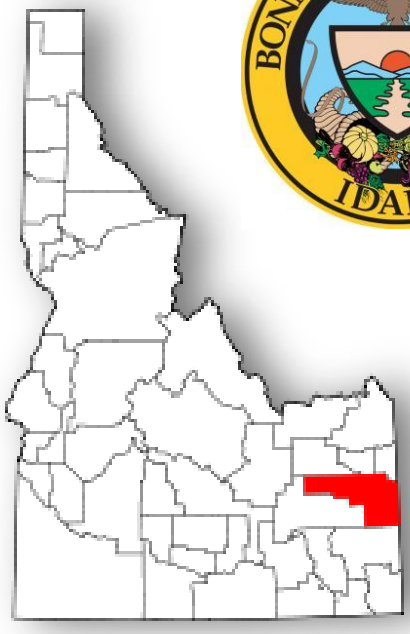
2014

BONNEVILLE COUNTY MULTI-JURISDICTION ALL HAZARD MITIGATION PLAN



NOVEMBER 2014

2014 Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan

November 2014

Prepared by
Portage, Inc.
1075 S. Utah Ave.
Idaho Falls, ID 83402

Bonneville County Idaho
Multi-Jurisdictional

All Hazard Mitigation Plan

Promulgation of Adoption

Be it known that the Bonneville County, Idaho, Board of County Commissioners does hereby approve the Adoption of the Bonneville County Idaho Multi-Jurisdictional All Hazard Mitigation Plan and direct its implementation through all the Bonneville All Hazard Mitigation Planning Committee.

Be it also known that the Board of County Commissioners hereby directs the Director of Emergency Management to continue to lead the implementation of this Plan as the Bonneville County All Hazard Mitigation Committee Chair.

This Plan has been developed in the interest of providing all hazard mitigation protection to populations living in Bonneville County and the incorporated cities within its boundaries. Through adoption of this Plan, all County and city agencies are requested to develop directives, standard operating procedures, checklists or other supplemental guidance to insure its maximum effectiveness.

Roger S Christensen — Oct 6, 2014
Bonneville County Commissioner — Date

Bonneville County Commissioner — Date

Bonneville County Commissioner — Oct 6-14
Date

Attest:

Ronald Longmore — 10-6-14
Bonneville County Clerk — Date

Endorsed: — 10-7-14
Tom Lenderink, Director of the Office of Emergency Management — Date

The City of Ammon

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, Dana Kirkham, Mayor for the City of Ammon endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Ammon.

DATED this 7 day of October, 2014

City of Ammon

By: _____
Mayor

Received by the City Clerk this 7th day of October, 2014

Signature: _____
Clerk

The City of Idaho Falls

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, Rebecca L. Noah Casper, Mayor for the City of Idaho Falls endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Idaho Falls.

DATED this 6 day of October, 2014

City of Idaho Falls

By: _____
Mayor

Received by the City Clerk this 4th day of October, 2014

Signature: Rosemarie Anderson
Clerk

The City of Iona

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, Brad S. Andersen, Mayor for the City of Iona endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Iona.

DATED this 21st day of October, 2014

City of Iona

By: BR Andersen
Mayor

Received by the City Clerk this 21st day of October, 2014

Signature: Julie Hammon
Clerk

The City of Irwin

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, LARRY PERCICHILLI, Mayor for the City of Irwin endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Irwin.

DATED this 7 day of OCT, 2014

City of Irwin

By: _____
Mayor

Received by the City Clerk this 7TH day of OCTOBER, 2014

Signature: _____
Clerk

CITY OF IRWIN
CORPORATE
SEAL
BONNEVILLE COUNTY, IDAHO

The City of Swan Valley

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, _____, Mayor for the City of Swan Valley endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Swan Valley.

DATED this ____ day of _____, 2014

City of Swan Valley

By:_____
Mayor

Received by the City Clerk this _____day of_____, 2014

Signature:_____
Clerk

The City of Ucon

Notice of Endorsement and Participation
in the
Bonneville County Multi-Jurisdictional
All Hazard Mitigation Plan

I, David Blain, Mayor for the City of Ucon endorse to support and participate in the implementation of the Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan as it applies to the City of Ucon.

DATED this 12th day of November, 2014

City of Ucon

By: _____
Mayor

Received by the City Clerk this 12th day of November, 2014

Signature: Ronda Deason
Clerk

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ACRONYMS

AHMP	all hazard mitigation plan
CFR	Code of Federal Regulations
CRS	Community Rating System
CWPP	county wildfire protection plan
DOT	U.S. Department of Transportation
EIRMC	Eastern Idaho Regional Medical Center
FEMA	Federal Emergency Management Agency
HazMat	hazardous material
HMGP	Hazard Mitigation Grant Program
IDWR	Idaho Department of Water Resources
INL	Idaho National Laboratory
ITD	Idaho Transportation Department
LIDAR	light detection and ranging
MM	Modified Mercalli Intensity Scale
mph	miles per hour
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NWS	National Weather Service
PAD	protective action distance
PDM	Pre-Disaster Mitigation (Program)
PGA	peak ground acceleration
SARS	Severe Acute Respiratory Syndrome
SHMO	state hazard mitigation officer
SPI	Standardized Precipitation Index

TB	tuberculosis
TORRO	Tornado and Storm Research Organization
WCT	wind chill temperature
WUI	wildland-urban interface

2014 Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan

1. PLAN OVERVIEW AND PLANNING PROCESS

1.1 Introduction

Bonneville County, Idaho, and the incorporated cities that lie within its boundaries are vulnerable to natural and technological (human-made) hazards that threaten the health, welfare, and security of county residents. The cost of response to, and recovery from, disasters and the potential for loss of life and property can be lessened when attention is turned to mitigating impacts before they occur or reoccur.

The Disaster Mitigation Act of 2000 (Public Law 106-390) was established to improve the disaster planning process by increasing hazard mitigation planning requirements for hazard events. Public Law 106-390 requires states and local governments to prepare hazard mitigation plans to identify and assess hazards, document the hazard mitigation process, and document mitigation needs.

To meet this requirement, in 2008, the Bonneville County Office of Emergency Management proposed a multi-jurisdiction all hazard mitigation plan (AHMP). This plan identified the county's and incorporated cities' hazards, an analysis of the impacts or potential impacts of those hazards on the population and infrastructure, and potential mitigations to those hazards. The AHMP was reviewed by the Idaho Department of Homeland Security and the Federal Emergency Management Agency (FEMA) and endorsed by Bonneville County, the city of Idaho Falls, and city of Ammon officials.

FEMA requires that hazard mitigation plans be updated every five years per the Code of Federal Regulations (CFR), Title 44, Part 201.6(d)(3). This 2014 AHMP update reflects changes in development patterns, progress in local mitigation efforts, and changes in mitigation priorities within the multi-jurisdiction since the 2008 AHMP.

1.2 Purpose

The purposes of this plan are as follows:

- Fulfill federal and local government mitigation planning responsibilities.
- Promote pre- and post-disaster mitigation measures with short- and long-range strategies to minimize suffering, loss of life, impact on traditional culture, and damage to property and the environment.
- Eliminate or minimize conditions that would have an undesirable impact on the people, culture, economy, environment, and well-being of Bonneville County at large.
- Enhance elected officials', departments', and the public's awareness of the threats to the community's way of life and of what can be done to prevent or reduce the vulnerability and risk.

1.3 Guiding Principles

Effective November 1, 2004, a multi-hazard mitigation plan approved by FEMA is required for Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) Program eligibility. The

HMGP and PDM programs provide funding, through state emergency management agencies, to support local mitigation planning and projects to reduce potential disaster damages.

The new local multi-hazard mitigation plan requirements for HMGP and PDM eligibility are based on Public Law 106-390, which amended the Robert T. Stafford Disaster Relief Act and Emergency Assistance Act, as Amended (Public Law 93-288) to promote an integrated, cost-effective approach to mitigation. Local multi-hazard mitigation plans must meet the minimum requirements of the Stafford Act – Section 322, as outlined in the criteria contained in 44 CFR 201. The plan criteria cover the planning process, risk assessment, mitigation strategy, plan maintenance, and adoption requirements.

To be eligible for projects funds under the Flood Mitigation Assistance Program, communities are required under 44 CFR 79.6(d)(1) to have a mitigation plan that addresses flood hazards. On October 31, 2007, FEMA published amendments to 44 CFR 201 at 72 Federal Register 61720 to incorporate mitigation planning requirements for the Flood Mitigation Assistance Program (44 CFR 201.6). The revised *Local Mitigation Plan Review Guide* (FEMA 2011) used by FEMA to evaluate local hazard mitigation plans is consistent with Section 322 of the Stafford Act and the National Flood Insurance Act of 1968, as Amended (42 USC 4001 et seq.). The *Local Mitigation Plan Review Guide* (FEMA 2011) complements the *Local Mitigation Planning Handbook* (FEMA 2013a), and both were used as official guides for the development of this 2014 AHMP update.

1.4 Scope

The jurisdictions covered in this plan are all of the unincorporated areas within Bonneville County, Idaho, and the incorporated cities of Idaho Falls, Ammon, Iona, Ucon, Swan Valley, and Irwin. All incorporated cities have been requested to endorse and participate in the implementation of this plan.

1.5 Mission Statement

This AHMP proposes public policy designed to protect citizens, critical facilities, infrastructure, private and public property, the local economy, and the environment from risks associated with natural and technological hazards.

1.6 Goals

The goals of the AHMP denote the broad direction that Bonneville County and associated incorporated city agencies, organizations, and citizens will take to select mitigating projects that are designed specifically to address risks posed by natural and technological hazards. Mitigation goals from the 2008 AHMP were modified to be broad statements by the planning committee. The modified goals allow the planning team and the committee to achieve the specific objectives described in the Mission Statement. Jurisdictional planning and mitigation goals for the County and each jurisdiction are as follows:

- *Mitigation* – Develop methods to prevent loss of, or damage to, infrastructure and structures through the implementation of mitigation techniques.

- *Planning* – Adopt codes and standards for construction in areas that are prone to specific hazards.

- *Planning* – Continue participating in the National Flood Insurance Program, Wildland Urban Interface Mitigation Program, and other programs that offer pre-disaster mitigation or limit the overall impact of hazards.

- *Mitigation* – Prioritize the protection of people, structures, infrastructure, and unique ecosystems that contribute to the socio-economic composition of the county and jurisdictions.

- *Planning* – Continue to examine the risks associated with technological hazards associated with the operations within and surrounding the county and jurisdictions.

1.7 Planning Process

The 2014 AHMP update was developed in accordance with FEMA and Idaho Bureau of Homeland Security requirements for a county level pre-disaster mitigation plan. As required by FEMA and Public Law 106-390 [44 CFR 201.4(c) and 201.6(c)(1)], the planning process for hazard mitigation plans must be documented and include public involvement. The planning process for this 2014 AHMP update includes the involvement of a designated planning team, a planning committee, and the public to help identify potential hazards, vulnerabilities, and mitigations that are assessed in the plan.

In the fall of 2013, Bonneville County's Office of Emergency Management solicited competitive bids from companies to provide the service of leading the assessment, developing the data, and updating the *Bonneville County Multi-Jurisdiction All Hazard Mitigation Plan*. Portage, Inc., was selected to provide this service to the county.

The following subsections include information on the planning team, public involvement, identified hazards, hazard analysis, and document review and adoption.

1.7.1 Planning Committee

The Bonneville All Hazard Mitigation Planning Committee was reconvened for the updated planning process with additional individuals who can contribute to the planning process. The committee is composed of representatives from the Bonneville County Local Emergency Planning Committee, heads of various Bonneville County departments, representatives from the Transportation Districts, representatives from the major utility providers, a representative from each of the incorporated cities in the county, and representatives from federal agencies (Table 1-1). A committee meeting was held on January 8, 2014, and minutes of that meeting are provided in Appendix A.

Table 1-1. Bonneville County Local Emergency Planning Committee.

Name	Organization	E-Mail
Blake Mueller	Bonneville County – Assessor	bmueller@co.bonneville.id.us
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Dave Radford	Bonneville County – Commissioner	dradford@co.bonneville.id.us
David Blain	City of Ucon – Mayor	ucon_mayor@msn.com
David Richards	City of Idaho – Falls Water	drichards@idahofallsidaho.gov
David Smith	City of Idaho Falls – Sewer	dsmith@idahofallsidaho.gov

Table 1-1. (continuous)

Name	Organization	E-Mail
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Richard Malloy	City of Idaho Falls – Idaho Falls Power	rmalloy@ifpower.org

Table 1-1. (continuous)

Name	Organization	E-Mail
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Steve Serr	Bonneville County	SSerr@co.bonneville.id.us
Susan Cleverley	Idaho Bureau of Homeland Security	scleverley@bhs.idaho.gov
Suzanne Stoddard	Bonneville County	sstoddard@co.bonneville.id.us
Tamara Cox	Eastern Idaho Public Health District 7	tcox@phd7.idaho.gov
Tom Lenderink	Bonneville County – Emergency Management	tlenderink@co.bonneville.id.us
Tony Anderson	Idaho State Police	tony.anderson@isp.idaho.gov
Troy Nelson	Eastern Idaho Public Health District 7	tnelson@phd7.idaho.gov
Zeke Prouse	City of Iona	publicworks@cityofiona.org

1.7.2 Public Involvement

A press release was issued to the *Post Register* on December 24, 2013, and February 21–26, 2014, stating that Bonneville County planned to update the AHMP. The press release encouraged the public to participate in the update process by contributing comments and suggestions to the Bonneville County Office of Emergency Management. Furthermore, a copy of the AHMP was made available to the public and the Idaho Falls Public Library for community members to comment and make suggestions.

An online survey for residents of Bonneville County was developed so that the planning committee could evaluate the concerns of community members. Based on the results of the survey, hazards that community members feel pose the most threat to their communities includes floods, earthquakes, hazardous materials, power outages, and wildfire. Furthermore, 81% of respondents felt that protecting critical facilities was a very important priority in mitigation planning. The majority of respondents suggested that outreach programs (i.e., community workshops, public education events, and availability of hazard information) would be the most effective way for Bonneville County and associated jurisdictions to eliminate risk of future damage from hazards in their respective communities.

The press releases and online survey form are located in Appendix A.

1.7.3 Identified Hazards/Vulnerabilities

The Bonneville All Hazard Mitigation Planning Committee reviewed and updated hazards identified in the 2008 AHMP. Existing hazards were updated per the FEMA *Local Mitigation Planning Handbook* (FEMA 2013a). The committee asked that “extended utility outages” be added to the list of identified hazards and that a hazard analysis is conducted. The hazards analyzed for the 2014 AHMP update are as follows:

Natural Hazards

- Weather:
    - Drought
    - Extreme heat
    - Extreme cold
    - Severe winter storm
    - Lightning
    - Hail
    - Tornado/high winds
- Flooding:
    - Flash flooding
    - River flooding
    - Dam failure
- Geologic:
    - Earthquake
    - Landslide
    - Avalanche
- Other:
    - Wildfire
    - Pandemic

Technological Hazards

- Structure fire
- Extended utility outage
- Hazardous material event
- Radiological event

- Riot/unlawful assembly/civil disorder
- Terrorism

The committee reviewed and updated vulnerabilities identified in the 2008 AHMP. New vulnerabilities were geographically identified using Geographical Information System technology, and potential damage and loss estimates were described.

1.7.4 Hazard Analysis

The hazard analysis was conducted using information gathered during the planning team committee meetings, the 2008 AHMP, current research, and the state hazard mitigation plan. For each hazard, two kinds of information are required to assess risk: (a) information pertaining to how frequently hazard events are likely to occur (hazard frequency) and (b) information concerning the potential amount of damage that a hazard event can cause (hazard magnitude) (FEMA 2013a). To the extent that such data can be obtained quantitatively, risk can then be determined as the product of the hazard's frequency and magnitude. The precise quantitative data of both kinds is often difficult or impossible to obtain. Hazard frequency and magnitude are described in detail below.

1.7.4.1 Hazard Frequency

To evaluate hazard frequency, historical events, scientific projections, and subjective judgments were used to determine the likelihood that the identified hazard would occur. Frequency occurrence for a given hazard was estimated using historical records. The value of frequency estimates obtained with historical records is subject to the existence of such records, their availability, and their accuracy. For this analysis, historical data were obtained from SHELDUS, a county-level hazard data set for the United States for 18 different natural hazard event types, such as thunderstorms, floods, and wildfires. The use of historical records was dependent on scientific projections that can account for natural cyclical events, economic conditions, technical advancements, and changes in land use. If the hazard frequency could not be determined solely from historical data and/or scientific projections, subjective judgments were used to give a semi-quantitative frequency.

Frequency projection data from these sources were used, as appropriate, in this plan. As part of the analysis process, frequency data were examined and assigned a relative level based on the criteria shown in Table 1-2.

Table 1-2. Frequency level criteria.

Ranking	Description
High	Multiple times a year to 5 years
Medium	5 to 25 years
Low	25 years or has yet to occur

1.7.4.2 Hazard Magnitude

Hazard magnitude estimates must rely on data gathered from a number of sources, including historical data, scientific projections, computer modeling, and subjective judgments. FEMA's HAZUS risk assessment software was used for the flood risk assessment. Magnitude estimates are generally based on the severity of potential impact of three critical vulnerabilities: human life, property, and the environment. These vulnerabilities and those described in Section 3 have been used to assign a quantitative magnitude for each identified hazard.

A scoring system was used to categorize the relative magnitude that each hazard may have on the community and is described in Table 1-3.

Table 1-3. Magnitude scoring criteria.

Value	Magnitude of Hazards					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/ no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care requires/ minimal death	$100,000s	Sheltering required/ neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/ a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

A hazard's total magnitude is the sum of the values for each of the six categories of hazard magnitudes shown in Table 1-3. For example, a hazard event that might be expected to require reconstruction assistance from the state government (Value = 4), affect an area consisting of multiple sections (Value = 4), cause little to no injury and no deaths (Value = 1), require little sheltering (Value = 2), and have a warning lead time of hours (Value = 4) would be assigned a magnitude value of 17 (4 + 4 + 1 + 2 + 2 + 4 = 17).

The hazard magnitude data from these sources were used, as appropriate, in this plan. As part of the analysis process, the hazard magnitude data were examined and assigned a relative level based on the criteria shown in Table 1-4.

Table 1-4. Magnitude level criteria.

Ranking	Magnitude Value
High	21 to 48
Medium	13 to 20
Low	6 to 12

1.7.4.3 Quantifying Risk

Once the hazard's frequency and magnitude were evaluated, an estimate of the overall risk severity associated with that hazard emerges. Because the values are necessarily imprecise and subjective, the risk was visualized by plotting them as shown in Figure 1-1. The frequency level determined in the analysis was plotted on the vertical axis, and the magnitude level determined in the analysis was plotted on the horizontal axis. Hazards with the most severe associated risk appear toward the lower right, and the lowest severity risk hazards appear near the upper left.

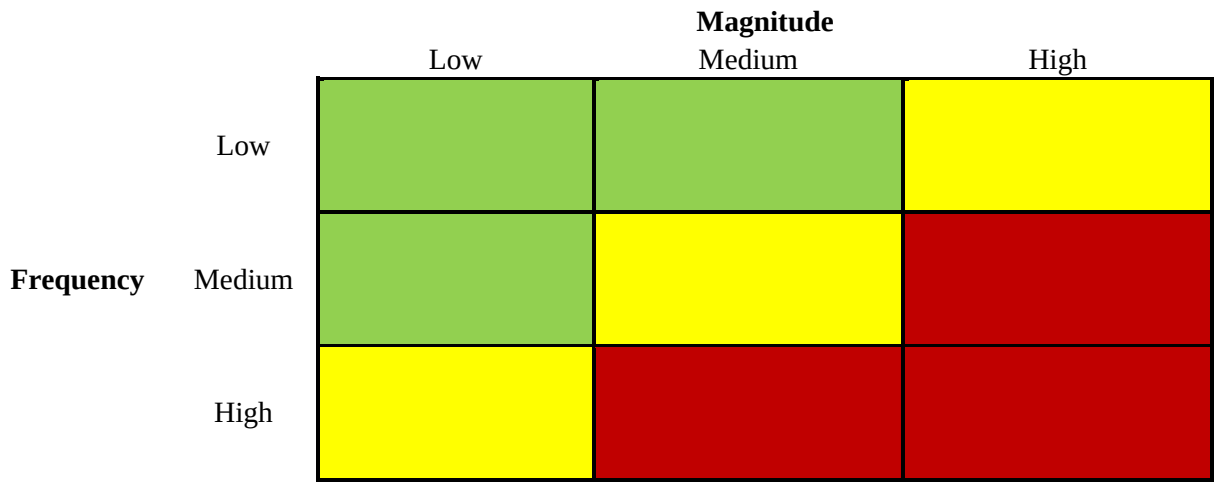

Figure 1-1. Risk ranking plot (green = low risk, yellow = medium risk, red = high risk).

The severity of each hazard considered in this plan is ranked relative to one another using the above plotting scheme to assist in the prioritization of mitigation activities.

1.7.5 Development of Mitigation Alternatives

Mitigation measures were evaluated or reassessed for the identified hazards that were updated or newly assessed for the 2014 AHMP update. For each mitigation project, descriptions for that project and associated roadmaps address approximate costs, possible returns on investments, and environmental and socio-economic benefits.

1.7.6 Plan Development and Document Review

The 2014 AHMP update is intended to meet all of the requirements set forth by FEMA for multi-hazard mitigation plans and Public Law 106-390 (44 CFR§201.6).

Plan drafts were presented to the Bonneville All Hazard Mitigation Planning Committee for review prior to submitting a final version to the appropriate state hazard mitigation officer (SHMO) for review and comments.

In Idaho, the SHMO is:

Mark Stephensen
Idaho Bureau of Homeland Security
4040 Guard Street, Bldg. 600
Boise, ID 83705

The SHMO submits the final plan to FEMA for review. FEMA reviews the final version of a plan prior to local adoption to determine whether the plan meets the criteria, but FEMA is unable to approve the plan prior to adoption. The plan is evaluated by FEMA on its adherence to a variety of criteria, as described in the *Local Mitigation Plan Review Guide* (FEMA 2011).

Before the plan is approved by FEMA, the plan must be adopted by Bonneville County. The director of Bonneville County's Office of Emergency Management makes a formal public presentation to the Bonneville County Board of County Commissioners seeking their approval of the plan. In addition to the approval by the county commissioners, each participating jurisdiction (Idaho Falls, Ammon, Iona, Ucon, Swan Valley, and Irwin) is requested to adopt the plan by resolution, with the respective mayors signing the appropriate multi-jurisdiction participation document. The finished plan includes a promulgation page for Bonneville County and an agreement to endorse and participate for each incorporated city.

1.8 Plan Use

The AHMP is used to help county and city officials, neighboring communities, and local and regional agencies plan, design, and implement programs and projects that will help reduce vulnerability to natural and technological (human-made) hazards. The focus of the updated plan is to continue support of the decision-making and the implementation of projects that will reduce the impact of disasters before they occur. Such actions can both reduce existing risk exposure and avoid creating new exposures.

The plan is also used to facilitate inter-jurisdictional coordination and collaboration related to all hazard mitigation planning and implementation within Bonneville County and at the regional level. Finally, the plan is used to develop or provide guidance for local emergency response planning. Although the AHMP is not an emergency response/management plan, it can be used to help identify weaknesses in, and improvement of, those types of plans.

1.9 Plan Maintenance

The Bonneville County AHMP maintenance process includes a schedule for annually monitoring and evaluating the programmatic outcomes called for in the plan and for producing a plan revision every five years.

1.9.1 Formal Review Process

The plan will be reviewed on an annual basis by the director of the Office of Emergency Management and reviewed and revised every five years by the Bonneville All Hazard Mitigation Planning Committee to determine the effectiveness of programs and to reflect changes that may affect mitigation priorities. The director or designee will be responsible for contacting the committee and organizing a review. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the plan. The committee will review the goals and action items to determine their relevance to changing situations in Bonneville County as well as changes in federal policy, and to ensure that they address current and future conditions. The committee will also review the risk assessment portion of the plan to determine whether this information should be updated or modified, given any new available data. The organizations responsible for the various action items will report on the status of the projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised or removed.

The director or designee will be responsible for ensuring that the plan is updated. The director will also notify all holders of the AHMP and affected stakeholders when changes have been made. Every

five years, the updated plan will be submitted to the State of Idaho Bureau of Homeland Security's Mitigation Program and FEMA for review.

1.9.2 Continued Public Involvement

The Bonneville County Office of Emergency Management is dedicated to the concept of public involvement in the planning process, including the review and updating of the plan. Copies of the plan will be made available to the public by appropriate Bonneville County departments and outside agencies, and the public will be provided with the opportunity to provide input to plan revisions and updates. Public meetings will be held when deemed necessary by the director to provide the public an opportunity to express concerns, opinions, or new alternatives. In addition to public meetings, the director has established an e-mail account, AHMP@co.bonneville.id.us, for members of the public to express concerns, opinions, or new alternatives. All correspondence will be recorded and considered by the committee when updating the plan. The Board of County Commissioners will be responsible for using county resources to publicize public meetings and to maintain public involvement.

2. BONNEVILLE COUNTY DESCRIPTION

Bonneville County is located in eastern Idaho in the Snake River Plain and Caribou Mountain Range. Major population centers in the area are Idaho Falls, Ammon, Ucon, Iona, Irwin, and Swan Valley. The western and central part of the county are cultivated, with the main crops being potatoes, barley, wheat, and alfalfa (University of Idaho 2013). The southern and eastern parts of the county consist of the Caribou and Snake River ranges, which consist of forested mountains. The most defining feature is the Snake River, which runs throughout most of the county. Elevations in the county range from 4,625 feet at the southwestern end of the Idaho Falls area to Mount Baird at 10,042 feet north of Palisades Reservoir in the Snake River Range.

2.1 Topography and Geography

Bonneville County is bordered on the north by Teton, Madison, and Jefferson counties; on the west by Bingham County; on the south by Bingham and Caribou counties; and on the east by Teton and Lincoln counties, Wyoming (Figure 2-1). Bonneville County has an area of approximately 1,194,286 acres, which ranks sixteenth in area among Idaho counties.

The topography of the county varies from broken lava beds and sagebrush steppe in the Snake River Plain and partly forested mountains in the Caribou and Snake River ranges (Caribou and Snake River highlands) (Figure 2-1). Typically, water flows from east to west as the elevation drops. Palisades Reservoir, Ririe Reservoir, Grays Lake, and the Snake River are the major water bodies located in Bonneville County. Seven watersheds cross the county; they are the Palisades, Salt, Idaho Falls, Teton, Willow, American Falls, and Blackfoot watersheds (EPA 2013). These watersheds contribute to the Snake River Basin.

2.2 Geology

The western portion of Bonneville County is mostly basalt lava fields and alluvium that consists of cross-bedded gravel with some sandstone and basalt (Figure 2-2). The eastern portion of the county is mostly sandstone and limestone in the Caribou and Snake River ranges and alluvium and basalt in Swan Valley and along the Snake River (Figure 2-2).

The eastern part of the county is in the Idaho-Wyoming thrust belt, with the Absaroka thrust running east along the extreme northeast corner of Bonneville County to the west of the Grand Valley graben (Link 2002). The Grand Valley graben includes the Grand Valley fault on the east side and the Snake River fault on the west side of Swan Valley. Subsurface geology creates the potential for seismic activity throughout the county. The entire state of Idaho is considered to have at least a moderate seismic threat, and earthquakes can occur anywhere (IBHS 2013).

2.3 Climate

The overall climate for Bonneville County is typical of the xeric intermontane west, with the climate affected mostly by elevation, where lower elevations are dryer and warmer than higher elevations (McGrath et al. 2002). Typical of the overall county climate is that the majority of precipitation occurs in the autumn and winter; however, Bonneville County typically has at least one inch of precipitation per month. Precipitation in the Snake River Plain in the western portion of the county is typically less than Swan Valley and the surrounding mountains in the eastern and central part of the county (Table 2-1) (WRCC 2013). The eastern part of the county typically experiences lower temperatures than the western part.

