- Bridge
- Interstate
- U.S. Highway
- Montana Highway
- Railroad

Date: 11/23/2016

Figure 6A

Hazardous Material & Railroad Transportation Buffer

City of Missoula, Montana

Pre-Disaster Mitigation Plan

4.4 Flooding

CPRI SCORE = 2.65

Description and History

A flood is a natural event for rivers and streams. Excess water from snowmelt and rainfall accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers and lakes that are subject to recurring floods. A flash flood generally results from a torrential (short duration) rain or cloudburst on a relatively small drainage area. Ice jam flooding occurs when pieces of floating ice carried by the streams accumulate and create an obstruction to the stream. The water held back can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can then occur downstream as well. Ice jams can be problematic on the Clark Fork and Blackfoot Rivers. Flash floods have the potential to occur, especially after a wildfire. Dam failure flooding is included as a separate hazard profile in *Section 4.9*.

It is estimated that flooding causes 90 percent of all property losses from natural disasters in the United States and kill an average of 150 people a year nationwide. Most injuries and deaths occur when people are swept away by flood currents and most property damage results from inundation by sediment-laden water. Faster moving floodwater can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can cause extensive damage to the structure and systems of a building.

Warming periods, which may be accompanied by rainfall, cause tributaries to swell rapidly. The resulting flood flows may be localized or basin-wide and may last from hours to several days depending on temperature, amount of rainfall, soil moisture content, and soil permeability.

The National Weather Service provides short-term forecasts and warnings of hazardous weather by producing regularly-scheduled severe weather outlooks and updates on various forms of hazardous weather including heavy rain and flooding. A "watch" is issued when conditions are favorable for severe weather in or near the watch area. A "warning" is issued when the severe weather event is imminent or occurring in the warned area. Warning and Advisory Criteria for flooding is presented in **Table 4.4-1.**

Table 4.4-1. Warning and Advisory Criteria for Flooding

Flooding	Warning Description
Flash Flood Watch	Issued when conditions are favorable for flash flooding. It does not mean that flash flooding will occur, but it is possible
Flash Flood Warning	Flash flooding is imminent, water levels rise rapidly with inundation occurring in less than 6 hours.
Flood Watch	Issues when conditions are favorable for flooding. It does not mean flooding will occur, but it is possible.
Flood Warning	Flooding is expected to occur more than 6 hours after the causative event.

Source: National Weather Service, 2016

FEMA published a Flood Insurance Study for Missoula County in 2015 which discusses historic flooding in the county, as summarized below.

Flooding along the Clark Fork drainage generally occurs in May and June as the winter snow accumulation in the higher elevations begins to melt. In addition to the stream flooding, shallow flooding may also occur because of a high ground-water table and the impounding of runoff water in low areas with poor drainage. This is particularly the case in the low-lying areas along the Bitterroot and Clark Fork Rivers. Winter flooding due to ice jams has also occurred in isolated areas, especially on the Blackfoot River and the Clark Fork River above the confluence with the Blackfoot.

The largest flood event known to occur in Missoula County was in May and June of 1908, and it involved nearly every major stream and river. Although gage records are few, newspaper accounts describe extremely high river stages that washed away houses, roads, and bridges and disrupted travel and communications for several weeks throughout the county. This great flood, caused by unseasonably warm temperatures combined with 33 consecutive days of rain, had an estimated peak flow for Clark Fork above Missoula of 48,000 cubic feet per second (cfs) at the former Milltown Dam, slightly greater than the 1-percent annual chance event.

There have been several other years when flooding has occurred in the county, but it was not as widespread as the 1908 event. More commonly, one of the major streams floods; and other streams remain at near normal levels. The June 1974 flooding along Bitterroot River was estimated at 29,000 cfs (the 2-percent annual chance frequency), but the Clark Fork River flow above Missoula was less than the 5-percent annual chance frequency. Likewise, flows for June 1964 and June 1975 were among the highest ever gaged on the Clark Fork River above Missoula, but simultaneous flows on the Bitterroot River did not approach significant flood magnitudes.

Rock Creek near Clinton has had two floods in recent years; one on June 20, 1975, recorded at 5,520 cfs and one in June 1972 that reached a peak of 6,500 cfs. Both are of an approximate 10-percent annual chance recurrence interval. Local residents reported a flood in 1927 that recorded a stage of approximately 9.5 feet and an approximate flow of 8,000 cfs, which is approximately a 2-percent annual chance event. The maximum flows ever recorded for Rattlesnake Creek were in June 1948 and June 1974. The 1974 event caused bank erosion but very little property damage in Greenough Park in Missoula.

In 1997, snowmelt flooding caused numerous road closures and road washouts throughout the county. At least four bridges were damaged, including a collapsed bridge on Sun Ray Lane in Lolo. Hardest hit was property along the Clark Fork, Grant Creek, Lolo Creek and Rock Creeks. Several culverts and dikes were damaged.

Flooding in the South Hills area near Missoula has occurred along Pattee Creek (May, 1980); in the Wapikiya Subdivision (December 1964); along Briggs Street (December 1967, March 1976, and February 1986) and in Moose Can Gully and along the adjacent lowland area where the Gully losses its defined flowpath (March 1976 and February 1986). Other areas that have occasionally experienced flooding are the Pattee Creek Market building and parking lot along Southwest Higgins and a relatively low area near Briggs, Cardinal, and Gharrett Streets. During 2003, the City of Missoula completed a new flood control project for Pattee Creek and South Hills area run-off. The project constructed new water storage basins, and removed numerous homeowners from the 100-year floodplain.

Ice jam flooding occurred on the Clark Fork and Blackfoot Rivers in February 2006. An extended period of severely cold weather created thick ice jams, followed by rapid warming temperatures with rainfall that melted low-elevation snow pack. The ice jam on the Blackfoot River was 12 miles in length and caused the closure of Hwy 200. One home had major damage and five homes had minor damage in Bonner. Other areas of the County impacted included: ice jams on Lolo Creek causing flooding and evacuation of several trailer parks; flooding of homes and I-90 east of Clinton; and, flooding and bridge damage in the Ninemile area (Atkins, 2011).

Missoula County has had five federal disaster declarations due to flooding, as listed in **Table 4.4-2**. Statewide flood emergencies were declared in 1978, 1981, 1984, 1986, 1997, 1998, 2003 and 2013 (DMA, 2016).

Table 4.4-2. Federal Disaster Declarations for Flooding

Year	Event	FEMA Disaster No.	Details
1974	Flood	FEMA-??-DR-MT	Missoula County and 6 other counties hit by flood waters which caused approximately $16 million in damage to Forest Service roads, bridges, facilities, and private property. The same counties suffered flood-related losses again in June 1975, totaling nearly $35 million
1981	Flood	FEMA-640-DR-MT	Missoula County and nine other counties hit by flooding resulting in over $4.3 million in $1.8 million in damages.
1996	Flood	FEMA-1105-DR-MT	Missoula County and 13 other counties hit by flooding resulting in over $4.3 million in damages.
1997	Flood	FEMA-1183-DR-MT	Flood-related damages for Missoula and 20 other counties was over $5.7 million.
2011	Flood	FEMA-1996-DR-MT	Missoula County and 30 other Montana counties and four reservations received over $62 million in flood-related damages.

Vulnerability and Area of Impact

Winter and spring snow accumulation and subsequent spring snowmelt runoff can cause high river flows in the Missoula Valley. Flooding can occur due to overland flow, when excessive groundwater fills the aquifer and surfaces, when stream channels erode their banks, and when ice jams break, releasing a surge of water that causes flooding downstream. Missoula County adopted new floodplain maps in 2015 which indicate areas of the county vulnerable to flooding.

Many of Montana's bridges have been compromised by scour associated with flooding. Scour is the hole left behind when sediment (sand and rocks) is washed away from the bottom of a river. Although scour may occur at any time, scour action is especially strong during floods. Swiftly flowing water has more energy than calm water to lift and carry sediment down river. The Montana Department of Transportation (MDT) has identified the following bridges in Missoula County as having critical scour conditions with bridge foundations unstable:

- Clark Fork River bridge at Schwartz Creek Road
- Clearwater River bridge at Boy Scout Road
- Swan River bridge at Cold Creek Road.

There is an increased risk of flash flooding and debris flows in areas of steep terrain in Missoula County burned by wildfire. Rainfall that would normally be absorbed will run off extremely quickly after a wildfire, as burned soil can be as water repellant as pavement. As a result, much less rainfall is required to produce a flash flood. As water runs downhill through burned areas it can create major

erosion and pick up large amounts of ash, sand, silt, rocks and burned vegetation. The force of the rushing water and debris can damage or destroy culverts, bridges, roadways, and buildings even miles away from the burned area. Most burn areas will be prone to flash flooding and debris flows for at least 2 years after the fire (DES, 2013).

Flood Protection Measures

Numerous flood protection measures exist throughout Missoula County including certified and uncertified levees, dikes, berms, and embankments. Flood protection measures in Missoula County, as described in the 2015 FEMA Flood Insurance Study, are presented below.

Minimum flood protection measures along the Bitterroot River consist of an earthfill dike in the vicinity of a housing development near the Lolo sewage-treatment plant. However, this dike was partially washed away in the 1975 flooding. Railroad and highway fills form artificial constraints to overbank flows in a few areas near Missoula, but they were not intended to provide flood protection.

Flood protection measures on the Clark Fork River consist of the following:

- A system of dikes around the settling ponds at the former Stone Container paper mill northwest of Missoula.
- A certified levee along the south bank in the Orchard Homes neighborhood west of Missoula.
- Bank shaping and rock riprap stabilization in the areas of the Reserve Street Bridge west of the City of Missoula.
- A certified levee on the north bank of the Clark Fork within the city limits from Madison Street to Orange Street.
- A certified levee on the north bank of the Clark Fork within the city limits from the California Pedestrian Bridge to Russell Street.

There are other isolated sections of rock riprap, but they are not of major significance. Railroad and highway embankments have resulted in some channel realignments in some areas, particularly from east of Milltown to Clinton, but they were not intended as flood-control measures.

There are no flood-control measures on the Clearwater River. The numerous lakes in the drainage system of the Clearwater River Valley provide some natural storage at times of high flow.

An approximately 3,000 foot long certified levee on the west bank of Grant Creek within city limits was constructed north of I-90. This levee was approved in a Letter of Map Revision (LOMR) and protects the Cottonwood condominiums and the Rocky Mountain Elk Foundation from the 100-year flood event.

A non-certified earthfill dike has been constructed on the north bank of Lolo Creek immediately downstream of the Burlington Northern Railroad Bridge, affording minor protection to a number of houses in the area. Other small dikes and riprap sections exist, but they are of little significance in flood protection or control. Highway fills form artificial constraints to overbank flows in a few areas upstream on Lolo Creek, but they were not intended to provide flood protection.

There are virtually no flood protection measures along Rattlesnake Creek. Rock walls, built many years ago, provide bank stabilization near the downstream end of Greenough Park.

The 2004 South Missoula Storm Drainage Project provides protection for 100-year flood event for the South Hills neighborhood.

Floodplain and Floodway Management

The National Flood Insurance Program (NFIP) encourages local governments to adopt "sound" floodplain management programs to reduce private and public property losses due to floods. Missoula County and the City of Missoula participate in the NFIP. **Table 4.4-3** presents statistics on flood insurance policies and losses.

Table 4.4-3. National Flood Insurance Program Statistics (through 8/31/2016)

Jurisdictions	Policies in Force	Insurance in Force	Number of Losses	Total Payments
Missoula County	230	$ 48,541,300	106	$539,074
City of Missoula	59	$ 17,553,500	26	$53,191

Source: FEMA, 2016. http://bsa.nfipstat.fema.gov/reports/1011.htm#MTT; http://bsa.nfipstat.fema.gov/reports/1040.htm#30

Many of the flood prone areas in Missoula County are covered by Flood Insurance Rate Maps (FIRMs), developed by FEMA. These maps show areas of 100-year Special Flood Hazard Areas, commonly referred to as 100-year floodplains in the County. New digital Flood Insurance Rate Maps (DFIRMs) were adopted in 2015 for Missoula County and the City of Missoula. These new maps were the result of several years of work by FEMA, Montana DNRC, Missoula County and the City of Missoula to document local floodplains. Light Detection and Ranging (LiDAR) was used to obtain high-resolution digital topographic data for portions of the Clark Fork, Blackfoot and Bitterroot Rivers and smaller streams including Grant, LaValle, Lolo, Rattlesnake and Rock Creeks. The advanced topographic data included 2-foot contours resulting in more accurate mapping and identification of 100-year flood elevations. These maps comprise the flood hazard map, shown in **Figures 7 through 7B**, which were used in the PDM analysis.

According to DNRC, there are five repetitive loss properties (RLP) in Missoula County and one RLP within the Missoula City limits that has been mitigated. A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978. There are no severe repetitive loss properties in Missoula County. Severe repetitive loss properties have had at least four NFIP claim payments over $5,000 each and the cumulative amount exceeding $20,000; or, where at least two separate claim payments have been made with the cumulative amount exceeding the market value of the building.

The NFIP's Community Rating System (CRS) recognizes community efforts (beyond minimum standards) by reducing flood insurance premiums for the community's property owners. CRS discounts on flood insurance premiums range from 5 percent up to 45 percent. Those discounts provide an incentive for new flood protection activities that can help save lives and property in the event of a flood. To participate in the CRS, a community can choose to undertake some of the 18 public information and floodplain management activities. Based on the total number of points a community earns, the CRS assigns you to one of ten classes. Your discount on flood insurance premiums is based on your class. Both Missoula County and the City of Missoula participate in the CRS and have a rating of 8 which entitles NFIP policy holders to a 10 percent discount in flood insurance rates.

Probability and Magnitude

Flood listings with associated property damage from the SHELDUS database and Montana DES database of State and Federal disaster declarations are presented in **Table 4.4-4**.

Table 4.4-4. Missoula County Flood Events with Damages

Date	Injuries	Fatalities	Property Damage (2016 $)	Crop Damage (2016 $)	Remarks
3/31/1969	0	0	$5,752	$0	Flooding
2/28/1986	0.04	0.04	$4,391	$0	Flooding
2/7-11/1996	0	0	$1,128,510	$0	Flooding
3/11/1996	0	0	$2,000,359	$0	Flood
6/4/1996	0	2	$0	$0	Flooding
5/1/1997	0	0	$1,092,0663	$0	Flooding
6/11/2011	0	0	$42,932	$0	Flooding
6/18/2011	0	0	$42,793	$0	Flooding
TOTAL	**0.04**	**2.04**	**$14,145,400**	**$0**	

Source: SHELDUS, 2016 (adjusted to 2016 dollars); NCDC, 2016

The flood hazard map used for the PDM analysis is shown on **Figures 7 through 7B**. Using GIS, the flood hazard area was intersected with the critical facility database and NRIS structures shapefile which was linked to the MDOR cadastral database for building values (**Table 4.4-5**). Vulnerable population was calculated using the NRIS structures shapefile and estimates by the U.S. Census that 2.35 individuals reside in each structure, 22.5 percent of whom are under age 18.

Table 4.4-5. Missoula County Vulnerability Analysis; Flooding (100-Year Floodplain)

Category	Missoula County (balance)	City of Missoula	Missoula County Total
Residential Property Exposure $	$51,792,145	$14,006,703	$65,798,848
# Residences At Risk	337	25	362
Commercial, Industrial & Agricultural Property	$1,510,380	$735,150	$2,245,530
# Commercial, Industrial & Agricultural	31	4	35
Critical Facilities Exposure Risk $	$1,987,434	$0	$1,987,434
# Critical Facilities At Risk	3	0	3
Bridge Exposure $	$73,252,344	$20,241,339	$93,493,683
# Bridges At Risk	46	16	62
Persons At Risk	614	46	660
Persons Under 18 At Risk	178	13	191

The GIS analysis indicates that about 30,451 acres in Missoula County (1.8 percent) are located within the 100-year flood hazard area including parcels with: 362 residences, 35 commercial, industrial and agricultural buildings, and 3 critical facilities. The *Flood* section in **Appendix C** presents supporting documentation from the risk assessment including the critical facilities and bridges located in the 100-year flood hazard area.

Based on the frequency of past events, the probability of flooding in Missoula County is rated as "likely"; an event that occurs more than once per decade but not every years.

Future Development

Missoula County and the City of Missoula have Floodplain and Floodway Management Ordinances to comply with the Montana Floodplain and Floodway Management Act and to ensure compliance with requirements for continued participation in the NFIP. These regulations basically preclude new structural development within areas classified as designated floodways under state law. The Missoula County Subdivision Regulations establish waterbody setbacks and buffer areas throughout the county. Building in the 100-year floodplain requires a permit that stipulates buildings to be elevated two feet above the base flood elevation with no basements. There are no restrictions for building in the 500-year floodplain.

According to the Missoula County Growth Policy (2016), the number of structures in Missoula County impacted by a 100-year flood should not substantially increase. Amendments to floodplain and subdivision regulations will reduce the potential for additional structures in flood hazard areas. The county is also working on identifying floodplains on unmapped streams, conducting additional channel migration mapping, and ensuring that reconstruction of existing buildings meets floodplain regulations.

Missoula County has completed channel migration zone mapping for a limited stretch of the Clark Fork River, which can help the public and policy makers better understand river movement and predict where the river may move in the future. Missoula County and landowners can use this information to help prevent costly and potentially catastrophic damage to private property and public infrastructure.

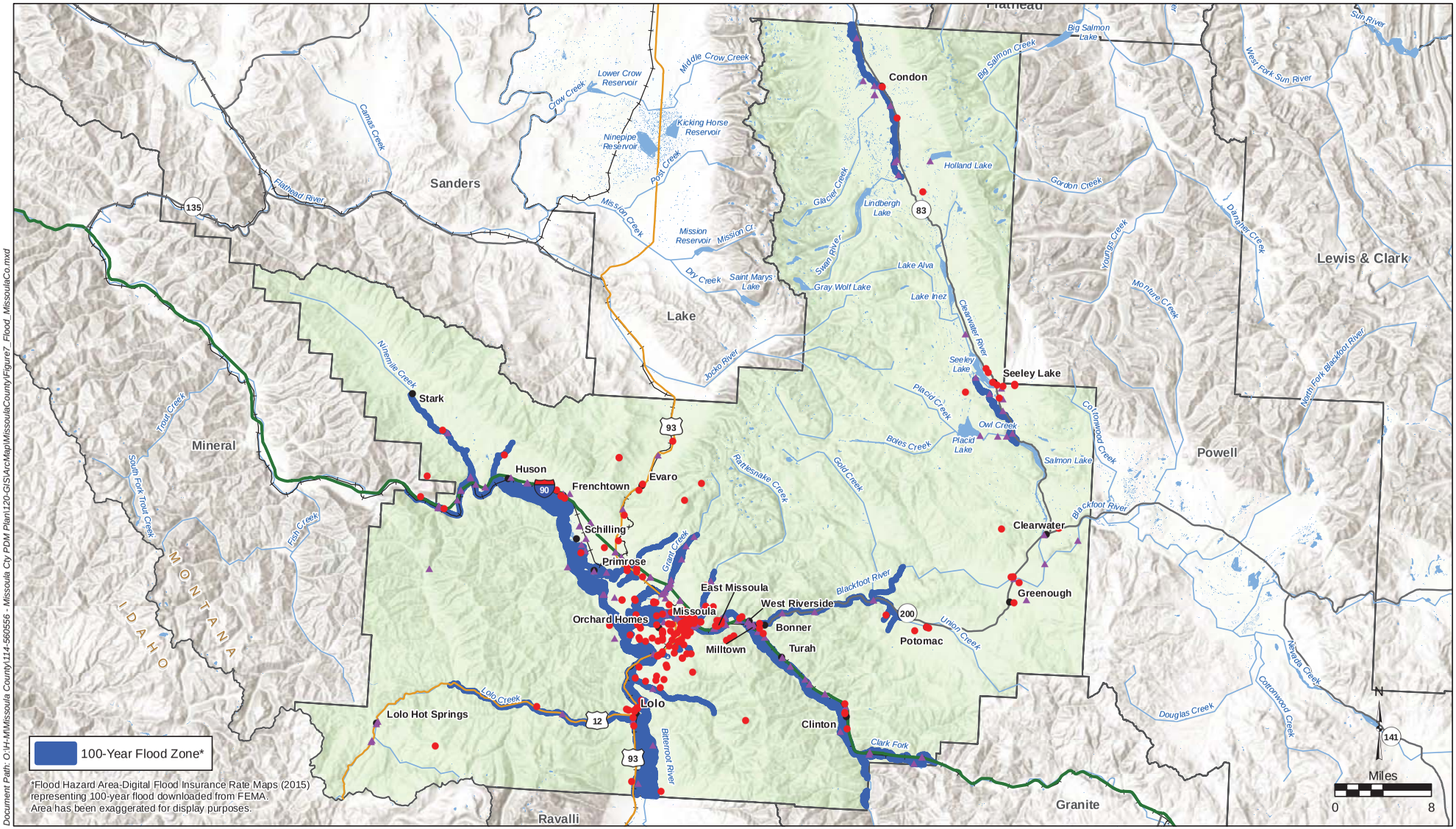
Climate Change

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas to contribute to peak storm runoff. High frequency flood events (e.g. 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 1-percent-annual-chance (100-year flood) may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local sewers and storm drains.

Population, property, and critical facility exposure and vulnerability may increase as a result of climate change impacts to the flood hazard. Runoff patterns may change resulting in flooding in areas where it has not previously occurred with an increased risk to facilities that have not historically flooded. Additionally, changes in the management and design of flood protection for critical facilities may be needed as additional stress is placed on these systems.



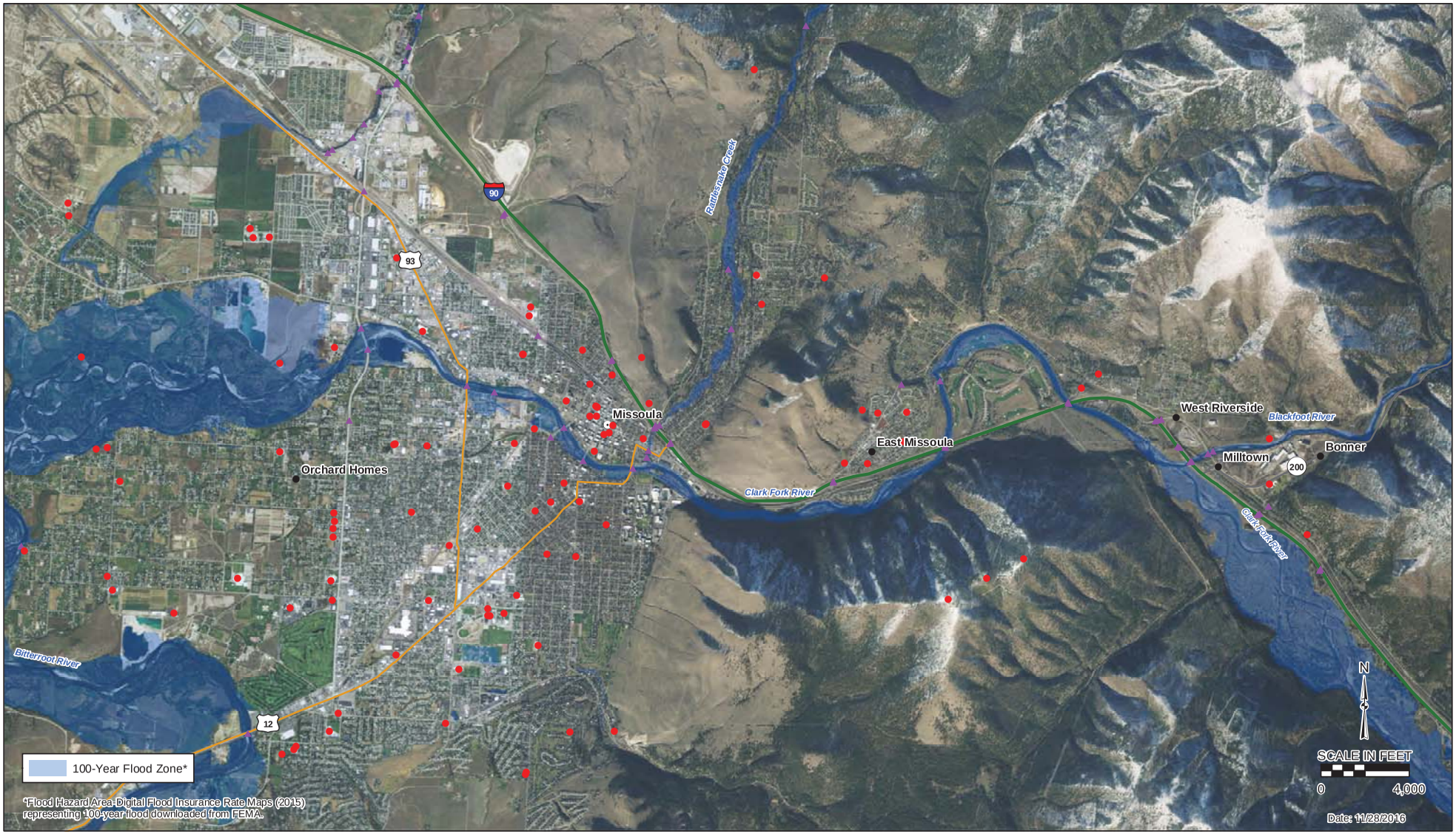
Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCountyFigure7_Flood_MissoulaCo.mxd

Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Figure 7
Flood Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCountyFigure7A_FloodMissoulaCo_Missoula.mxd

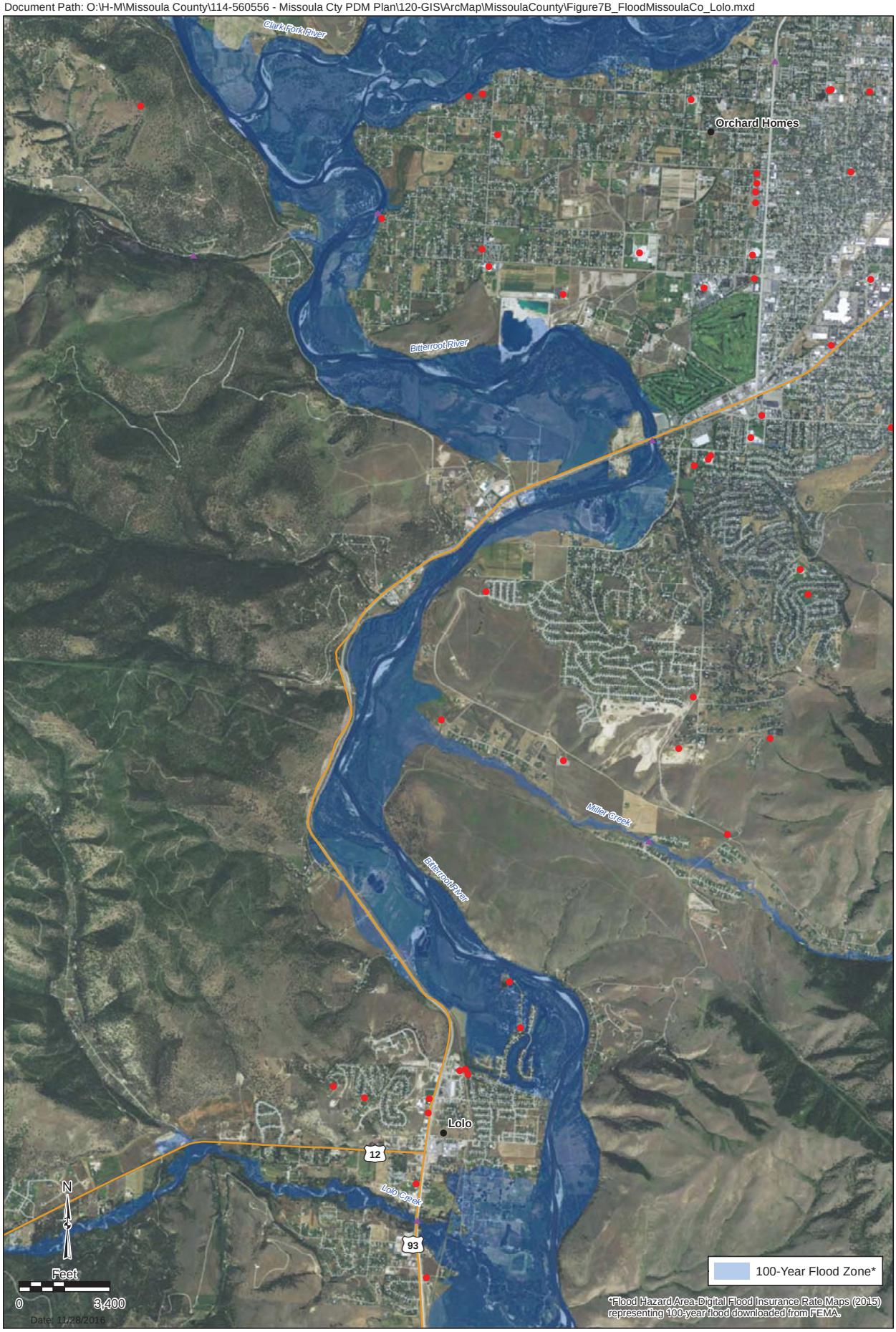
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Critical Facility
- Bridge

Figure 7A
Missoula East
Flood Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan

Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCounty\Figure7B_FloodMissoulaCo_Lolo.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Critical Facility
- Bridge

Figure 7B
Lolo to Missoula West
Flood Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan

4.5 Severe Weather and Drought

CPRI SCORES
SEVERE SUMMER WEATHER = 2.65
SEVERE WINTER WEATHER = 2.75
DROUGHT = 2.5

Description and History

Severe weather hazards have become more significant in recent years due to climate change. Natural resource trends indicate the mean annual precipitation has been below average and the mean annual temperatures have been above average for the past five years. Severe storms are not common; however, thunderstorms, hailstorms, high winds, heavy snow, freezing rain and sleet do occur. Available wind information indicates wind gusts exceeding 60 mph are not uncommon. The trend of variable weather conditions is expected to continue.