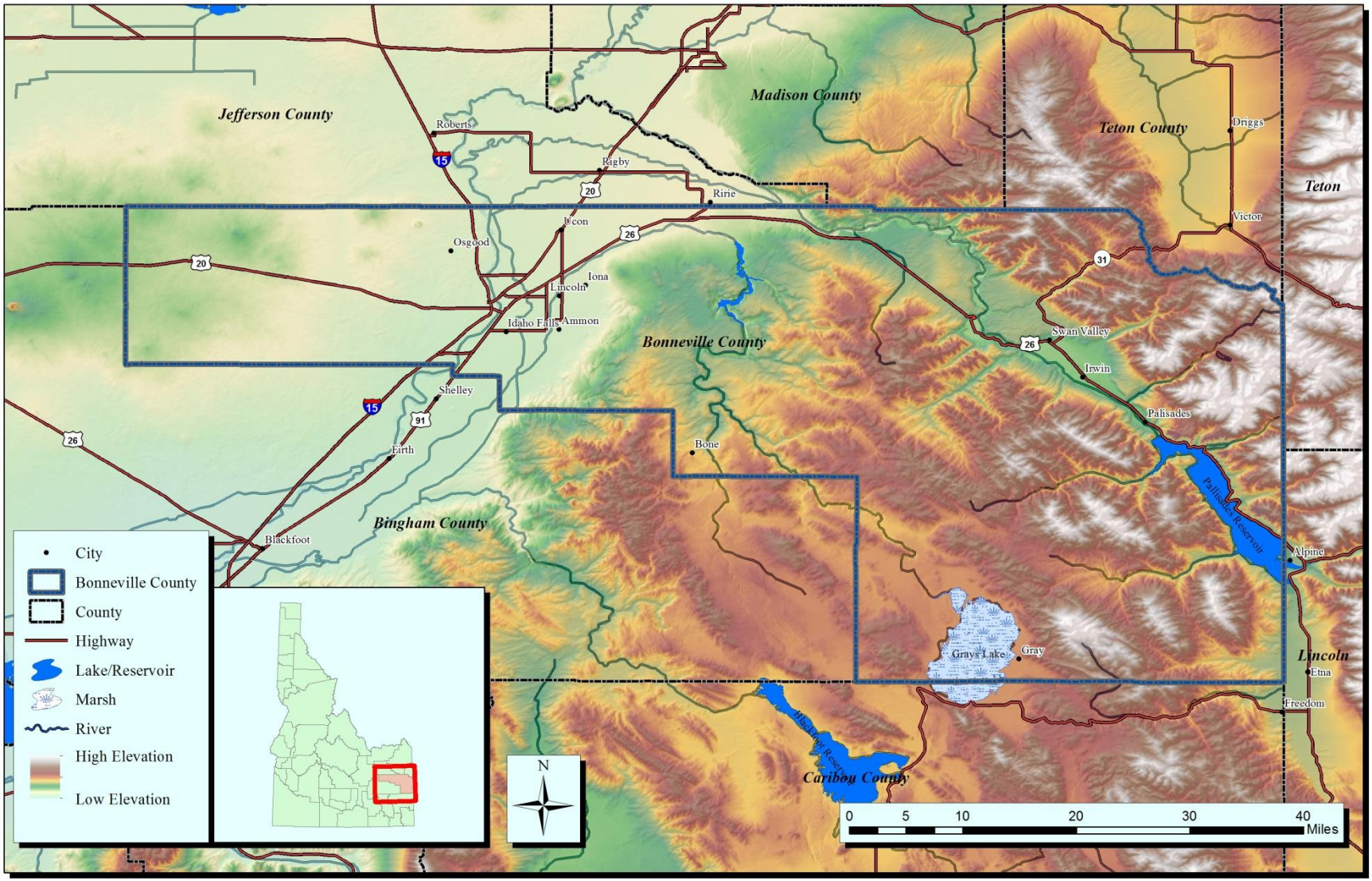

Figure 2-1. Map showing geography of Bonneville County.

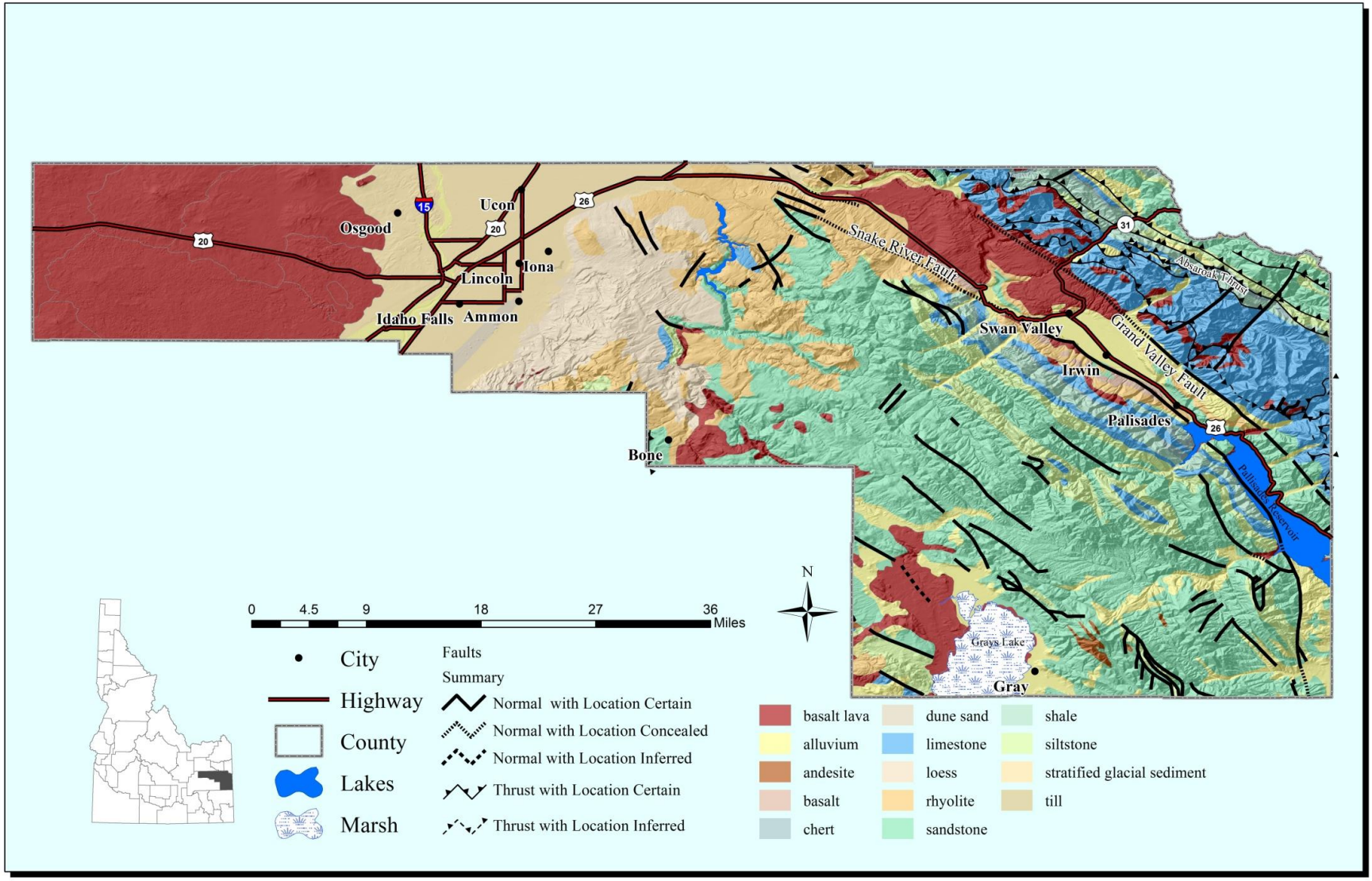

Figure 2-2. Map showing geology of Bonneville County.

Table 2-1. Average monthly weather for Swan Valley and Idaho Falls.

Period of Record Monthly Climate Summary													
SWAN VALLEY 2 E, IDAHO (108937) Period of Record: 7/8/1960 to 12/31/2012													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	30	35.2	43.9	55.1	65.2	74.7	84.6	83.2	73.6	59.9	42.3	31.1	56.6
Average Min. Temperature (F)	11	13.5	21.3	28.1	35	41.1	45.7	44.2	36.8	28.4	21.4	12.6	28.3
Average Total Precipitation (in.)	1.59	1.07	1.21	1.59	2.43	1.82	1.27	1.31	1.5	1.37	1.51	1.32	18
Average Total Snowfall (in.)	13.1	7	5.7	2.9	0.8	0	0	0	0.1	0.7	5.8	9.5	45.7
Average Snow Depth (in.)	9	8	3	0	0	0	0	0	0	0	1	3	2
Percent of possible observations for period of record. Max. Temp.: 97.7%. Min. Temp.: 98.8%. Precipitation: 98.7%. Snowfall: 89.4%. Snow Depth: 82.7%.													
IDAHO FALLS 2 ESE, IDAHO (104455) Period of Record: 5/20/1952 to 3/29/2013													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	30.2	36.6	47.4	58.3	68.3	77.7	87.1	85.7	75.4	61.6	43.9	32	58.7
Average Min. Temperature (F)	13.2	17.5	25	31.9	39.7	46.8	52.6	50.4	41.8	32.4	23.5	14.6	32.4
Average Total Precipitation (in.)	1.04	0.9	1.01	1.17	1.62	1.26	0.53	0.71	0.82	1.02	1.01	1.04	12.11
Average Total Snowfall (in.)	7.7	4.9	2.8	0.9	0.3	0	0	0	0	0.5	3.1	6.4	26.8
Average Snow Depth (in.)	3	2	0	0	0	0	0	0	0	0	0	2	1
Percent of possible observations for period of record. Max. Temp.: 94.5%. Min. Temp.: 94.8%. Precipitation: 91.4%. Snowfall: 83.8%. Snow Depth: 74.8%.													
Source: http://www.wrcc.dri.edu													

2.4 Ownership

The federal government owns and manages approximately 599,673 acres (49%) of public land in Bonneville County. Most of these acres are located in the central and eastern areas of the county in the Caribou-Targhee National Forest, which is managed by the U.S. Forest Service (Figure 2-3) (BLM 2012). The U.S. Department of Energy, U.S. Bureau of Land Management, and U.S. Bureau of Reclamation are other agencies that manage large tracts of land in the county. The State of Idaho owns and manages approximately 56,017 acres (5%) of land in Bonneville County. These lands are found throughout the county and mostly consist of state endowment lands and areas managed by the Idaho Department of Fish and Game. Approximately 536,177 acres (44%) of the county are privately owned. Most of these acres are located in the central and eastern part of the county, with some in the south.

2.5 Land Use/Land Cover

The three largest land use/cover types in Bonneville County are agriculture (365,456 acres), rangeland (375,602 acres), and forest (336,860 acres). Most of the acres that are used for agriculture are in the western part of the county on the Snake River Plain and in Swan Valley and Antelope Flats in the central and eastern portions of the county (Figure 2-4) (Fry et al. 2011). Developed lands for urban populations cover approximately 36,290 acres and make up 3% of the county's land cover. The majority of these areas are located in the western part of the county in the Idaho Falls area.

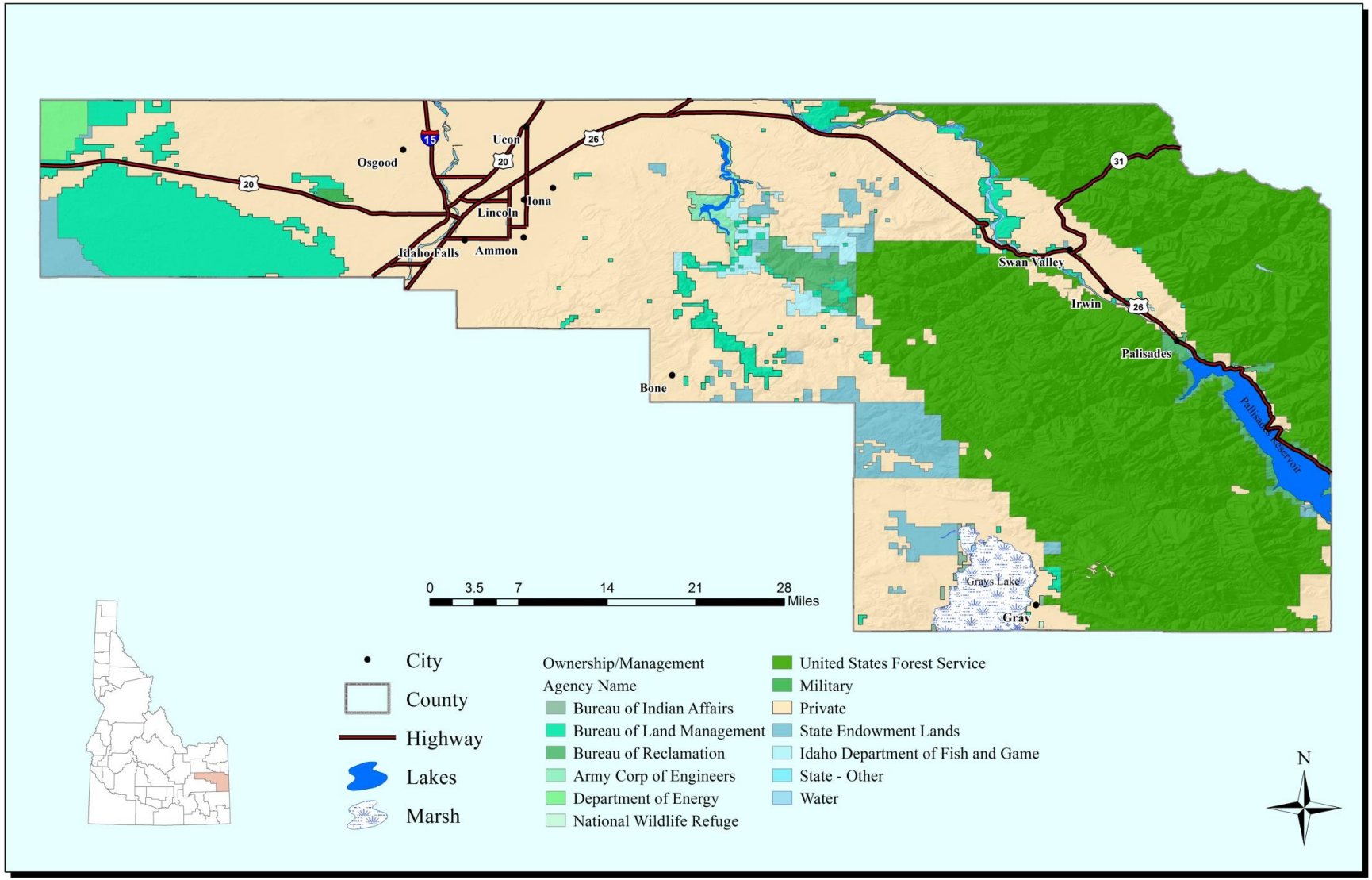

Figure 2-3. Map showing land ownership in Bonneville County.

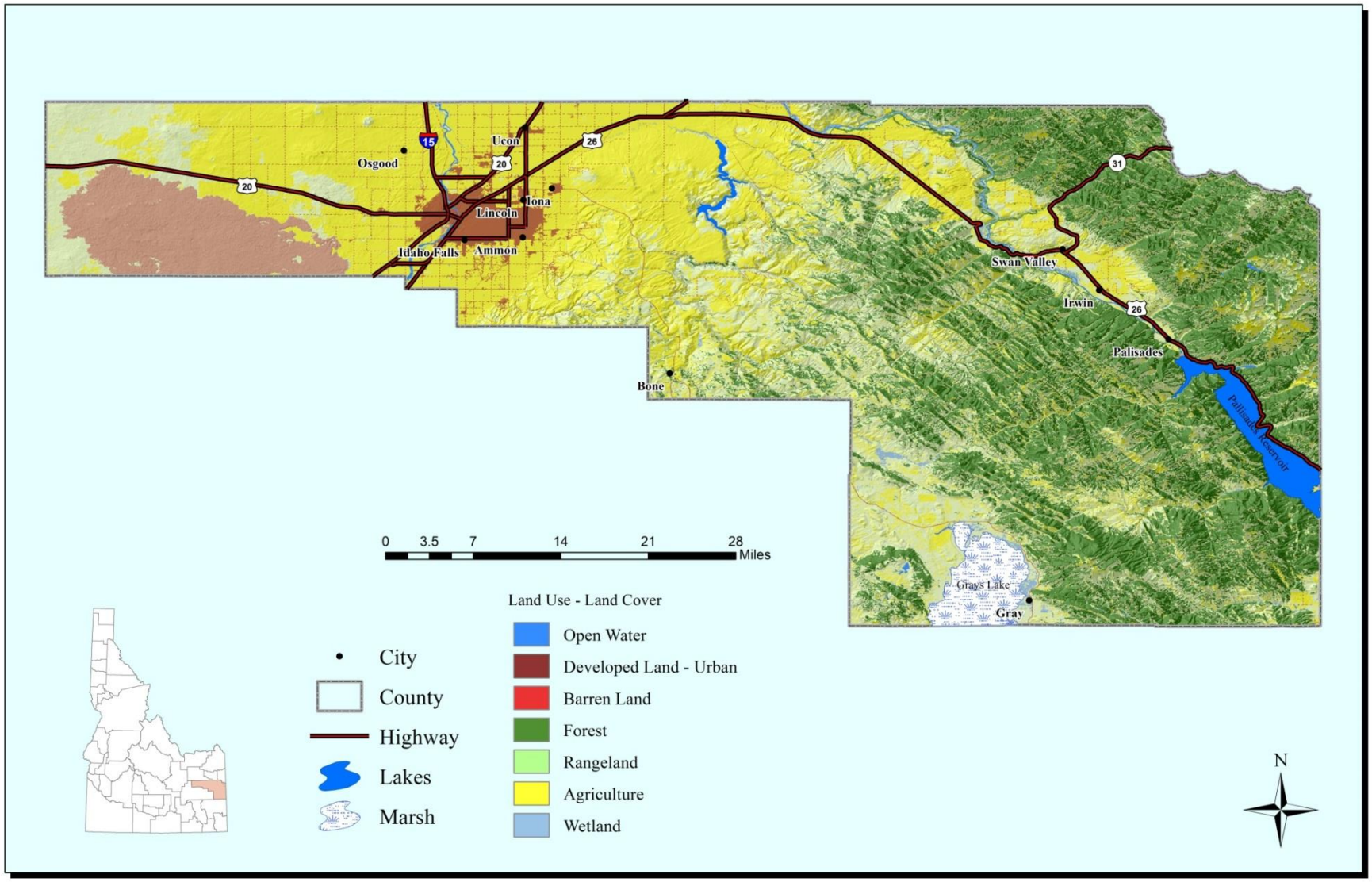

Figure 2-4. Map showing land use in Bonneville County.

Land cover significantly affects hazard vulnerability. For example, areas with large portions of forest cover, such as the eastern part of the county, are more susceptible to wildfire hazards. Areas that were once covered by trees or grasses but have experienced urbanization are more susceptible to flash flooding because of the buildup of roads, roofs, and parking lots that reduce infiltration of rainwater and increase the amount of storm water run-off (IBHS 2013).

2.6 Natural Resources

Two large ecosystems occur within Bonneville County. The eastern and central parts of the county have steep, dry, partly forested mountains that support open-canopied forests, shrublands, and grasslands with open valleys that historically were covered with sagebrush and grasses with some wetland areas (McGrath et al. 2002). As discussed earlier, most of the eastern and central part of the county is located in the Caribou-Targhee National Forest, which covers most of the Caribou and Snake River ranges. In the southern part of the county is a portion of the Grays Lake National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service. Grays Lake is a large, shallow marsh that provides breeding habitat for mammals, birds, fish, and amphibians (USFWS 2012).

The western part of the county has lava fields that are either barren or covered with some shrubs and grasses or rugged plateaus and basins that were historically covered with sagebrush (McGrath et al. 2002). Most of the historical sagebrush steppe in the western part of the county is used as rangeland or has been converted into cropland.

2.7 Demographics

Bonneville County is the most populous county in eastern Idaho. With a 2012 estimated population of approximately 106,684 people, it ranks fourth among Idaho counties in population (U.S. Census Bureau 2013). Most of the population lives in or near the Idaho Falls area, which includes the incorporated cities of Idaho Falls (the county seat), Ammon, Iona, and Ucon (Figure 2-5). Other incorporated cities within the county include Irwin and Swan Valley.

The population has continued to grow at a steady pace since 2006. From 2006 to 2012, the county's population has grown approximately 14% (Figure 2-5) (BEA 2013). The largest city in Bonneville County is Idaho Falls, with a 2012 estimated population of 57,899, making it the fourth largest city in Idaho (U.S. Census Bureau 2013).

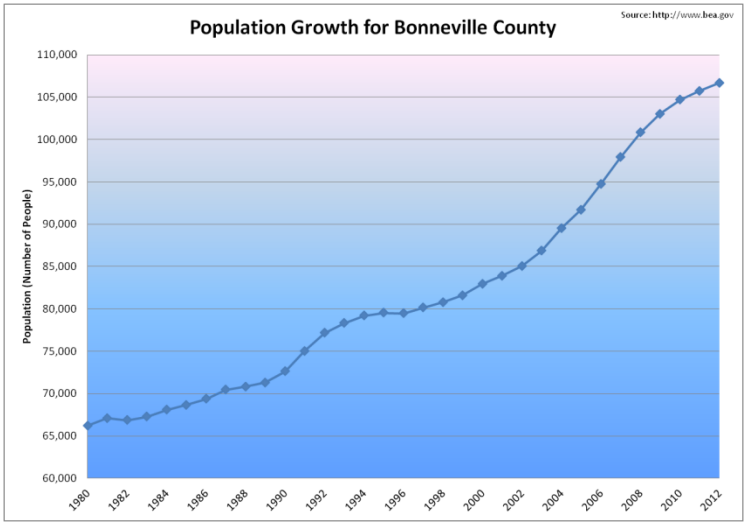

Figure 2-5. Bonneville County population from 1980 to 2012.

The geographic distrubution of the county's population is changing from being centered mainly in Idaho Falls to the surrouding areas of Ammon and Iona and to the small towns of Swan Valley and Irwin and unicorporated Bonneville County (Table 2-2) (U.S. Census Bureau 2008-2012; Idaho Falls 2010). As shown in Table 2-2, the cities of Iona, Irwin, and Swan Valley have had the largest percentage increase in population since 2000. Idaho Falls and Ammon have gained the most number of people since 2000, and they are expected to continue to increase in population (Idaho Falls 2010).

Table 2-2. Population changes for incorporated cities in Bonnville County.

City/Area	2000 Population	2005 Population	2010 Population	2010 Share of County Population	Percent Change 2000-2005	Percent Change 2005-2010
Ammon	6,187	10,925	13,816	13%	77%	26%
Idaho Falls	50,730	52,338	56,813	55%	3%	9%
Iona	1,201	1,256	1,803	1.7%	5%	44%
Irwin	157	166	219	0.2%	6%	32%
Swan Valley	213	230	299*	0.3%	8%	30%
Ucon	943	1,015	1,107	1.0%	8%	9%
Areas outside incorporated cities	23,537	25,779	30,476	29%	10%	18%
Total	82,968	91,709	104,234	—	11%	14%

*Estimated population for the city of Swan Valley.
Sources: U.S. Census Bureau (2013); U.S. Census Bureau (2008-2012); city of Idaho Falls (2010)

The size of a population in a particular area has a strong correlation with hazard vulnerabity and loss. For example, urban areas with high populations like Idaho Falls and Ammon naturally have a higher number of structures; therefore, they will experience greater loss during hazard events (IBHS 2013).

2.8 Socioeconomics

Bonneville County has an estimated total of 40,107 housing units and a population density of 56 people per square mile (U.S. Census Bureau 2013). Ethnicity in the county is distributed as follows: White, 95.3%; Black or African American, 0.7%; American Indian or Alaskan Native, 1.1%; Asian, 1.0%, Two or More Races, 1.9% (U.S. Census Bureau 2013).

Overall, the population of Bonneville County is aging. In 2000, 10.5% of the population was older than 65; in 2012, approximately 11.4% of the population was older than 65 (Table 2-3) (Idaho Falls 2010; U.S. Census Bureau 2013). The populations of Swan Valley and Irwin are older than the rest of the county, with a larger percentage of the population older than 65 and an older median age (U.S Census Bureau 2008-2012).

Table 2-3. Percentage of Bonneville County population younger than 18 years and 65 years and older.

	Percentage of Population Younger than 18 Years and 65 Years and Older				
	Median Age Estimate	Percentage Younger than 18 Years		Percentage 65 Years and Older	
Area/City	2010	2000	2010	2000	2010
County	31.7	20.3	31.1	10.5	11.4
Idaho Falls	32.2	30.3	29.3	11.1	11.8
Ammon	29.6	39.8	36.3	9.59	9.8
Iona	28.1	47	35.1	11.2	10.1
Irwin	52.4	33	11.9	23.8	23.7
Swan Valley	47.8	28	18.1	19	20.6
Ucon	28.6	38	38.1	7.75	9.6

Source: U.S. Census Bureau (2013); U.S. Census Bureau (2008-2012); Idaho Falls (2010)

2.9 Economic Profile

Bonneville County has continued to be economically stable and diversified. The economic stability is based on the Idaho National Laboratory, one of Idaho's largest employment sites (IDL 2013). The county also serves as a regional healthcare and retail hub, with consumer and client bases that extend into the surrounding counties and states. Agriculture continues to be a stable economic driver, with potatoes, wheat, barley, canola, and cattle being major county exports. Eeconomic growth has helped construction, wholesale trade, manufacturing, retail trade, and tourism become a major part of the local economy (Idaho Falls 2010).

Examples of the economic stability and growth in the metropolitan areas include professional and retail developments—such as Taylor's Crossing and Snake River Landing in Idaho Falls—that complement the revitalization efforts taking place for Idaho Falls historic downtown (IDL 2013). Additionally, the proposed France-based AREVA multibillion-dollar uranium enrichment facility is an example of potential future economic growth.

Trade, utilities, and transportation account for approximately 11,594 jobs in Bonneville County and are the largest contributers to the economy (Table 2-4) (IDL 2013). Education and healthcare are next with 7,588 jobs, followed by the government with 5,687 jobs (IDL 2013). Overall, the average number of jobs in the county is 42,750. The unemployment rate in the county as of August 2013 was 5.7%, which was lower than the national (7.3%) and state (6.7%) ratetime period (USBLS 2013).

Table 2-4. Covered employment and average annual wages per job for 2012 in Bonneville County.

Covered Employer Type	Average Employment	Average Wages ($)
Agriculture	392	34,062
Mining	41	17,041
Construction	2,228	40,417
Manufacturing	2,150	38,031
Trade, Utilities, and Transportation	11,594	31,431
Information	1,064	36,034
Financial Activities	1,780	39,762
Professional and Business Services	4,446	39,473
Educational and Health Services	7,588	33,952
Leisure and Hospitality	4,520	12,906
Other Services	1,260	24,282
Government	5,687	36,634
Total	42,750	32,509
Source: IDL (2013)		

Bonneville County households earn a median income of $51,254 annually (U.S. Census Bureau 2013). Iona and Ammon households have the highest median income in the county, with Idaho Falls, Irwin, and Swan Valley at the lowest (Table 2-5). The per capita personal income in 2012 was $36,646, which has increased approximately $900 in the past five years. Based on the steady increase, it is assumed that per capita personal income and median household income will continue to increase (Figure 2-6) (BEA 2013). Bonneville County's percentage of people below the poverty level, as estimated for 2008–2012 is 11.6%, which is higher than reported in 2008 (Table 2-5) (U.S. Census Bureau 2008-2012).