The winter weather hazard includes several weather conditions that occur from late fall through early spring in Missoula County (November through April). Snow, blizzards, extended cold and high winds frequently occur together but also occur independent of one another during these months. Severe summer weather includes thunderstorms, wind, hail, lightning, tornadoes, and microbursts that typically occur between May and October of each year. Drought is a consequence of severe weather. Further details on these severe weather hazards are profiled below.

Severe Winter Weather

Winter storms and blizzards follow a seasonal pattern that begins in late fall and lasts until early spring. These storms have the potential to destroy property, and kill livestock and people. Winter storms may be categorized as sleet, ice storms or freezing rain, heavy snowfall or blizzards, and low temperatures. Blizzards are most commonly connected with blowing snow and low visibility. Winter also brings sustained straight line winds that can be well over 50 mph. Avalanches have occurred in Missoula County and are profiled separately in *Section 4.7*.

A severe winter storm is generally a prolonged event involving snow or ice and extreme cold. The characteristics of severe winter storms are determined by the amount and extent of snow or ice, air temperature, wind speed, and event duration. Severe winter storms create conditions that disrupt essential regional systems such as public utilities, telecommunications, and transportation routes.

A combination of temperatures to 30 below zero and high winds can close roads, threaten disruption of utilities, limit access to rural homes, impede emergency services delivery and close businesses. Such storms also create hazardous travel conditions, which can lead to increased vehicular accidents and threaten air traffic. Additionally, motorists stranded due to closed roads and highways may present a shelter problem.

The National Weather Service provides short-term forecasts of hazardous weather to the public by producing regularly-scheduled severe weather outlooks and updates on various forms of hazardous weather including blizzards and wind chill. Warning and Advisory Criteria for winter weather is presented in **Table 4.5-1**.

Table 4.5-1. Warning and Advisory Criteria for Severe Winter Weather

Winter Weather	Weather Advisory
Winter Storm Watch	Issued to give the public 12-48 hours of advance notice of the potential for snow 6 inches or more in 12 hours or 8 inches or more in 24 hours AND sustained or frequent wind gusts of 25 – 34 mph occasionally reducing visibilities to ¼ mile or less for three hours or more.

Table 4.5-1. Warning and Advisory Criteria for Severe Winter Weather

Winter Weather	Weather Advisory
Winter Weather Advisory	Issued when a combination of winter weather elements that may cause significant inconvenie nces are occurring, imminent, or have a high probability of occurring.
Winter Storm Warning	Issued when snow 6 inches or more in 12 hours or 8 inches or more in 24 hours AND sustained or frequent wind gusts of 25-34 mph occasionally reducing visibilities to ¼ mile or less for three hours or more are occurring, imminent, or have a high probability of occurring.
Blizzard Watch	Issued to give the public 12-48 hours of advance notice of possible blizzard conditions (sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling and/or blowing snow for 3 hours or more).
Blowing Snow Advisory	Issued for visibilities intermittently at or below ½ mile because of blowing snow.
Blizzard Warning	Issued when blizzard conditions (sustained winds or frequent gusts of 35mph or greater and visibilities of less than a quarter mile from falling and/or blowing snow for 3 hours or more) are occurring, imminent, or have a high probability of occurring.
Freezing Rain Advisory	Issued when an accumulation of ice will make roads and sidewalks slippery, but significant and damaging accumulations of ice are not expected.
Ice Storm Warning	Issued when a significant and damaging accumulation of ice is occurring, imminent or has a high probability of occurring.
Snow Advisory	Issued when snow accumulations of 2-5 inches in 12 hours are expected.
Sleet Advisory	Issued when sleet accumulations causing hazardous conditions are expected.
Heavy Snow Warning	Issued when snow accumulations of 6 inches or more in 12 hours or 8 inches or more in 24 hours are expected.
Wind Chill Watch	Issued to give the public 12-48 hours advanced notice of the potential for wind chills of -40°F or colder with a wind speed of 10 mph or higher and a duration of 6 hours or more.
Wind Chill Advisory	Issued when wind chills of -20°F to -39°F with a wind speed of 10 mph or higher and a duration of 6 hours or more are expected.
Wind Chill Warning	Issued when wind chills of -40°F or colder with a wind 10 mph wind in combination with precipitation.

Source: National Weather Service, 2016

Snow storms and cold temperatures are common occurrences in Missoula County and generally do not cause any problems as residents are used to winter weather and are prepared for it. Sometimes, however, blizzards can occur and overwhelm the ability to keep roads passable. Heavy snow and ice events also have the potential to bring down power lines and trees. Extreme wind chill temperatures may harm residents if unprotected outdoors or if heating mechanisms are disrupted.

A Presidential disaster declaration was issued in 2001 for the late winter storms in Missoula County (DR-1385). State-wide winter storm disasters were declared in 1978, 1989 and 1996. **Table 4.5-2** presents the severe winter weather events in Missoula County since 2005.

Table 4.5-2. Missoula County Severe Winter Weather Events (~November-April)

Date	Event	Date	Event	Date	Event	Date	Event
1/7/2005	Heavy Snow	12/29/2007	Winter Storm	1/30/2011	Heavy Snow	12/2/2013	Winter Weather
1/11/2005	Winter Storm	1/10/2008	Heavy Snow	2/4/2011	Winter Weather	12/5/2013	Extreme Cold/Wind Chill
1/12/2005	Heavy Snow	1/14/2008	Winter Storm	2/6/2011	Winter Storm	12/6/2013	Extreme Cold/Wind Chill
1/14/2005	Heavy Snow	1/19/2008	Heavy Snow	2/7/2011	Winter Storm	12/9/2013	Winter Weather
1/17/2005	Winter Storm	1/20/2008	Heavy Snow	2/13/2011	High Wind	12/18/2013	Winter Weather
3/12/2005	Heavy Snow	1/26/2008	Winter Storm	2/14/2011	Heavy Snow	12/20/2013	Heavy Snow
3/17/2005	Winter Storm	1/29/2008	Heavy Snow	2/15/2011	Heavy Snow	1/3/2014	Winter Weather
4/13/2005	Winter Storm	1/30/2008	Winter Storm	2/21/2011	Heavy Snow	1/7/2014	Winter Weather
11/7/2005	Winter	1/31/2008	Winter Storm	2/23/2011	Strong Wind	1/8/2014	Winter Weather
11/13/2005	Winter	2/1/2008	Heavy Snow	2/24/2011	Cold/Wind Chill	1/11/2014	High Wind
11/30/2005	Winter Storm	2/5/2008	W54inter Storm	3/14/2011	Heavy Snow	1/12/2014	Winter Weather

Table 4.5-2. Missoula County Severe Winter Weather Events (~November-April)

Date	Event	Date	Event	Date	Event	Date	Event
12/1/2005	Heavy Snow	2/6/2008	Winter Storm	11/12/2011	Heavy Snow	1/18/2014	Winter Weather
12/4/2005	Heavy Snow	2/7/2008	Winter Storm	11/16/2011	Heavy Snow	1/29/2014	Winter Storm
12/21/2005	Heavy Snow	3/3/2008	Winter Storm	11/17/2011	Heavy Snow	1/30/2014	Winter Storm
12/22/2005	Heavy Snow	4/19/2008	Heavy Snow	11/18/2011	Heavy Snow	2/3/2014	Winter Weather
1/9/2006	Heavy Snow	6/10/2008	Heavy Snow	11/23/2011	Strong Wind	2/4/2014	Extreme Cold/Wind Chill
1/16/2006	Cold/Wind	11/13/2008	High Wind	11/25/2011	Strong Wind	2/6/2014	Extreme Cold/Wind Chill
1/20/2006	Heavy Snow	12/12/2008	Winter Storm	11/27/2011	Strong Wind	2/8/2014	Winter Weather
1/28/2006	Winter Storm	12/13/2008	Cold/Wind Chill	11/30/2011	Heavy Snow	2/9/2014	Winter Weather
1/29/2006	Heavy Snow	12/14/2008	Cold/Wind Chill	12/21/2011	Heavy Snow	2/11/2014	Winter Weather
2/4/2006	Heavy Snow	12/17/2008	Heavy Snow	12/28/2011	Heavy Snow	2/12/2014	Strong Wind
2/16/2006	Heavy Snow	12/27/2008	Winter Storm	12/29/2011	High Wind	2/14/2014	Winter Weather
2/23/2006	Heavy Snow	12/29/2008	Heavy Snow	1/8/2012	Winter Weather	2/17/2014	Heavy Snow
3/8/2006	Winter Storm	1/1/2009	Winter Weather	1/10/2012	Winter Weather	2/18/2014	Winter Weather
4/1/2006	Heavy Snow	1/4/2009	Heavy Snow	1/15/2012	Heavy Snow	2/20/2014	Heavy Snow
4/5/2006	Heavy Snow	1/6/2009	Heavy Snow	1/16/2012	Heavy Snow	2/21/2014	Winter Weather
5/27/2006	Heavy Snow	1/27/2009	Heavy Snow	1/18/2012	Heavy Snow	2/22/2014	Winter Weather
9/15/2006	Heavy Snow	1/31/2009	High Wind	1/19/2012	Ice Storm	2/23/2014	Winter Storm
10/29/2006	Winter Storm	2/24/2009	Heavy Snow	1/25/2012	High Wind	2/24/2014	Heavy Snow
11/10/2006	Heavy Snow	2/25/2009	Heavy Snow	1/29/2012	Heavy Snow	2/27/2014	Winter Weather
11/12/2006	Winter Storm	3/5/2009	Heavy Snow	2/22/2012	High Wind	2/28/2014	Blizzard
11/13/2006	Winter Storm	3/15/2009	Winter Storm	2/24/2012	Heavy Snow	3/1/2014	Strong Wind
11/21/2006	Winter Storm	3/24/2009	Heavy Snow	3/12/2012	Heavy Snow	3/2/2014	Heavy Snow
11/23/2006	High Wind	3/28/2009	Heavy Snow	3/13/2012	High Wind	9/12/2014	Frost/Freeze
11/24/2006	Heavy Snow	10/8/2009	Heavy Snow	3/17/2012	Heavy Snow	11/1/2014	Heavy Snow
11/26/2006	Heavy Snow	10/26/2009	Winter Storm	3/18/2012	Heavy Snow	11/9/2014	Winter Storm
12/13/2006	Heavy Snow	11/7/2009	Winter Storm	3/20/2012	Heavy Snow	11/10/2014	Winter Storm
12/14/2006	Winter Storm	12/5/2009	Extreme Cold/ Wind Chill	3/21/2012	Heavy Snow	11/11/2014	Extreme Cold/Wind Chill
12/15/2006	Heavy Snow	12/6/2009	Extreme	10/27/2012	Heavy Snow	11/25/2014	Heavy Snow
12/24/2006	Extreme Cold/ Wind Chill	12/11/2009	Heavy Snow	11/8/2012	Heavy Snow	11/29/2014	Winter Storm
1/2/2007	Winter Storm	12/12/2009	Heavy Snow	12/1/2012	Heavy Snow	12/4/2014	Winter Weather
1/3/2007	Heavy Snow	12/31/2009	Heavy Snow	12/7/2012	Heavy Snow	12/27/2014	Winter Storm
1/5/2007	Heavy Snow	1/1/2010	Heavy Snow	12/16/2012	Heavy Snow	12/28/2014	Winter Storm
1/7/2007	Heavy Snow	1/4/2010	Winter Storm	12/17/2012	Winter Weather	1/4/2015	Winter Storm
1/11/2007	Heavy Snow	1/12/2010	Winter Weather	1/10/2013	Heavy Snow	1/5/2015	Heavy Snow
2/19/2007	High Wind	4/8/2010	High Wind	4/21/2013	Heavy Snow	3/2/2015	Heavy Snow
3/27/2007	Heavy Snow	4/13/2010	Heavy Snow	5/23/2013	Heavy Snow	11/17/2015	High Wind
4/17/2007	Heavy Snow	11/16/2010	Strong Wind	9/25/2013	Heavy Snow	11/24/2015	Winter Storm
5/21/2007	Heavy Snow	11/22/2010	Winter Storm	9/29/2013	Winter Weather	12/3/2015	Ice Storm
6/6/2007	Winter Storm	12/20/2010	Heavy Snow	10/3/2013	Winter Weather	12/9/2015	High Wind
11/12/2007	Heavy Snow	12/27/2010	Heavy Snow	11/2/2013	Winter Weather	12/12/2015	Winter Storm
11/18/2007	Heavy Snow	12/28/2010	Heavy Snow	11/3/2013	Winter Weather	12/14/2015	Winter Weather
11/26/2007	Winter Storm	12/29/2010	Winter Storm	11/5/2013	Winter Weather	12/18/2015	Winter Storm
11/27/2007	Heavy Snow	1/12/2011	Winter Storm	11/7/2013	High Wind	12/21/2015	Heavy Snow
12/2/2007	Winter Storm	1/21/2011	Heavy Snow	11/15/2013	Heavy Snow	1/13/2016	Winter Storm
12/19/2007	Winter Storm	1/25/2011	Winter Weather	11/29/2013	Winter Weather	2/2/2016	Winter Storm
12/23/2007	Blizzard	1/29/2011	Heavy Snow	12/1/2013	Heavy Snow	5/9/2016	Winter Weather

Source: NCDC, 2016

Severe Summer Weather

A severe thunderstorm is defined by the National Weather Service as a thunderstorm that produces wind gusts at or greater than 58 mph (50 knots), hail 1-inch or larger, and/or tornadoes. Thunderstorms can also produce intense downbursts, lightning, and microburst wind. Strong winds can occur outside of thunderstorms when the overall weather conditions are favorable. The PDM Planning Team recalled that in August 2015, a severe wind storm caused a major power outage in Missoula (see description below).

Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating wind and strong vertical motion, which possess remarkable strength and can cause widespread damage. The most violent tornadoes are capable of tremendous destruction with wind speeds of 300 mph or more. Maximum wind speeds in tornadoes are confined to small areas and vary over short distances. Thunderstorms can produce deadly and damaging tornadoes. As of February 1, 2007, the NWS began using the Enhanced Fujita Scale for Tornado damage. Tornadoes are not common in Missoula County but high winds occur frequently.

A microburst is a very localized column of sinking air, producing damaging divergent and straight-line winds at the surface that are similar to, but distinguishable from, tornadoes. The scale and suddenness of a microburst makes it a great danger to aircraft due to the low-level wind shear caused by its gust front, with several fatal crashes having been attributed to the phenomenon over the past several decades. Microbursts in forested regions have flattened acres of standing timber.

The National Weather Service provides short-term forecasts and warnings of severe summer weather to the public by producing regularly-scheduled severe weather outlooks and updates on various forms of hazardous weather including tornado warnings, as shown in **Table 4.5-3.**

Table 4.5-3. Warning and Advisory Criteria for Severe Summer Weather

Summer Weather	Weather Advisory
Hazardous Weather Outlook	Hazardous weather outlooks alert the public to the possibility for severe weather in the area from one to seven days in advance.
Severe Thunderstorm Watch	Issued when conditions for severe thunderstorms appear favorable for an area over the next several hours. Watches are typically in effect for 4-6 hours.
Severe Thunderstorm Warning	Issued when Doppler radar indicates or the public reports a thunderstorm with wind gusts of 5 8 mph or greater and/or hail 1-inch or larger in diameter. The warning is usually valid for 30-60 minutes.
High Wind Watch	Issued when conditions are favorable for non-thunderstorm sustained winds of 40 mph or greater or gusts of 58 mph or greater for a period of one hour or more, but the timing, location, and/or magnitude are still uncertain.
High Wind Warning	Issued when non-thunderstorm sustained winds of 40 mph or greater or gusts of 58 mph or greater for a period of one hour or more are expected.
Tornado Watch	Issued when conditions for tornadoes appear especially favorable for an area over the next several hours. Watches are typically in effect for 4-6 hours.
Tornado Warning	Issued when Doppler radar indicates or the public reports a tornado. The warning is usually valid for 15-45 minutes.

Source: National Weather Service, 2016

There have been no Presidential disaster declarations or state emergencies issued for severe summer weather in Missoula County. However, since the 2011 Missoula County PDM Plan was completed, numerous incidents of severe summer weather have affected the county. **Table 4.5-4** presents

severe summer storm events from the NCDC database indicating the magnitude of these events, followed by a media account of a recent event.

Table 4.5-4. Missoula County Severe Summer Weather Events (~May-October)

Date	Event	Magnitude	Date	Event	Magnitude	Date	Event	Magnitude
7/10/1957	Tstorm Wind	53 kts	7/20/1999	Tstorm Wind	56 kts	9/1/2004	Tstorm Wind	60 kts
9/12/1958	Hail	2.25 in	8/7/1999	Hail	0.75 in	4/5/2006	Heavy Rain	-
8/3/1960	Hail	0.75 in	9/25/1999	High Wind	50 kts	6/12/2006	Hail	1.75 in
8/16/1962	Tstorm Wind	55 kts	10/31/1999	High Wind	65 kts	6/13/2006	Hail	2 in
6/11/1968	Tstorm Wind	-	7/22/2000	Tstorm Wind	50 kts	8/8/2006	Tstorm Wind	60 kts
7/11/1968	Hail	0.75 in	9/9/2000	Dust Storm	-	8/16/2006	Hail	1 in
7/2/1969	Hail	1 in	6/9/2001	Tstorm Wind	51 kts	5/10/2007	Hail	1 in
8/15/1972	Hail	0.75 in	6/27/2001	Hail	0.88 in	6/4/2007	Tstorm Wind	52 kts
8/13/1973	Tstorm Wind	58 kts	7/11/2001	Tstorm Wind	52 kts	6/5/2007	Tstorm Wind	50 kts
6/15/1974	Hail	1.75 in	7/21/2001	Tstorm Wind	-	6/28/2007	Tstorm Wind	52 kts
8/20/1981	Hail	1.5 in	9/25/2001	High Wind	65 kts	8/5/2007	High Wind	50 kts
6/29/1982	Hail	2.5 in	5/19/2002	Tstorm Wind	52 kts	5/9/2008	High Wind	65 kts
8/1/1982	Hail	0.75 in	5/20/2002	High Wind	45 kts	7/10/2008	High Wind	50 kts
7/20/1983	Tornado	-	6/27/2002	Tstorm Wind	53 kts	7/23/2008	Hail	1 in
7/31/1983	Tstorm Wind	65 kts	7/7/2002	Tstorm Wind	50 kts	8/9/2008	Hail	1.25 in
8/3/1983	Hail	0.75 in	7/8/2002	Tstorm Wind	52 kts	8/9/2008	Tstorm Wind	52 kts
8/24/1984	Hail	1 in	7/13/2002	Tstorm Wind	53 kts	8/19/2008	Hail	0.75 in
6/17/1988	Tstorm Wind	70 kts	7/15/2002	Lightning	-	8/30/2009	Tstorm Wind	43 kts
6/28/1988	Hail	1.75 in	8/4/2002	Hail	0.75 in	5/3/2010	High Wind	62 kts
5/10/1989	Tstorm Wind	-	8/16/2002	High Wind	54 kts	6/29/2010	Hail	1.25 in
7/26/1989	Tstorm Wind	-	4/29/2003	Funnel Cloud	-	7/31/2010	Hail	1 in
8/12/1989	Tstorm Wind	51 kts	5/25/2003	Hail	0.75 in	8/18/2010	Heavy Rain	-
6/10/1992	Tstorm Wind	-	6/19/2003	Tstorm Wind	60 kts	5/13/2011	High Wind	52 kts
6/12/1992	Hail	1.5 in	7/2/2003	Dust Devil	52 kts	5/14/2011	High Wind	52 kts
7/22/1992	Tstorm Wind	-	8/5/2003	Tstorm Wind	50 kts	5/15/2011	High Wind	52 kts
5/20/1993	Hail	0.75 in	8/8/2003	Hail	1.25 in	6/23/2011	Hail	1.25 in
5/31/1993	Tstorm Wind	56 kts	8/16/2003	Dust Devil	40 kts	7/19/2011	Hail	1 in
8/12/1993	Tstorm Wind	-	8/19/2003	Tstorm Wind	44 kts	10/6/2011	Heavy Rain	-
8/19/1993	Tstorm Wind	53 kts	4/18/2004	Tstorm Wind	58 kts	10/10/2011	Heavy Rain	-
5/15/1994	Tstorm Wind	-	6/9/2004	Hail	0.75 in	4/26/2012	Tstorm Wind	80 kts
6/16/1995	Tstorm Wind	58 kts	6/26/2004	Hail	0.88 in	6/4/2012	Hail	1 in
7/26/1995	Hail	0.01 in	7/10/2004	Hail	1.5 in	6/17/2012	High Wind	52 kts
7/28/1995	Hail	-	8/3/2004	Hail	1.25 in	6/23/2012	Hail	1 in
8/7/1995	Tornado	-	8/5/2004	Hail	0.75 in	6/26/2012	Tstorm Wind	52 kts
8/23/1995	Tstorm Wind	52 kts	9/1/2004	Tstorm Wind	56 kts	7/27/2012	Hail	0.5 in
6/15/1996	Tstorm Wind	52 kts	4/5/2006	Hail	0.75 in	8/8/2012	Tstorm Wind	56 kts
8/1/1996	Hail	1 in	6/12/2006	High Wind	50 kts	8/21/2012	Tstorm Wind	50 kts
9/5/1996	High Wind	57 kts	6/13/2006	High Wind	65 kts	10/16/2012	Strong Wind	43 kts
9/12/1996	Tstorm Wind	44 kts	8/16/2002	Tstorm Wind	50 kts	4/29/2013	Strong Wind	43 kts
10/14/1996	High Wind	53 kts	4/29/2003	Dust Storm	-	5/13/2013	Tstorm Wind	50 kts
10/15/1996	High Wind	51 kts	5/25/2003	Tstorm Wind	51 kts	6/18/2013	Strong Wind	46 kts
10/22/1996	High Wind	53 kts	6/19/2003	Hail	0.88 in	7/8/2013	Hail	1.75 in
5/31/1997	Tstorm Wind	63 kts	7/2/2003	Tstorm Wind	52 kts	7/17/2013	Hail	0.75 in
9/5/1997	Hail	0.75 in	8/5/2003	Tstorm Wind	-	8/9/2013	Tstorm Wind	47 kts
9/15/1997	Tstorm Wind	60 kts	8/8/2003	High Wind	65 kts	8/12/2013	Tstorm Wind	43 kts
5/25/1998	Hail	2.5 in	8/16/2003	Tstorm Wind	52 kts	9/30/2013	Strong Wind	43 kts

Table 4.5-4. Missoula County Severe Summer Weather Events (~May-October)

Date	Event	Magnitude	Date	Event	Magnitude	Date	Event	Magnitude
5/26/1998	Hail	0.75 in	8/19/2003	High Wind	45 kts	8/2/2014	Strong Wind	48 kts
7/3/1998	Hail	2.5 in	4/18/2004	Tstorm Wind	53 kts	10/15/2014	Strong Wind	43 kts
7/4/1998	Hail	1 in	6/9/2004	Tstorm Wind	50 kts	2/10/2015	Heavy Rain	-
7/8/1998	Lightning	-	6/26/2004	Tstorm Wind	52 kts	8/10/2015	Tstorm Wind	64 kts
7/10/1998	Tstorm Wind	60 kts	7/10/2004	Tstorm Wind	53 kts	8/14/2015	Hail	1 in
8/22/1998	Hail	0.75 in	8/3/2004	Lightning	-	6/24/2016	Strong Wind	43 kts
6/24/1999	Hail	0.75 in	8/5/2004	Hail	0.75 in	7/17/2016	Hail	1 in

Source: NCDC, 2016. Notes: Tstorm = Thunderstorm; in = inch; kts = knots

August 10, 2015 – A line of thunderstorms converged over the Missoula valley with hurricane force winds, leaving downed power lines, toppled trees, blocked roads and crushed vehicles. Lightning and downed power lines sparked numerous fires in the area, including one in the lower Rattlesnake Valley at the base of Mount Jumbo. Residents scrambled to douse the fire, saying they were unable to get through to 9-1-1, despite trying for 20 minutes.

A large tree came down on Vine Street.
Source: KPAX.com

As many as 18,000 residents initially lost power when a line of thunderstorms converged over the valley. Nearly 8,000 residents remained without power 24 hours later. On the southern end of Missoula, an estimated 2,400 residents in Linda Vista lost power when a series of heavy-duty transmission lines serving the neighborhood were toppled. Power outages spread from Darby to Missoula to Philipsburg, At least 60 power poles were down as a result of the winds that accompanied the storm. (Missoulian, *Windstorm in Western Montana*, August 11, 2015)

Several poles in the Upper Linda Vista neighborhood snapped off during the storm.
Source: Missoulian

Drought

Drought is an extended period of unusually dry weather and is a special type of disaster because its occurrence does not require evacuation of an area nor does it constitute an immediate threat to life or property. People are not suddenly rendered homeless or without food and clothing. The basic effect of a drought is economic hardship, but it does, in the end, resemble other types of disasters in that victims can be deprived of their livelihoods and communities can suffer economic decline.

The effects of drought become apparent when they are in longer duration because more and more moisture-related activities are affected. Non-irrigated croplands are most susceptible to moisture shortages. Rangeland and irrigated agricultural lands do not feel the effects as quickly as the non-irrigated, cultivated acreage, but their yields can also be greatly reduced due to drought.

Typically, federal drought declarations are not issued by the President, but by the Secretary of the Department of Agriculture. Conservation Reserve Program (CRP) grazing may be opened to livestock

owners for feed but other than this, the only real help for producers and growers is the fact that federal low interest loans are made available.

In periods of severe drought, range fires can destroy the economic potential of the agricultural industry, and wildlife habitat in, and adjacent to, the fire areas. Under extreme drought conditions, lakes, reservoirs, and rivers can be subject to severe water shortages. Insect infestation is an additional hazard resulting from drought. **Table 4.5-5** presents the National Weather Service warnings and advisories that relate to drought.

Table 4.5-5. Warning and Advisory Criteria for Drought

Summer Weather Warning	Warning Description
Blowing Dust Advisory	Issued for widespread or localized blowing dust reducing visibilities to less than a mile but greater than ¼ mile with sustained winds of 25 mph or greater.
Dust Storm Warning	Issued when widespread or localized blowing dust reduces visibilities to less than ¼ mile with sustained winds of 25 mph or greater.
Heat Advisory	Issued when conditions are favorable for heat index values reaching 105 degrees or greater for three days or more.
Heat Warning	Issued when high temperatures are expected to be over 105 degrees and low temperatures are expected to be over 80 degrees for three days or more.

Source: National Weather Service (NWS, 2016)

The State of Montana established a Drought Advisory Committee and developed a Drought Plan to address the hazard. Information from the National Drought Mitigation Center also identifies Montana as a drought prone state. Temperatures can reach 100°F in the summer with extremely low humidities and high winds. Such dry, hot conditions contribute to drought conditions.

The history of drought in Montana, as presented in the State of Montana Natural Hazards Mitigation Plan (DES, 2001) is summarized below.

In the 1930's, the "Dust Bowl" drought affected the State of Montana, including Missoula County. This nationwide drought produced erosion problems in the creation of dust storms throughout the State. Again in the mid 1950's, Montana had a period of reduced rainfall; however, Missoula County did not suffer as severely as those counties in the eastern and central portions of the state.

Drought struck Missoula County again in 1961, and by July, the State's Crop and Livestock Reporting Service called it the worst drought since the 1930's. Better conservation practices such as strip cropping were used to lessen the impacts of the water shortages. Five years later in 1966, the entire state was experiencing yet another episode of drought. Although water shortages were not as great as in 1961, a study of ten weather recording stations across Montana showed all had recorded below normal precipitation amounts for a ten month period.

Then in the 1970's, a seven month survey ending in May of 1977 estimated that over 250,000 acres of Montana farmland had been damaged by winds. Inadequate crop cover and excessive tillage practices had resulted in exaggerated soil damage due to low soil moisture. The State of Montana began taking protective measures to conserve water.

Missoula County was severely affected by drought again in 1985 and received a federal drought disaster declaration. For a typical 2,500 acre Montana farm/ranch, the operator lost more than $100,000 in equity over the course of that year. The state's agriculture industry lost nearly $3 billion in equity.

Missoula County had drought conditions from 2000 through 2007 and received several U.S. Department of Agriculture (USDA disaster declarations. The State of Montana received a total of $152.4 million in disaster assistance in 2004, 2005, and 2006. This history shows that the county experiences drought almost once every decade and the drought may last for several years. Since the Missoula County PDM Plan was completed in 2011, severe drought conditions impacted the county in 2016.