2.10 Regional Hazard Profile

Data were collected for developing Bonneville County's hazard profile. SHELDUS is a county-level hazard data set for the United States for 18 different natural hazard event types, such as thunderstorms, hurricanes, floods, wildfires, and tornados. For each event, the database includes the beginning data,

location (county and state), property losses, crop losses, injuries, and fatalities that affected each county (HVRI 2013).

SHELDUS was developed by the Hazard and Vulnerability Research Institute (HVRI 2013) and is described as follows:

> *The data were derived from several existing national data sources such as National Climatic Data Center's monthly Storm Data publications and NGDC's Tsunami Event Database. With the release of SHELDUS 12.0, the database includes every loss causing and/or deadly event between 1960 through 1992 and from 1995 onward. Between 1993 and 1995, SHELDUS reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.*

The SHELDUS database does not include every hazard event that occurred within an area. Only events that met a specific reporting criterion were listed. This means that many local events are not included in this database. Some of the missing events may be considered major local hazard events even though they did not cause a fatality or more than $50,000 in property damage. The results of the SHELDUS data search for Bonneville County are provided in Appendix B.

Table 2-5. Median household income.

2012 Median Household Income/2008-2012 People Below Poverty Level		
Location	Median Household Income ($)	Percentage of People Below Poverty Level
Bonneville County	51,254	11.6
Ammon	56,808	11.2
Idaho Falls	46,291	14.8
Iona	59,125	11.9
Irwin	46,250	2.8
Swan Valley	46,250	0
Ucon	50,568	5.6
Source: U.S. Census Bureau (2008-2012)		

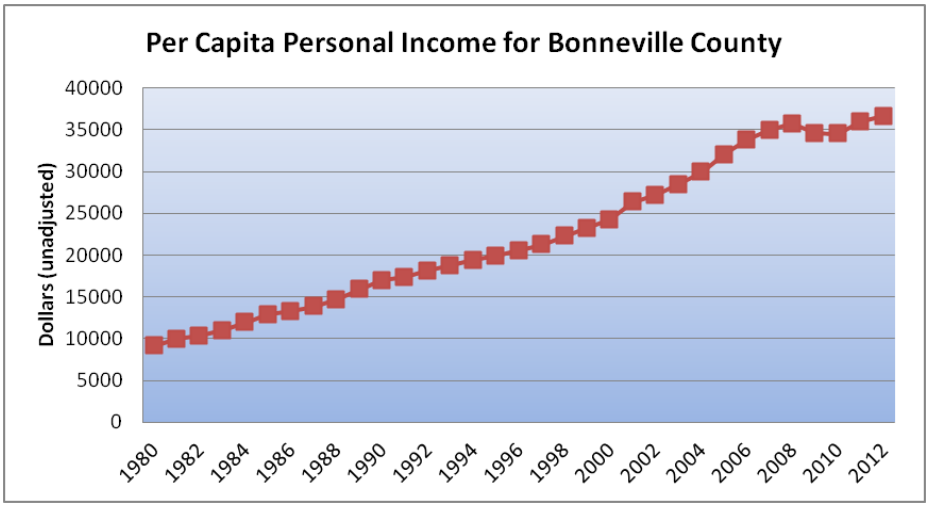

Figure 2-6. Per capita personal income for Bonneville County from 1980 to 2012.

3. RISK ASSESSMENT

3.1 Overview

A risk assessment was conducted to determine the potential damage, loss, or other impacts created by the interaction of identified hazards to community assets. The severity of that risk depends on the extent of the hazard and the vulnerability of the asset, as well as the community's capabilities to mitigate, prepare for, respond to, and recover from the events. The focus of the overall risk assessment in the 2014 AHMP update was to build on the risk assessments from the 2008 AHMP. Additionally, the 2014 AHMP update identifies how potential impacts from the previously identified hazards have changed since the 2008 AHMP. Changes related to land use development and new hazard information were added to the 2014 AHMP update and used in the overall risk assessment.

This section reviews the hazards identified in the 2008 AHMP, identifies new hazards, identifies vulnerabilities, analyzes the risks associated with the hazards, and summarizes community vulnerabilities to each of the hazards.

3.2 Purpose

The purpose of a risk assessment is to establish a basis to determine the cost effectiveness and priority of implementing mitigation strategies. Risk assessments are used to evaluate hazards for the overall county, but they are also jurisdiction-specific in that they examine the assets, vulnerabilities, and overall risks that are unique to each community (FEMA 2013a).

3.3 Process

The risk assessment process for the 2014 AHMP update was as follows:

1. Describe hazards and analyze risks (Subsection 3.4)
2. Identify community assets (Subsection 3.5)
3. Summarize and rank risk severity (Subsection 3.6).

3.4 Hazard Description and Assessment

The Bonneville All Hazard Mitigation Planning Committee reviewed the hazards identified in the 2008 AHMP and recognized that these hazards are still significant and present within the county. The committee also identified "extended utility outages" as a significant hazard that should be included in the 2014 AHMP update. The hazards that have been identified as significant are categorized as either being natural or technological hazards. A technological hazard is a human-caused event.

The hazards that are described and analyzed in the 2014 AHMP update are as follows:

<u>Natural Hazards</u>

- Weather:
    - Drought
    - Extreme heat

    - Extreme cold
    - Severe winter storm
    - Lightning
    - Hail
    - Tornado/high winds
- Flooding:
    - Flash flooding
    - River flooding
    - Dam failure
- Geologic:
    - Earthquake
    - Landslide
    - Avalanche
- Other:
    - Wildfire
    - Pandemic

<u>Technological Hazards</u>

- Structure fire
- Extended utility outage
- Hazardous material event
- Radiological event
- Riot/demonstration event
- Terrorism

Each hazard description was updated to include information on the location, extent, previous occurrences, and probability of future occurrences within Bonneville County. The locations consist of the geographic areas within the county that can be affected by the hazard. The extent is the strength or magnitude of the hazard and is described by using scientific scales, speed of onset, and duration of the event. Past occurrences are previous hazard events for each identified hazard. Past occurrence events include those that have occurred since the 2008 AHMP. Future event occurrence tries to identify the probability of an event occurring in the future and the typical warning period before that event occurs.

The hazard vulnerability assessment discusses the potential impacts that a specific hazard has on people, the economy, the built environment, and the natural environment within the county and jurisdictions. The hazard summary takes information from the description and hazard vulnerability assessment to determine the hazards' estimated magnitude and frequency.

3.4.1 Weather Hazards

The impact of weather hazards may be widespread (e.g., drought) or more localized (e.g., lightning), but all have the potential to be severe and life threatening. Historical weather data are generally available in good detail over long periods, allowing for reasonably accurate risk assessment for planning purposes.

3.4.1.1 Drought

3.4.1.1.1 Description and Location

In Idaho, drought is an expected phase in the climatic cycle (IBHS 2013). Objective, quantitative definitions for drought exist, but most authorities agree that, because of the many factors contributing to it and because its onset and relief are slow and indistinct, none is entirely satisfactory. For this assessment, a simplified definition is needed. To simply the definition of a drought, the National Drought Mitigation Center (NDMC) defines a drought as "a protracted period of deficient precipitation" within a geographical area (NDMC 2014). Therefore, a "drought" is the result of a significant decrease in water supply relative to what is "normal" in that area.

Drought in Idaho is generally associated with a sustained period of low winter snowfall (IBHS 2013). This results from a temporary, yet significant, change in the large-scale weather patterns in the western United States. The limited snowpacks result in reduced stream flows and groundwater recharge. Idaho's system of reservoirs and natural storage can buffer the effects of minor events over a few years, but a series of dry winters will result in a shortage of available water. Extended periods of above-average temperatures during the spring and summer can increase the impacts of low snowpacks.

Drought has the potential to impact the entirety of Bonneville County and associated jurisdictions. However, based on typical precipitation in the Snake River Plain, any impacts from drought are more likely to impact the western part of the county.

3.4.1.1.2 Extent

The extent or magnitude of a drought is dependent on the amount of precipitation within the area. By measuring precipitation rates, the extent of drought conditions can be estimated. For the purpose of this plan, the NDMC's Standardized Precipitation Index (SPI) is used to identify emerging droughts (NDMC 2014b). The SPI measures precipitation shortfall and excess over a variety of time scales. The current drought condition can be mapped and used to predict future drought conditions, such as Figure 3-1 for January, 2014.

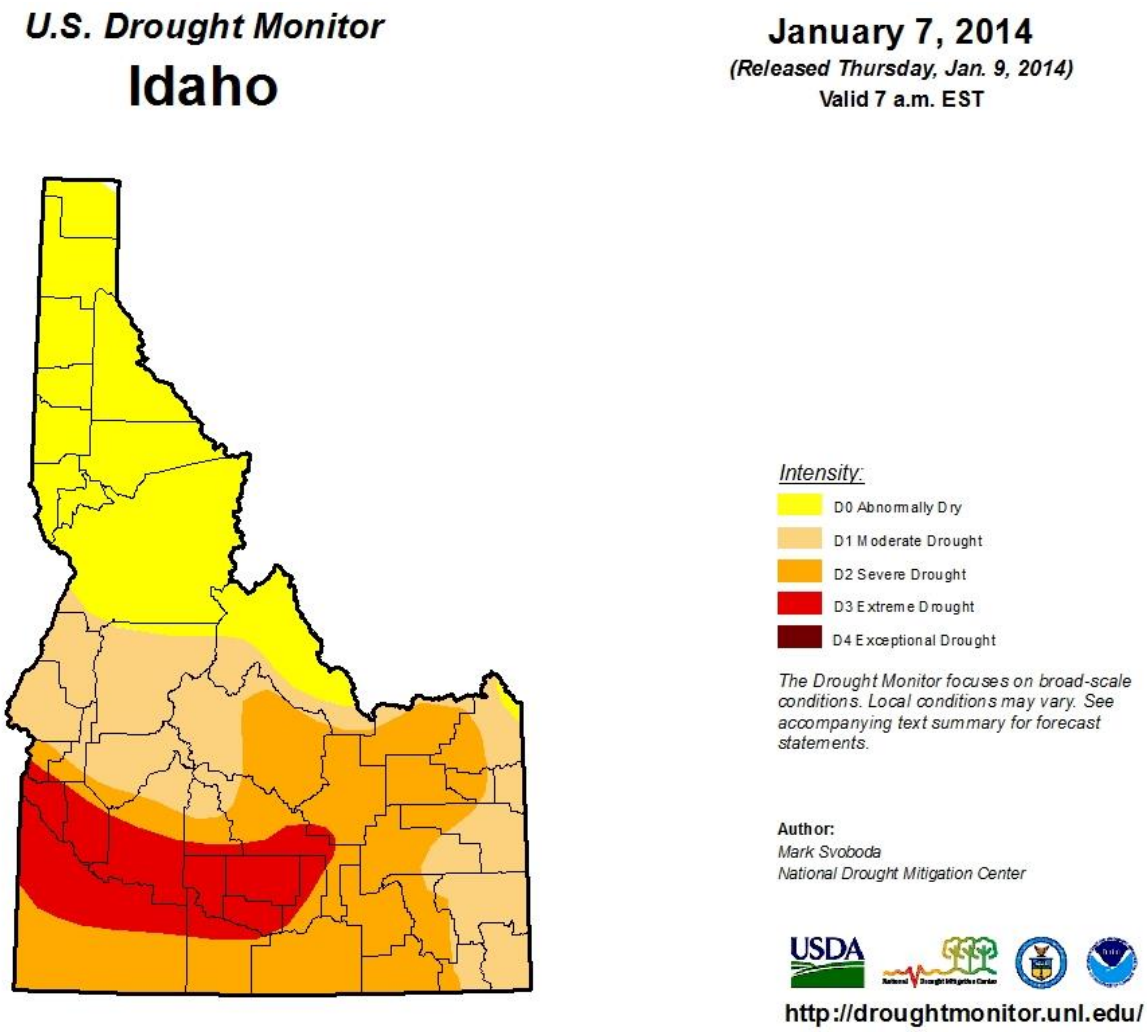

Figure 3-1. Drought conditions in Idaho as of January 7, 2014.

3.4.1.1.3 Previous Occurrences

Previous occurrences include events that have occurred since the 2008 AHMP was completed.

The NDMC's Drought Monitor was used to identify the frequency of droughts within Bonneville County over the past five years (NDMC 2014b). Based on a review of data from Drought Monitor, Bonneville County as a whole was identified as having a severe drought in January 2008, partially with a severe and moderate drought as of January 2014, a moderate drought in January 2009 and January 2013, abnormally dry in January 2010, and no drought condition in January 2011 and January 2012 (NDMC 2014b).

Since 2008, the Idaho Department of Water Resources (IDWR) has issued one drought declaration for Bonneville County. That declaration was issued on July 13, 2013 (IDWR 2013). IDWR drought declarations apply only to the administrative processing of applications for temporary changes of water rights and do not apply to issues of financial or disaster support (IBHS 2013).

3.4.1.1.4 Future Occurrences

Based on past occurrences within the county and throughout most of Idaho, it is anticipated that droughts will continue. Since the 1920s, Idaho has had drought conditions for at least one year each decade and usually for more prolonged periods (IBHS 2013). The magnitude of the drought is dependent on the amount of precipitation that is received throughout the year, which varies from year to year; therefore, the extent of future events is unknown. However, with the SPI, Drought Monitor, and other tools used to predict droughts, warnings can be issued months in advance.

3.4.1.1.5 Vulnerability Assessment

Bonneville County is vulnerable to drought because it is located in an arid region. Drought has the potential to impact people and the built and natural environments. Because of the large agricultural and other resource-based industries within the county, impacts to the economy would result in long-term consequences.

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Furthermore, because of the complex web, it is difficult to assess financial estimates and damages as a direct result of drought impacts.

Drought impacts can be categorized as economic, environmental, or social. Many of these impacts overlap, and direct impacts cannot be tied specifically to one category. Some examples of drought impacts include reduced crop, rangeland, and forest productivity; increased fire hazard; increased livestock mortality rates; and damage to wildlife and fish habitat. Examples of indirect impacts include soil erosion caused by wind and water, fewer recreational opportunities, and increased problems with insects and diseases to forests.

Economic impacts include:

- Losses of crop, livestock, and timber production and associated businesses
- Losses from recreation providers and associated business
- Losses related to the increased costs resulting from increased energy demand and shortages caused by reduced hydroelectric generation capacity
- Long-term loss of economic growth and development.

Economic loss is an indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenues for local, state, and federal governments.

Income losses are typically related to temporary and permanent losses of property, particularly agricultural damages, rather than loss of life. Furthermore, the overall income loss is dependent on the extent of the drought. More severe droughts will have higher losses than moderate droughts.

3.4.1.1.6 Hazard Summary

Drought occurs regularly and, with modeling tools, can be predicted (Magnitude Value = 1). Based on historical occurrences and the extent, droughts will typically occur countywide but are more likely to occur in the western part of the county (Magnitude Value = 4). An estimated loss is difficult to determine

because of the overall impact to the economy; however, based on reported average historical crop loss estimates of $740,000, estimated losses would be in the $100,000s (HVRI 2013) (Magnitude Value = 2). For severe droughts, the state would provide reconstruction assistance in the form of a temporary change in water rights, which has occurred in the past five years (Magnitude Value = 4). No sheltering is required during a drought event (Magnitude Value = 1). Droughts do not typically cause bodily harm (Magnitude Value = 1). The total magnitude score is 13, which is in the medium range (Table 3-1). Historical records indicate that drought events occur regularly, with a severe drought occurring twice in the past five years and a moderate drought occurring twice; therefore, the overall frequency of these events is high.

Table 3-1. Magnitude scoring criteria for droughts.

	Magnitude of Droughts					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/ neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.2 Extreme Heat

3.4.1.2.1 Description and Location

The term “extreme heat” is, to some extent, a relative one describing a period when weather conditions include temperatures and humidity significantly higher than those that are usual for a particular geographic area. The National Weather Service (NWS) issues alerts to the public based on the NWS Heat Index, which takes both the temperature and humidity into account (NWS 2013a) (Figure 3-2). The NWS will initiate alert procedures when the high temperature is expected to exceed 105 to 110°F (depending on the local climate) for at least two consecutive days (NWS 2013a). Extreme heat conditions are uncommon in Idaho, where, in general, humidity is low and weather patterns are variable.

Extreme heat has the potential to impact the entirety of Bonneville County and associated jurisdictions.

3.4.1.2.2 Extent

Higher-than-normal humidity and temperatures can cause a short or prolonged period of extreme heat. A prolonged period of excessive heat is referred to as a heat wave and is related to very humid conditions. The extent or magnitude of an extreme heat event is measured using the NWS Heat Index (Figure 3-2). Based on the index, an extreme heat event could occur with an air temperature as low as 80°F if the percentage of humidity was equal to or greater than 40%.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Figure 3-2. NWS Heat Index.

3.4.1.2.3 Previous Occurrences

Bonneville County has experienced four extreme heat events since 1991 (two in 1991, one in 1992, and one in 1993) (HVRI 2013). During these events, five injuries were reported. No new events have occurred within the past five years.

The record high for the county was 104°F, which was recorded on July 12, 2002.

3.4.1.2.4 Future Occurrences

Based in the historical frequency, the likelihood or future probability of occurrence of excessive heat is limited. The probability of future occurrences can be developed from the historical records that are available (IBHS 2013).

Based on recorded observations from 1991 through 2014, it can be reasonably assumed that an extreme heat event has occurred once every 5.75 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 23 years

[(Years on Record) 23] / [(Number of Historical Events) 4] = 5.75 years

Drought conditions and above-average temperatures increase the likelihood of an extreme heat event. In the case of future events, the NWS will notify the affected communities when conditions meet the NWS Heat Index reporting standards.

3.4.1.2.5 Vulnerability Assessment

There is no defined geographic boundary for extreme heat. Buildings, infrastructure, and critical facilities are exposed to extreme heat, but it is not anticipated that any significant damage to these locations will occur.

However, extreme heat does present a significant threat to the general population. The primary impact of extreme heat is on human health, causing such disorders as sunstroke, heat exhaustion, and heat cramps. Particularly susceptible are the elderly, small children, and people with chronic illnesses. There are also undoubtedly indirect and chronic health effects from the extreme heat that are difficult or impossible to estimate. Environmental effects can include loss of wildlife and vegetation and increased probability of wildfires.

Extreme heat places high demands on electrical power supplies, which can lead to power outages. Economic impacts result from such factors as increased energy prices, loss of business as people stay at home to avoid the heat, and agricultural losses. The magnitudes of these losses are difficult to assess, but, since 1991, extreme heat events have caused an estimated $13,450 in crop loss and $2,775 in building damage (HVRI 2013).

3.4.1.2.6 Hazard Summary

Extreme heat does occur within the county and can be predicted in advance, with appropriate warnings days in advance (Magnitude Value = 2). Based on historical occurrences, extreme heat typically affects large areas (Magnitude Value = 4). An estimated loss is difficult to determine, but, based on historical events, the loss estimate for an average event is approximately $2,000 (Magnitude Value = 1). It is anticipated that any assistance would occur within the family (Magnitude Value = 1). Some sheltering may be required for those whose home have been damaged (Magnitude Value = 2). Extreme heat can cause bodily harm and even death (Magnitude Value = 2). The total magnitude score is 12, which is in the low range (Table 3-2). Historical records for extreme heat indicate that four events have occurred in the county since 1990; therefore, the overall frequency for these events is medium.

Table 3-2. Magnitude scoring criteria for extreme heat.

	Magnitude of Extreme Heat					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/ neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.3 Extreme Cold

3.4.1.3.1 Description and Location

Extreme cold events are when temperatures drop well below normal in an area. Extremely cold temperatures typically accompany winter storms; therefore, extended utility outages, failures in infrastructure, and other storm-related hazards may occur.

Extreme cold events have historically occurred within Bonneville County and surrounding regions. These events have the potential to impact infrastructure, critical facilities, and the population throughout the county and associated jurisdictions.

3.4.1.3.2 Extent

The extent of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index. Whenever temperatures drop well below normal and wind speed increases, heat can leave the body more rapidly. The WCT Index is the temperature a body feels when the air temperature is combined with the wind speed (NWS 2013b). The index is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from the body much more quickly, causing skin temperature to drop. When there are high winds, serious weather-related health problems are more likely, even when temperatures are only cool (NWS 2013b). The Wind Chill Chart shows the difference between actual air temperature and perceived temperature. The chart also shows the amount of time until frostbite occurs (NWS 2013b) (Figure 3-3).

NWS Windchill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 3-3. NWS wind chill chart (NWS 2013b).

3.4.1.3.3 Past Occurrences

Since 1996, 12 extreme cold/wind-chill events have occurred in the Upper Snake River Plain, Upper Snake River Highlands, and Caribou Highlands (NCDC 2014) (Table 3-3). No deaths or injuries have been attributed to these events.

Table 3-3. NCDC reported extreme cold/wind-chill events.

Date	Area Location	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
6/2/2001	Caribou Highlands	0	0	0	0
5/8/2002	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
1/11/2007	Upper Snake River Plain, Upper Snake River Highlands	0	0	0	0
2/2/2007	Upper Snake River Plain, Upper Snake River Highlands	0	0	0	0
1/16/2008	Upper Snake River Plain, Upper Snake River Highlands	0	0	0	0
12/10/2009	Upper Snake River Highlands, Caribou Highlands	0	0	0	0
12/10/2009	Caribou Highlands	0	0	0	0
1/7/2010	Upper Snake River Highlands	0	0	0	0
2/1/2011	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
12/4/2011	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
1/3/2013	Upper Snake River Highlands, Caribou Highlands	0	0	0	0
1/14/2013	Upper Snake River Highlands, Caribou Highlands	0	0	0	0
Source: NCDC (2014)					

3.4.1.3.4 Future Occurrences

Extreme cold events are anticipated to occur in the future, especially during the winter months. The probability of future occurrences can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a high wind event has occurred once every 1.5 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 18 years

[(Years on Record) 18] / [(Number of Historical Events) 12] = 1.5 years

Based on historical probability, there is a 100% chance that a high wind event will occur any given year in Bonneville County.

The severity of the extreme cold events is expected to vary by year and location. The potential impacts from climate change may also influence the severity and duration of extreme cold events.

Overall, the amount and extent of future extreme cold events is difficult to predict, but warnings can be issued anticipating the severity of an event. The NWS has developed a formula for calculating wind chill based on temperature and wind speed, and the NWS will issue wind chill advisories in this region when the

wind chill temperature are predicted to be -10°F or less with winds of 10 mph or higher for one hour or more (NWS 2013b). Wind chill warnings are issued when wind chill temperature will be -20°F or less with winds of 10 mph or higher for one hour or more. As with extreme heat, extreme cold is of the greatest concern when the condition persists for an extended period.

3.4.1.3.5 Vulnerability Assessment

There is no defined geographic boundary for extreme cold. Extreme cold events are common to the county, causing impacts and losses to the county and local roads, structures, facilities, utilities, and the population. Impacts include damage to roadways, utility outages, freezing of water and sewer mains, frost heaves/ice jams in rivers, injuries, and loss of life.

Health effects of exposure to extreme cold include hypothermia and frostbite, both of which can be life-threatening. Infants and the elderly are most susceptible. Damage to infrastructure and critical facilities can occur, causing utility outages, property damage, and limited response from emergency services.

Extreme cold may cause loss of wildlife and vegetation and can kill livestock and other domestic animals. Economic losses may result from flooding due to burst pipes, large demands on energy resources, and diminished business activities. River flooding may take place as a result of ice jams.

Overall, the economic losses are variable, and, depending on the time of year, agricultural, industrial, and commercial damages may occur. Because of this variability, an estimate average sum for an extreme cold event is anticipated to be in the thousands of dollars.

3.4.1.3.6 Hazard Summary

Extreme cold occurs within the county and can be predicted in advance, with appropriate warnings days in advance (Magnitude Value = 2). Based on historical occurrences, extreme cold typically affects large areas (Magnitude Value = 4). An estimated loss is difficult to determine, but, based on historical events, the loss estimate for an average event is in the $1,000s (Magnitude Value = 1). It is anticipated that any assistance would occur within the family (Magnitude Value = 1). Some sheltering may be required for those whose homes have been damaged (Magnitude Value = 2). Extreme cold can cause bodily harm and even death (Magnitude Value = 2). The total magnitude score is 12, which is in the low range (Table 3-4). Historical records for extreme cold events indicate that 12 events have occurred in the county since 1996; therefore, the overall frequency for these events is high.

Table 3-4. Magnitude scoring criteria for extreme cold.

	Magnitude of Extreme Cold					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/ minimal death	$100,000s	Sheltering required/ neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.4 Severe Winter Storms

3.4.1.4.1 Description and Location

A severe winter storm event can include heavy snow, blizzards, sleet, freezing rain, and ice storms and can be accompanied by extreme cold. For the purposes of this analysis, a severe winter storm is defined as any winter condition where the potential exists for a blizzard (winds ≥35 mph and falling/drifting snow that causes reduced visibility < ¼ mile for ≥ 2 hours), heavy snowfall (valleys six inches or more snowfall in 24 hours and mountains nine inches or more snowfall in 24 hours), ice storms, and/or strong winds.

Severe winter storms occur regularly throughout the county and typically occur in conjunction with cold temperatures. It is expected that winter storms will continue throughout the county.

3.4.1.4.2 Extent

The extent or magnitude of severe winter storms depends on several factors, including the region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day, and time of season. The Idaho Transportation Department (ITD) uses a Storm Severity Index to rate the magnitude of winter storms as part of the Winter Performance Index (ITD 2013). ITD's Storm Severity Index uses the following formula:

Winds Speed Max + Precept Max + 300/Surface Temp Minimum = Storm Severity Index

Lower values for the index indicate light events, which typically range from 80–500. Severe winter storm events would exceed the 500 index value (ITD 2013). These indices can be used to evaluate the extent of a winter storm in the county.

3.4.1.4.3 Previous Occurrences

Since 1996, 40 severe winter storm events have been reported in the Upper Snake River Plain, Upper Snake River Highlands, and Caribou Highlands (NCDC 2014) (Table 3-5). One death and no injuries were reported during these events.

Table 3-5. National Climatic Data Center-reported severe winter storm events.

Date	Area Location	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
11/17/1996	Upper Snake River Plain	0	0	0	0
12/1/1996	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
12/4/1996	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
2/11/1997	Upper Snake River Highlands	0	0	0	0
2/6/1999	Caribou Highlands, Upper Snake River Highlands	0	0	2,857	0
2/9/1999	Caribou Highlands, Upper Snake River Highlands	0	0	4,000	0
2/21/1999	Upper Snake River Highlands	0	0	0	0
4/5/1999	Caribou Highlands, Upper Snake River Highlands	0	0	20,000	0
4/8/1999	Upper Snake River Highlands	0	0	0	0
12/2/1999	Upper Snake River Highlands	0	0	0	0
12/12/1999	Upper Snake River Highlands	0	0	0	0
1/10/2000	Caribou Highlands, Upper Snake River Highlands	0	0	0	0

Table 3-5. (continued)

Date	Area Location	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
2/24/2000	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	7,083	0
1/21/2002	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	1	0	1,538	0
2/7/2002	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
11/8/2002	Caribou Highlands, Upper Snake River Highlands	0	0	0	0
3/5/2003	Caribou Highlands, Upper Snake River Highlands	0	0	0	0
12/25/2003	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
1/24/2004	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	14,235	0
1/28/2004	Upper Snake River Highlands	0	0	0	0
1/7/2005	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
10/6/2007	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	10,714	0
1/27/2008	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
1/31/2008	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
2/7/2008	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
10/11/2008	Upper Snake River Plain, Upper Snake River Highlands	0	0	0	0
12/18/2008	Upper Snake River Highlands	0	0	0	0
12/24/2008	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	0	0
12/27/2008	Upper Snake River Highlands	0	0	0	0
1/25/2009	Upper Snake River Highlands	0	0	0	0
3/29/2009	Upper Snake River Highlands	0	0	0	0
10/4/2009	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	173	0
1/18/2011	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	28,000	0
10/6/2011	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	0	0	600	0
2/25/2012	Upper Snake River Highlands	0	0	0	0
2/29/2012	Caribou Highlands	0	0	0	0
1/10/2013	Upper Snake River Plain (Zone), Upper Snake River Highlands, Caribou Highlands	0	0	0	0
2/22/2013	Caribou Highlands (Zone), Upper Snake River Highlands	0	0	0	0
2/23/2013	Upper Snake River Plain (Zone)	0	0	0	0
3/17/2013	Upper Snake River Highlands (Zone)	0	0	0	0

Source: NCDC (2014); HVRI (2013)

3.4.1.4.4 Future Occurrences

Extreme winter storms are anticipated to occur in the future, especially during the winter months. The probability of future occurrences can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a severe winter storm has occurred once every 0.4 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 18 years

[(Years on Record) 18] / [(Number of Historical Events) 40] = 0.4 years

The severity of the storm is expected to vary by year and location. The potential impacts from climate change may also influence the severity and duration of winter storms.

Overall, the amount and extent of future extreme winter storms is difficult to predict, but warnings can be issued anticipating the severity of an event. The NWS predicts winter storms and provides warnings in advance of the storm. These predictions can occur several days in advance and can be specific with regard to snowfall, temperature, and wind speed. Using the ITD Storm Severity Index, the extent of the storm can be estimated using the predicted information from NWS.

3.4.1.4.5 Vulnerability Assessment

There is no defined geographic boundary for winter storms. Extreme winter storms are common in the county, causing impacts and losses to the county and local roads, structures, facilities, utilities, and the population. Impacts include damage to infrastructure, critical facilities, utility outages, injuries, and loss of life.

Winter storms have the potential to directly or indirectly cause injuries or deaths, primarily from automobile accidents, overexertion, and exposure (NOAA 2014a). Winter storms are often accompanied by strong winds that cause blizzard conditions with blinding wind-driven snow, drifting snow, extreme cold temperatures, and dangerous wind chill. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all transportation routes and disrupting medical and emergency services. Snow and wind can damage the roofs of structures and infrastructure.

The economic impact of winter storms each year is huge, with costs for removal of snow, damage, and loss of business extremely high. Approximately $5,200 in damages has been reported per year as a result of winter storms over the past 17 years.

3.4.1.4.6 Hazard Summary

Winter storms can occur within the county and can be predicted with appropriate warnings days in advance (Magnitude Value = 2). Based on historical occurrences, winter storms typically affect large areas (Magnitude Value = 4). The duration of a winter storm is generally a few days or less, and Bonneville County and associated jurisdictions offer reconstruction assistance in the form of clearing roads and restoring power (Magnitude Value = 2). Winter storms can, in some cases, necessitate somewhat extensive recovery and reconstruction, requiring county resources (Magnitude Value = 2). Some sheltering may be required for those who have damaged homes or are stranded because of closed roads (Magnitude Value = 2). Severe winter storms can cause bodily harm and even death (Magnitude Value = 2). The total magnitude score is 14, which is in the low range (Table 3-6). Historical records for winter events indicate that 40 events have occurred in the county since 1996; therefore, the overall frequency for these events is high.

Table 3-6. Magnitude scoring criteria for winter storms.

Value	Magnitude of Winter Storms					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/ minimal death	$100,000s	Sheltering required/ neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.5 Lighting

3.4.1.5.1 Description and Location

Lightning is a giant spark of electricity produced by a thunderstorm. The discharge may occur within or between clouds, between a cloud and air, or between a cloud and the ground (NWS 2014c). A lighting discharge may be more than five miles in length, generate temperatures upwards of 50,000°F, and carry 50,000 volts of electrical potential (IBHS 2013). Lightning is most often associated with thunderstorm clouds, but lightning can strike as far as five to 10 miles from a storm (IBHS 2013). Thunder is caused by the rapid expansion of air heated by a lightning strike (NWS 2014c).

The National Lightning Detection Network reported an average of 80,563 lightning flashes in Idaho between 1997 and 2012 (Vaisala 2013). The flash density for Bonneville County ranges from 0.25 to 1 flashes/km^2/year. Lightning flash density is less in the western part of the county than the eastern part (Vaisala 2013) (Figure 3-4). However, lightning flashes can occur almost anywhere. Lightning is more likely to strike tall trees, mountain tops, and tall buildings.

3.4.1.5.2 Extent

There is no classification system for measuring the extent or magnitude of lightning (IBHS 2013).

3.4.1.5.3 Past Occurrences

Except when significant wildfires are ignited by lightning, it generally does not result in a large-scale disaster (IBHS 2013). From 2002 to 2011, two deaths in Idaho have been attributed to lightning (Vaisala 2013). Since 1960, only one death and three injuries have been attributed to lightning in Bonneville County (HVRI 2013) (Table 3-7).

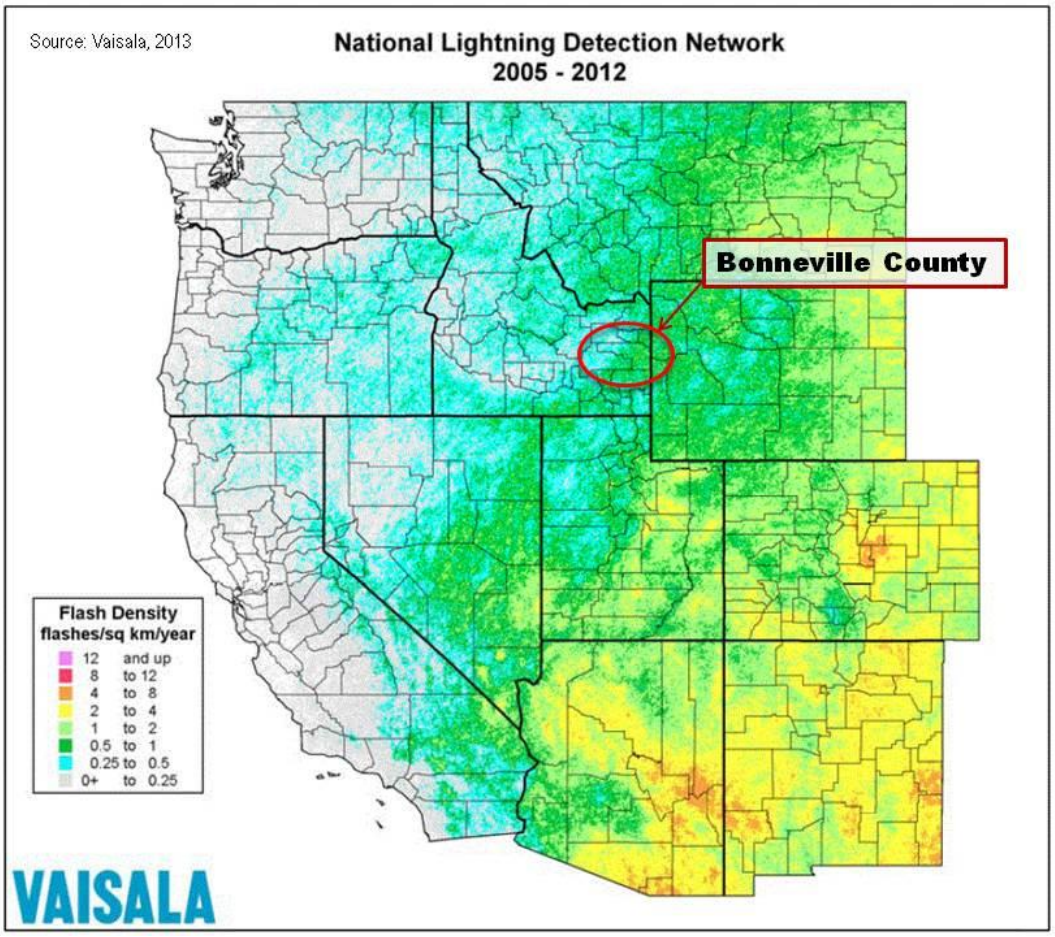

Figure 3-4. Lightning flash density (Vaisala 2013).

Table 3-7. Past occurrences of lighting causing deaths/injuries or damage in Bonneville County (HVRI 2013).

Date	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
9/3/1960	0	0.05	1,136.36	0
5/22/1965	0	1	0	0
7/26/1965	0	0	111.11	0
7/18/1966	0	1	0	0
7/29/1968	0	1	500	113.64
8/13/1973	0	0	0	0
7/29/1975	0	0	1,851.85	1,428.57
6/7/1977	0	0.5	1,250	2,083.33
8/21/1977	0	0	500	0
7/16/1989	0	0	0	25,000
8/19/1989	0	0	500	0
7/23/1990	0	0	208.33	0
8/22/1991	0	0	142.86	1,851.85
6/26/1992	1	0	0	0

Table 3-7. (continued)

Date	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
8/11/1992	0	0	1,136.36	0
7/6/1995	0	0	50,000	111.11
8/17/1995	0	0	50,000	50
6/28/2004	0	0	5,000	0
6/5/2009	0	0	13,000	0

3.4.1.5.4 Future Occurrence

The general weather patterns of the past several decades are expected to continue (IBHS 2013). The probability of future occurrences can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a major lightning event has occurred once every 2.84 years.

[(Current Year) 2014] – [(Historical Year) 1960] = 54 years

[(Years on Record) 54] / [(Number of Historical Events) 19] = 2.84 years

Historical rates of injury are also expected to continue. An increasing dependence on electronics may lead to an increase in the amount and extent of property damage resulting from lightning strikes (IBHS 2013).

3.4.1.5.5 Vulnerability Assessment

In Idaho, the average number of deaths per year is less than one (Vaisala 2012). Despite the enormous energy carried by lightning, only 10% of lightning strikes on humans are fatal. Lightning also strikes structures, causing fires and damaging electrical equipment. The majority of all power outages are lightning related.

Overall, lightning strikes have minute environmental impacts (IBHS 2013). These impacts typically include damaged or killed trees. However, when lightning strikes are the source of wildfire ignition, the overall impact can be quite extensive. The impacts of wildfire are discussed later in this section.

The economic losses are difficult to estimate because not all lightning damage is reported. The average homeowner's insurance claim and payout in the United States for lightning losses for 2011 was $5,112 (Vaisala 2014) (Table 3-8). Based on historical occurrences, the average cost of property damage and crop loss in Bonneville County since 1960 is $6,596 and $1,612, respectively (Table 3-7). Historical rates of injury and damage by lightning is expected to continue. The increasing dependence on electronic equipment and its use in all aspects of daily life may lead to an increase in the amount and extent of property damage resulting from lightning strikes.

Table 3-8. Insurance claims for lightning losses in the United States, 2004–2011.

HOMEOWNERS INSURANCE CLAIMS AND PAYOUT FOR LIGHTNING LOSSES, 2004-2011

	Number of paid claims	Insured losses ($ millions)	Average cost per claim
Percent change 2010-2011	-12.60%	-7.80%	5.50%
Percent change 2004-2011	-33.00%	29.50%	93.20%
2004	278,000	$735.50	$2,646
2009	185,789	$798.00	$4,296
2005	265,700	$819.60	$3,084
2006	256,000	$882.20	$3,446
2007	177,100	$942.40	$5,321
2011	186,307	$952.50	$5,112
2010	213,278	$1,033.50	$4,846
2008	246,200	$1,065.50	$4,329

Source: Insurance Information Institute, State Farm

Source: Vaisala, 2014

3.4.1.5.6 Hazard Summary

Lightning occurs throughout the county and can be predicted with appropriate warnings days in advance (Magnitude Value = 2). Based on the nature of lightning, it typically affects small areas (Magnitude Value = 1). Lightning strikes are highly localized in Bonneville County (Magnitude Value = 1). The majority of damage is localized to a small area, and insurance claims cover reconstruction assistance (Magnitude Value = 1). Some sheltering may be required for those who have damaged homes, but, most likely, people will be able to remain in the building (Magnitude Value = 1). Lightning can cause bodily harm and even death, but, based on historical frequencies, the chances are extremely low. (Magnitude Value = 1). The total magnitude score is 7, which is in the low range (Table 3-9). Historical records for lightning indicate that 19 events causing damage have occurred in the county since 1960; therefore, the overall frequency for these events is high.

Table 3-9. Magnitude scoring criteria for lightning.

	Magnitude of Lightning					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.6 Hail

3.4.1.6.1 Description and Location

The NWS defines hail as a "showery precipitation in the form of irregular pellets or balls of ice more than 5 mm (0.2 inches) in diameter, falling from a cumulonimbus cloud" (NWS 2014d). Hail occurs when updrafts in thunderstorms carry raindrops upward into extreme cold areas of the atmosphere, where they freeze into ice (NSSL 2014a). Hail size can vary from the defined minimum up to 4.5 inches or more in diameter. Severe hail is defined as being three-fourths inches or more in diameter.

Hail and severe hail are relatively uncommon in Idaho; therefore, associated damage is relatively small. Hail that does occur is typically smaller than one-half inch in diameter, and the areas affected are small. Typically, hail occurs in connection with spring thunderstorms.

Hail, like thunderstorms, can occur throughout Bonneville County.

3.4.1.6.2 Extent

The severity of hail events is based on the size of hail, winds, and structures in the path of a hailstorm. Large hail and stronger winds typically are classified has severe hailstorms and, therefore, are more likely to cause more damage to structures, crops, livestock, and wildlife. Hail that is typical to Idaho and Bonneville County is typically smaller and has less potential to cause severe damage. A scale showing hail intensity categories was developed by the Tornado and Storm Research Organization (TORRO) and modified with a size scale developed by the National Climatic Data Center (TORRO 2014; NCDC 2014) (Table 3-10).

Table 3-10. TORRO Hail Intensity Scale.

Modified TORRO Hailstorm Intensity Scale				
Size Code	Intensity Category	Typical Hail Size Diameter (inches)	Descriptive Term	Typical Damage Impacts
H0	Hard hail	Up to 0.33	Pea	No damage
H1	Potentially damaging	0.33 – 0.60	Marble	Slight general damage to plants, crops
H2	Significant	0.60 – 0.80	Dime	Significant damage to fruit, crops, and vegetation
H3	Severe	0.80 – 1.20	Nickel	Severe damage to fruit and crops, damage to glass and plastic structures, and scored paint and wood
H4	Severe	1.20 – 1.60	Quarter	Widespread glass damage and vehicle bodywork damage
H5	Destructive	1.60 – 2.0	Half dollar	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0 – 2.4	Ping pong ball	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	2.4 – 3.0	Golf ball	Severe roof damage, risk of serious injuries
H8	Destructive	3.0 – 3.5	Hen egg	Severe damage to aircraft bodywork
H9	Super hailstorms	3.5 – 4.0	Tennis ball	Extensive structural damage; risk of severe or even fatal injuries to persons caught in the open
H10	Super hailstorms	4.0 +	Baseball	Extensive structural damage; risk of severe or even fatal injuries to persons caught in the open

3.4.1.6.3 Past Occurrences

Twenty hailstorm events have been reported since 1996 in Bonneville County (Table 3-11). Six of these had hail larger than one inch in diameter, with the potential to cause significant damage. No deaths or injuries related to hailstorms have been reported in Bonneville County.

Table 3-11. Hail events in Bonneville County from 1996 to 2014.

Date	Location	Magnitude	Size Code	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
5/29/1996	Ucon	0.5	H1	0	0	0	0
5/29/1996	Ucon	0.75	H2	0	0	0	0
5/6/1998	Idaho Falls	0.75	H2	0	0	0	0
9/1/2000	Ucon	0.75	H2	0	0	0	0
9/13/2001	Idaho Falls	2.75	H7	0	0	0	0
8/3/2002	Idaho Falls	0.75	H2	0	0	0	0
8/8/2003	Idaho Falls	0.75	H2	0	0	0	0
6/20/2004	Ucon	0.88	H3	0	0	0	0
6/27/2004	Bone	1	H3	0	0	0	0
7/18/2004	Palisades	0.75	H2	0	0	0	0
8/22/2004	Bone	0.75	H2	0	0	0	0
6/14/2006	Swan Valley	0.88	H3	0	0	0	0
6/14/2006	Palisades	0.75	H2	0	0	0	0
6/14/2006	Swan Valley	0.75	H2	0	0	0	0
9/21/2006	Idaho Falls	0.75	H2	0	0	0	0
9/21/2006	Ammon	0.75	H2	0	0	0	0
7/22/2008	Bone	1.25	H5	0	0	0	2,000
6/26/2009	Ammon	1	H3	0	0	0	0
6/30/2009	Herman	1	H3	0	0	0	0
6/12/2013	Palisades	1	H3	0	0	0	0
Source. NCDC (2014)							

3.4.1.6.4 Future Occurrences

Based on the past occurrences for Bonneville County, hail events occur regularly and are possible in the future. Therefore, there is a possibility of future events occurring occasionally in the county. The probability of future occurrences can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a hail event has occurred once every 0.9 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 18 years

[(Years on Record) 18] / [(Number of Historical Events) 20] = 0.9 years

Warning time for a hailstorm is generally minimal or none. The NWS classifies a storm as severe if hail of three-fourths of an inch in diameter or greater is imminent on radar or is seen by observers (NWS 2014d).

3.4.1.6.5 Vulnerability Assessment

The severity of hailstorm impacts in Bonneville County is considered to be limited because of the past occurrences with no reported injuries. In the event of an injury, it can be treated locally with first aid. There are typically no severe impacts to the natural environment. Property damage and crop loss are the most likely impacts from a severe hailstorm event. Because large portions of Bonneville County are used for agriculture, the potential for crop loss is high in the event of a severe hailstorm.

Since 1996, $2,000 in crop damage has been reported within Bonneville County. Since 1996, the State of Idaho has reported $2,182,500 in property damage and $422,000 in crop damage (NCDC 2014). Reconstruction assistance typically comes from insurers.

3.4.1.6.6 Hazard Summary

Hailstorms are difficult to predict, and warning times are generally minimal (Magnitude Value = 8). Hailstorms have the potential to impact large areas (Magnitude Value = 2). The economic loss from a hailstorm can be extensive, but, based on historical data for Bonneville County, the estimated loss is low (Magnitude Value = 2). The majority of damage would be covered by insurers to cover reconstruction assistance (Magnitude Value = 1). No sheltering would be required (Magnitude Value = 1). Hailstorms can cause bodily harm, but it can typically be treated locally with first aid (Magnitude Value = 1). The total magnitude score is 15, which is in the medium range (Table 3-12). Historical records for hailstorms indicate that 20 have occurred in the county since 1996; therefore, the overall frequency for these events is high. However, these events were not all severe hailstorms.

Table 3-12. Magnitude scoring criteria for hail.

	Magnitude of Hail					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.1.7 Wind/Tornados

3.4.1.7.1 Description and Location

A straight-line wind is a common, nonrotating wind from a tornado-related wind (NSSL 2014b). Straight-line winds are responsible for most thunderstorm wind damage, with wind speeds in excess of

100 mph on occasion (IBHS 2013). A common association with a straight-line wind is a “downburst”. A downburst is a small area of rapidly descending air beneath a thunderstorm that can have wind velocities equal to that of a tornado (IBHS 2013). These can be extremely dangerous and can cause significant damage to buildings.

A tornado is a violently rotating column of air that bridges between thunderclouds and the earth, often forming a funnel-shaped cloud (NSSL 2014b). Wind speeds within the vortex range from 40 to over 300 miles per hour (IBHS 2013). The tornado itself can move across the ground at up to 70 miles per hour. Damage is generally confined to a narrow path, but the tornado may travel over a large distances (typically up to 10 miles) (IBHS 2013).

Straight-line winds are generated by thunderstorms. As previously discussed, thunderstorms typically occur during the spring and summer months. Thunderstorms can form anywhere in Bonneville County. Some areas are more susceptible to high winds, which would indicate areas more susceptible to damage. In the county, the Snake River Plain is the most susceptible to high winds and, therefore, is more susceptible to damage (DOE 2014) (Figure 3-5).

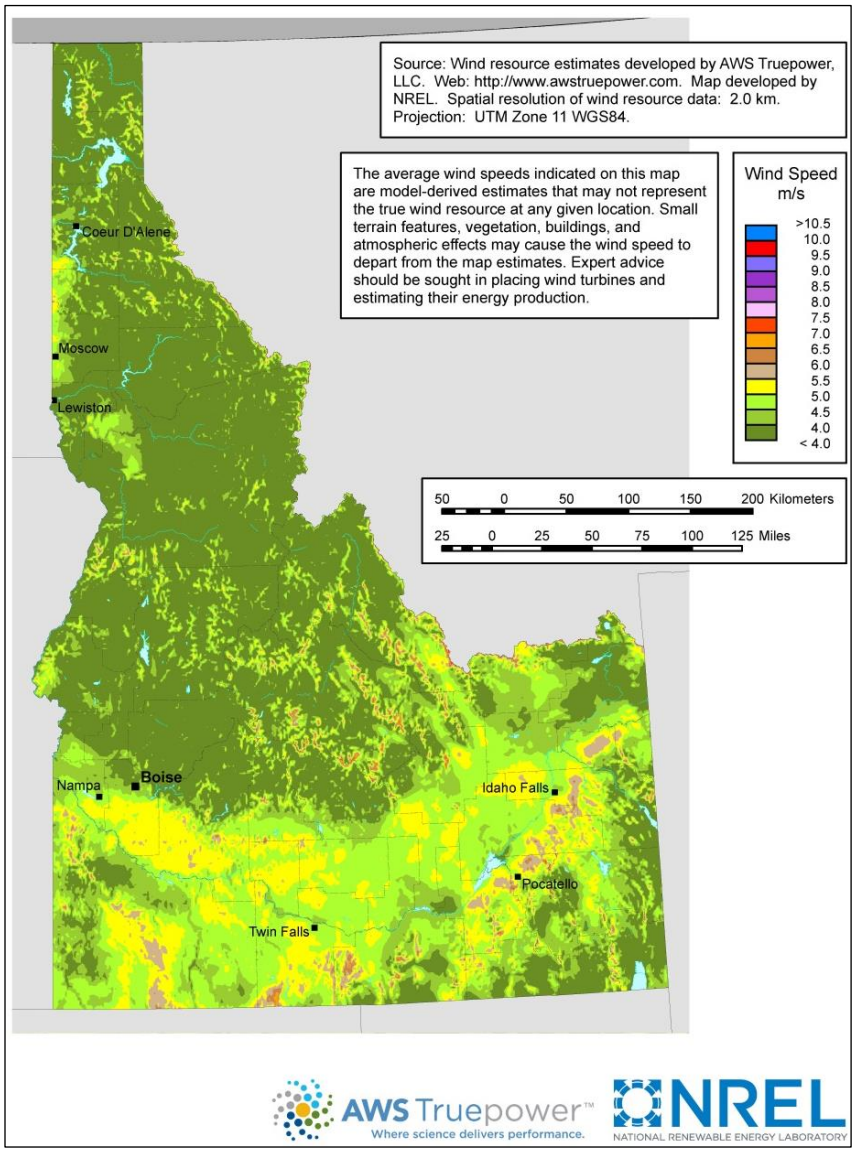

Figure 3-5. Annual average wind speed at 30 meters.

Tornados can also occur anywhere thunderstorms form. Although no data currently exist to help identify regions of particular risk, records of past wind and tornado events provide useful information in this regard (IBHS 2013).

3.4.1.7.2 Extent

Straight-line winds of concerns are "high winds." A high wind is one that sustains wind speeds of 40 mph or greater for one hour or longer, or winds of 58 mph or greater for any duration (NSSL 2014b). High wind advisories, watches, and warnings are issued by the NWS according to the following criteria (IBHS 2013; NSSL 2014b):

- *High Wind Advisory:* Issued when wind speeds may pose a hazard. In Idaho, the criterion is the potential for sustained winds at 30–39 mph or gusts of 45–47 mph, covering a significant part of at least one zone, and lasting for several hours.

- *High Wind Warning:* Issued when there is the potential for high wind speeds developing that may pose a hazard or be life threatening. In Idaho, the criterion is the potential for sustained winds at 30–39 mph or gusts of 45–57 mph, covering a significant part at least one zone, and lasting several hours.

- *High Wind Watch:* Issued when wind speeds may pose a hazard or be life-threating. In Idaho, the criterion is the potential for sustained winds greater than or equal to 35 knots, lasting at least one hour, or gusts of 50 knots for any time.

Tornado intensity is measured on the Fujita Scale (NOAA 2014b) (Table 3-13). This table also describes characteristic damages.

Table 3-13. Fujita Scale.

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	*Light damage.* Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73–112	*Moderate damage.* Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113–157	*Considerable damage.* Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158–206	*Severe damage*. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207–260	*Devastating damage.* Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261–318	*Incredible damage.* Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

3.4.1.7.3 Past Occurrences

Forty-one high-wind events have been recorded in the Upper Snake River Plain, Upper Snake River Highlands, and the Caribou Highlands since 1996 (NCDC 2014) (Table 3-14). Thirty-four of these events have occurred in the Upper Snake River Plain. Sixteen of these events have caused significant property damage and one death.

Table 3-14. Regional high-wind events.

Date	Region	Magnitude (mph)	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
3/27/1999	Upper Snake River Plain	46	0	0	0	0
9/25/1999	Upper Snake River Plain	58	0	0	0	0
4/6/2000	Upper Snake River Plain	51	0	0	0	0
4/23/2002	Upper Snake River Plain, Upper Snake River Highlands	58	0	0	3,000,000	0
5/7/2002	Upper Snake River Plain	47	0	0	0	0
3/6/2003	Upper Snake River Plain	47	0	0	0	0
9/16/2003	Upper Snake River Plain	42	0	0	0	0
10/29/2003	Upper Snake River Plain	60	0	0	8,000	0
10/29/2003	Upper Snake River Plain	54	0	0	0	0
10/29/2003	Upper Snake River Plain	44	0	0	0	0
3/6/2004	Upper Snake River Plain, Upper Snake River Highlands, Caribou Highlands	60	0	0	0	0
4/28/2004	Upper Snake River Plain	42	0	0	0	0
5/10/2004	Upper Snake River Plain	41	0	0	0	0
5/10/2004	Caribou Highland	39	0	0	0	0
7/7/2004	Upper Snake River Plain	40	0	0	0	0
4/13/2005	Upper Snake River Plain	43	0	0	0	0
3/28/2007	Upper Snake River Plain	42	0	0	0	0
5/20/2008	Upper Snake River Plain, Upper Snake River Highlands	61	0	0	0	0
5/12/2009	Upper Snake River Plain	36	0	0	60,000	0
5/12/2009	Upper Snake River Highlands	52	0	0	3,000	0
5/3/2010	Upper Snake River Plain	66	0	0	0	0
9/5/2010	Upper Snake River Plain	56	0	0	2000	0
10/24/2010	Upper Snake River Plain, Caribou Highlands	52	0	0	2,000	0
11/16/2010	Upper Snake River Plain	61	0	0	2,000	0
11/16/2010	Caribou Highlands	56	0	0	0	0
4/2/2011	Upper Snake River Plain	37	0	0	0	0
6/29/2011	Upper Snake River Highlands	56	0	0	54,000	0
8/20/2011	Upper Snake River Plain	-	1	0	15,000	0
12/29/2011	Caribou Highlands	56	0	0	3,000	0
2/22/2012	Upper Snake River Plain	64	0	0	50,000	0
2/22/2012	Caribou Highlands	61	0	0	10,000	0
2/25/2012	Upper Snake River Plain	69	0	0	3,000	0
4/30/2012	Upper Snake River Plain	50	0	0	3,000	0
6/17/2012	Upper Snake River Plain	40	0	0	8,000	0
6/18/2012	Upper Snake River Plain	45	0	0	0	0
10/16/2012	Upper Snake River Plain	63	0	0	0	0
12/17/2012	Upper Snake River Plain	41	0	0	0	0
4/13/2013	Upper Snake River Plain	59	0	0	0	0
4/29/2013	Upper Snake River Plain, Upper Snake River Highlands	58	0	0	3,000	0

Table 3-14. (continued)

Date	Region	Magnitude (mph)	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
6/19/2013	Upper Snake River Plain	52	0	0	0	0
9/30/2013	Upper Snake River Plain, Upper Snake River Highlands	50	0	0	1,000	0
Source: NCDC (2014)						

On average, there are two tornados per year in Idaho (IBHS 2013). Bonneville County has experienced several tornados (Table 3-15). On April 7, 1978, a tornado hit the edge of Idaho Falls, damaging nine homes and 23 businesses (IBHS 2013). The estimated damage for that event was $500,000, and it injured one person. On February 14, 2000, a Fujita Scale FI tornado started in Bingham County and moved to Bonneville County, where a house lost its roof in Ammon and several transmission poles were damaged (NCDC 2104). The estimated damage for that event was $150,000. Overall, five tornado events have occurred in Bonneville County since 1978.