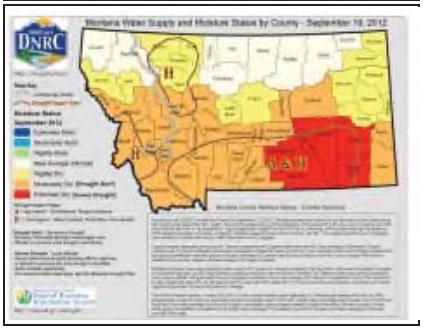
Table 4.5-6 shows the Montana drought status for the period 2009-2016. **Table 4.5-7** summarizes drought conditions in Missoula County during this period.

Table 4.5-6. Montana Drought Status; 2009 – 2016

2009 Montana County Drought Status		
May	**July**	**September**
2010 Montana County Drought Status		
May	**July**	**September**
2011 Montana County Drought Status		
May	**July**	**September**

Table 4.5-6. Montana Drought Status; 2009 – 2016

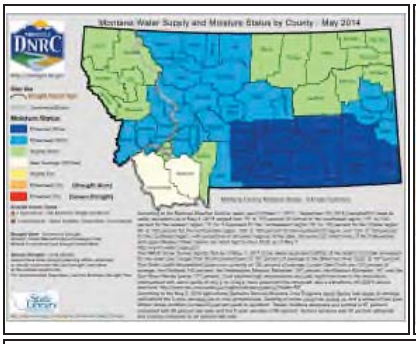
2012 Montana County Drought Status

May	July	September
		

2013 Montana County Drought Status

May	July	September

2014 Montana County Drought Status

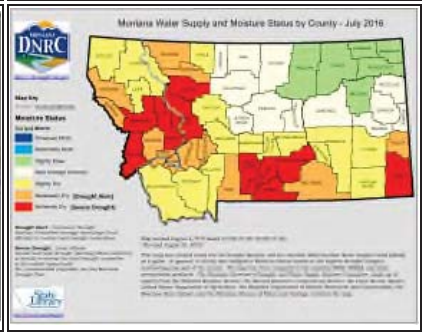
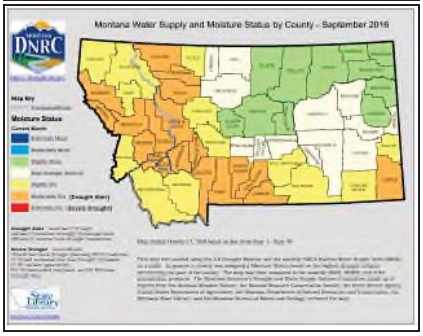
May	July	September
		

2015 Montana County Drought Status

May	July	September

Table 4.5-6. Montana Drought Status; 2009 – 2016

2016 Montana County Drought Status

May	July	September
		

Source: Montana Drought Website, 2016. https://mslservices.mt.gov/Geographic_Information/Maps/drought/

Table 4.5-7. Missoula County Drought Summary

Moisture	Alerts	2009			2010			2011			2012			2013			2014			2015			2016		
		May	July	Sept	May	July	Sept	May	July	Sept	May	July	Sept	May	July	Sept	May	July	Sept	May	July	Sept	May	July	Sept
Moderately Moist																									
Slightly Moist																									
No Drought																									
Slightly Dry																									
Moderately Dry	Drought Alert																								
Extremely Dry	Severe Drought																								

Vulnerability and Area of Impact

Based on review of historic weather data, the entire county has been classified with a uniform risk for severe weather events. Structures, utilities, and vehicles are most at risk from the wind component of these storms, with crops and livestock being additionally threatened by hail and drought. Winter storm events may affect the higher regions with more snowfall but the population is concentrated in the lower elevations so the hazard risk area is considered uniform.

Drought affects all facets of our society, from food production to water quality to public health, and there is a growing need to help communities, agriculture, businesses, and individuals threatened by drought to plan accordingly. From 1980-2000, major droughts and heat waves within the U.S. alone resulted in costs exceeding $100 billion. In 2012, approximately two-thirds of the continental U.S. was affected by chronic drought. Severe droughts are projected for the next several decades, impacting the nation's communities and economy (NDRP, 2016).

Drought is a hazard that does not normally cause structural damage but can have significant population and economic effects. Missoula County communities rely on water for irrigation and public water supplies. A drought could also have significant impacts on the agricultural community. Economic losses could result from loss of pasture and food supply for livestock. These losses would be in addition to those losses associated with lower crop yields due to drought conditions.

Another major impact of drought is to the natural resources of the area. As river and stream levels drop, fish populations and other natural resources are impacted. A hazard directly related to drought is wildfire. Drought conditions increase the chances that a major wildfire will threaten the

community. Unlike many other events, drought evolves slowly, and therefore, the direct impact to the population (i.e. loss of life, injuries) would be low.

On March 21, 2016, President Obama signed a Presidential Memorandum directing Federal agencies to build national capabilities for long-term drought resilience. The President tasked the National Drought Resilience Partnership (NDRP) to work collaboratively to deliver on a Federal Action Plan including six goals and 27 associated actions to promote drought resilience nationwide. Importantly, these goals reflect many of the priorities identified by the on-the-ground leaders and experts who work daily to build a more resilient future for their communities. The actions are designed to complement state, regional, tribal and local drought preparedness, planning and implementation efforts.

Federal agencies have mobilized to provide improved information and data, emergency and planning assistance, landscape-scale land management improvements, and investments in new technologies and approaches to water resource management. Continued drought conditions in the West and projections of more extreme droughts in the future underscore the urgency to pursue long term solutions for protecting our water resources and the communities and ecosystems that depend on them. In partnership with the Montana DNRC and other state and local collaborators, the Missouri Headwaters Basin was selected as a national drought resilience pilot project. Partners are leveraging multiple resources to engage communities in drought preparedness planning and to implement projects that build resiliency.

The Blackfoot Challenge Drought Response Plan provides the framework for the shared sacrifice approach to drought management in the Blackfoot. It details activities of the Blackfoot Drought Committee as well as actions taken by water users at biologically based stream flow and temperature triggers. The foundation of the plan lies in the fact that drought is a watershed-wide issue that requires action by all water users. When flows in the Blackfoot River fall below 700 cubic feet per second (cfs), consumptive water users, primarily irrigators, are asked to implement individual drought management plans. Irrigators who meaningfully participate in the Drought Response will not receive a call for water from Montana Fish, Wildlife, and Parks.

Probability and Magnitude

Table 4.5-8 and 4.5-9 present severe weather events with reported damages from winter and summer events, respectively, from the SHELDUS and NCDC databases. The dataset used to populate SHELDUS typically includes every loss causing and/or deadly event between 1960 through 1975 and from 1995 onward. Between 1976 and 1995, SHELDUS reflects only events that caused at least one fatality or more than $50,000 in property or crop damages. The NCDC data contains sporadic damage figures which were added to the dataset when they represented a unique damaging event.

Table 4.5-8. Missoula County Severe Winter Weather Events with Damages

Date	Injuries	Fatalities	Property Damage (2016 $)	Crop Damage (2016 $)	Remarks
4/22/1960	0	0	$203,249	$0	High wind
12/11/1960	0	1	$0	$0	Unusually cold
1/6/1961	0	0	$10,060	$0	Freezing rain
5/5/1961	0	0	$4,471	$0	Heavy snow
11/20/1962	0.07	0	$6,990	$0	High winds

Table 4.5-8. Missoula County Severe Winter Weather Events with Damages

Date	Injuries	Fatalities	Property Damage (2016 $)	Crop Damage (2016 $)	Remarks
12/16/1964	0	0	$68,095	$0	High wind, blowing snow, severe cold
1/15/1967	0	0	$6,320	$0	High wind
4/30/1968	0	0	$38,418	$0	High wind
1/31/1969	0	0	$575	$0	Cold and snow
3/3/1971	0	0	$990	$0	Wind, snow
3/26/1971	0	0	$29,710	$0	Gusty wind
11/30/1971	0.37	0	$1,100	$0	Hoarfrost, ice
1/11/1972	0	0	$5,050	$0	Strong winds
1/16/1972	0	0	$9,595	$0	Strong winds
2/16/1972	0	0	$993	$0	High wind
3/6/1972	0	0	$960	$0	High winds
10/31/1973	0.67	1	$9,033	$0	Heavy snow
1/30/1974	0	0	$4,358	$0	Wind
12/21/1974	0	0	$24,406	$0	High wind
12/31/1974	0	0	$842	$0	High winds
10/21/1975	0	0	$2,236,496	$22,365	Snow
11/30/1980	25	0	$0	$0	Black ice
2/3/1986	0	0	$2,196	$0	Ice storm
3/18/1987	0	0.25	$2,648	$265	Heavy snow
12/21/1987	0	0	$106	$0	Heavy snow
1/14/1988	0	0	$10	$0	Heavy snow
2/15/1988	0	0	$182	$0	High winds
12/13/1988	0	0	$20,342	$0	Wind
1/31/1989	0	1	$29,405	$0	Blizzard
2/1/1989	0	0	$170,2	$170	Severe cold
2/11/1989	0	1	$0	$0	Cold
4/5/1989	0	0	$16	$0	High wind
11/25/1990	0	0	$9,206	$0	High winds
5/12/1992	0	0	$0	$1,429	Hard freeze
8/23/1992	0	0	$373	$37,288	Winter storm
8/25/1992	0	0	$0	$1,505	Frost/freeze
1/20/1993	0	0	$1,189	$0	Freezing rain
1/24/1993	0	0	$1,189	$0	Freezing rain
2/19/1993	0	0	$1,388	$0	Heavy snow
10/8/1993	0	0	$8,327	$0	Winter storm
11/3/1993	0	0	$833	$8,327	High winds
2/24/1994	0	0	$14,244	$0	Winter storm
4/26/1994	0	0	$6,766	$0	Heavy snow, winter storm
11/17/1994	0	0	$6,766	$0	Heavy snow
11/26/1994	0	0	$11,599	$0	Heavy snow
3/27/1995	0	0	$78,952	$0	Winter storm
11/18/1996	0.09	0.18	$0	$0	Winter storm
11/19/1997	0	2	$0	$0	Ice storm
2/15/2001	0.25	0.13	$0	$0	Winter weather
6/4/2001	0	0	$203,938	$0	Winter weather
12/30/2004	0	0	$18,047	$0	Heavy snow
12/15/2006	0	0	$1,326	$0	High wind
11/12/2007	0	0	$12,573	$0	High wind

Table 4.5-8. Missoula County Severe Winter Weather Events with Damages

Date	Injuries	Fatalities	Property Damage (2016 $)	Crop Damage (2016 $)	Remarks
6/11/2008	0	0	$86	$0	Heavy snow
11/13/2008	0	0	$9,314	$0	High wind
1/2/2009	0	0	$1,397	$0	Winter storm
1/31/2009	0	0	$7,291	$0	High wind
4/8/2010	0	0	$3,311	$0	Wind
11/16/2010	0	0	$0	$552	Wind
11/22/2010	0	0	$8,277	$0	Winter weather
2/24/2011	0	0	$21,397	$13,373	Wind
6/18/2011	1	0	$106,047	$26,746	Winter weather
1/8/2012	1	0	$0	$0	Winter weather
1/10/2012	0	0	$1,048		Winter weather
1/25/2012	0	0	$524	$2,096	High wind
2/22/2012	0	0	$104,814	$0	Strong wind
3/13/2012	0	0	$46,118	$0	Strong wind
4/29/2013	0	0	$258	$0	Strong wind
5/23/2013	0	0	$386	$0	Heavy snow
11/7/2013	0	0	$517	$0	High wind
1/11/2014	0	0	$1,271	$0	High wind
2/12/2014	0	0	$126	$0	Strong wind
3/1/2014	0	0	$1,017	$0	Strong wind
9/12/2014	0	0	$0	$25,413	Frost/freeze
11/10/2014	0	0	$33,037	$0	Winter storm
11/26/2014	0	0	$51,078	$0	Winter weather
11/30/2014	0	0	$15,248	$0	Winter storm
TOTAL	**28.45**	**6.56**	**$3,676,131**	**$139,528**	

Source: SHELDUS, 2016 (adjusted to 2016 dollars). Note: Often casualties and damage information are listed without sufficient spatial reference. In order to assign the damage amount to a specific county, the fatalities, injuries and dollar losses were divided by the number of counties affected from this event.

Snow generally does not cause the communities to shut down or disrupt activities. Occasionally though, extreme winter weather conditions can cause problems. The most common incident in these conditions are motor vehicle accidents due to poor road conditions. Such incidents normally involve passenger vehicles; however, an incident involving a commercial vehicle transporting hazardous materials or a vulnerable population such as a school bus is also possible. Road closures associated with mountain passes can be problematic for travelers.

Sheltering of community members could present significant logistical problems when maintained over a period of more than a day. Transportation, communication, energy (electric, natural gas, and vehicle fuels), shelter supplies, medical care, food availability and preparation, and sanitation issues all become exceedingly difficult to manage in extreme weather conditions. Local government resources could be quickly overwhelmed. Mutual aid and state aid might be hard to receive due to the regional impact of this kind of event.

The American Red Cross has a presence in Missoula County and has the capacity to provide care for the duration of a severe weather event if need be through pre-determined sheltering agreements in accordance with national standards.

Windstorms and microbursts affect areas with significant tree stands, as well as areas with exposed property, major infrastructure, and aboveground utility lines. Severe hailstorms can also cause considerable damage to buildings and automobiles, but rarely result in loss of life. Nationally, hailstorms cause nearly $1 billion in property and crop damage annually, as peak activity coincides with peak agricultural seasons. **Table 4.5-10** presents severe summer weather events in Missoula County with reported damages since 1960.

Table 4.5-9. Missoula County Severe Summer Weather Events with Damages

Date	Injuries	Fatalities	Property Damage (2016$)	Crop Damage (2016 $)	Remarks
8/16/1962	0	0	$39,842	$0	Down draft from thunderstorm
9/19/1962	0	0	$398,422	$0	Lightning
6/7/1964	0	1.2	$0	$0	Heavy rain
7/19/1968	0	0	$1,192	$0	High wind, thunderstorms
1/26/1969	0	0	$6	$0	Lightning
7/2/1969	0	0	$328	$0	Hail, rain
5/4/1971	0	0	$9,903	$0	Thunderstorms
9/19/1971	0	0	$1,748	$0	Wind
8/13/1973	0	0	$2,710	$271	Damaging winds
9/12/1973	0	0	$17	$0	Wind storm
6/20/1974	0.33	0	$81,355	$0	Lightning
7/31/1974	0	0	$814	$0	High winds
6/1/1977	0.17	0	$33,092	$0	Wind
5/22/1981	0	0	$882,461	$0	Heavy rains
7/20/1983	0	0	$121	$0	Tornado (F0)
8/3/1983	0	0	$604	$604	Hail
6/20/1985	0.02	0	$2,601	$2,601	Hail/wind
6/17/1988	0	0	$101,710	$0	Severe storm-wind
5/10/1989	0	0	$106,739	$0	Thunderstorm wind
7/26/1989	0	0	$97	$0	Thunderstorm wind
8/12/1989	0	0	$97,035	$970	Thunderstorm wind
10/16/1991	0	0	$180,292	$0	Wind
5/15/1992	0	0	$86	$0	High winds
5/18/1992	0	0	$143	$0	High winds
7/8/1998	1	1	$0	$0	Lightning
7/10/1998	0	1	$383,854	$0	Thunderstorm wind
9/9/2000	2	0.25	$0	$0	Dust storm
7/8/2002	1	0	$0	$0	Severe storm/thunderstorm wind
7/15/2002	1	0	$0	$0	Lightning
6/19/2003	0	0	$39,236	$0	Severe storm/thunderstorm wind
7/2/2003	0	0	$52,315	$0	Wind
8/16/2003	3	0	$0	$0	Wind
8/19/2003	0	0	$32,697	$0	Severe storm/thunderstorm wind
4/18/2004	0	0	$127,394	$0	Severe storm/thunderstorm wind
5/9/2008	0	0	$8,942	$0	High wind
8/9/2008	0	0	$34,649	$0	Thunderstorm wind
5/3/2010	0	0	$5,518	$0	Wind
5/4/2010	0	0	$2,759	$0	Wind
5/14/2011	0	0	$13,373	$481	Wind
5/15/2011	0	0	$72,214	$57,236	Wind
6/18/2011	0	0	$1,872,402	$95,483	Hail, wind, severe storms

Table 4.5-9. Missoula County Severe Summer Weather Events with Damages

Date	Injuries	Fatalities	Property Damage (2016$)	Crop Damage (2016 $)	Remarks
6/23/2012	0	0	$1,615,186	$0	Hail
6/26/2012	0	0	$1,048	$79,659	Thunderstorm wind
7/27/2012	0	0	$524	$0	Hail
8/8/2012	0	0	$0	$3,144	Thunderstorm wind
10/16/2012	0	0	$26,728	$7,075	Strong wind
5/13/2013	0	0	$3,099	$0	Thunderstorm wind
6/18/2013	0	0	$128	$0	Strong wind
8/9/2013	0	0	$7,231	$0	Thunderstorm wind
8/12/2013	0	0	$5,165	$0	Thunderstorm wind
9/30/2013	0	0	$517	$0	Strong wind
8/2/2014	0	0	$677	$0	Strong wind
10/15/2014	0	0	$254	$0	Strong wind
TOTAL	**8.52**	**3.45**	**$6,247,225**	**$247,525**	

Source: SHELDUS, 2016 (adjusted to 2016 dollars). Note: Often casualties and damage information are listed without sufficient spatial reference. In order to assign the damage amount to a specific county, the fatalities, injuries and dollar losses were divided by the number of counties affected from this event.

Annual loss was computed for the severe summer and winter weather hazard in Missoula County using SHELDUS data and the formula: Frequency x Magnitude x Exposure = Annual Loss, as further explained in *Section 4.1.6*. **Table 4.5-10** presents the results of the calculations.

Table 4.5-10. Missoula County Severe Weather Annual Loss

No. of Events	Period of Record (Yrs)	Frequency	Damage	Magnitude	Exposure	Annual Loss
Severe Summer Weather						
140	59	2.37	$6,247,225	0.000575%	$7,756,846,191	$105,757
Severe Winter Weather						
412	20	20.60	$3,676,131	0.000115%	$7,756,846,191	$183,807

The National Drought Mitigation Center tracks indemnity payments for losses suffered due to drought on a county basis. **Table 4.5-11** presents drought damages for a 25 year period (1989 to 2014) for Missoula County and the State of Montana.

Table 4.5-11. Drought Insurance Claims; Missoula County 1989 - 2014

Year	Montana	Missoula Co.	Year	Montana	Missoula Co.	Year	Montana	Missoula Co.
1989	$14,361,948	$21,365	1998	$18,201,060	$0	2007	$22,015,676	$0
1990	$29,146,575	$12,431	1999	$19,189,328	$31,594	2008	$74,979,811	$0
1991	$2,775,746	$11,278	2000	$44,989,149	$33,529	2009	$30,435,526	$6,831
1992	$37,767,835	$11,871	2001	$131,976,513	$33,195	2010	$5,289,266	$0
1993	$344,432	$0	2002	$108,139,519	$13,962	2011	$52,075,321	$0
1994	$5,539,598	$7,732	2003	$41,148,170	$19,229	2012	$10,055,101	$0
1995	$2,413,758	$0	2004	$29,427,194	$0	2011	$11,670,134	$0
1996	$10,637,521	$0	2005	$5,905,724	$4,124	2014	$5,289,266	$0
1997	$3,830,310	$1,323	2006	$41,483,327	$0	**TOTAL**	**$759,087,808**	**$208,464**

Source: National Drought Mitigation Center, 2016;
http://drought.unl.edu/Planning/Impacts/DroughtIndemnityData.aspx

The NOAA's Paleoclimatology Program has studied drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the United States. According to their research, "…paleoclimatic data suggest that droughts as severe as the 1950's drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North America as recently as 500 years ago." Based on this research, the 1950's drought situation could be expected approximately once every 50 years or a 20 percent chance every 10 years. An extreme drought, worse than the 1930's "Dust Bowl" has an approximate probability of occurring once every 500 years or a 2 percent chance of occurring each decade (NOAA, 2004).

Severe weather occurs in Missoula County multiple times each year. Therefore, the probability of a severe storm in either the winter or summer is rated as "highly likely". Based on historic conditions, the probability of future drought events in Missoula County are ranked as "likely", occurring more than once every 10 years but not every year.

Future Development

The State of Montana has adopted the 2012 International Building Codes (IBC) which include a provision that buildings must be constructed to withstand a wind load of 75 mph constant velocity and three second gusts of 90 mph and must be designed to withstand a snow load of 30 pounds per square foot minimum. The IBC does not cover single-family residences.

The State of Montana has adopted the 2012 International Residential Code (IRC) for one and two family residences and townhouses. Local jurisdictions (cities, counties and towns) can elect to become certified to take on enforcement of single-family residences. Both Missoula County and the City of Missoula are certified to enforce building codes.

Drought could have an effect on future development with regards to groundwater availability. New domestic water wells could use up more of the groundwater resource, particularly during periods of drought.

Climate Change

Climate change presents a challenge for risk management associated with severe weather and drought. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate.

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. According to the National Climate Assessment, "higher surface temperatures brought about by global warming increase the potential for drought. Evaporation and the higher rate at which plants lose moisture through their leaves both increase with temperature. Unless higher evapotranspiration rates are matched by increases in precipitation, environments will tend to dry, promoting drought conditions (Globalchange.gov, 2016).

Population exposure and vulnerability to severe weather and drought are likely to increase as a result of climate change. Severe weather events may occur more frequently which would lead to increased exposure and vulnerability. Although all people may be affected by the health-related impacts of climate change, the elderly, young children, and people with weakened immune systems are often the most susceptible. Indirect influences of climate change may create conditions that are more favorable to disease vectors. Some people without access to backup water supplies, may suffer water shortages during severe droughts. A greater number of people may need to engage in behavior change, such as water conservation.

Property exposure and vulnerability may increase as a result of increased severe weather and drought resulting from climate change. Increased structure damage from high winds and hail could result as well as damage to crops and landscaping. Secondary impacts, such as wildfire, may increase and threaten structures.

The effects of climate change can harm agricultural activities, both crops and livestock. The changes in temperature and precipitation brought on by climate change can make it harder to grow some crops. Intense rains can increase runoff and deprive plants of nutrient-rich topsoil and changes in temperatures may cause crops to mature earlier, which can expose them to harsh weather. Warmer temperatures can introduce new agricultural pests to the region or make conditions better for pests already present, including weeds and invasive plants that can crowd out crops. Maintaining agricultural activities on marginal lands may no longer be sustainable (FEMA, 2016).

Changes to the frequency, severity, and affected area of climate-related hazards may have economic consequences. Potential decreases in agricultural outputs may affect the economy in farming and ranching areas. Communities that rely on tourism may see a decrease in visitors due to severe weather, and areas that are popular sites for water recreation can be negatively affected by droughts. If these economic effects become widespread, the impacts could be felt at a statewide or regional level (FEMA, 2016).

Critical facility exposure and vulnerability would be unlikely to increase as a result of climate change impacts to the severe weather and drought; however, critical facility owners and operators may experience more frequent disruption to the services they provide. For example, extreme heat can decrease the effectiveness of electrical equipment, including power lines, which can lead to blackouts during very hot conditions. An increase in requests for medical assistance during a heat wave may challenge emergency response capabilities. In addition, critical facility operators may need to alter standard management practices and actively manage resources, particularly in water-related service sectors.

4.6 Communicable Disease

CPRI SCORE = 2.8

Description and History

Communicable diseases, sometimes called infectious diseases, are illnesses caused by organisms such as bacteria, viruses, fungi and parasites. Sometimes the illness is not due to the organism itself, but rather a toxin that the organism produces after it has been introduced into a human host. Communicable disease may be transmitted (spread) either by: one infected person to another, from an animal to a human, from an animal to an animal, or from some inanimate object (doorknobs, table tops, etc.) to an individual. A pandemic is a global disease outbreak. Human diseases, particularly epidemics, are possible throughout the nation and Missoula County is not immune to this hazard. In addition, livestock and animal disease could have a devastating effect on the economy and food supply in Missoula County and beyond. Highly contagious diseases are the most threatening to both populations.

Communicable disease or biological agents could be devastating to the population or economy of Missoula County. Human diseases when on an epidemic scale, can lead to high infection rates in the population causing isolation, quarantines and potential mass fatalities. Diseases that have been eliminated from the U.S. population, such as smallpox, could be used in bioterrorism.

The following list gives examples of biological agents or diseases that could occur naturally or be used by terrorists as identified by the Centers for Disease Control and Prevention (2011).

Category A

Definition - The U.S. public health system and primary healthcare providers must be prepared to address various biological agents, including pathogens that are rarely seen in the United States. High-priority agents include organisms that pose a risk to national security because they:

- Can be easily disseminated or transmitted from person to person;
- Result in high mortality rates and have the potential for major public health impact;
- Might cause public panic and social disruption; and
- Require special action for public health preparedness.

Agents/Diseases:

- Anthrax (Bacillus anthracis)
- Botulism (Clostridium botulinum toxin)
- Plague (Yersinia pestis)
- Smallpox (variola major)
- Tularemia (Francisella tularensis)
- Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo])

Category B

Definition - Second highest priority agents include those that:

- Are moderately easy to disseminate;
- Result in moderate morbidity rates and low mortality rates; and
- Require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance.

Agents/Diseases:

- Brucellosis (Brucella species)
- Epsilon toxin of Clostridium perfringens
- Food safety threats (e.g., Salmonella species, Escherichia coli O157:H7, Shigella)
- Glanders (Burkholderia mallei)
- Melioidosis (Burkholderia pseudomallei)
- Psittacosis (Chlamydia psittaci)
- Q fever (Coxiella burnetii)
- Ricin toxin from Ricinus communis (castor beans)
- Staphylococcal enterotoxin B
- Typhus fever (Rickettsia prowazekii)
- Viral encephalitis (alphaviruses [e.g., Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis])
- Water safety threats (e.g., Vibrio cholerae, Cryptosporidium parvum)

Category C

Definition - Third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of:

- Availability;
- Ease of production and dissemination; and
- Potential for high morbidity and mortality rates and major health impact.

Agents:

- Emerging infectious diseases such as Nipah virus and hantavirus

These diseases/bioterrorism agents can infect populations rapidly, particularly through groups of people in close proximity such as schools, assisted living facilities, and workplaces.

Historically, the Spanish influenza outbreak after World War I in 1918-1919 caused 9.9 deaths per 1,000 people in the State of Montana (Brainerd and Siegler, 2002). Historical records from newspapers show that the influenza outbreak was so bad in 1918 that residents were quarantined from November 30 to December 17 after 18 people died and 53 new cases were discovered.

Influenza is a highly contagious viral infection of the nose, throat, and lungs that occurs most often in the late fall, winter, and early spring. It is a serious infection that affects between 5-20 percent of the U.S. population annually. Each year, more than 200,000 individuals are hospitalized and 3,000-49,000 deaths occur from influenza-related complications (IDSA, 2016). The Montana Department of Public Health and Human Services (DPHHS), maintains statistics of influenza cases in Montana counties. Recent data for Missoula County is summarized below:

- 2012-2013 season: 516 influenza cases in the County with 15 fatalities across the State.
- 2013-2014 season: 262 influenza cases in the County with 8 fatalities across the State.
- 2014-2015 season: 429 influenza cases in the County with 33 fatalities across the State.
- 2015-2016 season: 458 influenza cases in the County with 24 fatalities across the State.

Norovirus is the leading cause of illness and outbreaks from contaminated food in the United States. Most outbreaks happen when infected people spread the virus to others. Health care facilities, including nursing homes and hospitals, are the most commonly reported settings for norovirus outbreaks.

Montana DPHHS manages a database of reportable communicable disease occurrences. The communicable disease summary for Missoula County between 2006 and 2015 is presented in **Table 4.6-1.**

Table 4.6-1. Missoula County Communicable Disease Summary

Disease	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Vaccine Preventable Diseases										
Hepatitis C, chronic	62	-	-	-	-	-	130	125	91	110
Legionella	2	-	-	2	-	-	1	-	-	1
Meningitis, viral	-	1	3	-	1	-	-	-	-	-
Meningococcal	-	1	-	1	1	1	3	-	1	1
Pertussis	12	2	10	3	20	9	23	14	-	2
Strep Pneumonia	-	-	-	-	3	-	7	-	-	1
Tuberculosis	1	-	2	-	-	-	-	-	-	-
Varicella	-	9	6	-	5	8	9	2	4	12
Enteric Diseases										
Campylobacter	13	20	23	27	25	29	15	14	16	38
Cryptosporidiosis	68	7	9	6	9	14	7	7	9	8
E Coli	7	4	1	9	6	2	3	5	5	11
Giardia	8	15	10	34	32	14	15	11	13	17
Salmonella	10	12	9	12	13	13	17	9	7	12
Shigella	-	3	-	5	-	2	1	1	-	3
Other Communicable Diseases										
Rabies	3	1	1	2	1	-	1	2	-	4
STD	261	297	295	365	404	402	457	412	577	540
Tick Fever, Lyme	-	1	2	-	-	3	2	2	1	2
West Nile Virus	2	1	-	-	-	-	-	-	-	-

Source: Montana DPHHS Communicable Disease Summaries, 2006 – 2015
Notes: STD = Sexually Transmitted Disease

According to the Montana Department of Livestock, known livestock and animal diseases such as Foot and Mouth, Bovine Spongiform Encephalopathy (Mad Cow Disease), Exotic Newcastle, Rabies, Scabies, and Brucellosis could have damaging effects on the livestock population. Losses from these diseases would be devastating and could have an economic effect county-wide.