Table 3-15. Tornado events in Bonneville County.

Date	Location	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
4/7/1978	Bonneville County	1	0	500,000	0
5/24/1989	Bonneville County	0	0	500	0
4/21/1981	Bonneville County	0	0	500	0
4/17/1988	Bonneville County	0	0	500	0
2/14/2000	Bonneville County	0	0	150,000	0
Source: HVRI (2013)					

3.4.1.7.4 Future Occurrences

The meteorological processes that produce wind and tornado events are statistically independent of past events. As with similar natural processes, a return period and probability of future occurrence can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a high-wind event has occurred once every 0.43 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 18 years

[(Years on Record) 18] / [(Number of Historical Events) 41] = 0.43 years

Based on historical probability, there is a 100% chance that a high-wind event will occur during any given year in Bonneville County.

It can be reasonably assumed, based on recorded observations from 1978 through 2014, that a tornado has occurred once every 7.2 years.

[(Current Year) 2014] – [(Historical Year) 1996] = 36 years

[(Years on Record) 36] / [(Number of Historical Events) 5] = 7.2 years

Based on historical probability, there is a 100% chance that a tornado will occur every seven years in Bonneville County.

The current average lead time for tornado warnings is 13 minutes (NSSL 2014b). The NWS uses two classifications for notification of tornados: Tornado Watches and Tornado Warnings (NSSL 2014b). A tornado watch means tornados are possible in the area. The National Oceanic and Atmospheric Administration Storm Prediction Center issues tornado and severe thunderstorm watches. A tornado warning means a tornado has been sighted or indicated by weather radar. The NWS office issues tornado and severe thunderstorm warnings.

Lead times for high-wind warnings and advisories average times from 6 to 11 hours (NSSL 2014b). High-wind warnings are issued by the NWS.

3.4.1.7.5 Vulnerability Assessment

High-wind and tornado events could impact the initiation of other hazards. Wildfires could be ignited by downed or damaged electrical transmission systems. Additionally, these events may cause a hazardous material event, extended utility outages, and civil disturbances.

Tornado impacts to humans include injuries and/or death. Deaths and injuries are not typically associated with high-wind events but can occur. However, with both tornados and high winds, debris may contact humans and cause significant injury or death.

The greatest potential impact to the county from high winds or a tornado is property damage and crop loss. Direct impacts from high winds can cause structural damage to buildings, creating debris. If the tornados or high winds occur during the dryer months, blowing dust can interfere with local functions.

Based on past occurrences in Bonneville County, the estimated damages from 1996 to 2014 from wind total approximately $3,313,000, and damage that occurred from 1978 to 2014 from tornados totals approximately $651,000. These costs are representative of the damage to property. No crop loss has been reported in the county. Other direct costs can include emergency response and cleanup of debris. Indirect costs include loss of industrial and commercial productivity (IBHS 2013). The overall cost can be greater than the recorded historical losses.

3.4.1.7.6 Hazard Summary

High winds and tornados are difficult to predict, and warning times range from minutes to hours (Magnitude Value = 8). Severe events can impact large areas, not just in the direct path but also parallel and perpendicular to the event for several miles (Magnitude Value = 4). The economic loss from a high wind or tornado event can be extensive, but, based on historical data for Bonneville County, the estimated loss is in the $100,000s (Magnitude Value = 2). In the event of a severe event, reconstruction assistance would need to come from the state or federal government; however, because high wind events are more frequent and most of the reconstruction assistance would come from the county, the overall magnitude score is less (Magnitude Value = 2). For an extreme event, minimal sheltering would be required for those displaced by the event. However, based on historical events, no sheltering would be required because damage would be minor (Magnitude Value = 2). Based on historical events, little to no injury has occurred from these events expect for one death(Magnitude Value = 1). The total magnitude score is 18, which is in the medium range (Table 3-16). Historical records for high wind and tornados indicate that there is a high frequency of high-wind events and medium frequency of tornados.

Table 3-16. Magnitude scoring criteria for high winds/tornados.

Value	Magnitude of High Winds/Tornados					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.2 Floods

Flooding is a dynamic, natural process. Along rivers and streams, a cycle of erosion and deposition is continuously rearranging and rejuvenating the aquatic and terrestrial systems. Although many plants, animals, and insects have evolved to accommodate and take advantage of these ever-changing environments, property and infrastructure damage often occurs when people develop areas where natural processes are altered or ignored.

Flooding can also threaten life, safety, and health and often results in sustainable damage to infrastructure, homes, and other property. The extent of damage caused by a flood depends on the topography, soils, and vegetation in an area; the depth and duration of flooding; velocity of flow; rate of rise; and amount and type of development in the floodplain.

In Idaho, flooding most commonly occurs in the spring and is caused by snowmelt. Floods occur in Idaho every one to two years and are considered the most serious and costly natural hazard affecting the state (IBHS 2013). The amount of damage caused by a flood is influenced by the speed and column of the water flow, the length of time the impacted area is inundated, the amount of sediment and debris carried and deposited, and the amount of erosion that may take place.

Flooding can be caused by natural elements or humans. Natural causes include heavy rainfall, rapid snowmelt, flash floods, and alluvial fan flooding. Human causes include dam failure and urban storm water overflow. In this section, both natural and human-caused floods are discussed.

Flood Terminology

A number of flood-related terms are frequently used in this plan and are defined below:

- *Flood Insurance Study* – An official report, provided by the Federal Insurance Administration, that provides flood profiles, the flood boundary-floodway map, and the water surface elevation of the estimated 100-year base flood.

- *Flood Insurance Rate Map* – An official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zone applicable to the community.

- *100-Year Base Flood* – A flood having a 1% chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood" or "regulatory flood."

- *Floodplain* – Land adjacent to a lake, river, stream, estuary, or other water body that is subject to flooding. If left undisturbed, the floodplain serves to store and discharge excess floodwater. In riverine systems, the floodplain includes the floodway.

- *Floodway* – A channel of a river or other watercourse and the adjacent areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

- *National Flood Insurance Program (NFIP)* – The federal standard for floodplain management that establishes a 100-year floodplain.

- *100-Year Floodplain* – An area chosen using historical data to define where, in any given year, there is a 1% chance of a flood that covers or exceeds the floodplain.

Floodplain Management

Bonneville County and associated jurisdictions with portions in the 100-year Flood Insurance Rating Maps floodplain are areas near and around Ammon, Iona, Irwin, Swan Valley, and Ucon. All of these cities, and Bonneville County, participate in the NFIP and have developed local ordinances to regulate and direct development in floodplains (IDWR 2010). An important advantage of being an NFIP community is the availability of low-cost flood insurance for those homes and businesses within designated floodplains or areas that are subject to flooding but that are not designated as Special Flood Hazard Areas. There are no communities in Bonneville County that are designated as Special Flood Hazard Areas. Furthermore, no NFIP structures in the county have been repeatedly damaged by floods.

3.4.2.1 Flooding

3.4.2.1.1 Description and Location

As described above, flooding is the partial or complete inundation of normally dry land. Natural types of flooding include riverine flooding, flash flooding, alluvial fan flooding, and ice/debris jam flooding. There is often no sharp distinction between the various types of flood events (IBHS 2013).

Riverine Flooding: Riverine or overbank flooding of rivers and streams is the most common type of flood event (FEMA 1998). Riverine floodplains range from narrow, confined channels in the steep valleys of hilly and mountainous areas to the wide, flat areas (IBHS 2013). The volume of water in the floodplain is a function of the size of the contributing watershed; topographic characteristics, such as watershed shape and slope; and climatic and land-use characteristics. In steep, narrow valleys, flooding usually occurs quickly and is of short duration, and floodwaters are likely to be rapid and deep (FEMA 1998). In relatively flat floodplains, areas may remain inundated for days or even weeks, but floodwaters are typically slow moving and relatively shallow and may accumulate over long periods (FEMA 1998).

Overbank flooding occurs when downstream channels receive more rain or snowmelt from their watershed than normal and the excess water overloads the channels and flows out onto the floodplain (FEMA 1998). For large rivers, overbank flooding typically follows large-scale precipitation events that

occur over a large area (IBHS 2013). For small rivers and streams, overbank flooding can occur after small precipitation events because the small channels can become easily overwhelmed (IBHS 2013). Overbank flooding often occurs in the late winter or spring because of snowmelt, often caused by a rain-on-snow event, and the extent of flooding depends on the depth of winter snowpack and spring weather patterns (IBHS 2013).

Flash Floods: A flash flood can occur when a severe storm generates a lot of rainfall in a short amount of time (FEMA 1998). Flash flood events are often characterized by a rapid rise in water level, high velocity, and large amounts of debris. Flash-flood intensity is determined by the amount of rainfall and the steepness of watershed and stream gradients. The amount of watershed vegetation, the natural and artificial flood storage areas, and the configuration of the stream bed and floodplain are also important factors (IBHS 2013). Changes to these can increase or decrease the severity of a flash flood. For example, the loss of vegetation in a steep canyon after a wildfire could cause severe flash flooding. Flash flooding in urban areas is an increasing hazard because of impervious surfaces, gutters, and storm sewers that can increase the velocity of runoff (FEMA 1998).

Alluvial Fan Floods: Alluvial fans are sloping, fan-shaped landforms common at the base of mountain ranges in arid and semiarid regions (National Research Council 1996). They are made of soft sediments that are deposited where a stream or river leaves a defined channel and enters a broader flatter floodplain (IBHS 2013). The soft sediments can be easily moved by water, causing shifting of river channels and erosion of river banks. These areas have a high risk of flooding because, as rivers or streams continually deposit sediments, the channel can exceed capacity causing overbank flooding (IBHS 2013). Human developments, including roads, can alter flow patterns and increase erosion, which increases the likelihood of severe flooding.

Ice/Debris Jam Floods: Flooding caused by ice/debris jams is similar to flash flooding. Ice or debris that is blocked in a stream channel can cause a rapid rise of water at the jam and extend upstream. Failure or release of the jam causes sudden flooding downstream. Ice/debris jams are most likely to occur where the channel slope naturally decreases; at headwaters of reservoirs; at natural channel constrictions, such as bends and bridges; and along shallow stretches of streams (IBHS 2013).

Ice jam floods can occur during fall freeze-up from the formation of frazil ice, during midwinter periods when stream channels freeze solid to form anchor ice, and during spring break-up when rising water levels from snowmelt or rainfall break the existing ice cover into large floating masses that lodge at bridges and other constrictions (IBHS 2013). Debris jam may result from land sliding, dumping, or inappropriate streamside vegetation management. These can occur at any time of the year.

Natural floods are most likely to occur within floodplains, especially the NFIP-identified 100-year floodplain. One-hundred-year floodplains are found throughout Bonneville County (Figures 3-6 and 3-7). Flash floods can occur in floodplains but especially in urban areas with impervious surfaces (Figure 3-8)

3.4.2.1.2 Extent

Floods vary greatly in frequency and magnitude. Small flood events occur much more frequently than large, devastating events. In order to identify the extent of a flood, the term “base flood” is used. A base flood is a flood that covers or exceeds the determined floodplain or a flood that has a 1% chance of being equaled or exceeded in any given year. Base floods can occur in any year, even successive ones. As defined above, base floods are also referred to as a “100-year flood” or a “regulatory flood.” Floods are described by their statistical frequency. A “100-year flood” describes an event or an area subject to a 1% probability of a certain size flood occurring in any given year, even successive ones (FEMA 1998). This concept does not mean that a flood will happen only once every 100 years. Since floodplains can be mapped, the boundary of the 100-year flood is commonly used in floodplain mitigation programs to identify areas where the risk of flooding is significant (FEMA 1998).

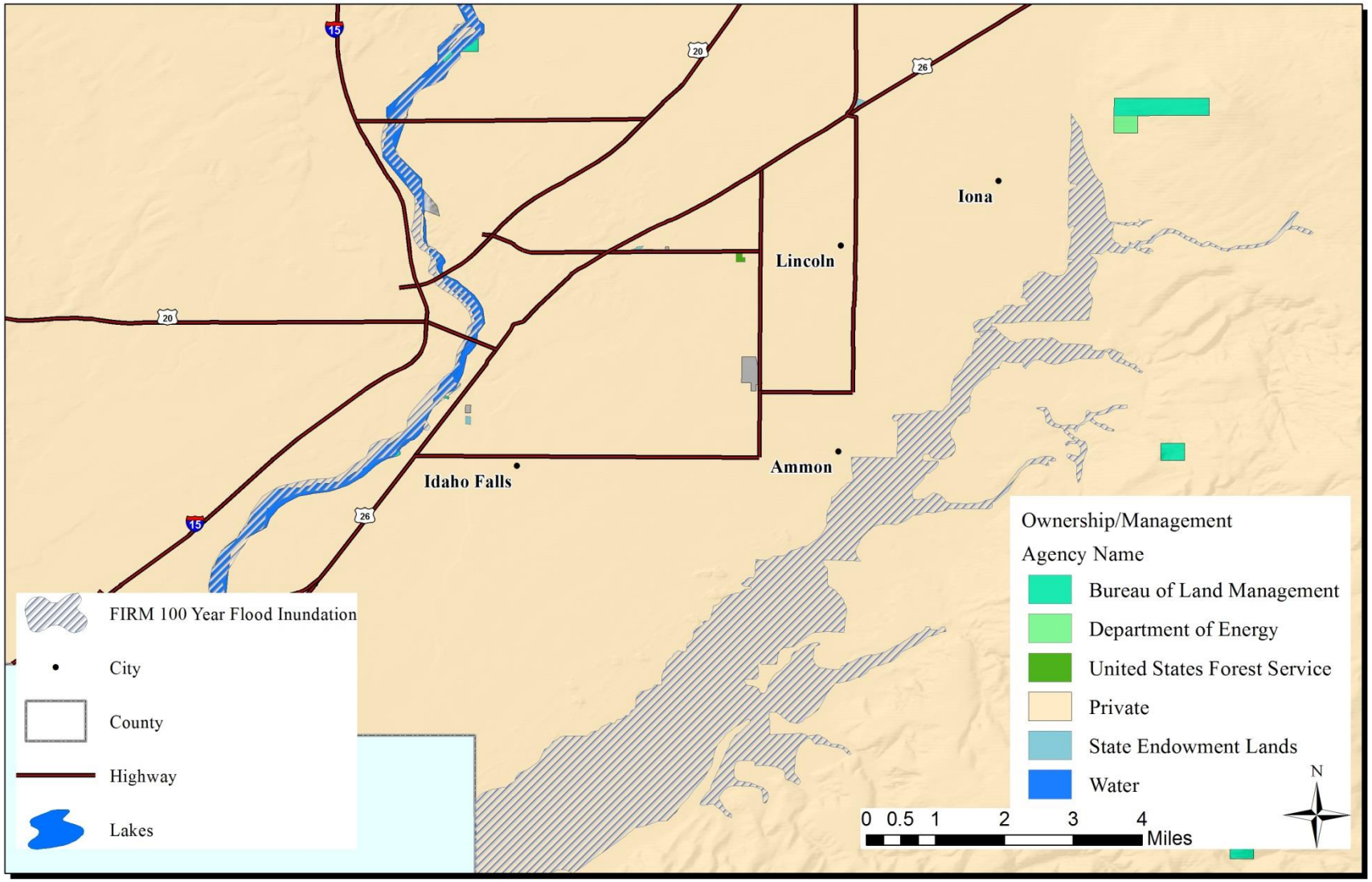

Figure 3-6. Western Bonneville County floodplain.

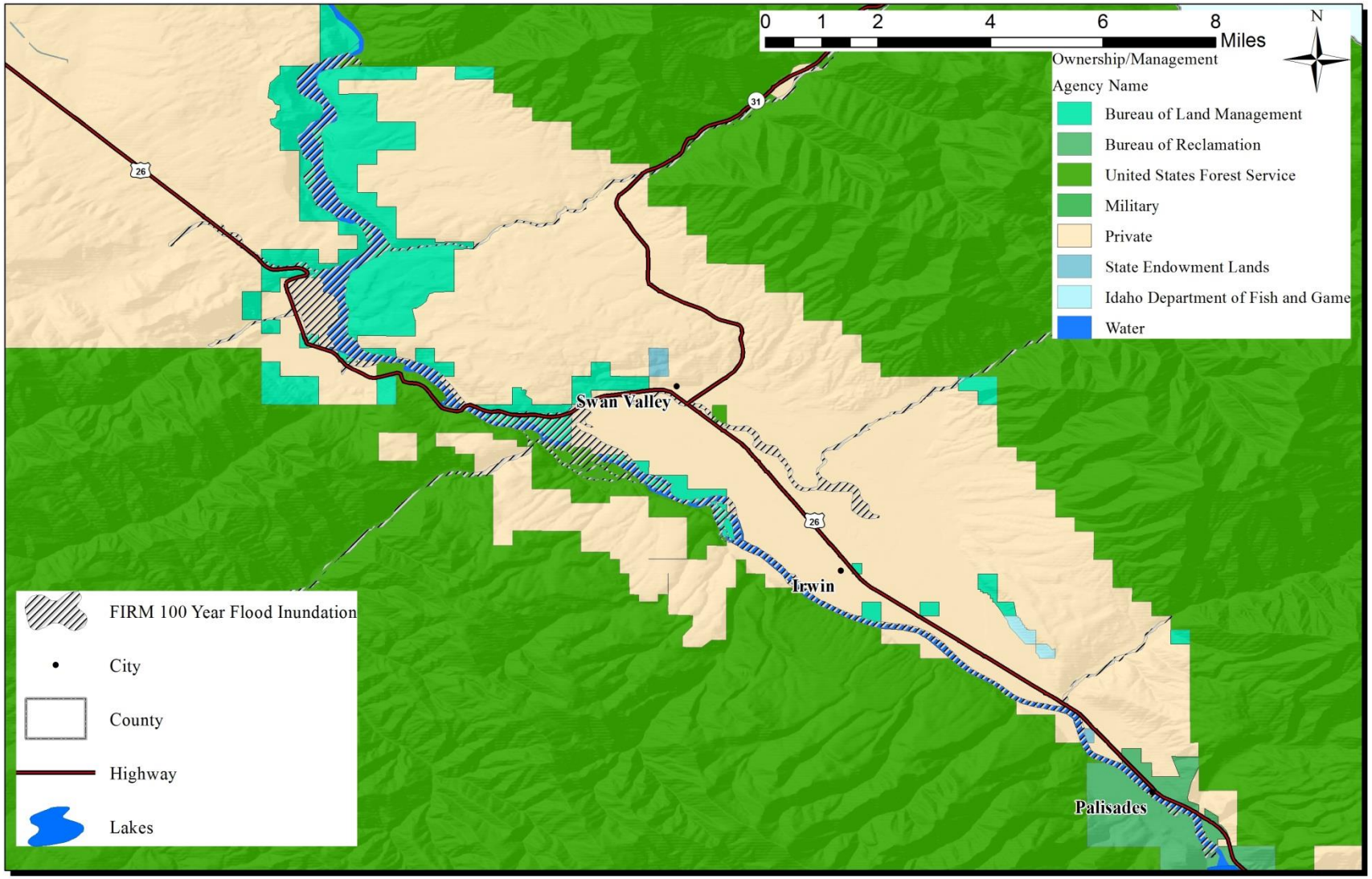

Figure 3-7. Swan Valley floodplain.

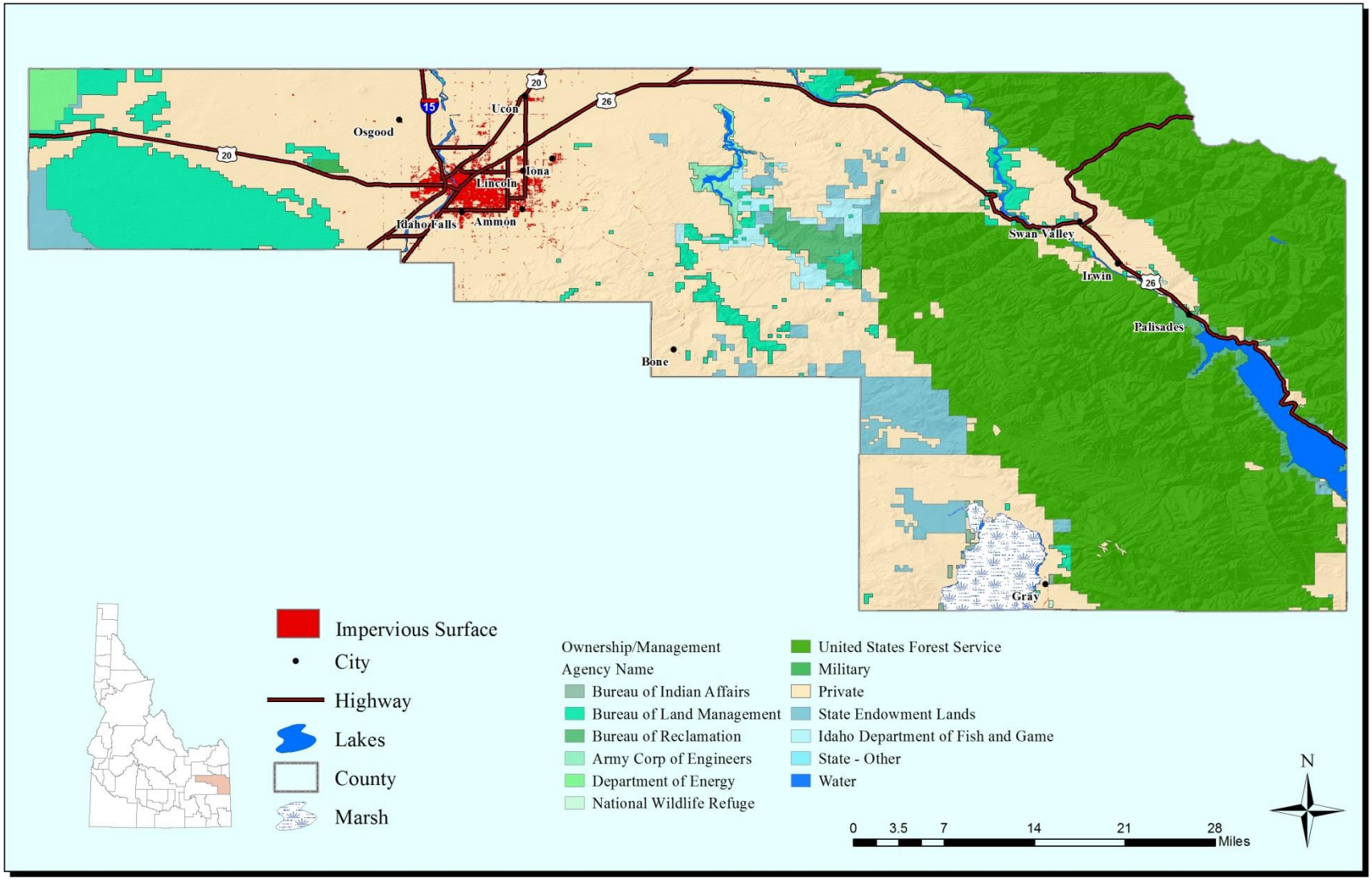

Figure 3-8. Impervious surface areas in Bonneville County.

There are two meanings to the term floodplain: practical and regulatory. The practical term, as described above, is an area that can be inundated by floodwater. The duration and size of the inundation is dependent on the magnitude of the event. Historic floodplains can be altered by human activities and, therefore, can alter natural flooding processes. In regulatory terms, a floodplain is an area where specific regulations and programs apply. Idaho code defines a floodplain as "…land that has been or may be covered by floodwaters, or is surrounded by floodwater and inaccessible, during the occurrence of the regulatory flood" (IBHS 2013). Using the regulatory meaning of a floodplain and 100-year flood boundaries, planning and zoning efforts regulate some human activities in floodplains in order to protect the population, infrastructure, and facilities.

Application of these terms and concepts to flash floods and ice/debris jam floods can be difficult (IBHS 2013). Instead of floodplain, the term inundation zone is used to describe areas most likely impacted by flash floods and ice/debris jam floods. Inundation zones may be determined by projecting the anticipated volume of water, terrain features, and vegetation. However, inundation zones are less obvious than identified floodplains.

3.4.2.1.3 Past Occurrences

From 1956 to 2013, there were 17 federal and 36 state disaster declarations due to flooding in Idaho (IBHS 2013). Of these, one federal and state declaration was for flooding in Bonneville County. In June 1997, spring snowmelt caused extensive flooding along 225 miles of the Snake River and many of its tributaries from Roberts to Blackfoot. Damage was extensive to numerous roads, canals, farmland, and more than 300 homes. A Federal Disaster was declared on July 7, 1997, for seven counties in eastern Idaho, including Bonneville County. Approximately 500 people were evacuated in Jefferson and Bingham counties; more than 50,000 acres of agricultural land was flooded; and more than $1.3 million in grants and loans was distributed to all impacted counties in southeastern Idaho.

Overall, flooding events within Bonneville County are relatively infrequent. Since 1980, there have been eight reported flood events, seven riverine floods, and one flash flood, causing approximately $133,337 in property damage in Bonneville County (Table 3-17).

Table 3-17. Past flood occurrences in Bonneville County.

Date	Location	Flooding Type	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
1/13/1980	Bonneville County	Riverine	0	0	83,333.33	0
8/1/1984	Bonneville County	Flash	0	0	5,000	0
5/30/1990	Bonneville County	Riverine	0	0	4.55	0
5/17/1996	Bonneville County	Riverine	0	0	5,000	0
7/25/1997	Idaho Falls	Riverine	0	0	0*	0*
9/12/1998	Idaho Falls	Riverine	0	0	0	0
5/1/2011	Swan Valley	Riverine	0	0	0	0
2/22/2012	Ammon	Riverine	0	0	40,000	0

Source: HVRI (2013); NCDC (2014)
*Does not include the $1.3 million in grants and loans because that amount was distributed to seven different counties.

Extreme precipitation- and runoff-event flash floods can occur at all times of the year. Many are not recorded because they are relatively small and do little damage. The NWS recorded 121 flash floods during the period of 1982–2000 in Bonneville County (IBHS 2013).

There have been no recorded ice/debris jam floods in Bonneville County.

3.4.2.1.4 Future Occurrences

Although flooding is relatively infrequent in Bonneville County, it is likely to occur in the future. The majority of flood events have been riverine flooding, but, based on the topography of the county, flash floods are likely to occur.

As with other similar natural processes, a return period and probability of future occurrence can be developed from the historical records that are available (IBHS 2013).

It can be reasonably assumed, based on recorded observations from 1996 through 2014, that a flooding event has occurred once every 4.25 years. A major flood event (state declaration) has occurred once every 34 years.

[(Current Year) 2014] – [(Historical Year) 1980] = 34 years

[(Years on Record) 34] / [(Number of Historical Events) 8] = 4.25 years

Based on historical probability, there is a 23.5% chance that a flood event will occur during any given year in Bonneville County.

Flood warning lead times can vary depending on the forecasting. The NWS issues forecasts and warnings of floods (NWS 2014e). Warnings are determined by water flow and computer modeling. Most riverine floods can be anticipated in advance, and flood watches are issued no later than six hours after a heavy rain event. Flood warnings are issued as the flood is imminent or occurring. Flash floods are more difficult to predict but will generally follow heavy rain events, and areas that are prone are easily identified.

3.4.2.1.5 Vulnerability Assessment

Human deaths and injuries sometimes occur as a result of river flooding but are uncommon. Hazards during flooding include drowning, electrocution due to downed power lines, leaking gas lines, fire and explosions, hazardous chemicals, and displaced wildlife. Economic loss and disruption of social systems are often enormous. Floods may destroy or damage structures, furnishings, business assets (including records), crops, livestock, roads and highways, and railways. Floods often deprive large areas of electric service, potable water supplies, wastewater treatment, communications, and many other community services, including medical care, and may do so for long periods.

The Idaho Flood and Seismic Risk Portfolio prioritizes flood risk by watersheds across Idaho (IDWR 2012). This portfolio can be used to identify the location of potential flood risk within the county. The portfolio identifies the watershed sub-basin, population, and potential risks from flooding. The portfolio then ranks all of the watersheds in order of risk associated with flooding.

Seven watershed sub-basins cover Bonneville County: American Falls, Teton, Idaho Falls, Blackfoot, Willow, Palisades, and Salt. A full description of each sub-basin is provided in Appendix C. A brief description of the watershed flood risks are provided below:

- *American Falls* – The American Falls sub-basin covers parts of Idaho Falls and the southwestern part of the county. The majority of inhabitants within this sub-basin live near the main flooding source in the area: the Snake River. This area is susceptible to flash flooding due to minimal slope and significant rural agriculture and urban development along the Snake River. Flood hazards include seasonal high stream flows that exceed bankfull discharge. Since 1978, there have been 26 flood insurance claims worth about $114,340.

- *Teton* – The Teton sub-basin is located in the northeast portion of the county and includes surface water typically flowing toward Teton and Madison counties. No cities in Bonneville County are impacted by potential flood events in this sub-basin.

- *Idaho Falls* – The Idaho Falls sub-basin covers parts of Idaho Falls, Ucon, Osgood, and the northern part of the county. The majority of inhabitants within this sub-basin live near the main flooding source in the area: the Snake River. Idaho Falls is the largest city in the sub-basin and is adjacent to the floodplain. Flood hazards include seasonal high stream flows that exceed bankfull discharge. Since 1978, there have been 23 flood insurance claims worth about $143,400.

- *Blackfoot* – The Blackfoot sub-basin covers Ammon, Iona, parts of Idaho Falls, and the south-central part of the county. Flood hazards include seasonal high stream flows that exceed bankfull discharge. Since 1978, there have been six flood insurance claims worth about $18,600.

- *Willow* – The Willow sub-basin covers the central part of the county. There is no city within this sub-basin. The majority of the development in this sub-basin is agriculture, mostly near Gray's Lake and Ririe Reservoir. Flood hazards include seasonal high stream flows that exceed bankfull discharge. Since 1978, there has been one flood insurance claim worth about $6,711.

- *Palisades* – The Palisades sub-basin covers Swan Valley, Irwin, and the eastern part of the county. The majority of the inhabitants live near or in the Snake River floodplain. Flood hazards include seasonal high stream flows that exceed bankfull discharge. Since 1978, there have been no flood insurance claims.

- *Salt* – The Salt sub-basin is located in the southeast portion of the county and the surface water typically flowing toward Lincoln County, Wyoming. No cities in Bonneville County are impacted by potential flood events in this sub-basin.

A HAZUS 2.1type I analysis was conducted to determine the estimated loss of from a 100-year and a 25-year flood (IBHS 2013). As discussed earlier, a 100-year flood event is more severe. A 25-year event is more frequent and less severe. In Bonneville County, a 25-year flood event would potentially damage 63 buildings and cause $44.9 million in damage (IBHS 2013). A 100-year flood event would potentially damage 134 buildings and cause $74.9 million in damage (IBHS 2013).

The results from HAZUS 2.1 type I analysis are similar to the analysis conducted in the 2008 AHMP because the inventory did not change.

3.4.2.1.6 Hazard Summary

Floods can be predicted, and warning times range from hours to days (Magnitude Value = 4). Floods have the potential to impact large areas (Magnitude Value = 4). The economic loss from a large flood can be extensive; based on a HAZUS analysis for Bonneville County, the estimated loss is in the 10,000,000s (Magnitude Value = 8). The majority of damage would be covered by NFIP to cover reconstruction assistance (Magnitude Value = 8). Sheltering would be required (Magnitude Value = 2). Floods can cause bodily harm, and even some deaths may occur (Magnitude Value = 2). The total magnitude score is 32, which is in the high range (Table 3-18). Historical records for flood events indicate that eight have occurred in the county since 1996; therefore, the overall frequency for these events is high.

Table 3-18. Magnitude scoring criteria for flooding.

Value	Magnitude of Flooding					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/ no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.2.2 Dam Failure

3.4.2.2.1 Description and Location

A dam is defined as an artificial barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Most dams are constructed of earth, rock, and/or concrete. Dam failure is the unintended release of impounded waters. Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Poor design and/or construction methods
- Movement and/or failure of the foundation supporting the dam
- Settlement of concrete or embankment dams
- Piping and internal erosion of soil in the embankment
- Inadequate maintenance and upkeep.

Failures may be categorized into two types: (1) component failure of a structure that does not result in a significant reservoir release and (2) uncontrolled breach failure that leads to a significant release. With an uncontrolled breach failure of a man-made dam there is a sudden release of the impounded water, sometimes with little warning.

IDWR regulates 15 dams located in Bonneville County (Table 3-19). These dams are located on watercourses throughout the county (Figure 3-9). The IDWR gives each dam a size and risk classification (IDWR 1999). The size classification is based on the dam height and storage capacity. The risk classification is based on the potential losses and damages anticipated in downstream areas that could be attributed to dam failure during typical flow conditions. Descriptions of both are provided below:

Size Classification

- *Small* – 20 feet high or less and a storage capacity of less than 100 acre feet of water.

- *Intermediate* – More than 20 feet but less than 40 feet high or with a storage capacity of 100 to 4,000 acre feet of water.

- *Large* – 40 feet high or more or with a storage capacity of more than 4,000 acre feet of water.

Risk Classification

- *Low* – No permanent structures for human habitation. Minor damage to land, crops, agricultural, commercial or industrial facilities, transportation, utilities, or other public facilities or values.

- *Significant* – Non-concentrated urban development, one or more permanent structures for human habitation which are potentially inundated with flood water at a depth of two feet or less or at a velocity of two feet per second or less. Significant damage to land; crops; agricultural; commercial or industrial facilities; or loss of use and/or damage to transportation, utilities, or other public facilities or values.

- *High* – Urban development or any permanent structure for human habitation that is potentially inundated with flood water at a depth of more than two feet or at a velocity of more than two feet per second. Major damage to land; crops; agricultural; commercial or industrial facilities; and loss of use and/or damage to transportation, utilities, or other public facilities or values.

3.4.2.2.2 Extent

Dam failure is most likely to impact inundation areas that are downstream and immediately around the dam. The extent of the hazard is difficult to determine because of different factors that are involved in a dam failure. In order to assess the hazards that a dam poses to downstream areas, a risk assessment is conducted. The risk assessment is divided into three analyses: (1) analysis of the probability of failure for a given structure, (2) analysis of the flood wave charateristics and extent of inundation resulting from the uncontrolled release, and (3) analysis of the potential consequences to life and property within the inundation zone. All of these analyses include substantial uncertainty; therefore, these analyses are limited in estimating the extent of flooding, but they provide a basis for determining the severity of a dam failure.

The IDWR Dam Safety Program has classified dams and reservoirs as high, significant, and low risk. As described above, this classification system is based on the potential loss of life and property from a potential dam failure and uncontrolled release. Based on this system, dams with the most potential to impact developed urban areas and large populations are classified as higher risk, not the potential for dam failure.

Table 3-19. Dams of Bonneville County.

Name	Watercourse	Status	Year Completed	Dam Height (ft)	Storage Capacity (acre ft)	Size Classification	Risk Classification
Palisades	Snake River	Regulated	1957	260	1,401,000	Large	High
Gem State	Snake River	Regulated	1988	47.5	5,000	Large	High
Ririe	Willow Creek	Regulated	1976	204	100,500	Large	High
Little Valley	Little Valley Creek	Regulated	1897	22.7	1,000	Intermediate	Low
Grays Lake-North End Outlet	Grays Lake Outlet	Regulated	1924	9.4	40,000	Large	Low
Green Valley Ranch	Birch Creek	Regulated	1986	26.6	25	Intermediate	Low
Elkington	Squaw Creek	Regulated	1994	35.3	90	Intermediate	Low
Pipe Creek No. 4	Pipe Creek	Nonregulated	1996	12	5	Small	Low
Pipe Creek No. 3	Pipe Creek	Nonregulated	1996	12	5	Small	Low
Pipe Creek No. 1	Pipe Creek	Regulated	1996	18.7	15	Small	Low
Idaho Falls Power Dam No. 1	Snake River	Regulated	1982	29.8	800	Intermediate	Low
Idaho Falls Power Dam No. 2	Snake River	Regulated	1982	36.5	0	Intermediate	Low
Idaho Falls Power Dam No. 4	Snake River	Regulated	1982	42.7	800	Intermediate	Significant
Idaho Falls Power Dam No. 3	Snake River	Regulated	1982	30	0	Intermediate	Significant
Antelope Creek	Antelope Creek	Regulated	1991	21.8	80	Small	Significant

Source: IWDR (2012)

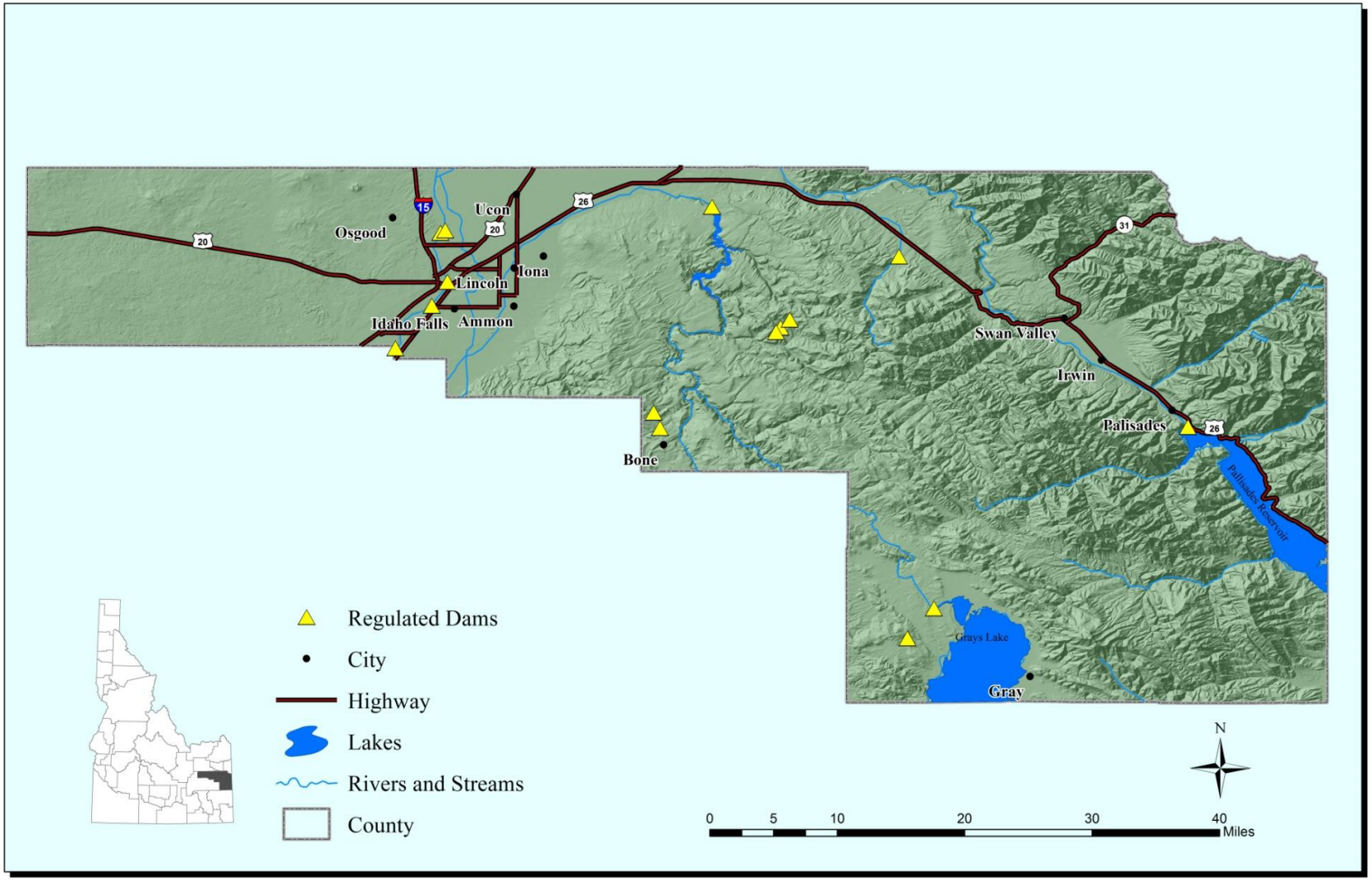

Figure 3-9. Dams of Bonneville County.

3.4.2.2.3 Previous Occurrences

Dam failure is infrequent but can have significant consequences. In total, Idaho has experienced two major dam failures: the Teton Dam (1976) and Kirby Dam (1991). The Teton Dam failure impacted areas of Bonneville County, with approximately 19,000 acres and 38 homes damaged in the county, totaling $250 million in damage.

Overall, five dam and canal failures have impacted Bonneville County (Table 3-20). The Teton Dam failure recorded the most damage. Other flood events caused damage to croplands and some structures.

Table 3-20. Past dam failures.

Location	Date	Time	Details	Reported Damage
Bonneville County	5/19/1927		Gros Ventre Dam in Wyoming failed	Took out bridges in Bonneville County and damaged buildings near Heise
Poplar	6/14/1945		Birch Creek Dam failed	Covered 300 acres of land with water and destroyed bunk houses and equipment
Idaho Falls	7/12/1945	6:00 a.m.	New Sweden Canal failed	Flooded 150 acres of farmland
Bonneville County	6/5/1976	11:00 a.m.	Teton Dam failed, releasing 80 billion gallons of water	In Bonneville County, damaged 9,000 acres and 38 homes; total damage in the county was $250 million
Bone	5/6/1993		Heavy rain caused two earthen dams to fail, washing out sections of Bone Road	Unknown

3.4.2.2.4 Future Occurrences

Dam failures can be controlled through good design, proper construction, regular inspection by qualified personnel, and a commitment to strong enforcement to correct identified deficiencies (IBHS 2013). The risk to downstream life and property can be reduced substantially with efforts to limit some types of development adjacent to streams and rivers.

The IDWR Dam Safety Program oversees the regulation and safety of dams and reservoirs throughout Idaho in order to protect the health, safety, and welfare of citizens and their property (IBHS 2013). Program personnel regularly inspect existing projects according to the potential consequences that the dam's failure would present to downstream life and property. The frequency of individual dam inspections depends in the project's physical condition, method of construction, maintenance record, age, hazard rating, and size and storage capacity. All statutory-sized dams must be inspected by IDWR at least once every five years (IBHS 2013).

The greater the warning time the fewer people are at risk of injury or death resulting from a flood caused by a dam failure. It is estimated that with less than 15 minutes of warning time, 50% of the population in an estimated inundation zone risk loss of life (Graham 1999). With more than 90 minutes of

warning time, the estimate loss is approximately 0.0002% of the population (Graham 1999). Early detection systems can increase the warning time.

3.4.2.2.5 Vulnerability Assessment

Dam failures can have a greater environmental impact than that associated with a normal flooding. Potential population losses, property loss, critical facility and infrastructure losses, soil loss, and exposure to hazardous materials would be greater than normal flooding.

To assess potential impacts to Bonneville County, two of the county's largest and highest-risk dams are used as case scenarios: the Ririe Dam and Palisades Dam. The Ririe Dam is located in the central part of the county. It is 204 feet high and has a storage capacity of 100,500 acre feet of water. The purpose of the Ririe Dam is to control flooding and provide irrigation water. The Ririe Dam is classified as a high risk because of potential flooding to residential and agriculture development downstream. If the dam failed catastrophically, flood waters would reach Ucon in 108 minutes and Idaho Falls in 187 minutes (Figure 3-10). Because the dam is not manned 24 hours a day, it is anticipated that there would be at least a 15-minute lag between event initiation and the commencement of notification to residents. The inundation area would experience impacts greater than a normal flood event (Figure 3-11). Flooding from a sudden dam failure could potentially damage dams on the Snake River, including Idaho Falls Power Dams 1–4.

The Palisades Dam is located in the eastern part of the county at the east end of Swan Valley. It is 260 feet high and has a storage capacity of 1,401,000 acre feet of water. The purpose of the dam is to control flooding, provide irrigation water, and generate power. A failure of the Palisades Dam would cause significant damage throughout the county (Figure 3-12).

The potential losses from a dam failure are difficult to quantify. Based on the Teton Dam failure, Bonneville County experienced approximately $250 million in damage. The overall losses from the Teton Dam failure are estimated at $2 billion.

Similar damage could occur if the Ririe Dam or Palisades Dam fails, but the potential for loss of life is greater. Smaller dam failures would result in some crop and property damage, infrastructure losses, and impact some people.

The Ririe Dam and Palisades Dam mitigation projects were completed in 2011 in order to develop early warning systems in the event of a sudden dam failure. These projects included the installation of dam failure surveillance systems, development of vertical evacuation plans, and development of dam failure evacuation routes/sheltering plans. These systems would increase the warning times in the event of a dam failure and potentially reduce loss of life.

Not for Public View

Figure 3-10. Ririe Dam flood inundation zone.

Not for Public View

Figure 3-11. Ririe Dam failure flood arrival times.

Not for Public View

Figure 3-12. Palisades Dam flood inundation zone.

3.4.2.2.6 Hazard Summary

Dam failure can be predicted, and warning times range from minutes to hours (Magnitude Value = 8). Dam failures have the potential to impact large areas (Magnitude Value = 4). The economic loss from a large flood can be extensive (Magnitude Value = 8). The majority of damage would be covered by the federal government for reconstruction assistance (Magnitude Value = 8). Long-term sheltering or relocation would be required for those in the inundation areas (Magnitude Value = 8). Large-scale dam failures can cause bodily harm, and even some deaths may occur (Magnitude Value = 4). The total magnitude score is 40, which is in the high range (Table 3-21). Historical records for dam failure events indicate that Bonneville County has been affected by five events since 1927; therefore, the overall frequency, once every 17.4 years, for these events is medium.

Table 3-21. Magnitude scoring criteria for dam failure.

	Magnitude of Dam Failure					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.3 Geologic Hazards

Geologic hazards are adverse conditions that can cause injury, loss of life, and damage to property and involve the movement of geologic features or elements of the surface of the earth. There is a wide variety of such hazards that may be categorized as either sudden or slow phenomena. Slow-developing geologic hazards include soil erosion, sinkholes and other ground subsidence, and migrating sand dunes. Only sudden geologic hazards will be considered in this planning and will be limited to earthquakes, landslides, and avalanches.

3.4.3.1 Earthquakes

3.4.3.1.1 Description and Location

An earthquake is associated with energy traveling in wave radiating outward from the point of release. When these waves travel along the surface, the ground shakes and rolls, and fractures form. Earthquakes generally last a matter of seconds, but the waves can travel around the world in a matter of minutes and may cause damage elsewhere.

The formed factures are breaks in the earth’s crust known as faults and are classified as either active or inactive. Faults may be expressed on the surface by sharp cliffs or scarp or may be buried below surface deposits.

Active faults exist within Idaho and Bonneville County. Because the majority of earthquakes in Idaho are caused by crustal stretching and by basin and range forming, many of the faults are located in mountain and plain areas. These faults are classified as normal faults. In Bonneville County, normal faults are located in the eastern and central areas (Petersen et al. 2008) (Figure 3-13).

Earthquakes are likely to occur throughout Bonneville County, but the locations with greater seismic potential are in the central and eastern parts of the county (Figure 3-13). Seismic potential is the estimated peak horizontal acceleration value in the event of an earthquake (USGS 2008).

3.4.3.1.2 Extent

The extent and magnitude of earthquakes are measured in two ways:

- Magnitude (as measured by the Richter Scale) – measures the energy that is released
- Intensity (as measured by the Modified Mercalli Intensity Scale [MM]) – measures physical effects.

Magnitude is calculated by seismologists from seismograph readings and is most useful to scientists comparing the power of earthquakes. Magnitude is often described using the Richter Scale and does not express damage. Earthquakes of Magnitude 2.0 or less are called microearthquakes and are not commonly felt. Events with magnitudes of about 4.5 or greater are strong enough to be recorded on a seismograph. The largest known shocks have had magnitudes in the 8.8 to 8.9 range (USGS 2013a).

An earthquake's intensity consists of a series of key responses, such as people waking up, movement of furniture, and overall destruction (USGS 2013a). Intensity typically decreases with the distance from the epicenter, or focal point, but also depends on the local geologic features, such depth of sediment and bedrock layers. The intensity of an earthquake is measured by the MM. This scale is composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction (USGS 2013a). Each level is designated by roman numeral. The scale does not have a mathematical basis but an arbitrary ranking based on observed effects.

The lower numbers of the scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. The following is an abbreviated description of the 12 levels of the MM:

I. Not felt except by a very few under especially favorable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.

IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

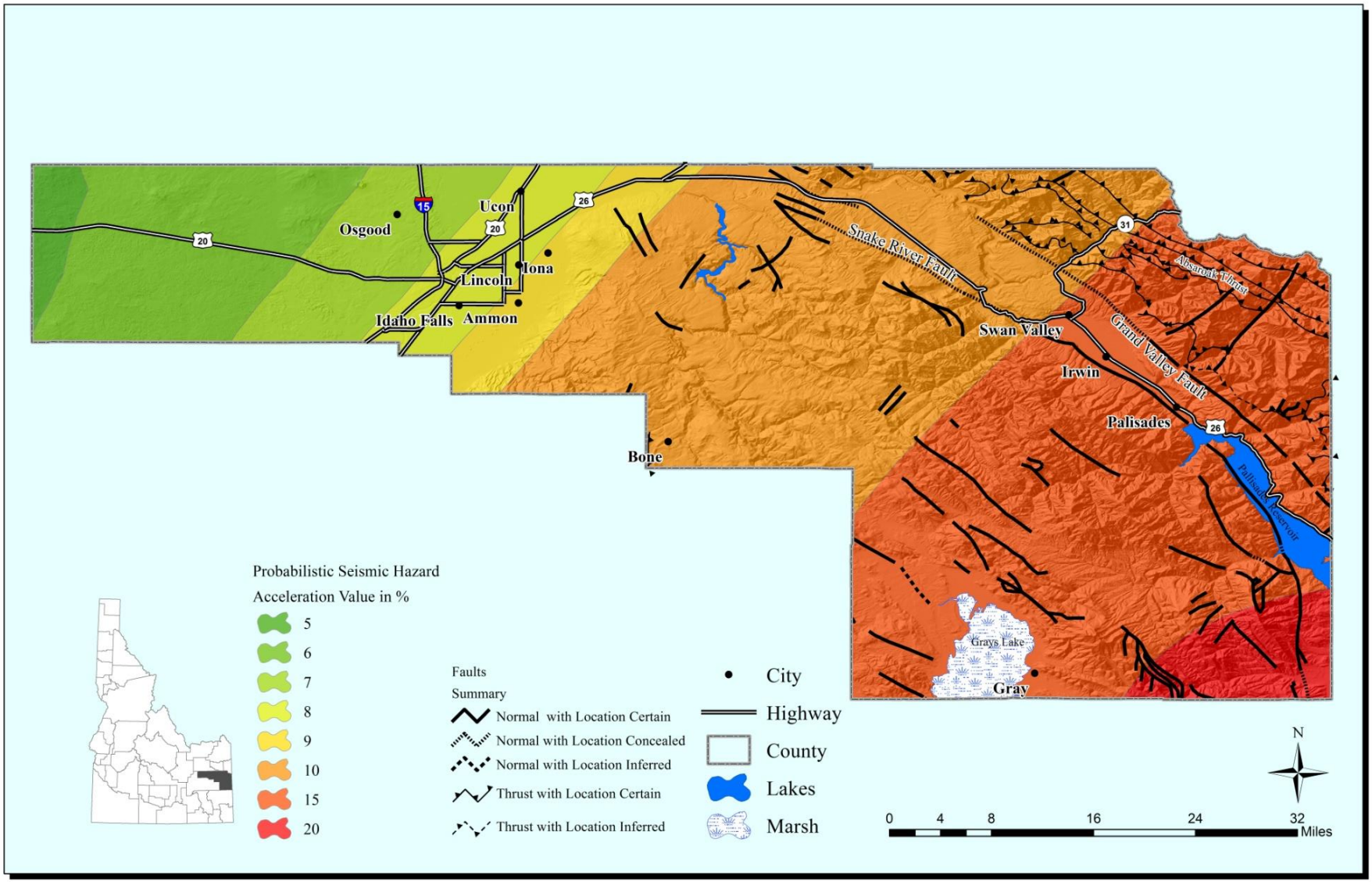

Figure 3-13. Geologic faults and probabilistic seismic hazards.

VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings, with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rail bent.

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

More quantitatively than the MM is peak ground acceleration (PGA), which measures intensity by the acceleration of gravity and is determined by seismographic instruments. While the MM and PGA intensities are arrived at differently, they can be correlated (USGS 2013b) (Table 3-22).

Table 3-22. Correlated MM and PGA intensity scales (USGS 2013b).

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

3.4.3.1.3 Past Occurrences

Between 1950 and 2013, Bonneville County had 29 earthquakes with a magnitude of 3.5 or higher (USGS 2014) (Table 3-23). There were more recorded earthquakes in that time, but they were small in magnitude and not easily felt.

3.4.3.1.4 Future Occurrences

Currently, there are no realistic methods to predict earthquakes (IBHS 2013). As of 2013, no studies, past or present, could create anything more than the general probabilities currently available. The past rate of occurrence is a modest predictor of future occurrences (IBHS 2013). Based on previous occurrences, there is a 58% chance that an earthquake could happen in Bonneville County in any given year.

There is little to no warning time for an earthquake.

Table 3-23. Historic earthquakes in Bonneville County.

Date	Magnitude	Date	Magnitude
09/22/1963	3.70	06/10/1966	3.70
09/22/1963	3.90	09/19/1969	4.40
09/23/1963	3.50	09/20/1969	3.80
09/28/1963	3.70	02/08/1983	4.40
09/29/1963	3.60	07/02/1985	4.00
10/11/1963	4.20	11/10/1992	4.20
10/12/1963	3.90	11/10/1992	4.40
10/12/1963	3.90	11/11/1992	4.10
10/13/1963	3.70	11/13/1992	3.60
10/26/1963	4.30	11/29/1994	3.70
11/03/1963	4.20	07/22/1999	4.10
11/05/1963	3.90	07/22/1999	3.60
01/28/1964	4.20	07/25/1999	3.60
02/03/1964	4.10	10/19/2013	3.80
06/05/1964	3.7		

3.4.3.1.5 Vulnerability Assessment

The hazards associated with an earthquake are secondary to ground shaking, which can cause buildings to collapse; displacement or cracking of the earth's surface; flooding as a result of damage to dams and levees; and fires from ruptured gas lines, downed power lines, and other sources.