Vulnerability and Area of Impact

Diseases threaten the population, plants, and animals of Missoula County as opposed to structures. The entire population is at risk for contracting disease. The more urban nature of Missoula makes it

more vulnerable to rapidly spreading and highly contagious diseases than other more rural parts of the County. In addition, tourist visits in the county could introduce a disease to the local population as could local residents traveling abroad who return with a communicable disease. The number of fatalities in the county would depend on the mortality (disease/agent attack) rate and the percentage of the population affected. The ability to control the spread of disease will be dependent on the contagiousness of the disease and movement of the population.

Given the uncertain nature of diseases, Missoula County is assumed to have the same communicable disease risk county-wide.

Probability and Magnitude

The magnitude of a communicable disease outbreak varies from common viral outbreaks to widespread bacterial infection. During the 1918 influenza pandemic, infection rates approached 28 percent in the United States (Billings, 1997). Other pandemics produced infection rates as high as 35 percent of the total population (WHO, 2009). Such a pandemic affecting Missoula County represents a severe magnitude event. Almost any communicable disease that enters the regional population could overwhelm local health resources as would any rapidly spreading bioterrorism event for which there is no available vaccine or containment capability.

While the U.S. saw an Ebola outbreak in 2014, news of an Ebola virus for the state of Montana was minimal. Montana DPHHS said the likelihood of Ebola showing up in Montana is small.

Montana's local and state public health officials are monitoring developments regarding Zika virus closely. At this time, the impact of Zika in Montana will likely be confined to individuals returning from or planning travel to Zika-affected areas and Montana's mosquitoes are not expected to be able to transmit the virus.

The probability of an epidemic in Missoula County is difficult to assess based on history and current data. Individual infectious diseases will likely be reported on an annual basis giving this hazard a probability rating of "highly likely". The PDM Planning Team rated the probability of a major communicable disease outbreak affecting Missoula County as "likely".

Future Development

There are no land use regulations for future development that relate to the communicable disease hazard. New residents and population add to the number of people threatened in the county, but the location of such population increases would not increase their vulnerability to the hazard.

Climate Change

Many prevalent human infections are climate sensitive. In some cases, this is in part because the disease is transmitted by mosquitoes which cannot survive if temperatures are too low. For others, climate restricts where an infection can occur because it limits the distribution of other species that are required for disease transmission.

Although some evidence indicates that warming may be causing infectious disease to spread, predicting how climate change will ultimately influence the incidence of diseases transmitted by

insects remains challenging. More predictable as climate change unfolds is the spread of so-called waterborne infections. These infections most often cause diarrheal illness and flourish in the wake of heavy rainfalls as runoff from land enters into and may contaminate water supplies. Many pathogens that cause diarrheal disease reproduce more quickly in warmer conditions as well (Harvard School of Public Health, 2016).

The effects of climate change on the communicable disease hazard are mainly to the population. Outbreaks of insect- and water-borne infection associated with higher temperatures and/or flooding could increase population exposure; especially vulnerable would be the young and elderly. Property and critical facilities are not expected to have an increase in exposure or vulnerability due to the effects of climate change on communicable disease.

4.7 Avalanche

CPRI SCORE = 2.5

Description and History

Avalanches come in many shapes and sizes and even small ones can be dangerous. According to the U.S. Forest Service National Avalanche Center (http://www.fsavalanche.org/), there are three types of avalanches:

1) Slab avalanches: Most people that die in avalanches, die in slab avalanches. Slab avalanches occur when a more cohesive or harder layer of snow sits on top of a less cohesive or softer and weaker layer of snow. Sometimes the weak layer can barely support the layers above it and when additional weight like a skier or snow boarder is added to the upper layers, the weak layer collapses and the snowpack fractures and a slab avalanche occurs. Slab avalanches often involve large volumes of fast moving snow. Victims, like the skiers, typically trigger slabs at mid-slope below the fracture line which often makes escape very difficult.

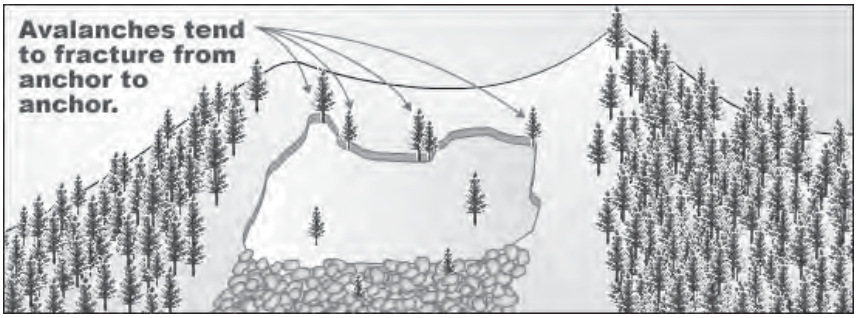
2) Sluffs or loose snow avalanches: Sluffs are cold snow powdery surface slides that typically are the least dangerous type of slide; however, sluffs can and often do injure skiers and boarders by pushing them over cliffs and rock bands in steep terrain.

3) Wet avalanches: Wet slides occur when warm temperatures melt the surface snow layers and saturate them with water. The water weakens the bonds between layers and avalanches often occur. Wet avalanches move more slowly than dry avalanches but they can still be very dangerous.

The West Central Montana Avalanche Center provides pre-season avalanche information updates beginning in November, scheduled avalanche advisories three times a week from December through March. They also provide extra avalanche updates/bulletins/special advisories during this period, as needed.

Ninety percent of all avalanches occur on moderate slopes with an angle of 30 to 45 degrees (snow tends not to accumulate on steeper slopes). Avalanches occur when the gravity pushing the collection of snow at the top of the slope is greater than the strength of the snow itself. A change in temperature, a loud noise, or vibrations are all that are necessary to trigger one of these snowfalls that begin at a "starting zone." Artificial triggers of avalanches include skiers, snowmobiles, and controlled explosive work. The avalanche continues downslope along the "track" and ultimately the avalanche fans out and settles in the "runout zone."

Avalanche initiation can start at a point with only a small amount of snow moving initially; this is typical of wet snow avalanches or avalanches in dry unconsolidated snow. However, if the snow has sintered into a stiff slab overlying a weak layer then fractures can propagate very rapidly, so that a large volume of snow, that may be



thousands of cubic meters, can start moving almost simultaneously. Avalanche fracture lines tend to run from anchor to anchor because they are stress concentration points (http://www.fsavalanche.org/encyclopedia/)

Table 4.7-1 lists avalanche incidents in Missoula County that have caused injuries or fatalities, followed by a description of two recent avalanches from the West Central Montana Avalanche Center (missoulaavalanche.org).

Table 4.7-1. Missoula County Avalanches

Date	Location	Summary
6/14/2010	Lolo Peak, Montana	1 skier caught, carried into rocks, killed
12/29/2010	Rattlesnake Wilderness, 1 air mile NE of MT Snowbowl Ski Area	2 skiers caught and partially buried in two separate avalanches.
3/4/2012	Lake Marshall near Seeley Lake	1 snowmobiler completely buried and 1 rider partially buried. No fatalities.
1/14/2013	West Aspect of Point Six, N. of MT Snowbowl Ski Area	1 Skier caught and fully buried while skiing the area locally known as Evaro Bowl. Skier sustained a minor leg injury.
2/28/2014	Mount Jumbo, Missoula	1 snowboarder caught and self-arrested, 1 child caught and partially buried, 1 child caught and fully buried, recovered with injuries, and 2 residents fully buried and recovered with injuries, 1 later died from injuries.
12/27/2014	North Fork Placid Creek near Seeley Lake	4 snowmobilers caught, 2 partially buried, 2 completely buried. No fatalities.

Source: CAIC, 2016; avalanche.org; missoulaavalanche.org

June 14, 2010 - On June 14, 2010, Christopher Spurgeon, a 37 year old backcountry skier from Missoula, died while skiing a steep north facing couloir off the north summit of Lolo Peak. He was skiing solo and there were no witnesses to the accident. Based on reports from experienced backcountry skiers/mountaineers who found him, evidence at the site suggests that Chris was entrained in a wet, loose snow avalanche with no chance for escape. He lost a ski, fell and was dragged through exposed rock talus near the terminus of the avalanche path. He sustained severe head injuries and died immediately (missoulaavalanche.org).

February 28, 2014 - At approximately 4:15 pm, a snowboarder triggered a hard slab avalanche on a west facing, 35 degree slope of Mount Jumbo, located within the Missoula City limits on Missoula Conservation District land. The snowboarder was caught by the avalanche but able to self-arrest by digging in with the edge of his board and using his arms and fingers to grab the bed surface as the snow passed by. The avalanche entrained most of the available snow in the fetch zone and accelerated as it advanced over a terrain convexity halfway down the track.

At the base of the ravine, the avalanche caught two children, Phoenix and Coral Scoles-Coburn, ages 8 and 10, who were playing in their backyard as it slammed into and destroyed a two story wood frame home. The two residents of the home, Fred Allendorf, 66, and his wife Michel Colville, 68, were inside the house when it was hit.

The two children saw and heard the avalanche coming down the ravine and ran downslope toward their home. Both were caught and carried several feet before coming to rest next to their home. Coral was partially buried, up to her armpits, and was able to dig herself out quickly. Phoenix was completely buried next to the house about 3 feet deep. Fred and Michel were together in their home and were also completely buried under several feet of snow and debris from their destroyed home.

At 4:18 pm, Missoula City Fire, Police, Missoula County Sheriff, MT Highway Patrol units and local EMS teams were dispatched. A large contingent of well-equipped neighbors with avalanche rescue gear soon began arriving on scene. Rescue coordination was complicated by live power lines, broken natural gas lines and the very real possibility of another avalanche.

Spot probing began and a probe line formed near the home just below Phoenix's last seen point. Phoenix described being in the dark and unable to move his arms after being buried. He stated that he tried eating and chewing away at the snow until he became so tired that he fell asleep. He was located 3-4 feet deep by a probe strike after approximately 55 minutes at 5:09 pm. When extricated from the snow, he was unresponsive. Rescue breaths were given and he was immediately transported by ground ambulance to Saint Patrick Hospital's Emergency Department.

Looking downslope from the foundation of the destroyed home.
Source: missoulaavalanche.org

Rescue efforts then concentrated on spot probing and digging in areas directly below the last known location of Allendorf and Colville. A neighbor showed rescue teams the probable location on the remaining foundation of where the couple may have been. Probe teams were directed to concentrate on possible catchment features on the fall line below this area of the house. A probe strike was confirmed and Allendorf was located at 5:58 pm in a cavity under a brick chimney and a wall or roof partition approximately 4 feet deep. He was responsive and able to inform rescuers that his wife was 3 feet from him when the house was hit. He was extricated and transported by ground ambulance to Saint Patrick Hospital's Emergency Department.

At 7:07 pm, Colville was located by a responding neighbor with a probe. An earlier probe detected a soft spot where a sofa was removed. This location was re-probed after a few minutes and a probe strike confirmed as Colville. She was approximately 25 feet below her husband's location 2-3 feet deep. Colville was breathing but unresponsive. Extricated at 7:14 pm, she was transported to Saint Patrick Hospital's Emergency Department in critical condition. She died on March 3 from traumatic injuries.

Three other homes, several vehicles and an apartment building were also damaged by the avalanche.

<u>Events Leading Up To The Avalanche</u>

Four friends, ages 13-27, wanting to take advantage of a rare day when schools were closed, decided to snowboard or ski the untracked west face of Mount Jumbo. Earlier storms had deposited enough snow on the low elevation terrain in the mountains surrounding Missoula to allow for unique skiing and riding opportunities within walking distance of many residents. Near record snowfall was recorded by NOAA Weather Service Missoula Office at the Missoula airport during February. Mount Sentinel, above the University of Montana and south of Mount Jumbo, had been skied and ridden earlier in the week and was heavily tracked.

The sledders planned to hike to the summit and meet the snowboarder at the base of the mountain. They all described the wind as severe at the ridge top with poor visibility from the blowing and drifting snow. The snowboarder was several hundred feet behind the sledders when they began their descent next to a large group of trees.

View from Jackson and Holly Street Intersection.
Source: missoulaavalanche.org

The snowboarder reached a point above the slide path and opted not to push toward the summit as the wind was making travel difficult at best. He strapped on his board, entered the slide path at the highest point where there was adequate snow, and immediately fell. He got back up and noticed movement in his peripheral vision and realized he was being carried downslope by an avalanche. He was at the top of the slab and able to self-arrest by digging in with the edge of his board and using his arms and fingers to grab the bed surface as the snow passed by.

The sledders were near the base of the mountain to the north of the slide path. At least one of them saw a powder cloud and heard the avalanche slam into the home. They immediately went to the site and began digging for the buried child. Shortly after this the snowboarder walked down the slide path and also assisted with the initial rescue effort. (missoulaavalanche.org).

Vulnerability and Area of Impact

Avalanches are dangerous natural phenomena to the winter sport industry that threaten the safety of recreationists, primarily in back country locations. But, as was seen in the Rattlesnake Canyon residential area in Missoula in 2014, avalanches also have the potential to impact residences and critical facilities located beneath steep slopes, and the occupants of these structures. Both Mount Jumbo and Mount Sentinel are steep slopes above highly populated areas of Missoula. The Seeley-Swan and Lolo Pass areas of Missoula County exhibit a greater vulnerability to avalanche in Missoula County due to their steep slopes and high level of winter recreational.

In recent years, Montana has seen thinner snowpack and big ranges between daytime and nighttime temperatures. With these conditions, the structure of snow crystals can transform into "sugar" snow which doesn't bond well to other snow crystals. This can create a weak layer in the snowpack that lasts all season long, and can cause some slopes to slide two and three times as the weak layer persists. Conditions like this mean that Montana may see prolonged periods of avalanche danger and more fatalities (www.climatechangemt.org).

Probability and Magnitude

The size and frequency of avalanches are related to a number of factors, including increases in air temperatures and the 24 hour-period after a heavy snowfall: both of which can create unstable snow layers that are more likely to slide. **Table 4.7-2** presents avalanche events with reported damages from the SHELDUS database.

Table 4.7-2. Missoula County Avalanche Events with Damages

Date	Injuries	Fatalities	Property Damage (2016 $)	Crop Damage (2016 $)	Remarks
12/29/2010	1	1	$0	$0	Avalanche
6/18/2011	1	0	$170,638	$0	Avalanche
2/28/2014	2	1	$325,322	$0	Avalanche
TOTAL	**4**	**2**	**$495,960**	**$0**	

Source: SHELDUS, 2016 (adjusted to 2016 dollars); NCDC, 2016.

The PDM Planning Team rated the probability of a significant avalanche as "possible", an event that would occur more than once per 100 years but not more than once a decade.

No vulnerability analysis for the avalanche hazard is provided since Missoula County has not completed mapping designating areas vulnerable to avalanche. Much of the county is mountainous and steep slopes border some residential areas; however, much of the avalanche activity is human-caused and not associated with a specific area. The avalanche hazard does not affect Missoula County in a uniform manner and therefore, loss data for the general building stock, critical facilities, and population is not provided.

Future Development

Missoula County subdivision regulations do not currently prevent new construction in avalanche prone areas. There is currently no disclosure requirement for properties located in areas subject to avalanche.

Climate Change

While it is hard to tell the exact results that climate change will have on avalanches, one possibility includes an increase in the number of avalanches from current levels and the duration of high avalanche danger, followed by an eventual drop-off if snow-pack continues to decline over time.

Average winter temperatures in Montana have increased by more than 3 degrees over the past century, which has led to more rain-on-snow events and long-term declines in snowpack. These warming trends have the potential for creating the "right" conditions for avalanches. A warming climate in Montana has already meant more winter days above the freezing point, which can lead to a significantly wetter snowpack - possibly resulting in wet, as opposed to dry, avalanches. http://www.climatechangemt.org/learn/climate-impacts-in-montana/avalanches/

4.8 Earthquake

CPRI SCORE = 2.05

Description and History

An earthquake is ground shaking and radiated seismic energy caused most commonly by a sudden slip on a fault, volcanic or magmatic activity, or other sudden stress changes in the earth. An earthquake of magnitude 8 or larger on the Richter Scale is termed a great earthquake. Montana has not experienced a great earthquake in recorded history. A major earthquake (magnitude 7.0-7.9) occurred near Hebgen Lake (Gallatin County) in 1959 and dozens of active faults have generated magnitude 6.5-7.5 earthquakes during recent geologic time.

The earthquake hazard is defined as any physical phenomenon associated with an earthquake that may produce adverse effects on human activities. This includes surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, tsunami, and seiche and their effects on land use, manmade structures, and socioeconomic systems. Populations have little or no warning prior to an earthquake, so the impact to that population could be considered high with little time to take protective actions.

Earthquakes are measured by two variables, magnitude and intensity. The magnitude of an earthquake, as measured on the Richter scale, reflects the energy release of an earthquake. The intensity of an earthquake is gauged by the perceptions and reactions of observers as well as the types and amount of damage. The intensity of an earthquake is rated by the Modified Mercalli Scale. This scale ranks the intensity from I to XII. An earthquake rated as a I, would not be felt except by very few people under especially favorable circumstances. An intensity rating of XII on the other hand would result in total destruction. Damage is predicted to be slight in buildings designed especially for the seismic zone. Buildings not constructed to meet the standards for the seismic zone would experience considerable damage with partial collapse.

Montana ranks fifth in the nation in terms of number of historic earthquakes greater than magnitude 6. A map from the Montana Bureau of Mines and Geology (MBMG) website shows the location and magnitude of earthquakes in Montana. Missoula County lies on the western edge of what is called the Intermountain Seismic Belt. This belt of seismicity extends from western Montana south to southern Nevada. Earthquake density within the Intermountain Seismic Belt is anomalous within North America, and eight of the 16 largest historic earthquakes in the belt occurred in Montana (Stickney, 2007).

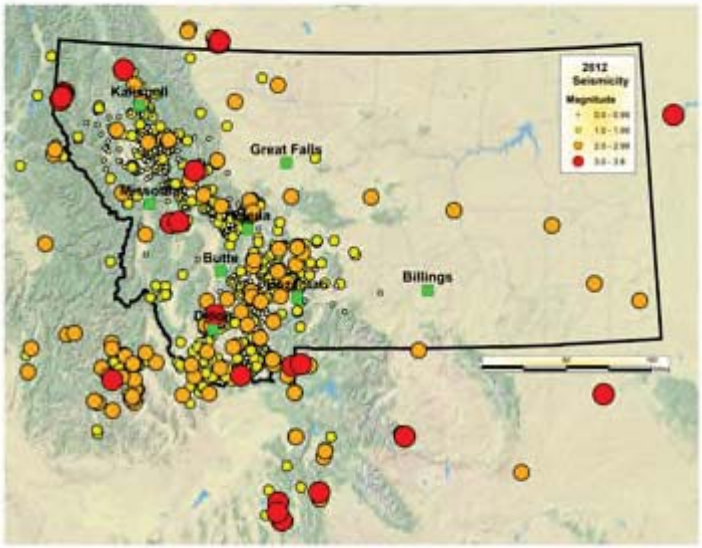


Table 4.8-1 presents the historic earthquakes which have occurred in Montana and surrounding region since 1900 with a magnitude of 5.5 or greater. Although one significant earthquake occurred in eastern Montana in 1909, the majority have occurred along the Intermountain Seismic Belt and Centennial Tectonic Belt in western Montana.

Table 4.8-1. Historic Earthquakes of Montana and Surrounding Regions with Magnitudes of 5.5 or Greater Since 1900

Date	Magnitude	Approximate Location	Date	Magnitude	Approximate Location
05/16/1909	5.5	Northeast Montana	08/18/1959	6.0	Hebgen Lake
06/28/1925	6.6	Clarkston Valley, MT	08/18/1959	5.6	Hebgen Lake
02/16/1929	5.6	Clarkston Valley, MT	08/18/1959	6.3	Hebgen Lake
10/12/1935	5.9	Helena	08/19/1959	6.0	Hebgen Lake
10/19/1935	6.3	Helena	10/21/1964	5.6	Hebgen Lake
10/31/1935	6.0	Helena	06/30/1975	5.9	Yellowstone Park
07/12/1944	6.1	Central Idaho	12/08/1976	5.5	Yellowstone Park
02/14/1945	6.0	Central Idaho	10/28/1983	7.3	Challis, ID
09/23/1945	5.5	Flathead Valley	10/29/1983	5.5	Challis, ID
11/23/1947	6.1	Virginia City	10/29/1983	5.5	Challis, ID
04/01/1952	5.7	Swan Range	08/22/1984	5.6	Challis, ID
08/18/1959	7.5	Hebgen Lake	07/26/2005	5.6	Beaverhead County
08/18/1959	6.5	Hebgen Lake			

Source: Stickney and others, 2000

Vulnerability and Area of Impact

Missoula County is considered to be a region of low seismicity and therefore has a low earthquake hazard (Qamar and Stickney, 1983). According to Mike Stickney of the MBMG, Missoula County is west of the main part of the Intermountain Seismic Belt and is thus devoid of larger historical quakes (earthquakes greater than 5.5 in magnitude on the Richter Scale).

Seismic activity within Missoula County in historic times has been limited to earthquakes of magnitude 5.0 or less (ANSS, 2003 in Atkins, 2011). Earthquakes of magnitude 4.0 or greater have been recorded along the Ninemile Fault and Swan Fault (**Figure 8**). Two earthquakes of 5.0 magnitude occurred near Seeley Lake in 1947 and 1950 along the Swan Fault. This fault extends north of the County boundary and was the source of a 5.7 magnitude Flathead County earthquake in 1952. Between 1974 and 1976 there were scattered small earthquakes along the Ninemile Divide northwest of Missoula. According to Qamar (1983), these small quakes northwest of Missoula may be caused by the Ninemile Fault, which probably extends southwest to Missoula along the Clark Fork River. The Jocko and Bitterroot Faults have had a notable lack of earthquake activity and the Bitterroot Fault is considered aseismic (Qamar, 1983).

The U.S. Geological Survey (USGS) National Seismic Hazard Mapping Project has created peak ground acceleration maps that show the strength of seismic shaking with a 10 percent probability of being exceeded in a 50 year period. The strength of the shaking is measured as a percent of the acceleration of gravity (%g). **Figure 8** shows peak ground acceleration maps for Missoula County indicate that the southwestern half of Missoula County is at less risk from earthquake damage than the northeastern half (southern Seeley-Swan Valley and Mission Mountains).

Table 4.8-2. Earthquake Zones in Missoula County

Zone	Location within Missoula County	Percentage of the Acceleration of Gravity
Zone 1	South and west of Greenough, Montana (including Missoula, Lolo and the Ninemile Valley)	7.5 - 15% g
Zone 2a	North of Greenough, Montana (including the southern Seeley-Swan Valley)	15 - 20% g
Zone 2b	Northwest of Condon, Montana (including the eastern portion of the Mission Mountains)	20 - 30% g

Source: Stickney et al, 2000.

According to Qamar (2008), at 9.2%g the earthquake is felt by all with many frightened. Some heavy furniture is moved with a few instances of fallen plaster. Damage is considered slight. At 18%g, damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly-built or badly designed structures. Some chimneys may be broken, and the shaking is noticed by people driving cars. At 34%g, damage is slight in specially designed structures, considerable in ordinary substantial buildings with partial collapse, and great in poorly built structures. Chimneys and walls may fall and heavy furniture is overturned.

Probability and Hazard Magnitude

Earthquake damages can be hard to predict and assess without detailed structure information or a damage model. The FEMA HAZUS-MH earthquake loss estimation model was used in the 2011 Missoula County PDM Plan to model the effect an earthquake would have on Missoula County critical facilities. HAZUS-MH is a software program that uses mathematical formulas and information about building stock, local geology and the location and size of potential earthquakes, economic data, and other information to estimate losses from a potential earthquake. The model earthquake used for analysis was a magnitude 5.0 earthquake that occurred on the Swan fault in the Seeley Swan Valley of Missoula County in 1947 and 1950. The earthquake simulation and loss estimate was based on default building and income data in the HAZUS earthquake model and no user specific data was incorporated in the model to develop a refined loss estimate. Estimated losses were expected to be $2.32 million allowing for structural, content and business inventory loss, and income related losses. The losses all occur in the Clearwater and upper Blackfoot River areas (Atkins, 2011).

To complete the earthquake vulnerability analysis for the 2017 PDM Plan, GIS was used to intersect the USGS peak ground acceleration maps with both the critical facility and MDOR cadastral parcel datasets. Estimates of vulnerable population were calculated by determining the percent exposure in each census block for the hazard area. Exposure values are presented in **Table 4.8-3**.

Table 4.8-3. Missoula County Vulnerability Analysis; Earthquake (21-30%g)

Category	Missoula County (balance)	City of Missoula	Missoula County Total
Residential Property Exposure $	$107,982,938	$0	$107,982,938
# Residences At Risk	600	0	600
Commercial, Industrial & Agricultural Property	$4,412,830	$0	$4,412,830
# Commercial, Industrial & Agricultural	28	0	28
Critical Facilities Exposure Risk $	$208,096	$0	$208,096
# Critical Facilities At Risk	3	0	3
Bridge Exposure $	$1,371,391	$0	$1,371,391
# Bridges At Risk	3	0	3
Persons At Risk	1,058	$0	1,058
Persons Under 18 At Risk	177	0	177

GIS analysis of the earthquake risk to Missoula County indicates that 101,100 acres (6.0 percent) are located within the shaking zone (peak horizontal acceleration) over 21 to 31%g. According to the vulnerability analysis, 600 residences, 28 commercial, industrial and agricultural buildings 3 critical facilities are located in the 21-30% g zone. The *Earthquake Section* in **Appendix C** presents supporting documentation from the risk assessment including a list of critical facilities and bridges in the various seismic zones.

The greatest activity on the Intermountain Seismic Belt passes to the east and south of Missoula County and it is most likely that future earthquakes that affect Missoula will be centered at some distance away within the more seismically active region. Most of the county has low seismic risk based on the peak ground acceleration probabilities. Based on this, critical facilities and vulnerable populations are considered to have a low probability for impacts from seismic shaking. Because Missoula County is rated as having a low seismic risk; the probability of future earthquakes causing significant damage is rated as "unlikely" (less than 1 event every 100 years).

Future Development

The Missoula County and the City of Missoula have adopted the 2012 International Building Code (IBC). Seismic provisions found in the IBC are what are required for new commercial construction. Compliance with the IBC is enforced through the building permit system, which means new buildings will better withstand earthquakes and the accompanying liquefaction hazard.

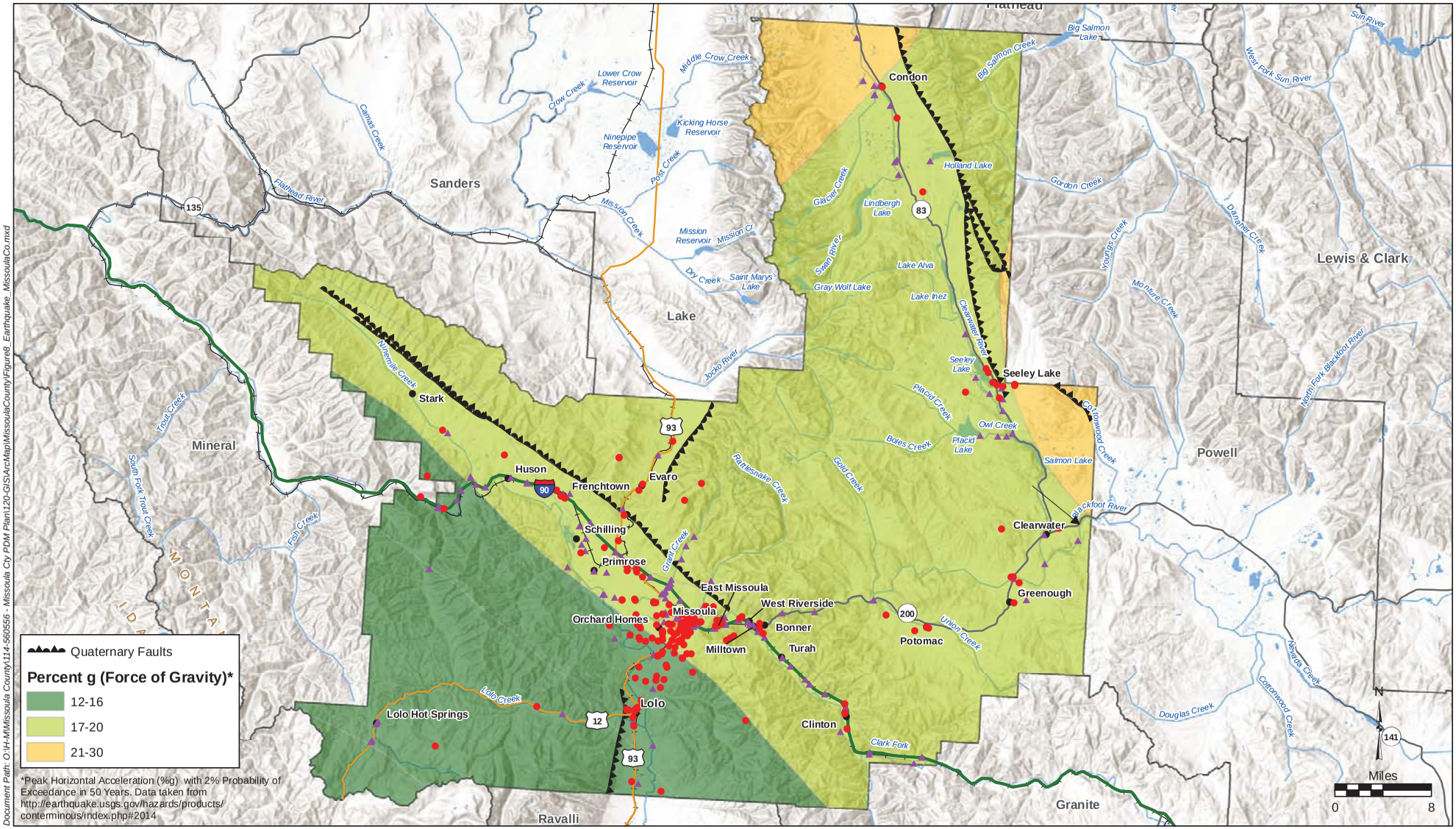
The IBC does not cover single-family residences. The State of Montana has adopted the International Residential Code (IRC), 2012 edition for one and two family residences and townhouses. Local jurisdictions (cities, counties and towns) can elect to become certified to take on enforcement of single-family residences. Both Missoula County and the City of Missoula are certified to enforce these building codes.