The severity of the impacts depends on the location of the epicenter, urban development and populations, the magnitude and intensity, the geologic features and soil type, and the time of day. Earthquakes with a high magnitude and intensity that occur in unpopulated areas may have less of an overall impact than smaller earthquakes that occur in urban areas because of the potential for structural damage and resulting loss of life.

In Bonneville County, the potential for severe impacts from an earthquake increases as the population centers expand. Seismic building codes, earthquake monitoring equipment, and seismic susceptibility studies can reduce the overall impacts in developed and developing areas. However, in the event of a severe earthquake, damage is likely to occur.

Bonneville County was affected by both the Hebgen Lake earthquake in 1959 and the Borah Peak earthquake in 1983. Throughout the affected area, these two events combined caused 30 deaths and cost more than $20 million dollars in losses in spite having been centered in relatively remote areas.

A HAZUS 2.1 analysis was conducted to determine the estimated loss of from a 7.0 magnitude earthquake for Idaho Falls (IBHS 2013). In Idaho Falls, a 7.0 magnitude earthquake would potentially damage 48,140 buildings, result in $608 million in direct economic losses, and cause 196 deaths (IBHS 2013).

The results from HAZUS 2.1 type I analysis are similar to the analysis conducted in the 2008 AHMP because the inventory did not change.

3.4.3.1.6 Hazard Summary

Earthquakes are difficult to predict, with little to no warning times (Magnitude Value = 8). Earthquakes have the potential to impact large areas (Magnitude Value = 8). The economic loss from a severe earthquake can be extensive (Magnitude Value = 8). The majority of damage would be covered by the federal government for reconstruction assistance (Magnitude Value = 8). Sheltering may be provided in structurally sound buildings (Magnitude Value = 2). Severe earthquakes can cause bodily harm, and minimal deaths may occur (Magnitude Value = 2). The total magnitude score is 36, which is in the high range (Table 3-24). Historical records for earthquakes indicate that Bonneville County regularly experiences earthquakes, but they are not severe; therefore, the overall frequency for these events is medium.

Table 3-24. Magnitude scoring criteria for earthquakes.

	Magnitude of Earthquake					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.3.2 Landslides

3.4.3.2.1 Description and Location

A landslide encompasses several types of occurrences in which slope-forming materials, such as rock and soil, move downward under the influence of gravity. Such downward movement may occur as the result of an increase in the weight of the slope-forming materials, an increase in the gradient (angle) of the slope, a decrease in the forces resisting downward motion (friction or material strength), or a combination of these factors. Factors that may trigger a landslide include weather-related events, such as heavy rainfall (one of the most common contributors); erosion and freeze-thaw weakening of geologic structures; human causes, such as excavation, mining, deforestation, and vibration from explosions or other sources; and such geologic causes as earthquake, volcanic activity, and shearing or fissuring. The speed of descent ranges from sudden and rapid to an almost imperceptibly slow creep where effects are only observable over a period of months or years.

Landslides are localized events that can occur when conditions are adequate (i.e., ideal slope, geologic features, and erosion). The United States Geological Survey has identified regions that are more susceptible to landslides and have an increased percent of incidence. The percent of incidence is the chance of a landslide occurring. Susceptibility to landsliding is defined as the probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation (Godt 2001). The central and eastern parts of Bonneville County are more susceptible to landslides than the western part (Figure 3-14).

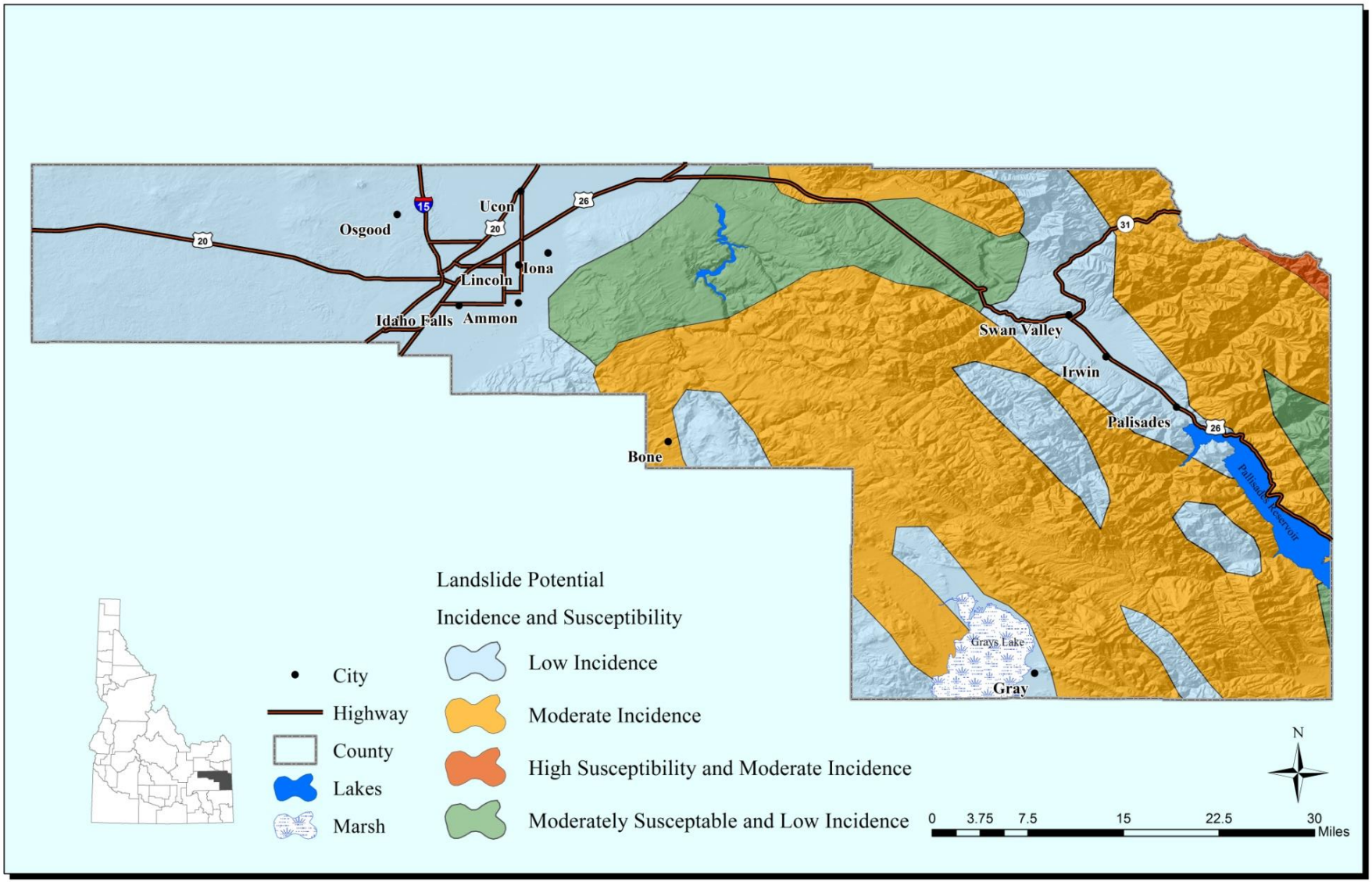

Figure 3-14. Bonneville County landslide potential.

3.4.3.2.2 Extent

At this time, there is no magnitude scale for landslides (IBHS 2013).

3.4.3.2.3 Past Occurrences

Idaho is one of the most landslide-prone states (Brabb 1989). Not all landslide events are recorded, but, based on the Landslide Map of Idaho, there have been 11 small-scale landslide events in Swan Valley, near Ririe, and near Bone (Brabb 1989). Most of these events are related to the movement of earth on a slope.

3.4.3.2.4 Future Occurrences

The geophysical processes that contribute to landslides during a particular year are statistically independent of past years (IBHS 2013). The short period of recorded and observed landslides and associated conditions that contribute to the risk make it difficult to develop return periods for landslide-prone areas. Landslide occurrence is not directly attributed to a specific major meteorological event, but rainfall events are one known cause of landslides (IBHS 2013).

3.4.3.2.5 Vulnerability Assessment

Based on historical data, landslides cause little damage to structures and the overall environment but can severely impact transportation corridors, limiting access to communities for a short time. Furthermore, landslides can impact power and communication lines. As development continues into areas that have some susceptibility to landslides, they are more likely to impact human populations.

Landslides typically do not cause injuries or death, unless people are in the path of the landslide. If transportation corridors are blocked, access to specific locations may become difficult for emergency response.

Financial losses due to landslides are most frequently linked to the costs of road repair and the removal of debris from roadways. The overall costs are dependent on the size of the landslide and amount of damage incurred.

3.4.3.2.6 Hazard Analysis

Landslides are difficult to predict, with little to no warning times (Magnitude Value = 4). Landslides are localized events with the potential to impact small areas (Magnitude Value = 2). The economic loss is from road repair and removal of debris (Magnitude Value = 2). The majority of damage would be covered by the state government for reconstruction assistance (Magnitude Value = 4). No sheltering would be required (Magnitude Value = 1). Injuries are not likely, and deaths are not typical (Magnitude Value = 1). The total magnitude score is 13, which is in the low range (Table 3-25). Historical records for landslide events indicate that Bonneville County rarely experiences landslides; therefore, the overall frequency for these events is low.

Table 3-25. Magnitude scoring criteria for landslides.

Value	Magnitude of Landslides					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.3.3 Avalanche

3.4.3.3.1 Description and Location

Avalanches are common in mountainous terrain where heavy snowfall accumulates on steep slopes. Avalanches generally occur on slopes between 30 and 45 degrees, with 38 degrees being the “ideal” slope for development of avalanche conditions (NSIDC 2014). They are often categorized as either “loose snow” or “slab” types. A loose avalanche is initiated when snow is dislodged at a point upslope and, in turn, dislodges more snow as it moves downward. Such avalanches usually grow wider and larger as they proceed but are usually somewhat limited in size. The generally more dangerous slab avalanche occurs when a cohesive mass of snow breaks free and moves downward, either as a single unit or breaking into smaller pieces traveling together. Four factors combine to produce a slab avalanche: (1) a large mass of snow that is cohesive as a result of a single, large snowfall or some physical change due to temperature, introduction of water content, or other factors; (2) some source of instability or weakness that forms a boundary capable of breaking free; (3) a surface, called a sliding layer, upon which the slab may easily slide; and (4) a triggering event, such as increased weight, strong vibration, wind, or a temperature increase, that overcomes the binding forces at, or further weakens, the boundary of instability. (It is estimated that around 90% of avalanches where victims are involved are triggered by their victims or those who accompany them.) Avalanches are composed of three zones: (1) the release zone where the mass breaks free and accelerates, (2) the track where the mass travels downward at a relatively constant speed (often approaching 80 mph), and (3) the run-out zone where the mass slows and comes to rest. While the exact moment of an avalanche cannot be predicted, avalanche conditions are readily recognizable, and avalanches tend to recur on the same slopes year after year.

Because the topography of eastern Bonneville County is more mountainous, it is more likely that an avalanche will occur in that portion of the county.

3.4.3.3.2 Extent

Several classification systems are used for rating hazards and conditions associated with avalanches. The United States uses a five-level scale to classify the size of an avalanche (Table 3-26).

Table 3-26. United States classification for avalanche size.

Size	Destructive Potential
1	Sluff or snow that slides less than 50 meters (150 feet) of slope distance
2	Small, relative to path
3	Medium, relative to path
4	Large, relative to path
5	Major or maximum, relative to path
Source: American Avalanche Association (2014)	

Avalanche danger can be forecasted using the North American Avalanche Danger Scale (American Avalanche Association 2014) (Table 3-27). The scale was designed to facilitate communication between forecasters and the public. The categories represent the probability of avalanche activity and recommend travel precautions.

Table 3-27. North American Avalanche Danger Scale.

North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size and distribution of avalanches.

Danger Level		Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme	4 5	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High	4 5	Very dangerous avalanche conditions. Travel in avalanche terrain not recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable	3	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate	2	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low	1	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

3.4.3.3.3 Past Occurrences

It is impossible to determine how many avalanches occur each year and how big all of them are. Events that have caused a reported accident have been recorded in various databases. Three avalanche events in Bonneville County have caused injury or death (Table 3-28).

Table 3-28. Historical avalanche events in Bonneville County.

Date	Location	Damage
2/1949	Bonneville County	Two children died
2/17/2007	Palisades Peak	Snowmobiler died
12/26/2013	Palisades Peak	Snowmobiler died
Source: American Avalanche Association (2014)		

3.4.3.3.4 Future Occurrences

The geophysical processes that contribute to avalanches during a particular year are statistically independent of past events (IBHS 2013). Avalanche occurrence is not directly attributed to a specific major meteorological event. Avalanches are typically the result of a combination of weather and snowpack conditions. It can be reasonably assumed, based on recorded observations from 1949 through 2014, that a hazardous avalanche event has occurred once every 21.6 years.

[(Current Year) 2014] – [(Historical Year) 1949] = 65 years

[(Years on Record) 65] / [(Number of Historical Events) 3] = 21.6 years

Based on historical probability, there is a 4.5% chance that an avalanche event will occur during any given year in Bonneville County. However, with increased activity in the backcountry during the winter months, it is likely that events will increase.

The NWS can issue an avalanche warning in advance by examining the weather forecast and snowpack conditions. However, warnings are not available in some areas due to their remote locations.

3.4.3.3.5 Vulnerability Assessment

Avalanche impacts are often limited, and, in Bonneville County, primarily roadways and related infrastructure are threatened. Because avalanches usually occur in remote areas, victims are usually recreational users on slopes where the avalanches occur. Avalanches may also damage or destroy structures, break power lines, block roadways and railroads, and damage trees and vegetation.

Because avalanches occur mostly in the backcountry and on federal lands, the overall losses to the county are limited. Most of the losses come from damage to roadways and the resulting snow and debris removal costs. Bonneville County has approximately 344 miles of roadways that are in areas prone to avalanches.

3.4.3.3.6 Hazard Summary

Avalanche conditions can be predicted in advance, but an actual event cannot (Magnitude Value = 2). Avalanches are localized events with the potential to impact small areas (Magnitude Value = 2). The economic loss is from road repair and removal of debris (Magnitude Value = 2). The majority of damage would be covered by the state government for reconstruction assistance (Magnitude Value = 4). No sheltering would be required (Magnitude Value = 1). Injuries and death are common for those that get trapped by an avalanche (Magnitude Value = 2). The total magnitude score is 13, which is in the low range (Table 3-29). Historical records for landslide events indicate that Bonneville County rarely experiences avalanches that cause injuries or death; therefore, the overall frequency for these events is low.

Table 3-29. Magnitude scoring criteria for avalanches.

Value	Magnitude of Avalanches					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.4 Other

3.4.4.1 Wildfire

3.4.4.1.1 Description and Location

A wildfire is defined as a fire that is caused naturally or by humans and occurs in areas of combustible vegetation, typically in or near wildland areas. Typically, wildfires occur in areas that are undeveloped except for the presence of roads, railroads, and power lines. Wildfires occur near areas where improved property and wildland fuels meet at a well-defined boundary (Bonneville County 2004). For the purpose of this analysis, these areas are called the wildland-urban interface (WUI) zones.

Historically, wildfire had been an integral part of ecosystems within Bonneville County (BLM 2009). Depending on the ecosystem and build-up of plant biomass, historical fire events occurred regularly. However, modern fire suppression has changed the historic fire intervals, and wildfire occurs less regularly. With larger fire intervals, plant biomass tends to accumulate, creating large areas of combustible vegetation. In these cases, wildfires that are caused naturally or by humans tend to be larger and cause severe damage to local populations and the overall environment.

Because wildfire is considered to be natural and a necessary component of local ecosystems, wildfires that occur in wildland areas are allowed to progress to the extent that they do not threaten inhabited areas or human interests and well-being (BLM 2009). For this reason, wildfires in WUI areas are vigorously controlled and suppressed. However, suppression is becoming more challenging as more development for recreational and living takes place in wildland areas.

Wildfires are typically started by either lightning or humans. In 2012, lightning ignitions accounted for a 1,259 wildfires, and human ignitions accounted for 1,140 in the Great Basin (NIFC 2013). Of these, wildfires ignited by lighting account for approximately 1,405,873 acres burned, and those ignited by humans account for approximately 483,019 acres burned (NIFC 2013). Typically, wildfires started by lightning occur in remote areas and are not suppressed immediately, and human-caused fires start in populated areas and are controlled relatively quickly (Ecowest 2013). Wildfires that are human caused are either from careless human activities or are intentional. Intentional fires are typically prescribed burns used by land management agencies.

Wildfires can occur throughout Bonneville County.

3.4.4.1.2 Extent

Wildfires that occur in the WUI were examined because they pose the most risk to county vulnerabilities. The *Bonneville County Wildfire Protection Plan (CWPP)* has identified locations of the WUI zones within the county and assessed their risk to wildfire (Bonneville County 2004). That plan was completed in 2004 and updated in 2009 to include the Community Wildfire Protection Plan Addendum (Bonneville County 2004). The purpose of the plan and the addenda is to help communities clarify and refine community priorities for the protection of life, property, and critical infrastructure in the WUI. The locations of these zones are used to identify areas that are prone to wildfires and to establish a potential risk to structures on property (Figure 3-15). In future updates of the CWPP and addenda, locations of WUI zones may change. It is intended that the plan and addendum for identifying and mitigating wildfire hazards.

3.4.4.1.3 Past Occurrences

To establish a frequency, historic fire data were collected and mapped. Based on the CWPP (Bonneville County 2004), 418 fire starts were reported between 1980 and 2003, and they burned roughly 38,000 acres in Bonneville County. Of the reported fires, 231 were started naturally, and 187 were human-caused. Naturally started wildfires are typically located in the heavily forested land in the Palisades area. Human-caused fires are typically located near the developed areas of the Snake River Plain.

Since 1955, 78 wildfires have been reported in Bonneville County and have burned roughly 35,542 acres (BLM 2013) (Table 3-30). These fires occurred in locations throughout the county (BLM 2013) (Figure 3-16). The largest of these fires was the Blackhawk fire, which occurred in early July 2007. That fire consumed 6,222 acres and was located on the east bench above Ammon. The fire did get close to homes, and some people were evacuated, but no structures were damaged.

Table 3-30. Past occurrences of wildfires in Bonneville County.

Year	Number of Fires	Total Acres	Year	Number of Fires	Total Acres
1955	1	44.74593	**1998**	1	2,688.545
1957	1	140.8099	**1999**	5	561.2323
1962	1	571.8048	**2000**	12	4,212.154
1966	1	331.0462	**2001**	5	1,123.418
1974	1	157.7187	**2002**	1	83.52504
1982	1	246.4847	**2003**	6	3,256.3
1983	1	94.45853	**2004**	2	635.8959
1986	1	914.8988	**2005**	2	100.5439
1987	1	62.05917	**2006**	4	1,398.797
1990	2	571.0613	**2007**	2	6,296.21
1992	3	275.6041	**2008**	3	1,079.455
1994	4	1380.828	**2010**	2	1,855.787
1995	1	233.3438	**2011**	3	357.8692
1996	5	3172.553	**2012**	6	694.5492

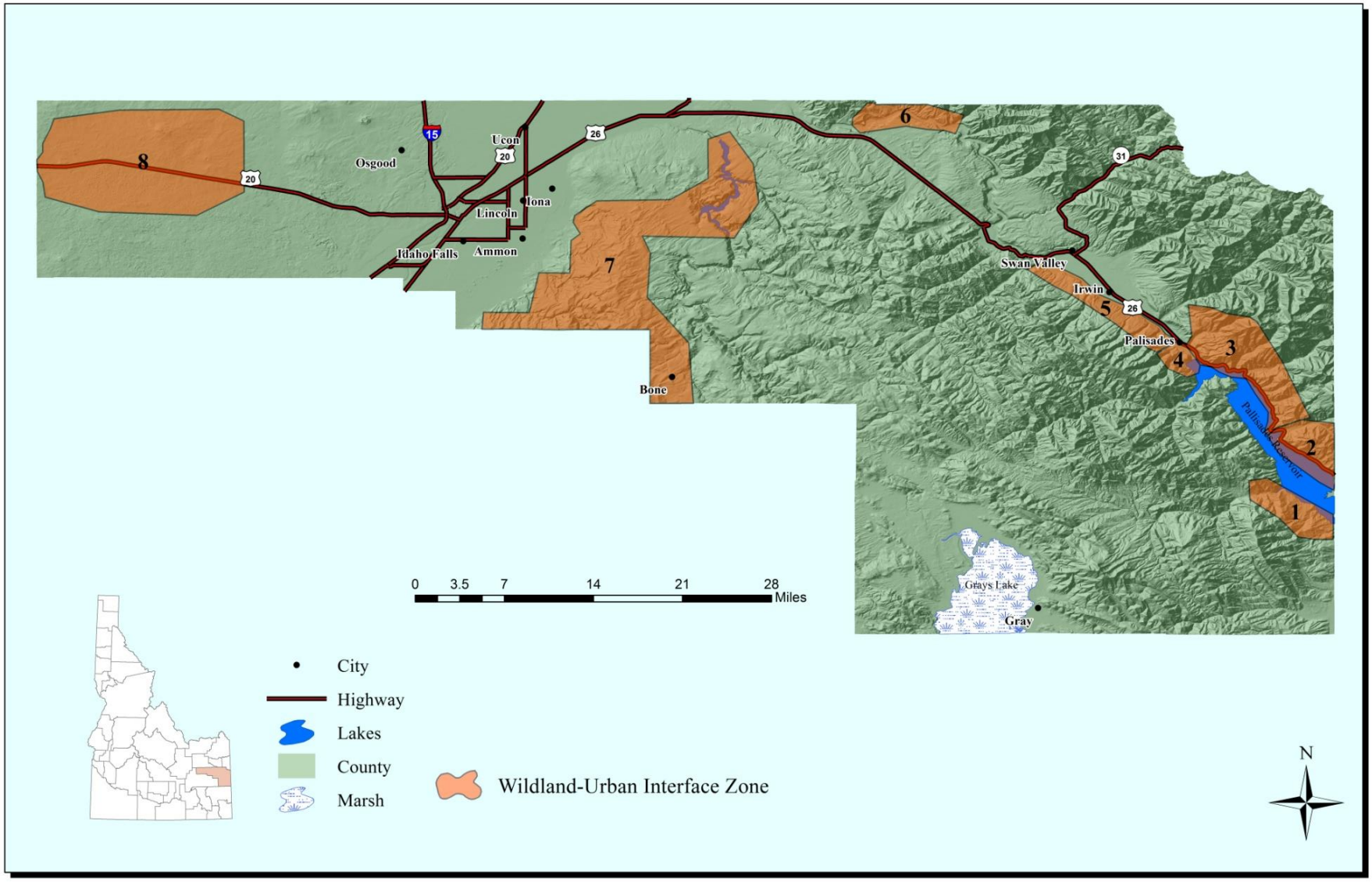

Figure 3-15. WUI zones in Bonneville County.

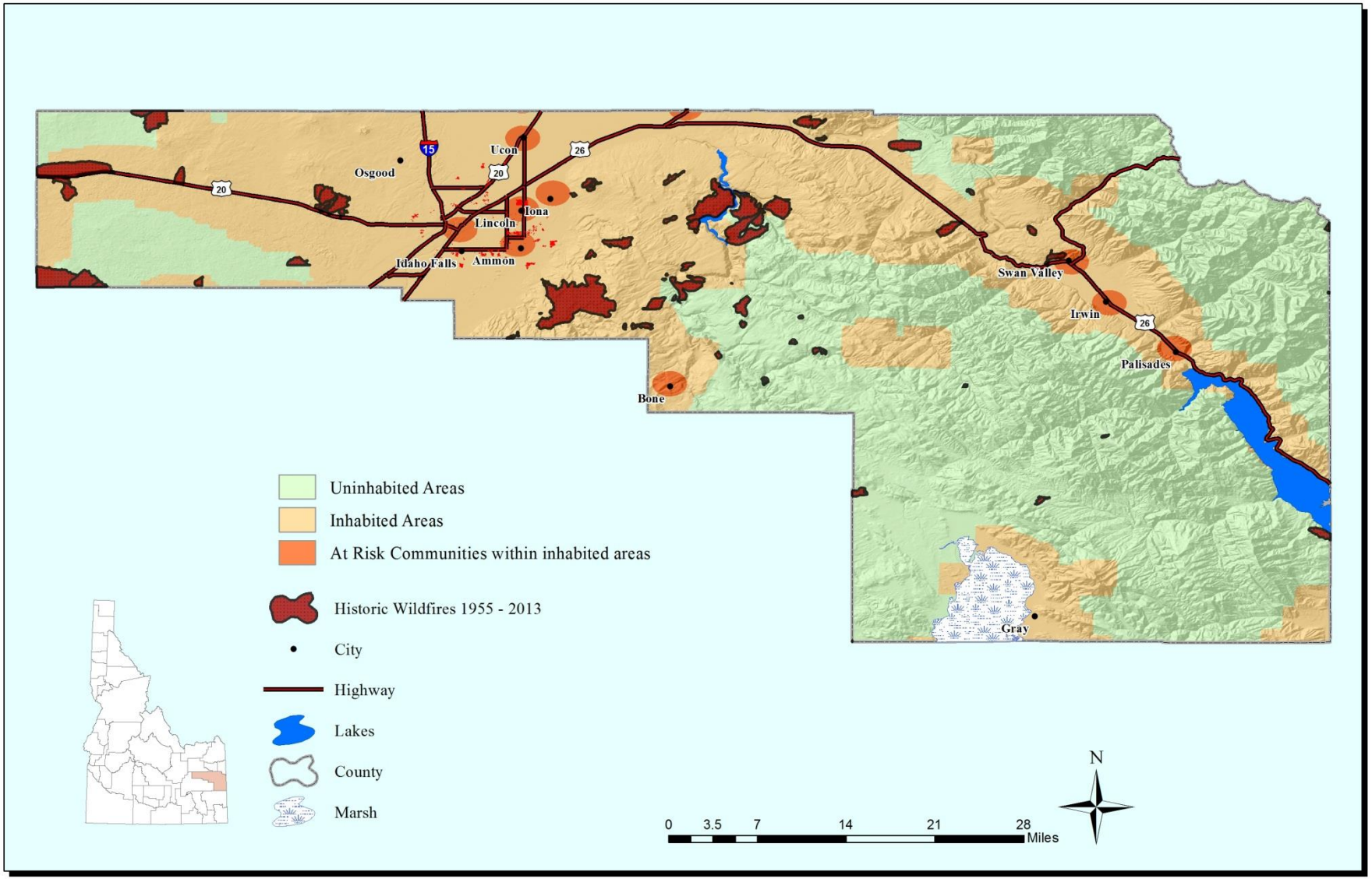

Figure 3-16. Location of past wildfires in Bonneville County.

3.4.4.1.4 Future Occurrences

Based on historical data, there is a 100% chance that a wildfire will occur in any given year in Bonneville County. The number of wildfires per year is consistent, but the number of acres burned can vary (IBHS 2013). Future occurrence of wildfires is not expected to diminish from current trends (IBHS 2013). Climate change and rangeland/forest management practices indicate that wildfire trends are likely to continue. And, with urban development increasing into wildfire prone areas, the amount of damage is likely to increase.

Wildfires typically are started by lightning or humans, and their direction and intensity vary depending on the conditions in the area. In a worst-case scenario and even with a rapidly developing wildfire, there is usually an hour or more warning time to affected residents because officials will be monitoring the fire.

3.4.4.1.5 Vulnerability Assessment

Potential risks from wildfires are not limited to the WUI zones and can occur anywhere under certain conditions. Furthermore, after a fire is started, the extent and intensity are determined by a number of factors, including:

- Weather – wind speed and direction, temperature, and precipitation
- Terrain – fires typically burn upslope
- Vegetation type
- Vegetation condition – dryness
- Fuel load – the amount and density of vegetation
- Suppression.