Climate Change

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events.

Because impacts on the earthquake hazard are not well understood, increases in exposure and vulnerability of the local resources are not able to be determined.



Document Path: O:\H-M\Missoula County\114-560556 - Missoula Cty PDM Plan\120-GIS\ArcMap\MissoulaCountyFigure8_Earthquake_MissoulaCo.mxd

Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Figure 8
Earthquake Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan

4.9 Dam Failure

CPRI SCORE: 2.65

Description and History

Dams have been placed around Montana for many reasons including recreation, flood control, irrigation, water supply, hydroelectricity, and mining. Dams are built and owned by a variety of entities such as private individuals, utilities, and the government. Dams come in all shapes and sizes from small earthen dams to large concrete structures. The structural integrity of a dam depends on its design, maintenance, and weather/drainage situation. Problems arise when a dam fails and people and/or property lie in its inundation area. Dams can fail for a variety of reasons including seismic activity, poor maintenance, overwhelming weather and flow conditions, or by an intentional act. Dam failure can be compared to riverine or flash flooding in the area downstream from the dam, and sometimes for long distances from the dam, depending on the amount of water retained and the drainage area. Other dams may be located in areas that result in little if any damages during a failure.

The U.S. Army Corps of Engineers, National Inventory of Dams (NID) website keeps a record of dams across the country. Montana DES also keeps an extensive library of Emergency Action Plans for the state's high hazard dams. Hazard ratings are given to those dams for emergency management planning purposes. These ratings, high, significant, and low, are based on the potential for loss of life and property damage from the failure of the dam, not the condition or probability of the dam failing, as described in **Table 4.9-1.**

Table 4.9-1. Hazard Ratings for Dams

Rating	Description
Low Hazard Potential	Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
Significant Hazard Potential	Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
High Hazard Potential	Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Source: National Inventory of Dams, 2016

Missoula County has four high hazard dams and two stormwater detention ponds that are typically empty but if full would be classified as high hazard dams. There are several dams located in adjoining counties that if breached would have the potential to impact Missoula County. Removal of the Milltown dam has increased the risk of inundation from upstream dams impacting Missoula County.

Table 4.9-2 presents details on these dams and **Figure 9** shows their location.

Table 4.9-2. High-Hazard Dams in and with Potential to Impact Missoula County

Dam Name	County	Drainage	Dam Height (feet)	Normal Storage (acre-ft)	Year Completed	Type	Owner
Black Lake Dam	Missoula	Middle Fork Jocko River	0	5,200	1967	Earth	CSKT
Blixit Creek Dam	Missoula	Blixit Creek	30	92	1961	Earth	Earl Pruyn
Issac Creek Dam	Missoula	Issac Creek	32	125	1948	Earth	G. Von Der Ruhr
Jocko Dam	Missoula	Middle Fork Jocko River	0	8,869	1937	Earth	CSKT
Spartan/Playfair Park Retention Basins	Missoula	Off-stream	8	115.6	2003	Earth	City of Missoula
Lake Como Dam	Ravalli	Rock Creek	70	40,700	1910	Earth	Bitterroot Irrigation Dist.
West Fork (Painted Rocks) Dam	Ravalli	West Fort of Bitterroot River	143	45,100	1940	Earth	State of MT - DNRC
East Fork Reservoir Dam	Granite	East Fork Rock Creek	105	16,040	1938	Earth	State of MT – DNRC
Lower Willow Creek Dam	Granite	Lower Willow Creek	85	4,930	1962	Earth	Lower Willow Cr Drainage District
Flint Creek Dam	Granite	Flint Creek	44.5	31,040	1905	Earth	Granite County
Nevada Creek Dam	Powell	Nevada Creek	105	11,152	1938	Earth	State of MT - DNRC

Source: DNRC, 2016; Atkins, 2011. Notes: CSKT = Confederated Salish Kootenai Tribe

Mountain Water Company owns the Rattlesnake Creek Dam, just upstream from the Lincoln Hills subdivision in Missoula, and eight dams on lakes in the Rattlesnake Wilderness Area. The dams were built in the early 1900s, and are earthen, with a mix of rocks and woods. Crews help maintain trails, take vegetation off the tops of dams, and do regular checkups. They check the lakes to make sure that the ice isn't jamming and having water flow over the top.

There is no record of a dam failure in Missoula County. There have been no federal disaster declarations issued to Missoula County for dam failure.

Vulnerability and Area of Impact

Dams with the highest risk to life and property were they to breach are rated as high hazard dams. Those areas directly downstream from high hazard dams would be the most vulnerable to loss of life and structural damage. **Figures 9 and 9A** present the inundation areas associated with the high hazard dams in Missoula County and the City of Missoula, respectively. Missoula County OEM has EAPs for some of these dams and conducts regular exercises with dam owners and other emergency response personnel.

The Milltown dam, formerly blocking the Clark Fork and Blackfoot Rivers, was a high-hazard dam in Missoula County. The dam was removed in 2006-2008 along with 2.6 million cubic yards of contaminated reservoir sediments. Removal of the accompanying Champion International Company Dam on the Blackfoot River was completed in 2006. The EPA was ready to release a cleanup plan that left the dam and sediments in place when, in January 1996, an ice jam broke loose on the Blackfoot River and sent an enormous flow of ice and debris toward Milltown Reservoir. Worried

dam operators opened the floodgates, saving the dam but sending a huge plug of highly polluted, ice-scoured reservoir sediments downstream (Missoulian, *Milltown Dam Removal Plan Finalized*, December 21, 2004). With the removal of the Milltown dam, failure of various upstream dams in Granite and Powell counties have the potential to impact more of Missoula County than when the Milltown dam was in place. These dams, listed above in **Table 4.9-2**, will need their Emergency Action Plans (EAPs) updated in the near future to accurately assess downstream vulnerabilities. The State of Montana plans to remap the area upon full project completion which includes channel and floodplain restoration on the Upper Clark Fork (FEMA, 2015).

Areas within western Missoula and community of Lolo have a very high potential for structural damages and injuries/fatalities associated with failure of the Lake Como Dam and/or Painted Rocks Reservoir Dam in Ravalli County. According to the 1988 Missoula County Flood Insurance Study (referenced in Atkins, 2011), failure of the Painted Rocks Dam during the probably maximum flood would cover most of Big Flat and the Stone Container ponds. With this dam failure, there would be over 12 hours for flood water to reach the Kona Bridge at the Bitterroot River in west Missoula. Painted Rocks is 92 miles from Lolo and under a clear-weather breach would approach a 100-year flood at Lolo and flood low lying areas in and around Lolo and Buckhouse Bridge. Modeled flooding of a Como Dam breach extends to two mile north of Big Flat; beyond that point, the flood would be confined to low lying areas. There would be 23 hours for flood water to reach the Bitterroot River at Lolo if there was a failure of Como Dam.

The East Fork Dam is 80 miles upstream of Missoula and under a clear-weather breach would flood low-lying areas near Clinton and Turah with flood waters about 2 feet above 100-year base flood elevations at Turah (Atkins, 2011).

Probability and Magnitude

The dam failure hazard area is shown in **Figures 9 and 9A**. These maps consist of digitized dam inundation areas available in Emergency Action Plans that were compiled during completion of the 2013 Montana PDM Plan. No inundation maps were available for the high-hazard Blixit Creek dam. The dam failure hazard area was intersected with the critical facility and MDOR parcel datasets using GIS (**Tables 4.9-3**). Vulnerable population was calculated based on the percentage of flood risk area in each census block.

Table 4.9-3. Missoula County Vulnerability Analysis; Dam Failure

Category	Missoula County (balance)	City of Missoula	Missoula County Total
Residential Property Exposure $	$307,569,247	$175,032,807	$482,602,054
# Residences At Risk	1,541	1,230	2,771
Commercial, Industrial & Agricultural Property	$37,131,330	$101,488,843	$138,620,173
# Commercial, Industrial & Agricultural	98	156	254
Critical Facilities Exposure Risk $	$2,787,520	$26,595,226	$29,382,746
# Critical Facilities At Risk	6	6	12
Bridge Exposure $	$36,567,302	$0	$36,567,302
# Bridges At Risk	24	0	24
Persons At Risk	10,313	7,902	18,215
Persons Under 18 At Risk	2,503	1,722	4,225

The GIS analysis indicates that 32,595 acres in Missoula County (1.9 percent) are located in the dam inundation hazard area including 2,771 residences, 254 commercial, industrial and agricultural buildings, and 12 critical facilities. This analysis has similar limitations as those described for flooding. The *Dam Failure* section in **Appendix C** presents supporting documentation from the risk assessment including the critical facilities and bridges located in the dam inundation hazard area.

A dam breach could cause significant losses and casualties. Circumstances causing a breach could be structural failure, earthquakes, terrorism, or even a major landslide. Of the dams affecting Missoula County, Painted Rocks Reservoir Dam (in Ravalli County) has the greatest potential to damage property, highway infrastructure, transportation systems, utility infrastructure, and cause the greatest number of deaths. Modeled flooding using a Clear Weather Breach showed that portions of Lolo would be flooded from a dam breach (DNRC, 2004).

Design standards for dams and spillways typically exceed 500 year return intervals for flooding and earthquakes; therefore, the likelihood for a breach to occur are very low. Based on lack of past events, the probability of dam failure in Missoula County is rated as "unlikely"; an event that occurs less than once per 100 years.

Future Development

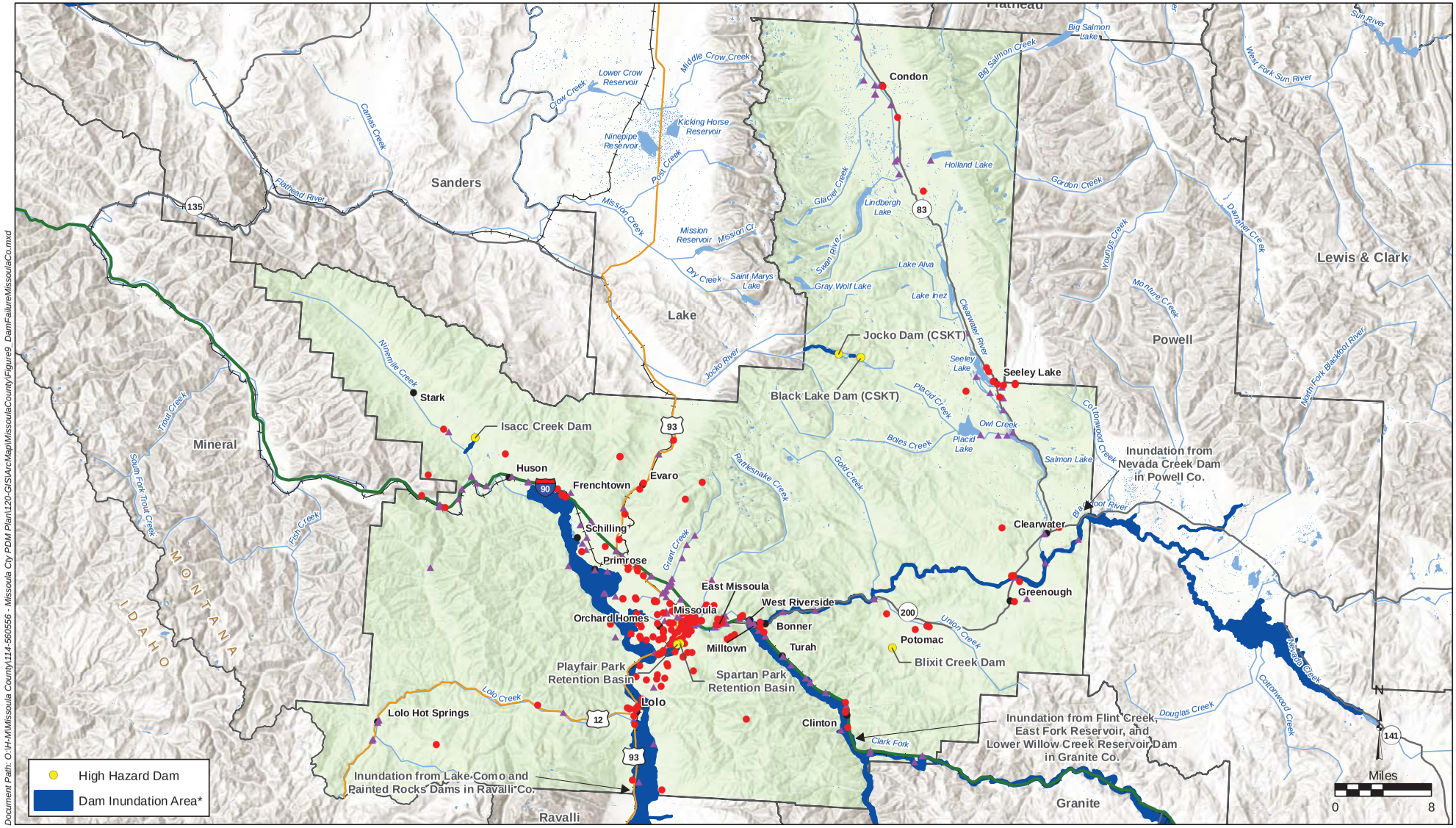
Missoula County subdivision regulations do not currently prevent new construction in dam inundation areas. There is currently no disclosure requirement for properties located within a dam inundation area.

Climate Change

Small changes in rainfall, runoff, and snowpack conditions may have significant impacts for water resource systems, including dams. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Population and property exposure and vulnerability to the dam failure hazard is unlikely to change as a result of climate change. The exposure and vulnerability of critical facilities are unlikely to change as result of climate change. Dam owners and operators may need to alter maintenance and operations to account for changes in the hydrograph and increased sedimentation.



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*Dam Hazard Areas as determined by Inundation Maps in high hazard dam Emergency Action Plans. Depiction is only as accurate as the maps provided in the plan (Area visible not to scale - Area has been exaggerated for display purposes).
No inundation map available for Blixt Creek Dam.

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Figure 9
Dam Failure Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan

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Date: 11/28/2016

Legend

- Critical Facility
- Bridge

Figure 9A

City of Missoula
Dam Failure Hazard Area
Missoula County, Montana
Pre-Disaster Mitigation Plan

4.10 Risk Assessment Summary

This section summarizes the results of the individual risk assessments presented under the hazard profiles. There have been five repetitive loss properties (RLP) due to flooding in Missoula County and one RLP within the City of Missoula which has been mitigated. Neither Missoula County nor the City of Missoula have repetitive loss properties associated with other hazards. Annual loss estimates are presented for each hazard where damage data is available. Future development projects in Missoula County are discussed as they relate to the hazard areas.

Vulnerability Analysis - Loss Estimation Summary

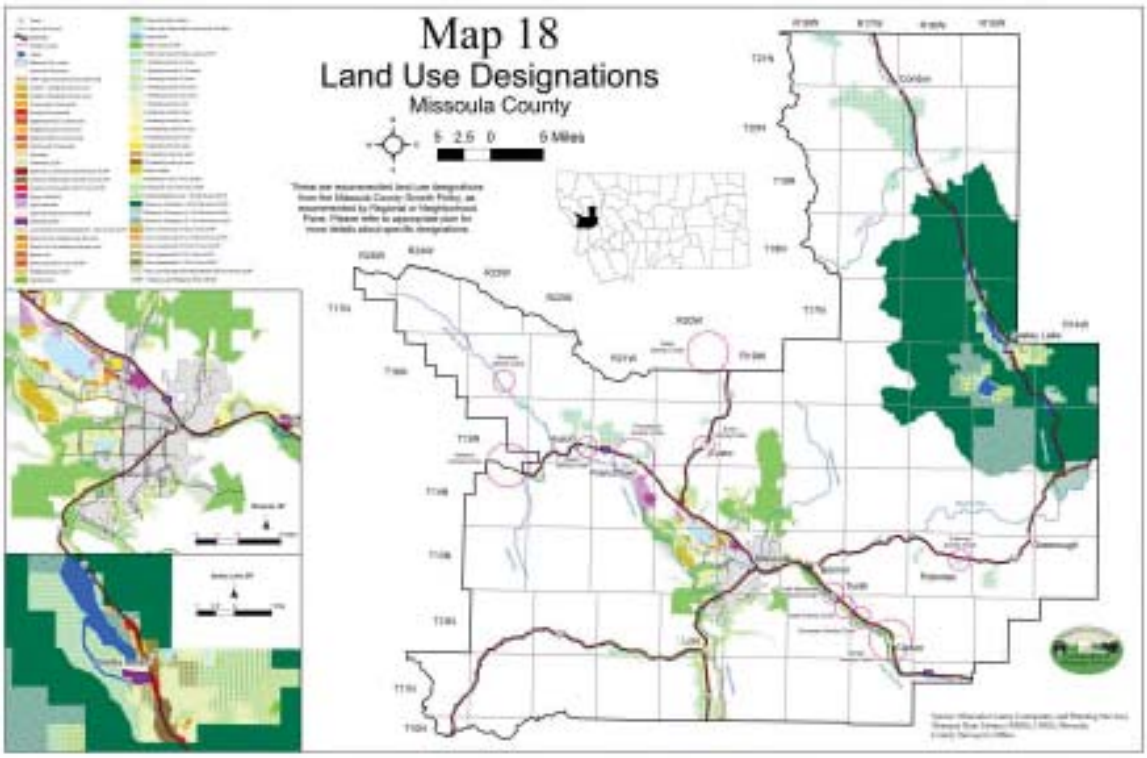
Estimating potential losses and calculating risk requires evaluating where hazard areas and vulnerabilities to them coincide, how frequently the hazards occur, and then estimating the magnitude of damage resulting from a hazard event. Rather than estimating loss, a vulnerability assessment was completed which estimates building stock exposure. *Section 4.1* presents the methodology for the vulnerability assessment completed for the 2017 PDM Plan. **Tables 4.10-1 and 4.10-2** present the results of the vulnerability assessment for the each hazard for residential and commercial/ industrial/agricultural structures, critical facilities, bridges, and population in Missoula County and the City of Missoula. **Appendix C** contains supporting information.

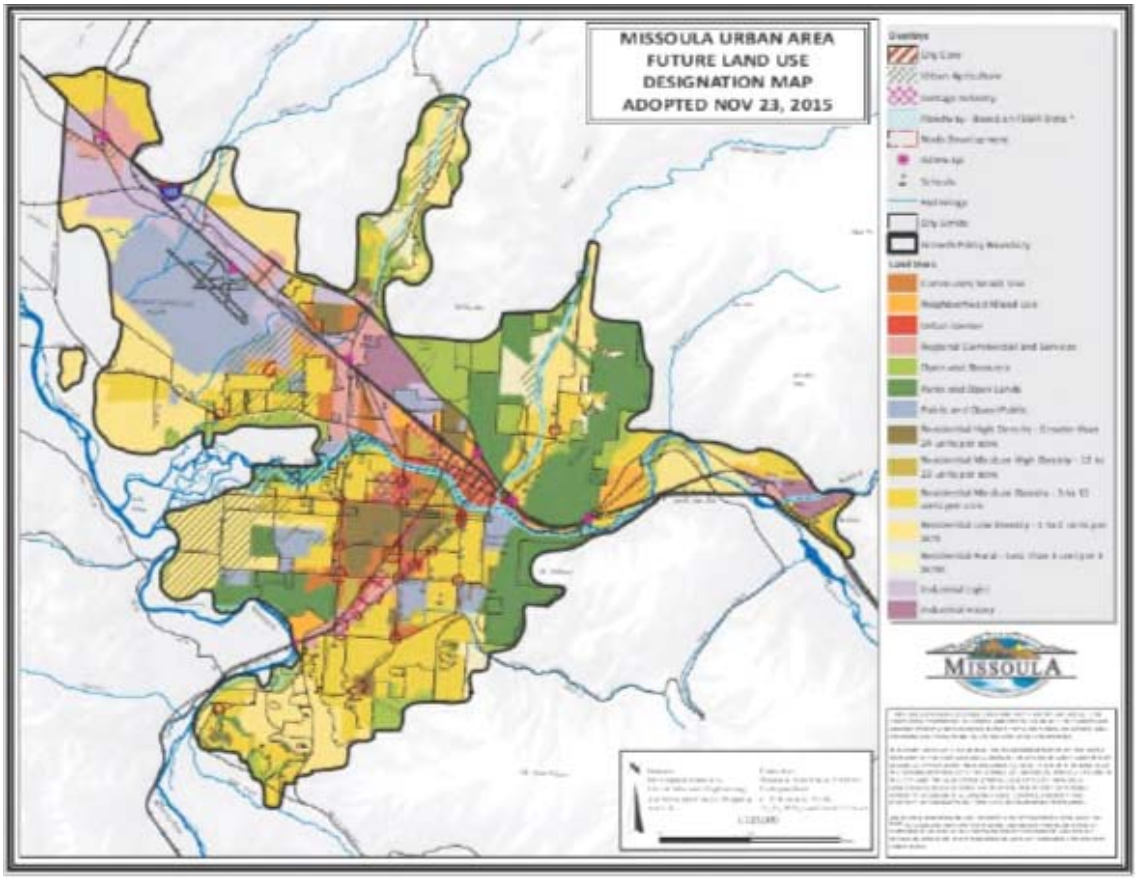
Composite Hazard Map and Future Development

Figures 10 and 10A present the composite of hazard prone areas in Missoula County and the City of Missoula which is an overlay of the wildfire, hazardous material, flooding, earthquake, and dam failure hazard areas.

The Missoula County and City of Missoula Growth Policies, outline areas for where future development may take place. These areas are shown on **Figures 10 and 10A,** as described below. These maps can be used to help locate future development outside hazard-prone areas.

- County - Alberton Activity Circle
- County - Clinton Activity Circle
- County - Donovan Activity Circle
- County - Evaro Activity Circle
- County - Frenchtown Activity Circle
- County - Huson Activity Circle
- County - Ninemile Activity Circle
- County - Potomac Activity Circle
- County - Turah Activity Circle
- County - Turah Int. Activity Circle
- County Residential - North of I-90 from Frenchtown to Huson
- County Residential - Seeley Lake Area
- County Residential - South of Condon
- County Residential -West of City of Missoula


Map 18
Land Use Designations
Missoula County
5 2.5 0 5 Miles


MISSOULA URBAN AREA
FUTURE LAND USE
DESIGNATION MAP
ADOPTED NOV 23, 2015
MISSOULA

- City Heavy Industrial l - Dark Purple on Future Land Use Map
- City Light Industrial – Light Purple on Future Land Use Map
- City Commercial – Pink on Future Land Use Map
- City Residential – Yellow/Gold/Brown on Future Land Use Map

Table 4.10-3 indicates which hazards each of the future development areas are exposed to.

Table 4.10-1. Hazard Vulnerability Summary; Missoula County (balance without City)

Hazard	Residential Building Stock - $ Exposure in Hazard Area	# Residential Structures in Hazard Area	Commercial, Industrial & Agricultural Building Stock - $ Exposure in Hazard Area	# Commercial, Industrial & Agricultural Structures in Hazard Area	Critical Facility $ Exposure in Hazard Area	# Critical Facilities Exposure in Hazard Area	Bridge Exposure $	# Bridges in Hazard Area	Persons in Hazard Area	Under 18 in Hazard Area
Wildfire	$2,624,077,721	14,349	$428,219,524	1,221	$189,970,747	104	$150,997,489	127	35,080	8,237
Hazardous Material Incidents/ Railroad Derailments	$738,180,278	4,695	$345,246,995	785	$77,310,241	49	$90,617,975	83	22,597	5,527
Flooding	$51,792,145	337	$1,510,380	31	$1,987,434	3	$73,252,344	46	614	178
Severe Weather & Drought	$2,617,552,181	14,333	$430,557,507	14,333	$191,423,682	14,333	$118,860,631	14,333	14,333	14,333
Communicable Disease	$2,617,552,181	14,333	$430,557,507	14,333	$191,423,682	14,333	$118,860,631	14,333	14,333	14,333
Avalanche	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Earthquake	$107,982,938	600	$4,412,830	28	$208,096	3	$1,371,391	3	1,058	177
Dam Failure	$307,569,247	1,541	$37,131,330	98	$2,787,520	6	$36,567,302	24	10,313	2,503

NOTES:

Critical facility replacement values were estimated where not provided by the City/County.

There are some inherent inaccuracies using a percentage of census block population to compute the number of individuals living in the hazard area. More persons than actually reside in the hazard area may be calculated where census blocks are large.

NA = Not Analyzed. Avalanche-prone areas were not established for this analysis.

Table 4.10-2. Hazard Vulnerability Summary; City of Missoula

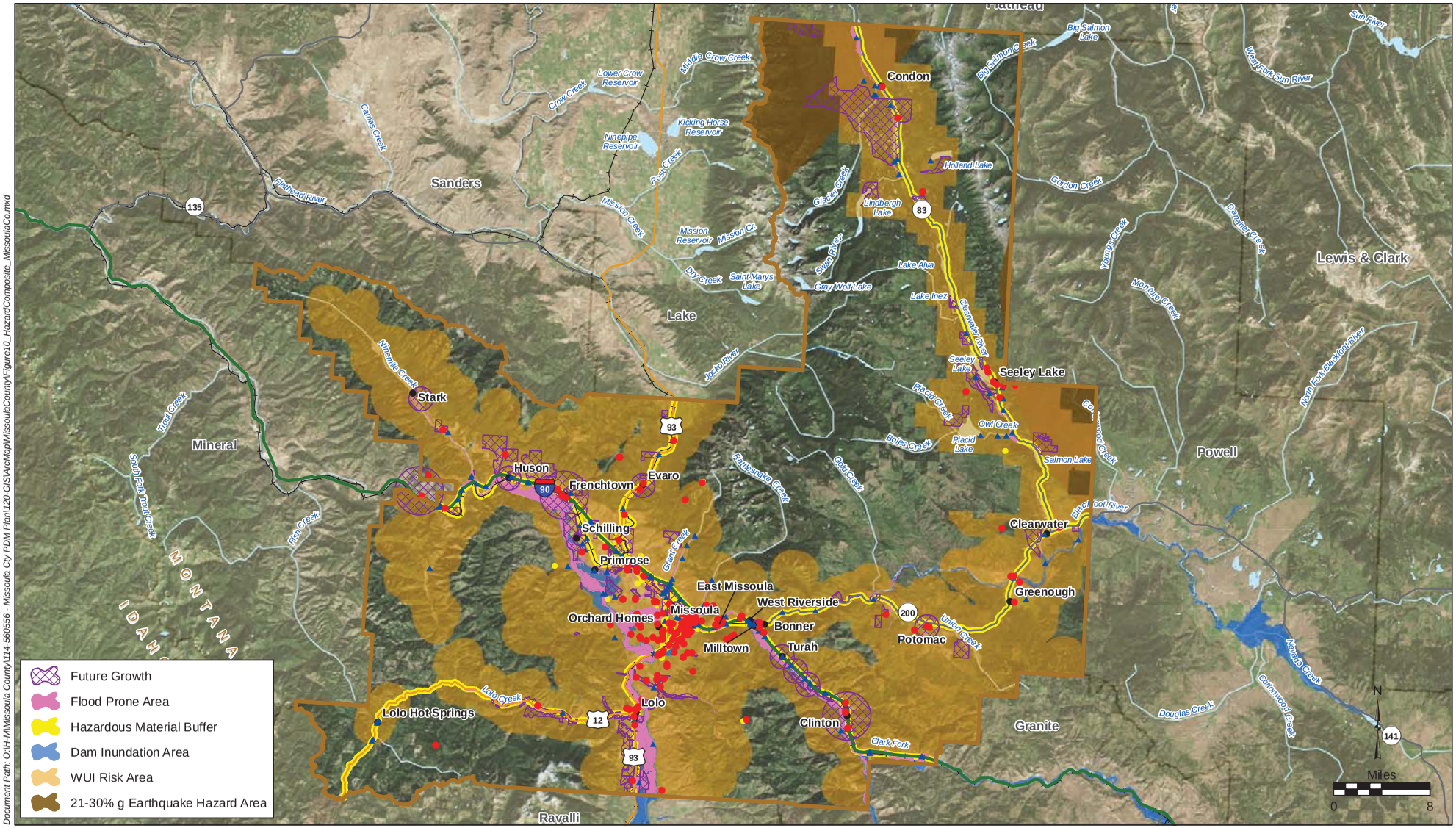
Hazard	Residential Building Stock - $ Exposure in Hazard Area	# Residential Structures in Hazard Area	Commercial, Industrial & Agricultural Building Stock - $ Exposure in Hazard Area	# Commercial, Industrial & Agricultural Structures in Hazard Area	Critical Facility $ Exposure in Hazard Area	# Critical Facilities Exposure in Hazard Area	Bridge Exposure $	# Bridges in Hazard Area	Persons in Hazard Area	Under 18 in Hazard Area
Wildfire	$2,919,107,711	16,514	$1,687,426,720	2,940	$869,202,523	70	$7,171,555	33	73,210	13,460
Hazardous Material Incidents/ Railroad Derailments	$919,654,514	6,693	$1,433,041,603	2,421	$713,384,970	49	$38,404,450	29	43,480	6,891
Flooding	$14,006,703	25	$735,150	4	$0	0	$20,241,339	16	46	13
Severe Weather & Drought	$2,992,188,468	17,051	$1,749,919,848	3,148	$912,281,957	73	$39,308,413	33	74,386	13,634
Communicable Disease	$2,992,188,468	17,051	$1,749,919,848	3,148	$912,281,957	73	$39,308,413	33	74,386	13,634
Avalanche	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Earthquake	$0	0	$0	0	$0	0	$0	0	0	0
Dam Failure	$175,032,807	1,230	$101,488,843	156	$26,595,226	6	$0	0	7,902	1,722

NOTES:

Critical facility replacement values were estimated where not provided by the City/County.

There are some inherent inaccuracies using a percentage of census block population to compute the number of individuals living in the hazard area. More persons than actually reside in the hazard area may be calculated where census blocks are large.

NA = Not Analyzed. Avalanche-prone areas were not established for this analysis.



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Critical Facility
- Bridge
- Place
- County Seat
- Interstate
- U.S. Highway
- Montana Highway
- Railroad
- Lake/Reservoir
- River/Stream
- County Boundary

Date: 12/4/2016

Figure 10

Hazard Composite & Future Development

Missoula County, Montana

Pre-Disaster Mitigation Plan

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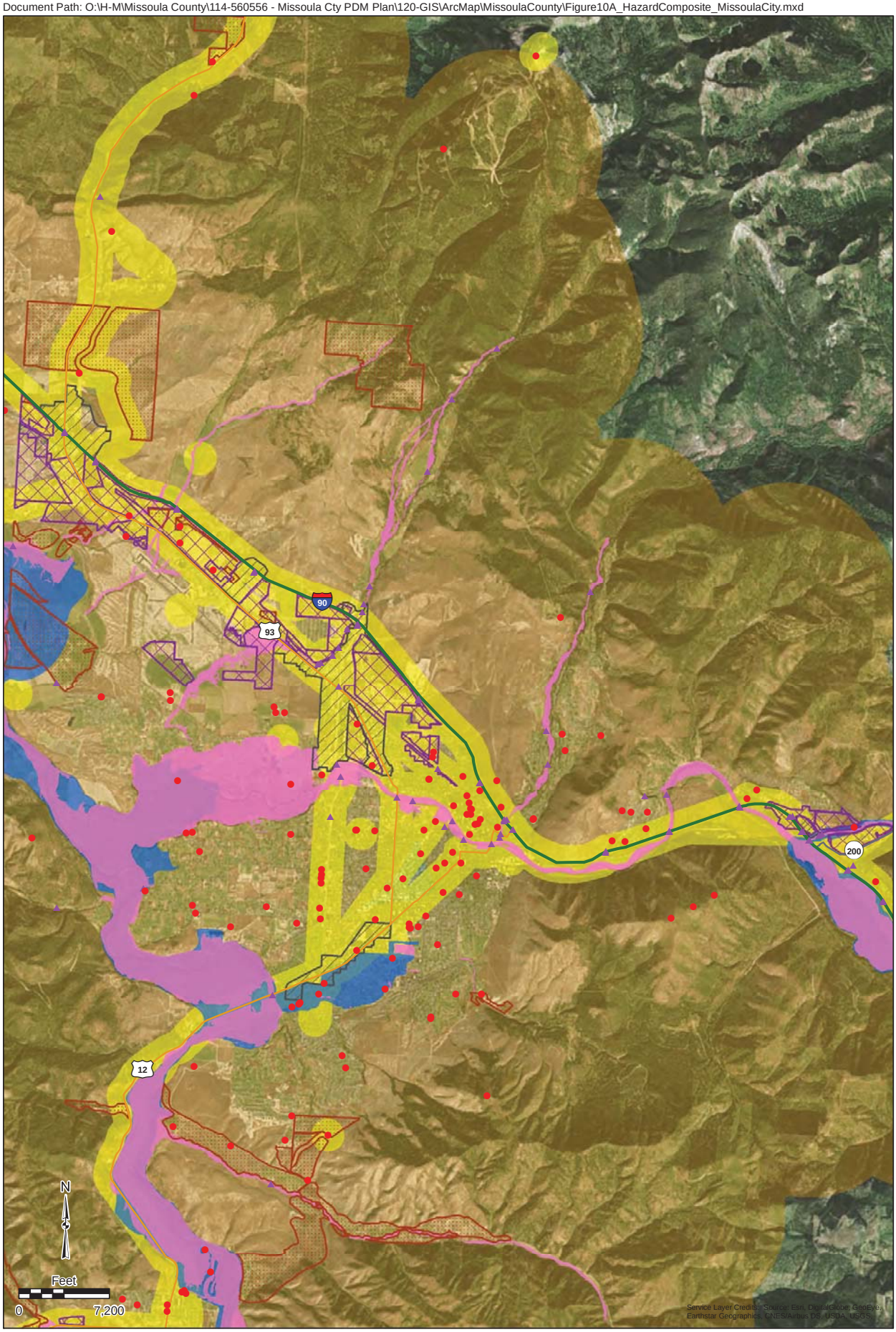

Date: 3/1/2017

Legend

- Critical Facility
- Bridge

Future Development

- Commercial Growth
- Industrial Growth
- Residential Growth

- Flood Prone Area
- Dam Inundation Area
- Hazardous Material Buffer
- WUI Risk Area

Figure 10A
City of Missoula
Hazard Composite & Future Development
Missoula County, Montana
Pre-Disaster Mitigation Plan

Table 4.10-3. Future Development Summary

Proposed Project	Hazard Areas							
	Wildfire	Haz-Mat Inc./ Railroad Derailments	Flooding	Severe Weather & Drought	Commun-icable Disease	Avalanche	Earthquake	Dam Failure
Alberton Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	No
Clinton Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Donovan Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Evaro Activity Circle	Yes	Yes	No	Yes	Yes	No	No	No
Frenchtown Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Huson Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	No
Ninemile Activity Circle	Yes	No	Yes	Yes	Yes	No	No	No
Potomac Activity Circle	Yes	Yes	No	Yes	Yes	No	No	No
Turah Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Turah Interchange Activity Circle	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Residential - North of I-90 Frenchtown/Huson	Yes	No	Yes	Yes	Yes	No	No	No
Residential - Seeley Lake Area	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Residential - South of Condon	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Residential - West of City of Missoula	Yes	Yes	Yes	Yes	Yes	No	No	Yes
City Heavy Industrial	Yes	Yes	Yes	Yes	Yes	No	No	Yes
City Light Industrial	Yes	Yes	Yes	Yes	Yes	No	No	Yes
City Commercial	Yes	Yes	Yes	Yes	Yes	No	No	Yes
City Residential	Yes	Yes	No	Yes	Yes	No	No	No

SECTION 5. MITIGATION STRATEGIES

This section presents mitigation actions for Missoula County and the City of Missoula to reduce potential exposure and losses from natural and man-made hazards. The PDM Planning Team reviewed the Risk Assessment to identify and develop the mitigation actions comprising the Missoula County mitigation strategy.

This section includes:

1. Background and Past Mitigation Accomplishments
2. General Mitigation Planning Approach
3. Mitigation Goals and Objectives
4. Capability Assessment
5. Mitigation Strategy Development

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.
Mitigation actions can include activities such as: revisions to land-use planning, training and education, and structural and nonstructural safety measures.

5.1 Background and Past Mitigation Accomplishments

In accordance with DMA 2000 requirements, a discussion regarding past mitigation activities and an overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and activities outlined in this Plan. The County, through previous and ongoing hazard mitigation activities, has demonstrated that it is pro-active in protecting its physical assets and citizens against losses from natural hazards. Ongoing and mitigation projects completed since the 2011 PDM Plan was adopted include the following:

Wildfire

- Missoula County continues to identify, maintain, update and support high priority fuel treatment areas within the WUI for hazardous fuel treatment by private landowners. **Table 5.1-1** presents the accomplishments of the Landowner Fuel Mitigation Program run through the Bitter Root RC&D and Blackfoot Challenge, a 50/50 cost-share grant funded through DNRC. Landowner fuel mitigation projects are also administered through the Clearwater Resource Council, Frenchtown RFD, and the Missoula RFD.

Table 5.1-1. Bitter Root RC&D and Blackfoot Challenge Fuel Mitigation Program Accomplishments in Missoula County - 2011 to 2016

Year	Program	Landowners	Acres Treated	Total Cost	Grant Funding Payments	Total Cost/Acre	Grant Cost/Acre
2011	RC&D	30	227.6	$255,345	$151,806	$1,122	$667
	BC	3	31.5	$67,749.99	$33,875.00	$2,150.79	$1,075.40
	Total	33	259.1	$323,094.99	$185,681.00	$1,246.99	$716.64
2012	RC&D	63	341.6	$530,087	$252,998	$1,552	$741
	BC	12	110.8	$134,844.22	$67,422.11	$1,217.01	$608.50
	Total	75	452.4	$664,931.22	$320,420.11	$1,469.79	$708.27
2013	RC&D	47	342.9	$451,907	$214,791	$1,318	$626
	BC	13	218	$160,309.73	$80,154.87	$735.37	$367.68
	Total	60	560.9	$612,216.73	$294,945.87	$1,091.49	$525.84

Table 5.1-1. Bitter Root RC&D and Blackfoot Challenge Fuel Mitigation Program Accomplishments in Missoula County - 2011 to 2016

Year	Program	Landowners	Acres Treated	Total Cost	Grant Funding Payments	Total Cost/Acre	Grant Cost/Acre
2014	RC&D	25	214.7	$193,306	$94,084	$900	$438
	BC	8	99.05	$102,408.70	$50,268.10	$1,033.91	$507.50
	Total	33	313.75	$295,714.70	$144,352.10	$942.52	$460.09
2015	RC&D	26	128	$172,374	$70,438	$1,347	$550
	BC	8	94	$119,597.00	$64,212.25	$1,272.31	$683.11
	Total	34	222	$291,971	$134,650	$1,315.18	$606.53
2016	RC&D	37	144.4	$142,862	$56,825	$989	$394
	BC	4	72.5	$72,491.96	$36,245.98	$999.89	$499.94
	Total	41	216.9	$215,353.96	$93,070.98	$992.87	$429.10
TOTAL		**276**	**2025.05**	**$2,403,283**	**$1,173,120**	**$1,176**	**$574.41**

Sources: Bitter Root RC&D (RC&D), 2016; Blackfoot Challenge (BC), 2016.

- Missoula County has compiled maps showing completed fuel treatment projects and associated project data which will update vulnerability and support future grants.
- Missoula County OEM has worked with cooperating agencies to complete risk mapping which will be used in updating the CWPP and population protection plans.
- Missoula County has been successful in receiving grants for fuel mitigation on private land including funding from the FireWise organization, the Secure Rural School Title III program, and from a FEMA-HMGP grant.
- Completing the Marshall Grade wildfire mitigation project was a significant accomplishment.
- The Volunteer Fire Departments have used the existing CWPP to target education towards landowners in high priority WUI areas. During the fire season extensive outreach is conducted in cooperation with the U.S. Forest Service, DNRC, and Missoula County Fire Protection Association.
- Missoula County OEM and the VFDs continue to encourage the use of fire-resistant materials/design of non-combustible homes in the county.
- The framework has been created for formalized agreements for fire response in unprotected land in Missoula County lands.

Flooding

- Missoula County has been using their subdivision regulations to regulate development within unmapped flood prone and channel migration zones.
- Floodplain modeling has been completed for all subdivisions in unmapped drainages.
- New digital flood insurance rate maps were adopted in 2015 along with a new Floodplain Ordinance.
- In 2011, a FEMA grant was received to purchase a home which had repeatedly flooded on Power Street. The house was burned down as a training exercise for the fire dept.

All Hazards

- Missoula County OEM has provide targeted education and information to public officials on hazard mitigation by making presentations at commissioner and council meetings.
- Missoula County OEM provides day-to-day coordination with Community and Planning Services to assist with comprehensive planning to mitigate disasters.

5.2 General Mitigation Planning Approach

The overall approach used to update the Missoula County mitigation strategy was based on FEMA guidance regarding local mitigation plan development, including:

- DMA 2000 regulations, specifically 44 CFR 201.6 (local mitigation planning)
- FEMA "Local Mitigation Planning Handbook", March 2013
- FEMA "Integrating Hazard Mitigation into Local Planning", March 2013
- Identifying Mitigation Actions and Implementing Strategies (FEMA 386-3)
- FEMA "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards", January 2013

The mitigation strategy approach includes the following steps that are further detailed in later sections of this Plan:

- Review and update mitigation goals and objectives.
- Identify mitigation capabilities, and evaluate their capacity and effectiveness to mitigate and manage hazard risk.
- Identify past and ongoing mitigation activities throughout the County.
- Identify appropriate county and local mitigation strategies to address the regions risk to natural and man-made hazards.
- Prepare an implementation strategy, including the prioritization of projects in the mitigation strategy.

5.3 Mitigation Goals and Objectives

This section documents the efforts to develop hazard mitigation goals and objectives established to reduce or avoid long-term vulnerabilities to the identified hazards.

According to CFR 201.6(c)(3)(i): "The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards." For the purposes of this plan, goals are general guidelines that explain what is to be achieved. They are usually broad, long-term, policy-type statements and represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).

> FEMA defines ***Goals*** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.
> FEMA defines ***Objectives*** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.
> FEMA defines ***Mitigation Actions*** as specific actions that help to achieve the mitigation goals and objectives.

The 2011 Missoula County PDM Plan had five goals; one goal specific to wildfire, flooding, and earthquake hazards, and two all-hazard goals including communication for hazard warning and developing greater resistance and responsiveness to disasters. For this 2017 PDM update, the Planning Team reviewed the mitigation goals and determined that there should be one goal for each hazard profiled in the Plan and an all-hazard goal. Mitigation goals for the 2017 Plan are presented in **Table 5.3-1**.

Mitigation objectives developed for the original PDM Plan were generally revised for this 2017 update. Where appropriate, mitigation objectives reflect FEMA's "Local Mitigation Planning Handbook, March 2013" guidelines (see *Section 5.5.1*) as either: Public Education and Awareness, Property Protection, Prevention, Structural, Natural Resource Protection, or Emergency Services. Tetra Tech also included an objective for Mapping, Analysis and Planning Projects. Mitigation objectives for the 2017 Plan are presented in **Table 5.3-1**.

Table 5.3-1. Summary of Goals and Objectives for 2017 PDM Plan

Goal #	Goal Statement	Objective #	Objective Statement
1	Reduce Wildland Fire Risk within the WUI	1.1	Conduct mapping/analysis/planning projects to reduce impacts from wildfires
		1.2	Perform property protection projects to reduce impacts from wildfires
		1.3	Implement public awareness and education projects to reduce impacts from wildfires
		1.4	Encourage projects to prevent impacts from wildfire
		1.5	Upgrade emergency service capabilities to reduce impacts from wildfires
2	**R**educe Impacts from Hazardous Materials and Railroad Derailments	2.1	Encourage projects to prevent impacts from haz-mat incidents and derailments
		2.2	Upgrade emergency service capabilities to reduce impacts from haz-mat incidents and derailments
		2.3	Implement public outreach and education projects to reduce impacts from haz-mat incidents and derailments
3	Reduce Exposure to Flooding	3.1	Implement projects to prevent impacts from flooding
		3.2	Implement structural projects to reduce impacts from flooding
		3.3	Conduct mapping/analysis/planning projects to reduce impacts from flooding
		3.4	Implement natural resource protection projects to reduce impacts from flooding
		3.5	Upgrade emergency service capabilities to reduce impacts from flooding
		3.6	Implement public outreach and education projects to reduce impacts from flooding
4	Minimize Impacts from Severe Weather and Drought	4.1	Implement public awareness and education projects to reduce impacts from severe weather and drought
		4.2	Implement property protection projects to reduce impacts from severe weather and drought
		4.3	Implement projects to prevents impacts from severe weather and drought
5	Minimize Impacts from Earthquakes	5.1	Implement property protection projects to reduce impacts from earthquakes
		5.2	Implement public awareness and education projects to reduce impacts from earthquakes
6	Reduce Impacts from Communicable Disease	6.1	Implement public awareness and education projects to reduce impacts from communicable disease
		6.2	Enhance emergency service capabilities to reduce impacts from communicable disease
7	Reduce Impacts from Avalanches	7.1	Implement public awareness and education projects to reduce impacts from avalanches
8	Reduce Impacts from Dam Failure	8.1	Enhance emergency service capabilities to reduce impacts from dam failure

Table 5.3-1. Summary of Goals and Objectives for 2017 PDM Plan

Goal #	Goal Statement	Objective #	Objective Statement
9	Reduce Impacts from All Hazards	9.1	Implement public awareness and education projects to reduce impacts from all hazards
		9.2	Conduct mapping/analysis/planning projects to reduce impacts from all hazards
		9.3	Enhance emergency service capabilities to reduce impacts from all hazards

5.4 Capability Assessment

The goals and objectives used to mitigate natural and manmade hazards build on the community's existing capabilities. Missoula County's capabilities to support and implement mitigation projects include the programs and resources of various local, regional, state, and federal partners and the administrative and technical capabilities of County and City staff who implement the legal and regulatory requirements used to manage growth (zoning, building codes, subdivision regulations, and floodplain ordinances).

Missoula County's hazard mitigation capabilities are summarized below. These resources have the responsibility to provide overview of past, current, and ongoing pre- and post-disaster mitigation projects including capital improvement programs, wildfire mitigation programs, stormwater management programs, and NFIP compliance projects. The fiscal capabilities of the County and City to support hazard mitigation and provide the funding to implement the Missoula County mitigation strategy are also described below.

5.4.1 Summary of Programs and Resources Available to Support Mitigation

A number of programs and resources in Missoula County support mitigation efforts. These are described below.

National Flood Insurance Program (NFIP)

The NFIP is aimed at reducing the impact of flooding on private and public structures. This is achieved by providing affordable insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of Risk Insurance in general, and NFIP in particular.

NFIP Community Rating System

As an additional component of the NFIP, the Community Rating System is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

5.4.2 Administrative and Technical Capabilities

Missoula County's administrative and technical capabilities to implement mitigation projects include community planners, engineers, floodplain managers, GIS personnel, emergency managers, and financial, legal and regulatory requirements. Expertise from local and regional planning partners also contribute to the County's mitigation capabilities. Several of these entities and programs are described below.

Missoula County Office of Emergency Management (OEM)

The mission of the Missoula County OEM is to save lives, prevent injury, and protect property and the environment by taking reasonable and affordable measures to mitigate, prepare for, respond to and recover from disasters. The Missoula County OEM Director is responsible for the planning, coordination, and implementation of all emergency management and Homeland Security related activities for the county. Other responsibilities include coordination of activities for the county's Emergency Operations Center. The EOC, when activated, is a central location where representatives of local government and private sector agencies convene during disaster situations to make decisions, set priorities and coordinate resources for response and recovery. These efforts are designed to enhance the capacity of the local government to plan for, respond to, and mitigate the consequences of threats and disasters using an all-hazard framework.

Missoula County OEM staff includes 3 full-time staff positions, the director, a Deputy DES Coordinator, and a support Services Coordinator, who devote 100 percent of their time to emergency management.

Local Emergency Planning Committee (LEPC)

The mission of the Missoula County LEPC is to provide resources and guidance to the community through education, coordination and assistance in hazmat planning; and to assure public health and safety. They do not function in actual emergency situations, but attempt to identify and catalogue potential hazards, identify available resources, and mitigate hazards when feasible. The LEPC consists of representatives from businesses, local government, emergency responders and citizen groups located in Missoula County. Quarterly meetings are held at the Emergency Operations Center in Missoula.

Missoula Consolidated Planning Board

The mission of the Missoula Consolidated Planning Board is to sustain and improve the health, safety, convenience and welfare of the citizens of Missoula and to plan for the future development of the community. Planning for the optimum land uses and orderly development of Missoula County recognizes: the need for adequate transportation, health, educational and recreational facilities; the needs of agriculture, industry and business as related to future growth; the needs of residential areas to promote and provide healthy surroundings for family life; and, the growth of the community shall be proportionate with and promote the efficient and economical use of public funds.

The Department of Community and Planning Services (CAPS) provides community planning and development services to Missoula County. The Department completes a formal review of development proposals for compliance with the community's goals, objectives and policies as

identified in the Missoula County Growth Policy. CAPS is responsible for the administration of several programs including: zoning; subdivision review; floodplain and shoreline management; growth policy development and implementation; and, community-based and natural resource planning.

Missoula City Developmental Services

The City's Development Services Department, formerly known as the Office of Planning and Grants, handles engineering, permitting, building inspections, floodplain administration, planning, zoning, and transportation. The department has an enforcement role but also a vision and understanding in the community's stake in affordable housing, reuse and redevelopment, sustainability, downtown vitality, trails, and open space, and local food and agriculture.

Missoula County Fire Protection Association (MCFPA)

The Missoula County Fire Protection Association is a voluntary non-profit association of city, rural, state and federal fire professionals, emergency responders, and others who work together to address issues in common. The MCFPA serves as a sounding board for fire prevention and other fire related needs in Missoula County. All fire protection agencies in the County belong to the MCFPA.

Bitter Root Resource Conservation & Development (RC&D)

The Bitter Root RC&D is a non-government, nonpartisan organization comprised of a network of local community volunteers from Missoula, Ravalli and Mineral counties. Councils are composed of local government officials, farmers, ranchers, civic leaders, business leaders and others who are interested in contributing to the overall well-being of the region.

Bitter Root RC&D administers the Hazardous Fuels Reduction Program. This program offers grant funds on a cost-share basis to private landowners who want to perform hazardous fuel reduction work on their land. The effort is made to work in coordination with areas adjacent to U.S. Forest Service and DNRC hazardous fuels reduction projects, thus broadening the area of treatment impact. Local neighborhoods are also encouraged to work together to create a local microcosm of greater fire protection. In order to make this all happen, many partnerships have been developed with federal, state, local and private organizations who have similar goals. The program assists private landowners and communities reduce hazardous fuels while improving forest health on private lands, helps landowners create and maintain defensible space around their homes from wildland fire, and improve the health and vigor of private forest lands. Their goal is to o treat 500 to 700 + acres per year (based on funding supply) of private lands to reduce fire risk and improve forest health, thus protecting lives, property, and other values at risk.

Blackfoot Challenge

The Blackfoot Challenge was formed in 1993 when landowners along the Blackfoot River started gathering community support for conservation and sharing the resource through public and private partnerships. Their mission is to coordinate efforts that conserve and enhance the natural resources and rural way of life throughout the watershed. In 2008, in response to high local interest in forest restoration and fuels mitigation, the Challenge formed the Forestry Committee to prioritize mitigation efforts, strategize on treatments, and increase fire safety in communities. The committee's cooperative work is intended to lead to stronger partnerships across ownerships, creating more resilient forests for the future. In cooperation with the Blackfoot Watershed Fuels Mitigation Task

Force, the Blackfoot Challenge administers a cost-share program to assist private landowners in reducing hazardous forest fuels around homes and along access roads. The goal of this program, funded largely by federal and state dollars, is to improve the safety for fire fighters and residents and reduce the cost of fighting fires.

Clearwater Resource Council

The mission of the Clearwater Resource Council (CRC) is to engage the community and facilitate efforts that will enhance, conserve, sustain, and protect the natural resources and rural lifestyle of the Clearwater Watershed. The CRC is committed to protecting the Seeley Lake community from wildfire and is heavily involved in fuels management efforts in the valley. CRC was recently awarded a Community Fire Protection grant to help landowners with the cost of forest management activities to reduce fire risk. CRS is a member of the Seeley Lake Fuels Mitigation Task Force, a cooperative group, including representatives from Seeley Lake Rural Fire Department, U.S. Forest Service, DNRC, Swan Ecosystem Center, and Bitter Root RC&D. The Task Force offers "one stop shopping" for private land owners who want assistance with thinning their lands. Under this program, landowners typically pay 25-50 percent of the cost of thinning their lands, and the Task Force contributes the remainder.

Montana DNRC and Federal Land Management Agencies

The Forestry Division, of the Montana DNRC is responsible for planning and implementing forestry and fire management programs through an extensive network of staff located in field offices across the state. The Fire and Aviation Management Bureau provides resources, leadership and coordination to Montana's wildland fire services to protect lives, property, and natural resources; working with local, tribal, state, and federal partners to ensure wildfire protection on all state and private land in Montana. There are numerous programs aimed at effective fire preparedness and capacity building. The Fire Preparedness effort is focused in four areas:

- Fire Prevention Program seeks to educate Montanans about fire risk, the wildland urban interface and reducing human-caused fires;
- Fire Training Program provides statewide training opportunities for DNRC and local government personnel;
- Equipment Development Center builds and maintains wildland fire equipment and radio communications;
- Fire Support Programs provide financial and technical expertise to assist all fire programs in meeting their respective goals and mandates. These include, but not limited to: Fire Assessment fees, GIS, repair and maintenance of radio systems and rolling stock equipment.

The U.S. Forest Service and BLM are involved in planning activities for public land area within Missoula County.

FireSafe Montana

FireSafe Montana is a private, non-profit organization coordinating and supporting a statewide coalition of diverse interests working together to help Montanans make their homes, neighborhoods, and communities fire safe. FireSafe Montana actively encourages and assists in the development of local FireSafe councils across the state. These councils are key to raising public awareness of local

wildland fire threats and issues, motivating residents to take positive action, and providing access to the expertise and resources homeowners need to get the job done. When people take personal responsibility for applying and maintaining Firewise practices on their property, they greatly increase the chances of their homes surviving a wildfire.

Through its public information programs and materials, website, newsletter, and special events, as well as its active involvement in federal, state, and local fire mitigation efforts, FireSafe Montana is working hard to reduce the potential loss of life and property from wildfire in Montana. The Seeley-Swan and Clearwater Fuels Mitigation Task Force participate in the organization.

National Fire Prevention Association's (NFPA) FireWise Communities Program

NFPA's Firewise Communities Program encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk. The program is co-sponsored by the U.S. Forest Service, the U.S. Department of the Interior, and the National Association of State Foresters. To save lives and property from wildfire, NFPA's Firewise Communities program teaches people how to adapt to living with wildfire and encourages neighbors to work together and take action now to prevent losses. They advocate playing a role in protecting ourselves and each other from the risk of wildfire.

NOAA Weather-Ready Nation Program

The Weather-Ready Nation (WRN) Ambassador initiative is the National Oceanic and Atmospheric Administration's (NOAA) effort to formally recognize NOAA partners who are improving the nation's readiness, responsiveness, and overall resilience against extreme weather, water, and climate events. As a WRN Ambassador, partners commit to working with NOAA and other Ambassadors to strengthen national resilience against extreme weather. In effect, the WRN Ambassador initiative helps unify the efforts across government, non-profits, academia, and private industry toward making the nation more ready, responsive, and resilient against extreme environmental hazards. WRN is a strategic outcome where society's response should be equal to the risk from all extreme weather, water, and climate hazards.

WRN Ambassadors serve a pivotal role in affecting societal change — helping to build a nation that is ready, responsive, and resilient to the impacts of extreme weather and water events.
To be officially recognized as a WRN Ambassador, an organization must commit to:

- Promoting Weather-Ready Nation messages and themes to their stakeholders;
- Engaging with NOAA personnel on potential collaboration opportunities;
- Sharing their success stories of preparedness and resiliency; and,
- Serving as an example by educating employees on workplace preparedness.

5.4.3 Fiscal Capabilities

Mitigation projects and initiatives are largely or entirely dependent on available funding. Missoula County is able to fund mitigation projects though existing local budgets, local appropriations

(including referendums and bonding), and through a myriad of Federal and State loan and grant programs. A number of these funding opportunities are described below.

FEMA Hazard Mitigation Funding Opportunities

Federal mitigation grant funding is available to all communities with a current hazard mitigation plan (this plan); however most of these grants require a "local share" in the range of 10-25 percent of the total grant amount. The FEMA mitigation grant programs are described below.

FEMA, Hazard Mitigation Grant Program (HMGP). The HMGP is a post-disaster mitigation program. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved Hazard Mitigation Plan (this plan).

Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to Montana DES and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

Flood Mitigation Assistance (FMA) Program. The FMA combines the previous Repetitive Flood Claims and Severe Repetitive Loss Grants into one grant program. FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is 75 percent. At least 25 percent of the total eligible costs must be provided by a non-federal source. Of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. FMA funds are distributed from FEMA to the state. Montana DES serves as the grantee and program administrator for FMA.

FEMA, Pre-Disaster Mitigation Competitive (PDMC) Grant Program**.** The PDM program is an annually funded, nationwide, competitive grant program. No disaster declaration is required. Federal funds will cover 75 percent of a project's cost up to $3 million. As with the HMGP and FMA, a FEMA-approved local Hazard Mitigation Plan is required to be approved for funding under the PDM program.

FEMA, Readiness, Response and Recovery Directorate, Fire Management Assistance Grant Program. This program provides grants to states, tribal governments and local governments for the mitigation, management and control of any fire burning on publicly (non-federal) or privately owned forest or grassland that threatens such destruction as would constitute a major disaster. The grants are made in the form of cost sharing with the federal share being 75 percent of total eligible costs. Grant approvals are made within 1 to 72 hours from time of request.

Fire Prevention and Safety Grants. The Fire Prevention and Safety Grants (FP&S) are part of the Assistance to Firefighters Grants, and are administered by the FEMA. FP&S Grants support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to target high-risk populations and reduce injury and prevent death. Eligibility includes fire departments, national, regional, state, and local organizations, Native American tribal organizations, and/or community organizations recognized for their experience and expertise in fire prevention and safety programs and activities. Private non-profit and public organizations are also eligible. Interested applicants are advised to check the website periodically for announcements of grant availability. More information: https://www.fema.gov/welcome-assistance-firefighters-grant-program

Other Mitigation Funding Opportunities

Grant funding is available from a variety of federal and state agencies for training, equipment, and hazard mitigation activities. Several of these programs are described below.

Program 15.228: Wildland Urban Interface Community and Rural Fire Assistance. This program is designed to implement the National Fire Plan and assist communities at risk from catastrophic wildland fires. The program provides grants, technical assistance, and training for community programs that develop local capability, including: Assessment and planning, mitigation activities, and community and homeowner education and action; hazardous fuels reduction activities, including the training, monitoring or maintenance associated with such hazardous fuels reduction activities, on federal land, or on adjacent nonfederal land for activities that mitigate the threat of catastrophic fire to communities and natural resources in high risk areas; and, enhancement of knowledge and fire protection capability of rural fire districts through assistance in education and training, protective clothing and equipment purchase, and mitigation methods on a cost share basis. More information: http://www.federalgrantswire.com/wildland-urban-interface-community-and-rural-fire-assistance.html#.WCx8ekYzWUk

Secure Rural Schools and Community Self-Determination Act - Title III- County Funds. The Self-Determination Act has recently been reauthorized and now includes specific language regarding the Firewise Communities program. Counties seeking funding under Title III must use the funds to perform work under the Firewise Communities program. Counties applying for Title III funds to implement Firewise activities can assist in all aspects of a community's recognition process, including conducting or assisting with community assessments, helping the community create an action plan, assisting with an annual Firewise Day, assisting with local wildfire mitigation projects, and communicating with the state liaison and the national program to ensure a smooth application process. Counties that previously used Title III funds for other wildfire preparation activities such as the Fire Safe Councils or similar would be able to carry out many of the same activities as they had before. However, with the new language, counties would be required to show that funds used for

these activities were carried out under the Firewise Communities program. More information: http://www.fs.usda.gov/wps/portal/fsinternet/!ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gjAwhwtDDw9_AI8zPwhQoY6BdkOyoCAPkATlA!/?ss=119985&navtype=BROWSEBYSUBJECT&cid=FSE_003853&navid=091000000000000&pnavid=null&position=BROWSEBYSUBJECT&ttype=main&pname=Secure%20Rural%20Schools-%20Home

Community Planning Assistance for Wildfire (CPAW) - Established in 2015 by Headwaters Economics and Wildfire Planning International, CPAW works with communities to reduce wildfire risks through improved land use planning. CPAW is a grant-funded program providing communities with professional assistance from foresters, planners, economists and wildfire risk modelers to integrate wildfire mitigation into the development planning process. All services and recommendations are site-specific and come at no cost to the community. More information: http://planningforwildfire.org/what-we-do/

Urban and Community Forestry (UCF) Program - A cooperative program of the U.S. Forest Service that focuses on the stewardship of urban natural resources. With 80 percent of the nation's population in urban areas, there are strong environmental, social, and economic cases to be made for the conservation of green spaces to guide growth and revitalize city centers and older suburbs. UCF responds to the needs of urban areas by maintaining, restoring, and improving urban forest ecosystems on more than 70 million acres. Through these efforts the program encourages and promotes the creation of healthier, more livable urban environments across the nation. These grant programs are focused on issues and landscapes of national importance and prioritized through state and regional assessments. Information: http://www.fs.fed.us/managing-land/urban-forests/ucf

Western Wildland Urban Interface Grants - The National Fire Plan (NFP) is a long-term strategy for reducing the effects of catastrophic wildfires throughout the nation. The Division of Forestry's NFP Program is implemented within the Division's Fire and Aviation Program through the existing USDA Forest Service, State & Private Forestry, State Fire Assistance Program.

Congress has provided increased funding assistance to states through the U.S. Forest Service State and Private Forestry programs since 2001. The focus of much of this additional funding was mitigating risk in WUI areas. In the West, the State Fire Assistance funding is available and awarded through a competitive process with emphasis on hazard fuel reduction, information and education, and community and homeowner action. This portion of the National Fire Plan was developed to assist interface communities manage the unique hazards they find around them. Long-term solutions to interface challenges require informing and educating people who live in these areas about what they and their local organizations can do to mitigate these hazards.

The 10-Year Comprehensive Strategy focuses on assisting people and communities in the WUI to moderate the threat of catastrophic fire through the four broad goals of improving prevention and suppression, reducing hazardous fuels, restoring fire-adapted ecosystems, and promoting community assistance. The Western States Wildland Urban Interface Grant may be used to apply for financial assistance towards hazardous fuels and educational projects within the four goals of: improved prevention, reduction of hazardous fuels, restoration of fire-adapted ecosystems and promotion of community assistance. Information: http://forestry.alaska.gov/fire/cwpp/wuigrants

U.S. Fish & Wildlife Service, Rural Fire Assistance Grants. Each year, the U.S. Fish & Wildlife Service (FWS) provides Rural Fire Assistance (RFA) grants to neighboring community fire departments to

enhance local wildfire protection, purchase equipment, and train volunteer firefighters. Service fire staff also assist directly with community projects. These efforts reduce the risk to human life and better permit FWS firefighters to interact and work with community fire organizations when fighting wildfires. The Department of the Interior (DOI) receives an appropriated budget each year for an RFA grant program. The maximum award per grant is $20,000. The DOI assistance program targets rural and volunteer fire departments that routinely help fight fire on or near DOI lands. More information: http://www.fws.gov/fire/living_with_fire/rural_fire_assistance.shtml

U.S. Bureau of Land Management (BLM), Community Assistance Program. BLM provides funds to communities through assistance agreements to complete mitigation projects, education and planning within the WUI. More information:
http://www.blm.gov/nifc/st/en/prog/fire/community_assistance.html

Fire Management Assistance Program. This program is authorized under Section 420 of the Stafford Act. It allows for the mitigation, management, and control of fires burning on publicly or privately owned forest or grasslands that threaten destruction that would constitute a major disaster. More information: http://www.fema.gov/fire-management-assistance-grant-program

NOAA Office of Education Grants - The Office of Education supports formal, informal and non-formal education projects and programs through competitively awarded grants and cooperative agreements to a variety of educational institutions and organizations in the United States. More information: http://www.noaa.gov/office-education/grants

NRCS Environmental Quality Incentives Program (EQIP). The Environmental Quality Incentives Program, administered through the NRCS, is a cost-share program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. Owners of land in agricultural or forest production or persons who are engaged in livestock, agricultural or forest production on eligible land and that have a natural resource concern on that land may apply to participate in EQIP. Eligible land includes cropland, rangeland, pastureland, non-industrial private forestland and other farm or ranch lands. EQUIP is another funding mechanism for landowner fuel reduction projects. More information: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

U.S. Department of Agriculture, Community Facilities Loans and Grants. Provides grants (and loans) to cities, counties, states and other public entities to improve community facilities for essential services to rural residents. Projects can include fire and rescue services; funds have been provided to purchase fire-fighting equipment for rural areas. No match is required. More information: http://www.usda.gov/wps/portal/usda/usdahome?navid=GRANTS_LOANS

General Services Administration, Sale of Federal Surplus Personal Property. This program sells property no longer needed by the federal government. The program provides individuals, businesses and organizations the opportunity to enter competitive bids for purchase of a wide variety of personal property and equipment. Normally, there are no restrictions on the property purchased. More information: http://www.gsa.gov/portal/category/21045

Hazardous Materials Emergency Preparedness Grants. Grant funds are passed through to local emergency management offices and HazMat teams having functional and active LEPC groups. More information: http://www.phmsa.dot.gov/hazmat/grants

U.S. Department of Homeland Security. Enhances the ability of states, local and tribal jurisdictions, and other regional authorities in the preparation, prevention, and response to terrorist attacks and other disasters, by distributing grant funds. Localities can use grants for planning, equipment, training and exercise needs. These grants include, but are not limited to areas of Critical Infrastructure Protection Equipment and Training for First Responders, and Homeland Security Grants. More information: http://www.dhs.gov/

Community Development Block Grants (CDBG). The U.S. Department of Commerce administers the CDBG program which are intended to provide low and moderate-income households with viable communities, including decent housing, a suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances, and during the times of "urgent need" (e.g. post disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event. CDBG funds can be used to match FEMA grants. More Information:
http://www.hud.gov/offices/cpd/communitydevelopment/programs/

Volunteer Fire Assistance Program Grants. The purpose of these grants is to organize, train and equip local firefighters to prevent and suppress wildfires. Communities under 10,000 in population are eligible for the funding. Smaller communities may join together in a group and or county effort to submit an application, even if their combined population is over 10,000. There is no pre-set award amount. Financial assistance on any project, during any fiscal year, requires a non-federal match for project expenditures. More information: http://dnrc.mt.gov/grants-and-loans

Conservation District Grants. This program provide funds to increase conservation district employee's hours to assist in planning, securing funding, and implementing programs that improve public outreach, improve conservation district administrative capabilities, and implement conservation plans. There is a $10,000 award amount. More information: http://dnrc.mt.gov/grants-and-loans

Western States Wildland Urban Interface. National Fire Plan funds are available to mitigate risk from wildland fire within the WUI. Funds are awarded through a competitive process to 22 western states and territories through the Western Wildland Urban Interface Grant Program. Each year, the Montana Department of Natural Resources and Conservation accepts proposals from partners around the state for submission to the National Fire Plan competitive process. The State scores and prioritizes these proposals before sending them on to the national competitive process. Non-profit organizations, conservation districts, county and municipal governments, and fire departments. Individual landowners may not apply but may be eligible for cost-share opportunities through this program. Each grant request is limited to a maximum of $300,000. More information: http://dnrc.mt.gov/grants-and-loans

Hazardous Fuel Reduction Grants. These grants are for hazardous fuel reduction on private lands to protect communities adjacent to National Forest System Lands where prescribed fire activities are planned. Prescribed fire activities must be imminent (to take place within 3 years of the award). Non-profit organizations, conservation districts, county and municipal governments, fire departments are eligible for this funding. Award amounts typically range from $50,000 to $100,000 depending upon availability of funding. More information: http://dnrc.mt.gov/grants-and-loans

Renewable Resource Grant Program. Administered by the Montana DNRC, this program provides both grant and loan funding for public facility and other renewable resource projects. Projects that conserve, manage, develop or protect Montana's renewable resources are eligible for funding. Numerous public facility projects including drinking water, wastewater and solid waste development and improvement projects have received funding through this program. Other projects that have been funded include irrigation rehabilitation, dam repair, soil and water conservation and forest enhancement. More information: http://dnrc.mt.gov/grants-and-loans

5.5 Mitigation Strategy Development

This subsection discusses the identification, prioritization, analysis and implementation plan of mitigation actions for Missoula County and the City of Missoula.

5.5.1 Mitigation Strategy Update and Reconciliation

The Planning Team reviewed the list of mitigation actions (projects) from the 2011 PDM Plan and determined which were complete, should be deleted, or reworded for the 2017 mitigation strategy during Planning Team conference calls held during September through November 2016. **Appendix D** presents a reconciliation of mitigation projects and their status.

Concerted efforts were made to assure that the county develop mitigation strategies that included activities and initiatives covering the range of mitigation action types described in recent FEMA planning guidance (FEMA "Local Mitigation Planning Handbook" March 2013), specifically:

- Prevention Projects – These actions include governmental regulatory authorities, including policies or codes that influence the way land and buildings are being developed and built.
- Property Protection Projects – Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocations, structural retrofits, storm shutters, and shatter-resistant glass.
- Structural Projects - These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- Natural Resource Protection Projects – These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.

- Education and Awareness Programs – These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as the National Flood Insurance Program and Community Rating System, StormReady (NOAA) and Firewise (NFPA) Communities.

- Emergency Service Projects – These are actions to enhance community preparedness through training and acquisition of equipment.

- Mapping/Analysis/Planning Projects – These actions include development of mapping and planning documents to assist with implementation of mitigation strategies.

In consideration of federal and state mitigation guidance, the PDM Planning Team recognized that all communities would benefit from the inclusion of certain mitigation actions. These include initiatives to address vulnerable public and private properties, including repetitive loss properties; initiatives to support continued and enhanced participation in the NFIP; improved public education and awareness programs; and initiatives to support countywide and regional efforts to build greater local mitigation capabilities.

Mitigation actions included in the 2017 Missoula County mitigation strategy are presented in **Table 5.5-2** at the end of this Section. **Appendix D** contains a mitigation action plan with individual project worksheets.

5.5.2 Mitigation Strategy Benefit/Cost Review and Prioritization

Each of the proposed mitigation actions has value; however, time and financial constraints do not permit all projects to be implemented immediately. By prioritizing the actions, the most critical, cost effective projects can be achieved in the short term. Mitigation actions retained and developed for this updated PDM Plan were re-prioritized to reflect current conditions and anticipated needs over the next five years.

Section 201.6.c.3iii of 44CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. Stated otherwise, cost-effectiveness is one of the criteria that must be applied during the evaluation and prioritization of all actions comprising the overall mitigation strategy.

The benefit/cost review used for the evaluation and prioritization of projects in this plan was qualitative; i.e. it does not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program.

- **Costs** are the total cost for the action or project, and may include administrative costs, construction costs (including engineering, design and permitting), and maintenance costs.

- **Benefits** are the savings from losses avoided attributed to the implementation of the project, and may include life-safety, structure and infrastructure damages, loss of service or function, and economic and environmental damage and losses.

When available, jurisdictions were asked to identify the actual or estimated dollar value for project costs and associated benefits. Having defined costs and benefits allows a direct comparison of

benefits versus costs, and a quantitative evaluation of project cost-effectiveness. Often, however, numerical costs and/or benefits have not been identified, or may be impossible to quantitatively assess.

For the purposes of this planning process, a cost-benefit matrix was developed to rank the mitigation projects using the following criteria. Each project was assigned a "high", "medium", or "low" rank for *Population Impacted, Property Impacted*, *Project Feasibility* and *Cost*, as described below:

- For the *Population Protected* category, a "high" rank represents greater than 50 percent of County residents would be protected by implementation of the mitigation strategy; a "medium" rank represents 20 to 50 percent of County residents would be protected; and, a "low" rank represents less than 20 percent of County residents would be protected.
- For the *Property Protected* category, a "high" represents that greater than $500,000 worth of property would be protected through implementation of the mitigation strategy; "medium" represents that $100,000 to $500,000 worth of property would be protected; and, "low" would be less than $100,000 would be protected.
- For the *Project Feasibility* category a "high" rank represents that technology is available and implementation is likely; a "medium" rank indicates technology may be available but implementation could be difficult; and, a "low" rank represents that no technology is available or implementation would be unlikely.
- For the *Project Cost* category, a "high" represents that the mitigation project would cost more than $500,000; a "medium" rank represents the project cost would be between $100,000 and $500,000; and, "low" represents the project would cost less than $100,000.

The overall cost-benefit was then calculated by summing the total score for each project. **Table 5.5-1** presents the cost-benefit scoring matrix. The mitigation action plans in **Appendix D** present the scoring of each project.

Table 5.5-1. Cost-Benefit Scoring Matrix

Score	Population Protected	Property Protected	Project Feasibility	Cost
High	5	5	5	1
Medium	3	3	3	3
Low	1	1	1	5

After considering all mitigation projects, the PDM Planning Team prioritized the projects as high, medium, or low based on which projects were most needed to protect life and property. Prioritization of the projects serves as a guide for choosing and funding projects. **Table 5.5-2** presents the County priority for each project.

Each year, FEMA partners with the State on training courses designed to help communities be more successful in their applications for grants, including the Unified Hazard Mitigation Grant Assistance Application Development Course and the Benefit Cost Analysis (BCA) course. The State Hazard Mitigation Officer can provide the course offering schedule.

5.5.3 Project Implementation

The PDM Planning Team reviewed the projects and assigned a corresponding County or City department responsible for its implementation. Cooperating organizations for implementation may also include local, federal or regional agencies that are capable of implementing activities and programs. The Planning Team identified a schedule for implementation and potential funding sources. The schedule for implementation included several categories including: "ongoing" for projects that are part of the County's emergency management program; "short-term" for projects to be completed within 1-2 years; "mid-term" for projects to be completed within 3-4 years; "long-term" for projects to be completed in 5 or more years; and "Ongoing" for projects which will span the entire planning period.

Implementation details are shown in **Table 5.5-3** and in the mitigation action plans in **Appendix D.** The Director of the Missoula County OEM will be responsible for mitigation project administration.

Table 5.5-2. Missoula County 2017 Mitigation Strategy

Goal	Objective	Project	Hazard	Jurisdiction	Benefit-Cost Ranking/Score	County Priority
Goal 1 – Reduce Wildland Fire Risk within WUI	Objective 1.1 - Conduct mapping/analysis/planning projects to reduce impacts from wildfires	Project 1.1.1 - Continue to work with cooperating agencies to develop population protection plans.	Wildfire	County, City	High/18	High
		Project 1.1.2 - Update CWPP based on new fire data.	Wildfire	County, City	High/18	High
		Project 1.1.3 - Assist fire jurisdictions/community groups with mapping.	Wildfire	County, City	High/18	Medium
	Objective 1.2 - Perform property protection projects to reduce impacts from wildfires	Project 1.2.1 - Continue to look for funding opportunities for fuel mitigation on private land.	Wildfire	County, City	High/18	Medium
		Project 1.2.2 - Implement FireWise principles and upgrade county facilities with non-combustible materials in Seeley Lake area.	Wildfire	County	Medium/14	Low
		Project 1.2.3 - Apply for federally competitive grant to sustain fuel mitigation on private land for 10 year period.	Wildfire	County, City	High/18	Medium
		Project 1.2.4 - Track completed fuel-reduction projects to update vulnerability and support future grants.	Wildfire	County, City	High/18	Medium
	Objective 1.3 - Implement public awareness and education projects to reduce impacts from wildfires	Project 1.3.1 - Update education materials targeting high priority areas.	Wildfire	County, City	High/18	High
	Objective 1.4 - Encourage projects to prevent impacts from wildfire	Project 1.4.1 - Encourage use of fire-resistant materials/design of non-combustible homes in future developments.	Wildfire	County, City	Medium/16	Medium
		Project 1.4.2 - Encourage review of subdivision regulations for coordination with the updated CWPP.	Wildfire	County, City	Medium/16	High
	Objective 1.5 - Upgrade emergency service capabilities to reduce impacts from wildfires	Project 1.5.1 - Continue to enhance availability of water supply for firefighting in urban and rural locations.	Wildfire	County, City	High/18	High
		Project 1.5.2 - Formalize agreements for fire response in unprotected County lands.	Wildfire	County	Medium/16	High
		Project 1.5.3 - Obtain mobile air quality monitors to determine unhealthy wildfire smoke conditions.	Wildfire	County, City	Medium/14	Medium

Table 5.5-2. Missoula County 2017 Mitigation Strategy

Goal	Objective	Project	Hazard	Jurisdiction	Benefit-Cost Ranking/Score	County Priority
Goal 2 – Reduce Impacts from Hazardous Material Incidents and Railroad Derailments	Objective 2.1 - Encourage projects to prevent impacts from haz-mat incidents and derailments	Project 2.1.1 - Encourage railroad to implement slower train speeds through towns and vulnerable areas to prevent derailments and protect water resources.	Haz-Mat/ Railroad Derailments	County, City	Medium/16	High
	Objective 2.2 - Upgrade emergency service capabilities to reduce impacts from haz-mat incidents and derailments	Project 2.2.1 - Ensure local emergency responders have adequate training to respond to hazardous material events consistent with local capabilities.	Haz-Mat/ Railroad Derailments	County, City	High/18	High
		Project 2.2.2 - Continue to involve railroad and fixed facilities owners in local emergency response exercises.	Haz-Mat/ Railroad Derailments	County, City	High/18	High
	Objective 2.3 - Implement public outreach and education projects to reduce impacts from haz-mat incidents and derailments	Project 2.3.1 - Develop population protection plans for residents along railroad or near chemical facilities.	Haz-Mat/ Railroad Derailments	County, City	Medium/16	High
Goal 3 – Reduce Exposure to Flooding	Objective 3.1 - Implement projects to prevent impacts from flooding	Project 3.1.1 – Determine feasibility of regulating development within unmapped flood prone and channel migration zones.	Flooding	County	Medium/14	Medium
		Project 3.1.2 – Relocate, elevate and/or floodproof structures which have been repeatedly flooded.	Flooding	County	Medium/10	High
	Objective 3.2 - Implement structural projects to reduce impacts from flooding	Project 3.2.1 – Maintain and improve the existing stormwater infrastructure to mitigate impacts from flash flooding.	Flooding	County, City	Medium/12	Medium
	Objective 3.3 - Conduct mapping/analysis/planning projects to reduce impacts from flooding	Project 3.3.1 – Complete floodplain mapping where LiDar data exists.	Flooding	County	Medium/12	High
		Project 3.3.2 – Evaluate and if appropriate, implement a telemetered river gauge on Rattlesnake Creek to notify community of possible flood surges.	Flooding	City	High / 18	Low
	Objective 3.4 - Implement natural resource protection projects to reduce impacts from flooding	Project 3.4.1 – Restore connectivity of floodplain and function around former Stone Container Plant.	Flooding	County	Low/6	Medium
		Project 3.4.2 – Enhance floodplain and wetland capacity as opportunities present themselves.	Flooding	County	Low/6	Medium

Table 5.5-2. Missoula County 2017 Mitigation Strategy

Goal	Objective	Project	Hazard	Jurisdiction	Benefit-Cost Ranking/Score	County Priority
Goal 3 – Reduce Exposure to Flooding	Objective 3.5 - Upgrade emergency service capabilities to reduce impacts from flooding	Project 3.5.1 - Conduct exercises on levee failure/breach.	Flooding	County, City	Medium/16	High
	Objective 3.6 - Implement public outreach and education projects to reduce impacts from flooding	Project 3.6.1 - Continue to educate the public on the National Flood Insurance Program.	Flooding	County, City	Medium/16	High
		Project 3.6.2 - Work towards achieving a lower rating through the National Flood Insurance Program Community Rating System.	Flooding	County	Medium/10	Medium
		Project 3.6.3 - Participate in the National Weather Service's Flood Awareness Program.	Flooding	County, City	High/18	High
Goal 4 – Minimize Impacts from Severe Weather and Drought	Objective 4.1 - Implement public awareness and education projects to reduce impacts from severe weather and drought	Project 4.1.1 - Partner with the National Weather Service to provide weather education presentations to educate the public on severe weather hazards.	Severe Weather & Drought	County, City	Medium/16	High
		Project 4.1.2 - Partner with the National Weather Service on the Weather Ready Nation Ambassador Program and increase participation in program.	Severe Weather & Drought	County, City	Medium/16	High
		Project 4.1.3 - Support local agency efforts to develop and distribute range and agriculture management tools to mitigate impacts from drought.	Severe Weather & Drought	County	Medium/12	High
	Objective 4.2 - Implement property protection projects to reduce impacts from severe weather and drought	Project 4.2.1 - Continue to work with City's Urban Forester to maintain trees that could impact property.	Severe Weather & Drought	City	High/18	Medium
	Objective 4.3 - Implement projects to prevents impacts from severe weather and drought	Project 4.3.1 - Improve water conveyance and application efficiencies in agricultural, municipal, and industrial uses.	Severe Weather & Drought	County, City	Low/8	High
		Project 4.3.2- Encourage voluntary water conservation by domestic, municipal, and industrial users.	Severe Weather & Drought	County, City	Medium/16	Medium
		Project 4.3.3 - Install meters on public water systems.	Severe Weather & Drought	County	Low/8	Low
		Project 4.3.4 - Support the State's efforts to establish a drought emergency fund for temporary water leases.	Severe Weather & Drought	County	Medium/10	High

Table 5.5-2. Missoula County 2017 Mitigation Strategy

Goal	Objective	Project	Hazard	Jurisdiction	Benefit-Cost Ranking/Score	County Priority
Goal 5 - Minimize Impacts from Earthquakes	Objective 5.1 - Implement property protection projects to reduce impacts from earthquakes	Project 5.1.1- Tie down/secure objects in critical facilities and schools that could fall during an earthquake.	Earthquakes	County, City	High/18	Medium
	Objective 5.2 - Implement public awareness and education projects to reduce impacts from earthquakes	Project 5.2.1 - Promote participation in Great Montana Shake-out in schools, municipal offices, businesses, and the media.	Earthquakes	County, City	Medium/16	High
Goal 6 - Reduce Impacts from Communicable Disease	Objective 6.1 - Implement public awareness and education projects to reduce impacts from communicable disease	Project 6.1.1 - Support Public Health Department's public education programs on communicable disease.	Communicable Disease	County, City	Medium/16	High
		Project 6.1.2 - Promote mass vaccination clinics.	Communicable Disease	County, City	Medium/14	High
	Objective 6.2 - Enhance emergency service capabilities to reduce impacts from communicable disease	Project 6.2.1 - Complete exercise and update Chempack Plan on annual basis.	Communicable Disease	County, City	Medium/16	High
		Project 6.2.2 - Keep pandemic plans up to date and complete exercises.	Communicable Disease	County, City	Medium/16	High
Goal 7 – Reduce Impacts from Avalanches	Objective 7.1 - Implement public awareness and education projects to reduce impacts from avalanches	Project 7.1.1 - Partner with avalanche center to do forecasting and public education and awareness.	Avalanche	County, City	Medium/12	High
Goal 8 – Reduce Impacts from Dam Failure	Objective 8.1 - Enhance emergency service capabilities to reduce impacts from dam failure	Project 8.1.1 - Work with DNRC and dam owners to update EAPs on annual basis.	Dam Failure	County, City	Medium/14	High
		Project 8.1.2 - Participate in dam exercises with emergency response partners.	Dam Failure	County, City	Medium/14	High
		Project 8.1.3 - Develop evacuation plan for Spartan-Playfair stormwater facilities.	Dam Failure	City	Medium/14	High
	Objective 8.2 - Conduct mapping/analysis/planning projects to reduce impacts from dam failure	Project 8.2.1 - Evaluate individual and cumulative risk of failure of Rattlesnake Wilderness Dams and the current Mountain Water Company Intake Dam, and options for mitigation of identified risks.	Dam Failure	County, City	High/18	High
Goal 8 – Reduce Impacts from Dam Failure	Objective 8.3 - Implement structural projects to reduce impacts from dam failure	Project 8.3.1 - Decommission or modify non-essential dams that present unacceptable risk of failure.	Dam Failure	County, City	Medium/14	High

Table 5.5-2. Missoula County 2017 Mitigation Strategy

Goal	Objective	Project	Hazard	Jurisdiction	Benefit-Cost Ranking/Score	County Priority
Goal 9 - Reduce Impacts from All Hazards	Objective 9.1 - Implement public awareness and education projects to reduce impacts from all hazards	Project 9.1.1 - Provide targeted education and information to public officials on general hazard mitigation.	All Hazards	County, City	Medium/12	High
		Project 9.1.2 -Encourage citizens to register cell phones for emergency alerts.	All Hazards	County, City	High/20	High
		Project 9.1.3 -Encourage citizens to create individual safety profiles in Smart-911.	All Hazards	County, City	Medium/16	High
		Project 9.1.4 -Create public education campaign aimed at informing public on appropriate uses of 911 and emergency alerts.	All Hazards	County, City	Medium/16	High
	Objective 9.2 - Conduct mapping/analysis/planning projects to reduce impacts from all hazards	Project 9.2.1 - Assist planners with comprehensive planning to mitigate disasters.	All Hazards	County, City	Medium/16	High
	Objective 9.3 - Enhance emergency service capabilities to reduce impacts from all hazards	Project 9.3.1 - Work with American Red Cross and City-County Health Department to determine which shelters need emergency generators.	All Hazards	County, City	Medium/16	High
		Project 9.3.2 - Obtain generators for critical facilities and shelters.	All Hazards	County, City	Medium/14	High
		Project 9.3.3 - Continue to work with vulnerable facilities to create or enhance emergency plans.	All Hazards	County, City	Medium/12	High
		Project 9.3.4 - Enhance or develop EOP annex for livestock and domestic animal management during emergencies.	All Hazards	County, City	Medium/16	High

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
WILDFIRE MITIGATION PROJECTS						
Project 1.1.1 - Continue to work with cooperating agencies to develop population protection plans.	County, City	OEM	Fire modeling and risk mapping completed.	Prepare Population Protection Plans for VFDs.	Short-term	County resources
Project 1.1.2 - Update CWPP based on new fire data.	County, City	OEM	New Project for 2017 Plan	Analyze of new data from Lolo NF. Update CWPP in 2017.	Short-term	County resources
Project 1.1.3 - Assist fire jurisdictions/community groups with mapping.	County, City	OEM, County GIS, CAPS	Risk mapping has been completed. GIS capabilities have increased.	Provide risk mapping to fire districts. Mapping ongoing based on needs.	Ongoing	County resources
Project 1.2.1 - Continue to look for funding opportunities for fuel mitigation on private land.	County, City	OEM	FireWise, and Rural School funding obtained. Also FEMA-HMGP grant for fuel mitigation received.	Continue more of same.	Ongoing	County resources
Project 1.2.2 - Implement FireWise principles and upgrade county facilities with non-combustible materials in Seeley Lake area.	County	Seeley Lake VFD, OEM	New project for 2017 Plan	Evaluate county structures and develop plan to upgrade.	Long-term	Grants
Project 1.2.3 - Apply for federally competitive grant to sustain fuel mitigation on private land for 10 year period.	County, City	OEM	New project for 2017 Plan	Compile scientific data to support need, CWPP update to identify risk.	Mid-term	County resources
Project 1.2.4 - Track completed fuel-reduction projects to update vulnerability and support future grants.	County, City	OEM, County GIS	Data compiled but hasn't been mapped.	Create comprehensive map layer of completed projects. Create spreadsheet with acreages and dollars spent.	On-going. Short-term on map.	County resources
Project 1.3.1 - Update education materials targeting High Priority Areas.	County, City	MCFPA	Fire Dept. has used existing CWPP to target education. During fire season extensive outreach w/ USFS, DNRC, MCFPA	Fire Dept. has used existing CWPP to target education. During fire season extensive outreach w/ USFS, DNRC, MCFPA	Ongoing	Federal, State, Local funding sources
Project 1.4.1 - Encourage use of fire-resistant materials/design of non-combustible homes in future developments.	County, City	OEM, CAPS	Fire Dept. and OEM have educated public on this topic. DNRC WUI guidelines mention this also.	Continue same.	Ongoing	County resources

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
Project 1.4.2 - Encourage review of subdivision regulations for coordination with the updated CWPP.	County, City	OEM	Will follow completion of CWPP 2017.	Review CWPP with CAPS and recommend revisions to subdivision regulations.	Ongoing	County resources
Project 1.5.1 - Continue to enhance availability of water supply for firefighting in urban and rural locations.	County, City	Agency/ jurisdiction specific depending on project	New project. Several dry hydrants installed each year.	Complete regular needs assessment, obtain funding	Ongoing	County & City resources
Project 1.5.2 - Formalize agreements for fire response in unprotected County lands.	County	OEM	Created framework.	Complete MOUs.	Short-term	County resources
Project 1.5.3 - Obtain mobile air quality monitors to determine unhealthy wildfire smoke conditions.		OEM, City-County Public Health	New project for 2017 Plan	Determine equipment specifications. Look for funding options. Make purchase.	Short-term	County resources
HAZARDOUS MATERIAL / RAILROAD DERAILMENT MITIGATION PROJECTS						
Project 2.1.1 - Encourage railroad to implement slower train speeds through towns and vulnerable areas to prevent derailments and protect water resources.	County, City	LEPC	New project for 2017 Plan	Start conversation at LEPC. Involve City & County elected officials and railroad in discussion.	Mid-term	County & City resources
Project 2.2.1 - Ensure local emergency responders have adequate training to respond to hazardous material events consistent with local capabilities.	County, City	Local fire departments	New project for 2017 Plan	Continue to provide training in coordination with railroad.	Ongoing	County & City resources
Project 2.2.2 - Continue to involve railroad and fixed facilities owners in local emergency response exercises.	County, City	OEM	New project for 2017 Plan	Continue to conduct exercises in coordination with railroad and fixed facilities.	Ongoing	County & City resources
Project 2.3.1 - Develop population protection plans for residents along railroad or near chemical facilities.	County, City	OEM, Law Enforcement	New project for 2017 Plan	Coordinate with OEM, law enforcement, and City to develop maps and plan evacuation routes.	Mid-term	County & City resources

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
FLOOD MITIGATION PROJECTS						
Project 3.1.1 – Determine feasibility of regulating development within unmapped flood prone and channel migration zones.	County	CAPS, WQ District	Have been implementing. WQPD has done multiple studies on channel migration. County has been doing this through subdivision regulations	Develop additional channel migration zone studies.	Ongoing	County & City Resources
Project 3.1.2 – Relocate, elevate and/or floodproof structures which have been repeatedly flooded.	County	CAPS	New Project for 2017 Plan	Evaluate repetitive loss properties throughout county and determine feasible treatments. Consult with FEMA/owners. Apply for funding.	Ongoing	FEMA grants
Project 3.2.1 – Maintain and improve the existing stormwater infrastructure to mitigate impacts from flash flooding.	County, City	City Public Works	New Project for 2017 Plan	Identify problem areas. Coordinate with right-of-way partners, Determine remedy. Obtain funding. Implement.	Ongoing	City & County Resources
Project 3.3.1 – Complete floodplain mapping where LiDar data exists.	County	CAPS	New Project for 2017 Plan	Obtain updated DFIRMs for the Bitterroot, Clearwater, Swan and Rock Creek per 2012 LiDAR. Clearwater and Swan are underway - Rock Creek and Bitterroot haven't been funded.	Ongoing	County Resources
Project 3.3.2 – Evaluate and if appropriate, implement a telemetered river gauge on Rattlesnake Creek to notify community of possible flood surges.	City	Developmental Services	New Project for 2017 Plan	Consult with USGS and NWS for input on what type of gauging would be appropriate and best location. Obtain funding for necessary equipment. Install and train on operation.	Long term	City Resources, USGS
Project 3.4.1 – Restore connectivity of floodplain and function around former Stone Container Plant.	County	WQPD, EPA, multiple agencies	New Project for 2017 Plan	Complete engineering analysis, hydraulic modeling, feasibility study, knock down berms	Long-term	FEMA, DNRC grant
Project 3.4.2 – Enhance floodplain and wetland capacity as opportunities present themselves.	County	WQPD, CAPS	New Project for 2017 Plan	Look at hydrologic modeling to determine benefits, landowner negotiations.	Long-term	DNRC, FEMA

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
Project 3.5.1 - Conduct exercises on levee failure/breach.	County, City	OEM, CAPS	New Project for 2017 Plan	Coordinate with Disaster Planning Committee and put on training schedule.	Short-term	County & City resources, Development Services
Project 3.6.1 - Continue to educate the public on the National Flood Insurance Program.	County, City	CAPS	New Project for 2017 Plan	Info on NFIP will continue to be available at City & County Planning offices.	Ongoing	County & City resources
Project 3.6.2 - Work towards achieving a lower rating through the National Flood Insurance Program Community Rating System.	County	CAPS	New Project for 2017 Plan	Collaborate with other agencies to try to get to Class 7.	Ongoing	County resources
Project 3.6.3 - Participate in the National Weather Service's Flood Awareness Program	County, City	OEM	New Project for 2017 Plan	Maintain collaboration with NWS. Push out info via social media.	Ongoing	NWS
SEVERE WEATHER AND DROUGHT MITIGATION PROJECTS						
Project 4.1.1 - Partner with the National Weather Service to provide weather education presentations to educate the public on severe weather hazards.	County, City	OEM & NWS	Made quarterly presentations at Emergency Planning Committee meetings.	Continue same. Push out info via social media.	Ongoing	County and Agency resources
Project 4.1.2 - Partner with the National Weather Service on the Weather Ready Nation Ambassador Program and increase participation in program.	County, City	OEM & NWS	New Project for 2017 Plan	Get signed up for program. Promote that LEPC and others become ambassadors. Participate in preparedness activities. Push out info via social media.	Ongoing	County and Agency resources
Project 4.1.3 - Support local agency efforts to develop and distribute range and agriculture management tools to mitigate impacts from drought.	County	Conservation District and Watershed Groups	New Project for 2017 Plan	Use social media to push out info on availability of drought resources.	Ongoing	Organization resources
Project 4.2.1 - Continue to work with City's Urban Forester to maintain trees that could impact property.	City	City Parks & Recreation	New Project for 2017 Plan	Identify vulnerable trees with potential to impact city infrastructure. Perform maintenance as needed.	Ongoing	City resources

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
Project 4.3.1 - Improve water conveyance and application efficiencies in agricultural, municipal, and industrial uses.	County, City	Conservation District	New Project for 2017 Plan	Provide outreach to irrigators about lining ditches and irrigation efficiency. Obtain cost-share funding. Hire contractor to implement.	Long-term	NRCS, grants
Project 4.3.2- Encourage voluntary water conservation by domestic, municipal, and industrial users.	County, City	Water distribution utilities	New Project for 2017 Plan	Push out info via social media.	Long-term	City and local water purveyors
Project 4.3.3 - Install meters on public water systems.	County	County and public water districts	New Project for 2017 Plan	Determine which water supplies are reaching water right limits. Provide outreach to water districts. Obtain funding to offset costs.	Long-term	County resources and water users
Project 4.3.4 - Support the State's efforts to establish a drought emergency fund for temporary water leases.	County	Clark Fork Coalition, Blackfoot Challenge, Lolo Watershed Group and others	New Project for 2017 Plan	Support efforts by Clark Fork Coalition, Blackfoot Challenge, Lolo Watershed Group and others to educate irrigators.	Ongoing	Organization resources
EARTHQUAKE MITIGATION PROJECTS						
Project 5.1.1- Tie down/secure objects in critical facilities and schools that could fall during an earthquake.	County, City	City & County Building Dept., Schools	New Project for 2017 Plan	Provide training to maintenance staff. Establish schedule for completion.	Long-term	City, County, School resources
Project 5.2.1 - Promote participation in Great Montana Shake-out in schools, municipal offices, businesses, and the media.	County, City	OEM	New Project for 2017 Plan	Prior to October event, push out info via social media and PSAs.	Ongoing	County resources
COMMUNICABLE DISEASE MITIGATION PROJECTS						
Project 6.1.1 - Support Public Health Department's public education programs on communicable disease.	County, City	City-County Public Health	New Project for 2017 Plan	Push info out via social media and PSAs.	Ongoing	City-County resources
Project 6.1.2 - Promote mass vaccination clinics.	County, City	City-County Public Health	New Project for 2017 Plan	Complete meningitis exercise with U of M and promote vaccinations.	Ongoing	City-County resources
Project 6.2.1 - Complete exercise and update Chempack Plan on annual basis.	County, City	City-County Public Health	New Project for 2017 Plan	Complete annual review of plan and determine updates. Coordinate exercise with response partners.	Ongoing	City-County resources

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
Project 6.2.2 - Keep pandemic plans up to date and complete exercises.	County, City	City-County Public Health	New Project for 2017 Plan	Complete annual review of plan and determine updates. Coordinate exercise with response partners.	Ongoing	City-County resources
AVALANCHE MITIGATION PROJECTS						
Project 7.1.1 - Partner with avalanche center to do forecasting and public education and awareness.	County, City	OEM, City Fire & County Sheriff, Avalanche Center, NWS	New Project for 2017 Plan	Support awareness training for responders prior to season. Coordinate with Avalanche Center and first responders during peak season.	Ongoing	City & County resources
DAM FAILURE MITIGATION PROJECTS						
Project 8.1.1 - Work with DNRC and dam owners to update EAPs on annual basis.	County, City	OEM	New Project for 2017 Plan	With assistance from DNRC, contact dam owners and request EAP updates.	Ongoing	City & County resources, DNRC, dam owners
Project 8.1.2 - Participate in dam exercises with emergency response partners.	County, City	OEM, Sheriff's Dept.	New Project for 2017 Plan	Determine partners in exercising dam EAP. Schedule and participate in exercises. Complete after actions reports.	Ongoing	CSKT, dam owners
Project 8.1.3 - Develop evacuation plan for Spartan-Playfair stormwater facilities.	City	OEM, Missoula PD	New Project for 2017 Plan	Work with Police Dept. and develop evacuation plan.	Short-term	City resources
Project 8.2.1 - Evaluate individual and cumulative risk of failure of Rattlesnake Wilderness Dams and the current Mountain Water Company Intake Dam, and options for mitigation of identified risks.	County, City	OEM	New Project for 2017 Plan	Contract with dam safety inspection engineer to model single and series dam failure during worst-case scenario	Short-term	City resources
Project 8.3.1 - Decommission or modify non-essential dams that present unacceptable risk of failure.	County, City	OEM	New Project for 2017 Plan	Prioritize and decommission non-essential dams in the Rattlesnake Wilderness	Short-term	City resources
ALL-HAZARD MITIGATION PROJECTS						
Project 9.1.1 - Provide targeted education and information to public officials on general hazard mitigation.	County, City	OEM	Have made presentations at commissioner/council meetings.	Continue same. Increase involvement in LEPC.	Ongoing	County resources

Table 5.5-3. Missoula County 2017 Mitigation Strategy – Implementation Details

Project	Jurisdiction	Responsible Agency / Department	Progress Made	Planned Activities	Schedule	Potential Funding Source
Project 9.1.2 -Encourage citizens to register cell phones for emergency alerts.	County, City	OEM	New Project for 2017 Plan	Implement outreach to include PSAs, billboards, radio advertisements.	Ongoing	County resources
Project 9.1.3 -Encourage citizens to create individual safety profiles in Smart-911.	County, City	OEM	New Project for 2017 Plan	Push out info through social media and PSAs	Ongoing	County resources
Project 9.1.4 -Create public education campaign aimed at informing public on appropriate uses of 911 and emergency alerts.	County, City	OEM	New Project for 2017 Plan	Push out info through social media and PSAs	Short-term	County resources
Project 9.2.1 - Assist planners with comprehensive planning to mitigate disasters.	County, City	OEM	Day-to-day coordination takes place.	Continue same.	Ongoing	County resources
Project 9.3.1 - Work with American Red Cross and City-County Health Department to determine which shelters need emergency generators.	County, City	OEM, City-County Health Dept., ARC	New Project for 2017 Plan	Schedule meeting with shelter partners. Make determination on shelter specifications needed.	Short-term	County resources
Project 9.3.2 - Obtain generators for critical facilities and shelters.	County, City	OEM	New Project for 2017 Plan	Develop list of generators needed, their specifications and hookup needs. Keep abreast of funding opportunities. Obtain funding and purchase equipment.	Long-term	County resources
Project 9.3.3 - Continue to work with vulnerable facilities to create or enhance emergency plans.	County, City	OEM	New Project for 2017 Plan	Provide outreach to vulnerable facilities on what an adequate emergency plan includes. Request they make updates then review plans and offer comments.	Short-term	County resources
Project 9.3.4 - Enhance or develop EOP annex for livestock and domestic animal management during emergencies.	County, City	OEM	New Project for 2017 Plan	Research similar annexes available on-line or from other counties. Obtain input from ARC. Draft annex for Missoula Co. EOP.	Short-term	County resources

Notes: ARC = American Red Cross; CAPS = Missoula County Community Assistance and Planning Services; CSKT = Confederated Salish & Kootenai Tribe; CWPP = Community Wildfire Protection Plan; DFIRM = Digital Flood Insurance Rate Maps; DNRC = Montana Department of Natural Resources and Conservation; EAP = Emergency Action Plan; EOP = Emergency Operations Plan; FEMA = Federal Emergency Management Agency; GIS = Geographic Information System; HMGP = Hazard Mitigation Grants Program; LEPC = Local Emergency Planning Committee; MCFPA = Missoula County Fire Protection Association; MEPA = U.S. Environmental Protection Agency; MOU = Memorandum of Understanding; NFIP = National Flood Insurance Program; NWS = National Weather Service; OEM = Office of Emergency Management; PD = Police Department; PDM = Pre-Disaster Mitigation; PSA = Public Service Announcement; U of M = University of Montana; USFS = United States Forest Service; USGS = United States Geological Survey; VFD = Volunteer Fire Department; WQPD = Water Quality Protection District

SECTION 6. PLAN MAINTENANCE PROCEDURES

The plan maintenance section details the formal process that will ensure that the Missoula County PDM Plan remains an active and relevant document. The maintenance process includes a schedule for monitoring and evaluating the plan and producing a plan revision every five years. The plan can be revised more frequently than five years if the conditions under which it was developed change significantly (e.g. a major disaster occurs and projects are accomplished and/or new projects need to be identified, or funding availability changes). This section also describes how Missoula County will monitor the progress of mitigation activities and be incorporated into existing planning mechanisms. The final section describes how the Missoula County will integrate public participation throughout the plan maintenance process.

6.1 Monitoring, Evaluating and Updating the Plan

The evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, if the Plan goals are being reached, and whether changes are needed.

6.1.1 2011 PDM Plan

The 2011 PDM Plan was monitored and evaluated a number of times since it was updated in 2011. According to the Missoula County OEM Director, the PDM Plan has been evaluated after major incidents including avalanche and wildfires. The Plan was also reviewed during grant writing as it provides a good profile of the jurisdiction as a whole. While it has not been part of regular LEPC meetings, the Plan was reviewed when creating the multi-year training and exercise plan to ensure that the core capabilities and likely events/impacts to Missoula County were being captured and exercised appropriately. The OEM Director frequently gets asked questions from the media about local risks and what the public should know about them and these interviews and encounters offered yet another opportunity to consult and review the PDM Plan.

6.1.2 2017 PDM Plan

The updated PDM Plan should be reviewed at meetings of the LEPC. A different hazard profile should be reviewed quarterly by the LEPC. The plan review should consider any new hazards and vulnerabilities as well as document completed mitigation projects, identify new mitigation projects and evaluate mitigation priorities. The review should determine whether a plan update is needed prior to the required five-year update.

The Director of the Missoula County Office of Emergency Management will be responsible for ensuring the PDM Plan review is on the agenda at the LEPC meetings so that applicability of the plan can be evaluated. The OEM Director should prepare a status report summarizing the outcome of the plan review and the minutes should be made available to interested stakeholders and kept in a permanent file designated for the next (2022) PDM Plan update.

The PDM Plan will also be evaluated and revised following any major disasters, to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damages. This is an opportunity to

increase the community's disaster resistance and build a better and stronger community. Three years after adoption of the PDM Plan, the Missoula County OEM Director may decide to apply for a planning grant through FEMA to start the 2022 PDM Plan update. Upon receipt of funding, the County will solicit bids in accordance with applicable contracting procedures and hire a contractor to assist with the project. The proposed schedule for completion of the plan update is one year from award of a contract, to coincide with the five-year adoption date of the 2017 PDM Plan Update.

The Missoula County OEM Director will be responsible for the plan update. Before the end of the five-year period, the updated plan will be submitted to FEMA for approval. When concurrence is received that the updated plan complies with FEMA requirements, it will be submitted to the Missoula County Board of County Commissioners and the Missoula City Council for adoption. The OEM Director will send an e-mail to individuals and organizations on the stakeholder list to inform them that the updated plan is available on the County website.

As part of the next PDM update, FEMA recommends that the story of mitigation for each jurisdiction be told describing success stories as well as challenges with implementation. In a direct, easily accessible method, an explanation should be given whether each project from the 2017 plan was implemented. As part of the next Plan update, the bulk of the Planning Team's time should be spent developing action plans for each mitigation strategy, i.e. really think through the steps that would be required for implementing the mitigation actions rather than updating the risk assessment.

6.2 Monitoring Progress of Mitigation Activities

The process for monitoring and evaluating mitigation projects is the responsibility of the LEPC, an organization comprised of individuals from Missoula County and City of Missoula departments, emergency response entities, local businesses, and non-profit organizations who meet on a regular basis.

6.2.1 2011 PDM Plan

Since development of the 2011 PDM Plan, several mitigation projects were completed in Missoula County while a number of other projects are on-going and will continue through the next planning period. Completed projects are identified in *Section 5.1*.

The Missoula County OEM Director has monitored completion of most of these activities; however, the 2011 PDM Plan did not outline a specific process to track the initiation, status, and completion of mitigation activities. Each department monitors completion of mitigation projects under their purview; the Missoula County Fire Protection Association monitors wildfire projects; the City and County Public Works Departments monitors bridge and culvert projects, and infrastructure projects; and, the City and County floodplain administrators monitor floodplain projects. In addition to completed projects from the 2011 PDM Plan, the Missoula County Comprehensive Emergency Management Plan was updated in 2011 and hazard-specific annexes were reviewed and revised.

6.2.2 2017 PDM Plan

The LEPC will review the mitigation goals, objectives, and activities to ensure progress is being made. They will evaluate the feasibility of the mitigation projects, monitor resources, budgets, and

schedules, and document project completion. This group will provide a venue for reporting and accountability.

Minutes should be prepared from these meetings and should be distributed to interested stakeholders as well as kept in a permanent file for the next PDM Plan update (2022). Agencies and organizations "assigned" responsibility for various aspects of the mitigation strategy will have the opportunity to coordinate with the LEPC on challenges, success and opportunities.

The information that the LEPC shall be expected to document, as needed and appropriate, include:

- Any grant applications filed on behalf of any of the participating jurisdictions;
- Hazard events and losses occurring in their jurisdiction;
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding;
- Obstacles or impediments to implementation of actions;
- Additional mitigation actions believed to be appropriate and feasible; and
- Public and stakeholder input.

Mitigation project evaluations will assess whether:

- Goals and objectives address current and expected conditions.
- The nature or magnitude of the risks has changed.
- Current resources are appropriate for implementing the PDM Plan and if different or additional resources are now available.
- Actions were cost effective.
- Schedules and budgets are feasible.
- Implementation problems, such as technical, political, legal or coordination issues with other agencies are presents.
- Outcomes have occurred as expected.
- New agencies/departments/staff should be included.

Individual projects will be monitored by the department implementing the project or the grant. Generally, HMGP and PDMC projects will be monitored by the OEM Director or Floodplain Administrator and any National Fire Plan projects or Community Assessment Agreements will be monitored by the Missoula County Fire Protection Association, U.S. Forest Service, BLM and/or DNRC. Each organization will track projects through a central database and issue quarterly reports to federal agencies.

The PDM Planning Team will continually observe the processes for implementation of the mitigation projects. By monitoring project implementation, the Planning Team will then be able to evaluate them at the time of the plan update and determine if any changes are needed.

Missoula County may want to consider measuring their mitigation success by participating in the STAR Community Rating System. Local leaders can use the STAR Community System to assess how

sustainable they are, set goals for moving ahead and measure progress along the way. To get started, go to http://starcommunities.org/get-started.

6.3 Implementation through Existing Programs

Missoula County will have the opportunity to implement hazard mitigation projects through existing programs and procedures through plan revisions or amendments. The PDM Plan will be incorporated into the plans, regulations and ordinances as they are updated in the future or when new plans are developed. **Table 6.3-1** presents a summary of existing plans and ordinances and how integration of mitigation projects will occur.

A summary of how the PDM Plan can be integrated into the legal framework is presented below:

- Partner with other organizations and agencies with similar goals to promote building codes that are more disaster resistant on the State level.
- Develop incentives for local governments, citizens, and businesses to pursue hazard mitigation projects.
- Allocate County resources and assistance for mitigation projects.
- Partner with other organizations and agencies in northwestern Montana to support hazard mitigation activities.

Table 6.3-1. Implementation of Mitigation into Existing Plans and Codes

Type	Name	Integration Technique
Plans		
Emergency Operations	Missoula County Emergency Operations Plan	Integrated by reference in PDM Plan.
	Emergency Action Plan, Black Lake Dam	Dam failure mitigation projects should be integrated in EAPs when these documents are revised.
	Emergency Action Plan, Blixit Creek Dam	
	Emergency Action Plan, Isaac Creek Dam	
	Emergency Action Plan, Jocko Dam	
	Emergency Action Plan, Spartan/Playfair Park Retention Basins	
Growth Policies	Missoula County Growth Policy, 2016	Integration of mitigation strategies will occur when growth policies are revised.
	City of Missoula Growth Policy, 2015	
	Lolo Regional Plan, 2002	
	Seeley Lake Regional Plan, 2010	
	Swan Valley-Condon Comprehensive Plan Amendment, 1996	
	Wye-Mullan West Area Comprehensive Plan, 2005	
	Butler Creek Area Comprehensive Plan Amendment, 1996	
	Grant Creek Area Plan, 1980	
	Historic Southside Neighborhood Plan, 1991	
	Miller Creek Plan, 1997	
	Northside-Westside Neighborhood Plan, 2006	
	Rattlesnake Valley Comprehensive Plan Amendment, 1995	
	Reserve Street Area Plan, 1995	
	South Hills Comprehensive Plan, 1986	
	Southside Riverfront Area Comprehensive Plan Amendment, 2000	

Table 6.3-1. Implementation of Mitigation into Existing Plans and Codes

Type	Name	Integration Technique
Wildfire Mitigation	Missoula County Community Wildfire Protection Plan, 2005	Wildfire mitigation projects will be incorporated when plan is revised.
	Seeley Swan Fire Plan, 2013	
Economic Development	Comprehensive Economic Development Strategy for the Bitterroot Economic Development District, Inc., 2013	Integration of mitigation strategies will occur, as appropriate, when plans are revised.
Transportation	Missoula Active Transportation Plan, 2011	Mitigation projects associated with Hazardous Material Incident hazard to be integrated during plan revision
Codes, Regulations & Ordinances		
Zoning	Missoula County Zoning Ordinance, 2001	Hazard areas will be incorporated into revisions of zoning ordinances.
	City of Missoula Zoning Ordinance, 2015	
Subdivisions	Missoula County Subdivision Regulations, 2016	Hazard areas will be incorporated into revisions of subdivision regulations.
	City of Missoula Subdivision Regulations, 2010	
Floodplain	Missoula County Flood Insurance Study, 2015	Flood mitigation projects will be incorporated into revisions of floodplain regulations.
	Missoula County Floodplain Regulations, 2015	
	Missoula County Shoreline Regulations, 2015	
	City of Missoula Floodplain Regulations, 2004	

Both Missoula County and City of Missoula use Growth Policies to guide development. Typically, a Growth Policy will address hazards; specifically, that life and property be protected from natural disasters and man-caused hazards. Mitigation goals in the PDM Plan will be recommended for incorporation into future revisions of these growth policies to ensure that high-hazard areas are being considered for low risk uses.

To ensure that the requirements of the PDM Plan are incorporated into other planning mechanisms and remain an on-going concern in Missoula County, responsibilities of various staff will be emphasized to include a mitigation component. It will be suggested that responsibilities of the Missoula County Planning Director include involvement in the LEPC. Participation in this group will provide an awareness of new and on-going mitigation initiatives for the purpose that they be integrated into plans, codes and regulations during revision. It will be suggested that responsibilities of the GIS Manager, include management and update of the spatial data compiled for the hazard analysis including coordinates of critical facilities and digital floodplain, inundation, and wildfire layers so this data can be integrated into other planning efforts. Responsibilities of the OEM Director will include implementing outreach activities for risk reduction in the County, coordinating with the Board of County Commissioners to secure funding for mitigation projects, ensure mitigation projects are implemented, and updating the PDM Plan. The OEM Director will also be responsible for maintaining permanent master file for the PDM planning process, which will include damage figures from hazard events, records of mitigation projects, and notes/minutes from relevant meetings.

Meetings of the Board of County Commissioners will provide an opportunity for the Missoula County OEM Director to report back on the progress made on the integration of mitigation planning elements into County planning documents and procedures.

6.4 Continued Public Involvement

Missoula County is dedicated to involving the public directly in review and updates of the PDM Plan. The public will have many opportunities to provide feedback about the plan. Hard copies of the plan will be kept at appropriate Missoula County and City of Missoula offices. An electronic copy of the plan will be available on the Missoula County website. The existence and location of plan hard copies will be publicized on the Missoula County website. *Section 2.0* includes the address and the phone number of the Missoula County OEM Director who will be responsible for keeping track of public comments on the plan.

The public will be invited to meetings of the LEPC when the PDM Plan is discussed. The meetings will provide the public a forum for which they can express concerns, opinions, or ideas about the plan. The OEM Director will be responsible for using County resources to publicize the public meetings and maintain public involvement through the newspapers, radio and Internet. Social media will be used to stay in touch with the public.

The PDM Planning Team will continually observe the processes for public outreach. By monitoring these activities, the Planning Team will then be able to evaluate them at the time of the plan update and determine if any changes are needed.

SECTION 7. REFERENCES

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