To assess the extent of a wildfire and the risk to property, infrastructure, and critical facilities, it is assumed that wildfires that occur in the WUI are most likely to pose the most risk because those areas are most likely to experience a wildfire that impacts vulnerabilities and have the vegetation type and fuel load for a severe wildfire.

Wildfires typically do not cause bodily harm to members of the general public, but injuries and death are common among those participating in the control and suppression efforts. In 2012, 15 firefighters were killed in the United States during activities involving wildfire control and suppression (FEMA 2013b). Injuries to the general public are most likely to occur when fires reach developed areas.

The overall loss of a wildfire is a complex figure that accounts for the direct and indirect costs (WFLC 2013). Direct costs include the cost of fire suppression and insurance reimbursements. Indirect costs include a loss of tax revenues and prolonged property damage. Wildfires that burn large areas will typically cost more than smaller ones. Loss estimates for wildfires are difficult to clearly quantify.

In order to anticipate direct costs, a figure of $178 per acre was used. This figure was derived from the estimated total cost of the 2012 Minidoka Complex fire that occurred in in Cassia County, Idaho. This figure is used because the Cassia and Bonneville county environments are similar (Idaho Conservation League 2013). The $178 per acre figure was applied to the average size (1,162 acres) of wildfires in Bonneville County since 1955 (Table 3-30). Based on this estimate, the approximate direct cost of a wildfire in Bonneville County is $206,836 per fire.

Based on the county parcel map, there are 2,731 parcels in the WUI zones. The estimated value of structures on these parcels is approximately $20,961,126. Although not all structures will be lost in any given fire because wildland firefighter personnel attempt to protect structures, this estimate is used to establish an estimated loss value of structures within these zones.

3.4.4.1.6 Hazard Summary

There is usually an hour or more of warning time to affected residents because officials will be monitoring the fire (Magnitude Value = 4). The extent of a wildfire is, again, dependent on the conditions of the area. The impacts to people, infrastructure, and critical facilities are most likely to occur in WUI areas. In Bonneville County, these areas are located mostly in the Swan Valley area and areas east and west of Idaho Falls and Ammon, and they typically contain multiple sections (Magnitude Value = 4). Based on the direct and indirect costs of wildfires, the estimated loss range is high (Magnitude Value = 8). Wildfires are vast, and the majority of the costs are covered by federal agencies, including reconstruction assistance (Magnitude Value = 8). Typically, sheltering is required for those that are evacuated in the event of a wildfire. Because the majority of the county's population lives outside a WUI, little sheltering would be required (Magnitude Value = 2). Because injuries and fatalities are most likely to occur to firefighters and not the general public, the overall bodily harm would be minimal (Magnitude Value = 2). The total magnitude score is 28 for Bonneville County, which is in the high range (Table 3-31). Historical records indicate that wildfires occur on a regular basis, and, therefore, the frequency is high.

Table 3-31. Magnitude scoring criteria for wildfire.

	Magnitude of Wildfire					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.4.2 Pandemic

3.4.4.2.1 Description and Location

A pandemic is a worldwide epidemic, while the term "outbreak" may be applied to a more geographically limited medical problem—for instance, in a single community rather than statewide or nationwide. Pandemic considerations include infection and illness, disease incubation time, how the disease spreads, and the geographic area affected. In addition, modern air travel has made it possible to cause a pandemic in a short period. Psychological effects to consider include increased levels of anxiety and fear of contracting the disease. Implementation of epidemical reaction pertains to pandemic waves or successive waves, infection rates from baseline levels, and effective control measures.

Previous pandemics that have affected the United States and populations worldwide include influenza, smallpox, tuberculosis (TB), severe acute respiratory syndrome (SARS), HIV, West Nile virus, and H1N1 "bird flu."

Pandemic Influenza versus Annual Influenza Season

A flu pandemic has little or nothing in common with the annual flu season. A flu pandemic is caused by a new, much more serious and contagious virus to which humans have little or no natural resistance. And while, in general, a vaccine has been developed in anticipation of the annual flu season, no vaccine would be available at the onset of a pandemic. If such a new, highly contagious strain of influenza began to infect humans, it would probably cause widespread illness and death within a matter of months, and the outbreak could last up to two years. The Centers for Disease Control and Prevention predict that as much as 25 to 30% of the U.S. population would become ill, that many of these would require hospitalization, and that many might die. The Eastern Idaho Public Health District is currently working on a plan to limit the spread of an influenza pandemic and to maintain essential health care and community services if an outbreak should occur. In fact, governments all around the world are preparing for the possibility of a pandemic outbreak. Even so, it may not be possible to prevent a pandemic or to halt it once it begins. A person infected with influenza may be contagious for 24 hours before symptoms appear and for seven days thereafter, making it extremely easy for the virus to infect large numbers of people.

Although the federal government is stockpiling large quantities of medical supplies and antiviral drugs, no country in the world has enough antivirals to protect all of its citizens. Antivirals would be used to treat severe cases as long as there was a reasonable chance that the drugs might help save lives. Antivirals might also be reserved for people who work in areas that place them at high risk for exposure in an outbreak, such as health care workers. Other strategies for slowing the spread of a potentially deadly pandemic influenza virus include temporarily closing schools, sports arenas, theaters, restaurants, taverns, and other public gathering places and facilities.

H1N1 "Bird Flu"

Efforts are currently underway to develop a vaccine to protect humans from the H1N1 bird flu virus. While it has so far affected few humans, there is the danger that the bird flu virus may mutate into a new form of human flu that would be easily spread from person to person. Some migratory waterfowl carry the H5N1 virus with no apparent harm to them, but they transmit the virus to susceptible domestic poultry. The highly lethal H1N1 outbreak among domestic poultry is widespread and uncontrolled and has directly infected a small number of humans.

People who have close contact with infected birds or with surfaces that have been contaminated with droppings from infected birds are at risk of becoming infected. In infected countries, poultry consumption has not been shown to be a risk factor if food is thoroughly cooked, nor are travelers in these countries at increased risk of infection, provided that the person does not visit or live near poultry markets, farms, or other environments where exposure to diseased birds may occur. More than 200 million birds in affected countries have either died from the disease or were killed in order to try to control the outbreak.

Many Asian countries are currently dealing with bird flu outbreaks. Bird flu continues to spread geographically from its original focus in Asia. Further spread of the virus along migratory routes of wild waterfowl is anticipated. So far, there has been no sustained person-to-person spread of the disease, but a few isolated cases of apparent human-to-human spread between family members are currently under investigation.

The reported symptoms of bird flu in humans range from typical influenza-like symptoms (e.g., fever, cough, sore throat, and muscle aches) to eye infections (conjunctivitis), pneumonia, acute respiratory distress, viral pneumonia, and other severe and life-threatening complications. Diarrhea, vomiting,

abdominal pain, chest pain, and bleeding from the nose and gums have also been reported as early symptoms in some cases. In many cases, health deteriorates rapidly, leading to a high percentage of death in those who become infected.

SARS

SARS is a viral respiratory illness caused by a corona virus, called SARS-associated corona virus. SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. According to the World Health Organization, a total of 8,098 people worldwide became sick with SARS during the 2003 outbreak. Of these, 774 died. In the United States, only eight people had laboratory evidence of SARS-associated corona virus infection. All of these people had traveled to other parts of the world where there were SARS outbreaks. In general, SARS begins with a high fever (temperature greater than 100.4°F). Other symptoms may include headache, an overall feeling of discomfort, and body aches. Some people also have mild respiratory symptoms at the outset. About 10 to 20% of patients have diarrhea. After two to seven days, SARS patients may develop a dry cough. Most patients develop pneumonia.

It appears that SARS is spread mainly by close person-to-person contact. The virus that causes SARS is thought to be transmitted most readily by respiratory droplets (droplet spread) produced when an infected person coughs or sneezes. Droplet spread can happen when droplets from the cough or sneeze of an infected person are propelled a short distance (generally up to 3 feet) through the air and deposited on the mucous membranes of the mouth, nose, or eyes of persons who are nearby. The virus also can spread when a person touches a surface or object contaminated with infectious droplets and then touches the mouth, nose, or eyes. It is also possible that the SARS virus is spread more broadly through the air (airborne spread) or by other means that are not now known.

Smallpox

Smallpox is a serious, contagious, and sometimes fatal infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination (IBHS 2013). There are two clinical forms of smallpox: variola major and variola minor. Variola major is the most common form of smallpox, with a more extensive rash and higher fever. Variola minor is less common, and the symptoms are less severe.

Smallpox outbreaks have occurred from time to time for thousands of years. With the increased access the smallpox vaccines, smallpox disease was eradicated in 1979. The last case of smallpox in the United States was in 1949 (IBHS 2013). Because the disease has been eradicated from the world, routine vaccination against smallpox among the public was stopped because it was no longer necessary for prevention.

TB

TB is a bacterial infection that usually attacks the lungs, but it can attach to any part of the body, such as the kidneys, spine, and brain. If not treated properly, TB can be fatal. TB was once the leading cause of death in the United States. TB is spread through the air from one person to another (CDC 2014). The TB bacteria are put into the air when a person with TB disease of the lungs or throat coughs, sneezes, speaks, or sings. People nearby may breathe in these bacteria and become infected.

West Nile Virus

West Nile virus is a potentially serious illness and is established as a seasonal epidemic in North America that flares up in the summer and continues into the fall (CDC 2014).

HIV/AIDS

HIV/AIDS is a viral infection transmitted by sexual intercourse, through contaminated blood transfusions, or from infected mother to child during pregnancy or breastfeeding. This disease compromises the immune system (CDC 2014). HIV/AIDS was first recognized by the Centers for Disease Control and Prevention in 1981, and no cure exists.

Cholera

Cholera is a bacterial infection in the small intestine that may cause diarrhea, dehydration, and death (CDC 2014). It spreads by ingesting food or water contaminated with the feces from infected persons. Cholera outbreaks no longer exist in the United States due to water treatment and sanitation.

Diphtheria

Diphtheria is a contagious infection caused by bacteria affecting the upper respiratory tract and less often the skin (CDC 2014). Coughing, sneezing, or even laughing easily transmits the disease. Complications are breathing problems, heart failure, and nervous system damage. Diphtheria is rare in the United States due to immunizations.

Measles

Measles is a serious respiratory disease caused by a virus (CDC 2014). It spreads easily through coughing and sneezing. The measles, mumps, and rubella vaccine protects against measles.

Pertussis

Pertussis, or whooping cough, is a serious respiratory bacterial infection (CDC 2014). It causes violent coughing. It is most harmful to infants. The DTaP vaccine protects against whooping cough.

Polio

Polio is a worldwide disease caused by poliovirus. It can cause paralysis and be deadly. The polio vaccine can protect against polio (CDC 2014).

Q Fever

Q fever is a worldwide disease with acute and chronic states caused by bacteria (CDC 2014). The bacteria can be found in the milk, urine, amniotic fluids, and feces of infected animals. The typical contact comes from domesticated cattle, sheep, and goats. Infection of humans occurs by inhalation from air that contains airborne barnyard dust contaminated by dried placental material, birth fluids, and excreta of infected animals. Humans are very susceptible to the disease, and very few organisms may be required to cause infection.

Typhoid Fever

Typhoid fever is a bacterial infection of the intestinal tract and bloodstream. Most of the cases are acquired during foreign travel to underdeveloped countries.

Plague

Plague is a disease caused by bacteria and affects humans and other mammals. Humans usually get plague after being bitten by fleas that carry the plague bacteria or by handling an animal infected with

plague. Currently, human plaque infections continue to occur in the western United States. It can be treated with antibiotics.

3.4.4.2.2 Extent

The relative ease of worldwide travel, in addition to the world's expanding global food industry, makes all countries vulnerable to pandemic events (IBHS 2013).

3.4.4.2.3 Past Occurrence

Based on data from the past six years, there have been a few incidences of diseases like those described above in Bonneville County (IDHW 2014) (Table 3-32). Based on disease trends, the reported incidences for these diseases have continued to decrease over the past couple of decades, except for pertussis (IDHW 2013). Q fever and West Nile virus continue to appear but not in large numbers, and they are treated when reported (IDHW 2014).

Table 3-32. Reported disease incidences in Bonneville County, 2006–2012.

Reported Disease	Year						
	2006	2007	2008	2009	2010	2011	2012
SARS[a]	0	0	0	0	0	0	0
Smallpox[a]	0	0	0	0	0	0	0
Tuberculosis	2	0	0	0	0	1	1
West Nile virus	32	4	2	1	0	0	0
Cholera[a]	0	0	0	0	0	0	0
Diphtheria[a]	0	0	0	0	0	0	0
Measles[a]	0	0	0	0	0	0	0
Pertussis	9	7	1	0	11	2	3
Q fever	0	0	0	0	1	0	0
Typhoid fever[a]	179[c]	155[c]	200[c]	174[c]	1	0	0
Plague[a]	0	0	0	0	0	0	0
HIV/AIDS[b]	5	3	2	2	3	3	0

a. Statewide
b. Health District 7
c. Until 2010, typhoid fever cases were counted as salmonellosis cases. Typhoid fever cases may have occurred before 2010, but the specific number of cases is unknown.
Source: IDHW (2014)

Pandemic events that have occurred in Bonneville County and Idaho include the 1918 Spanish influenza. Communities throughout Idaho reported 1918 influenza outbreaks and deaths. The State Board of Health cancelled public and private schools statewide. The outbreak was first reported in Canyon County and then spread throughout the entire state in about two weeks. Several cities, including Pocatello, were quarantined (IBHS 2013).

3.4.4.2.4 Future Occurrence

Future occurrences of pandemic events are expected to continue. As bacteria and viruses continually evolve, there is always the opportunity for new diseases to occur. The overuse of antibiotics has the possibility to allow diseases that were once under control to reemerge.

The Centers for Disease Control and Prevention will share cleared information about urgent public health incidents with public information officers; federal, state, and local public health practitioners; clinicians; and public health laboratories to reduce the rapid distribution diseases to the public (CDC 2014). Warning times will vary from days to months.

3.4.4.2.5 Vulnerability Assessment

Characteristics and impacts of a pandemic are:

- Rapid spread through the community
- Overloaded healthcare systems
- Inadequate medical supplies
- Economic and social disruption.

Overall, a pandemic is most likely to claim more lives than any other type of disaster. While modern epidemiology and medical advances make the decimation of populations much less likely, new forms of disease continue to appear. The potential, therefore, exists for pandemics to cause widespread loss of life and disability, overwhelm medical resources, and have a tremendous impact on the population.

Based on projections, the anticipated Gross Domestic Product loss from a pandemic event in Idaho is $2.6 billion or 5.42% of Gross Domestic Product (IBHS 2013). Overall, the total cost would be severe to the county due to medical costs and losses to the economy from a decline in the workforce.

3.4.4.2.6 Hazard Summary

The warning time can range from days to months (Magnitude Value = 2). Pandemics are typically large scale and will affect the entire county (Magnitude Value = 8). The overall costs are difficult to determine, but they are anticipated to be large scale (Magnitude Value = 2). The costs of medical services are typically covered by insurance (Magnitude Value = 1). No sheltering will be required. Based on historic occurrences, people are often asked to stay in their homes (Magnitude Value = 1). In the event of a pandemic, major injuries would occur and would require assistance from outside the county. Deaths are likely to occur (Magnitude Value = 4). The total magnitude score is 18 for Bonneville County, which is in the medium range (Table 3-33). Historical records indicate that pandemics do not occur regularly, and the frequency is relatively low.

Table 3-33. Magnitude scoring criteria for pandemics.

Value	Magnitude of Pandemic					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5 Technological Hazards

Technological hazards, or human-caused hazards, are typically hazards that occur accidentally with little or no warning. These hazards include structural fire, hazardous material spills, extended utility outages, radiological events, civil disorder, and terrorism.

3.4.5.1 Structural Fire

3.4.5.1.1 Description and Location

A structural fire is any fire inside, on, under, or in contact with a structure (NFPA 2014). This includes any mobile residential structure, such as a mobile or modular residence, but it does not include roadworthy vehicles such as recreation vehicles (NFPA 2014). Structural fires can be detrimental to life, property, and the local economy.

Major causes of structural fires include:

- Incendiary/arson
- Heating
- Cooking
- Open flame
- Electrical distribution
- Appliances
- Children playing
- Exposure to other fire (wildfires).

Based on the definition of a structural fire, such a fire is likely to occur anywhere a structure is located.

3.4.5.1.2 Extent

The severity of structural fires varies due to the losses associated with the incident. The impact to the local economy is minimal with the loss of a residential structure, but the loss of a large manufacturing facility can be more extensive. The loss of life during a residential fire is more likely than a fire at an industrial or commercial building. The building composition and the hour of the incident combine to increase the loss of life during a residential-type fire.

3.4.5.1.3 Past Occurrences

Structural fires occur every year in Bonneville County. Local fire departments responded to 1,434 fires between 2008 and 2012 (IDOI 2012) (Table 3-34). The majority of structural fires in Bonneville County occur in Idaho Falls, which is to be expected because of the relatively large population.

Table 3-34. Past occurrences of structural fires in Bonneville County.

Department Name	2008	2009	2010	2011	2012
Ammon	0	7	–[a]	–[a]	21
Greater Swan Valley	14	7	6	6	16
Idaho Falls	291	224	268	236	331
Ucon	0	0	7	0	0

a. No data available.
Source: IDOI (2012)

3.4.5.1.4 Future Occurrences

Based on historical data, it is expected that an average household in the United States will experience a fire within a structure every 15 years (NFPA 2014). Because of public outreach campaigns, better construction methods, fire mitigation plans, and building codes, there is a decreasing trend of structural fires in the United States (NFPA 2014). However, with new developments, structural fires are expected to continue.

There are no warning times for structural fires, as they are a technological hazard. The severity of the structural fire as related to time is dependent on the time of day and the quality of escape routes.

3.4.5.1.5 Vulnerability Assessment

Structural fires produce high heat, toxic gases, and particulate material as smoke and soot. The heat produced or burning debris can, in turn, cause additional fires. Toxic gases and smoke are extreme hazards in the interior of burning structures and may also be a threat downwind of the structure. Where the building contents include toxic materials, the downwind threat can extend a mile or more. Burning structures may collapse, injuring persons inside or nearby, and floors or roofs may give way beneath those walking on them. Burning structures present electrical, explosion, and flashover hazards, and partially burned structures may become physical hazards even after the fire is extinguished.

Indirect dollar losses may be much larger than direct losses. Costs also include those for development and enforcement of fire codes and maintaining fire response capabilities. Firefighters are at risk from such hazards as physical exhaustion and cardiac stresses, heat exhaustion or heat stroke, acute and chronic health effects from toxic exposures, hearing damage, and injuries from many sources.

Based on historic costs of responding to incidences in Bonneville County, the average cost to the fire departments is $591,293 per year (Table 3-35).

Table 3-35. Historic costs of structural fires.

Department Name	2008	2009	2010	2011	2012
Ammon	$0	$44,505	–[a]	–[a]	$50,065
Greater Swan Valley	$86,500	$2,000	$0	$3,500	$3,000
Idaho Falls	$1,613,450	$1,125,750	$2,012,300	$2,156,830	$3,545,320
Ucon	$0	$0	$0	$60	$0

a. No data available.
Source: IDOI (2012)

3.4.5.1.6 Hazard Summary

The warning time is dependent on the time of the day, but typically there is no warning time (Magnitude Value = 8). Structural fires typically impact one or two parcels (Magnitude Value = 1). The overall costs are difficult to determine, but they are anticipated to be large scale (Magnitude Value = 2). The costs of reconstruction are typically covered by insurance (Magnitude Value = 1). Sheltering will be required for those who are displaced (Magnitude Value = 2). Because of response times, major medical care may be required, and minimal death is expected (Magnitude Value = 2). The total magnitude score is 16 for Bonneville County, which is in the medium range (Table 3-36). Historical records indicate that structural fires occur regularly, and the frequency is high.

Table 3-36. Magnitude scoring criteria for structural fires.

	Magnitude of Structural Fires					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5.2 Extended Utility Outages

3.4.5.2.1 Description and Location

Outages can be caused by specific hazards, human error, or equipment failures. Short-term utility outages are easily handled and can be considered an inconvenience; however, extended outages can result in a failure of community infrastructure and services.

The utilities included in this discussion are electricity, gas, communications, and water. These are essential services in the county, and any extended outage would become problematic. A loss of electricity for any extended time would impact vulnerable populations by limiting their ability to heat their homes, pump drinking water, and power medical equipment. Additionally, community infrastructure and local businesses and schools would be difficult to keep functioning. A large portion of the population uses natural gas as a heat source. Any loss of natural gas service during winter months has the potential to expose large portions of the population to extreme cold. An outage of communication services would limit the ability of people to use the telephone, cell phone, and Internet services, causing little to no emergency communications. Finally, a loss of water service could limit people from accessing clean water and limit sewer services.

Utility failures can be caused by many hazard events. Anything from an earthquake to a terrorist event could cause utilities to fail. Hazards that can rapidly compromise utility systems include earthquakes, severe weather, floods, and wildfires.

Based on historic events, utility outages can occur anywhere in Bonneville County.

3.4.5.2.2 Extent

The degree of severity of a utility outage varies depending on the type of utility lost, the extent of the outage, cause of the outage, and the time it takes for the outage to be resolved.

3.4.5.2.3 Past Occurrences

Information gathered from the U.S. Energy Information Administration – Annual Disturbance Events Archive was used to aid in identifying significant events. Based on collected information, two significant outage events occurred in the county within the past five years. On December 4, 2013, approximately 53,000 Rocky Mountain Power customers lost power for an extended period. On December 18, 2013, approximately 2,799 Rocky Mountain Power customers lost power for an extended period.

3.4.5.2.4 Future Occurrences

Due to the lack of major historical events, the probability of a major utility outage is considered low. As growth occurs, however, the ability of many of the utility systems to keep up with the increased demand may increase the probability of a long-term outage.

There are typically no warning times with utility outages because they are a technological hazard.

3.4.5.2.5 Vulnerability Assessment

Characteristics and impacts of an extended utility outage are:

- Loss of potable water and sewer systems
- Loss of communication
- Increased exposure to extreme weather
- Potential loss of medical access.

Because power outages are the most common utility outage and, therefore, provide the most information, they are used as an example of utility outages. Within the United States, approximately 44% of power outages are due to weather-related events, with another 40% due to equipment failure and operator

error (Hines et al. 2008). The duration of outage depends on the event that caused it. Typically, outages caused by weather-related events are longer than events caused by equipment failure. In the Rocky Mountain Power service area, events that lasted longer than five minutes and affected more than 500 customers were identified as an extended outage event (Campbell 2012; Rocky Mountain Power 2014).

The overall loss is dependent on the geographic area where the outage occurred, event duration, time of the year, and extent of the outage (Hines et al. 2008). Direct costs include emergency responders, backup systems, utility crews to restore services, and other direct costs borne by the utility providers. Because the majority of utility outages are due to failed equipment, most of the losses are associated with the provider (Campbell 2012). The indirect cost includes economic losses that include commercial and industrial losses in productivity and losses to the residential population from a potential loss of work.

3.4.5.2.6 Hazard Summary

Extended power outage events often occur suddenly and with little warning. In the event of a severe storm, power outages can be anticipated, and the warning time is extended, e.g., approximately one day. However, power outages due to equipment failure may have no warning times. A warning lead time of minutes was assigned as an average indicator (Magnitude Value = 8). Based on recent events within the county and because outages usually affect local blocks of people the same way, an extended power outage would likely affect a section or numerous parcels (Magnitude Value = 2). Because power outages are the most common of utility outages, the loss estimate uses data collected by the Electric Power Research Institute, which estimates that incurred costs to businesses from a one-hour outage is approximately $20,000, and therefore the lost estimate would be limited (Campbell 2012) (Magnitude Value = 2). Reconstruction assistance is typically found within the same household (Magnitude Value = 1). Typically, no sheltering is required because people can stay in their homes (Magnitude Value = 1). No injuries have been reported due to outages, and this is anticipated to continue (Magnitude Value = 1). The total magnitude score is 17 for Bonneville County, which is in the medium range (Table 3-37). Historical records indicate that extended utility outages do not occur regularly or coverage is quickly restored and, therefore, the overall frequency of these events is low.

Table 3-37. Magnitude scoring criteria for extended utility outages.

	Magnitude of Extended Utility Outage					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5.3 Hazardous Material Events

3.4.5.3.1 Description and Location

Hazardous materials are substances that, because of their chemical or physical properties, are hazardous to humans and other living organisms, property, and the environment. These materials, when properly used, pose little risk to the community; however, accidental releases or exposure to them would be harmful and pose a risk to the community.

The U.S. Environmental Protection Agency maintains lists of substances that are considered hazardous or extremely hazardous. Hazardous substances are generally materials that, if released into the environment, tend to persist for long periods and pose long-term health hazards for living organisms (IBHS 2013). Extremely hazardous substances, when released, are immediately dangerous to living organisms and cause serious damage to the environment (IBHS 2013). When facilities have these materials in quantities at or above the threshold planning quantity, they must submit "Tier II" information to appropriate state and/or local agencies to facilitate emergency planning (40 CFR 370).

Transportation of hazardous material is regulated by the U.S. Department of Transportation (DOT). DOT defines a hazardous material as "a substance or material that … is capable of posing an unreasonable risk to health, safety, and property when transported in commerce…" (USDOT 2014a). Any transport of material in commerce that meets the DOT definition must be done in accordance with safety regulations providing for appropriate packaging, communication of hazards, and proper shipping controls.

The National Fire Protection Association (NFPA) develops codes and standards for the safe storage and use of hazardous materials. These codes and standards are generally adopted locally and include the use of the NFPA 704 (2012) standard communication of chemical hazards in terms of health, fire, and instability, and other special hazards. The most recognized feature of this organization is the diamond-shaped signs (NFPA 704 signs) that are located on or near hazardous materials. The NFPA 704 signs are used to identify potential hazards related to that specific material.

Hazardous materials are widely used, stored, and transported, and a hazardous material event can take place almost anywhere (IBHS 2013). Additionally, the extent of an event varies depending on the quantity of the material that is being used, stored, or transported. Typically, hazardous material events are likely to occur during transport and, therefore, occur on major highways, railways, or near facilities that store hazardous materials (Bonneville County 2009).

In 2009, Bonneville County conducted a hazardous material flow study. The purpose of the study was to collect and analyze data pertaining to the transportation of DOT-regulated hazardous materials in the county (Bonneville County 2009). The study identified primary modes of transportation, routes, hazardous material storage facilities, and locations of vehicle accidents. Information from this study is included in this description, and the report is provided in Appendix D.

Although there is potential for a hazardous material event to occur anywhere, large-scale events are relatively rare because potential hazards are mitigated with regular inspections, regulations, codes, and safety procedures. Additionally, even in the event of an incident, emergency response minimizes the extent and impact of that incident.

Although hazardous material can be stored anywhere, Tier II facilities have quantities that increase the extent of any potential hazard. A list of Tier II facilities within Bonneville County was compiled (Table 3-38). Tier II facilities are located in the Idaho Falls and Ammon area (Figure 3-17). The majority of Tier II facilities are located in areas with high numbers of residential households. Each facility has a designated protective action distance (PAD), which is based on a hypothetical worst-case scenario where the total quantity of the material explodes or is released directly into the air.

Table 3-38. Bonneville County Tier II facilities.

Facility Name	Street	City
Airgas USA, LLC – Intermountain – I.F.	4473 S. 15th W.	Idaho Falls
Ash Grove Cement Company	4550 S. 15th	Idaho Falls
AT&T	2432 S. Yellowstone Hwy.	Idaho Falls
Avis Rent A Car System, LLC	2140 N. Skyline Drive	Idaho Falls
Bingham Co-op Propane	4000 W. 65th S.	Idaho Falls
Birch Creek Radio Site	Hwy 26 to Birch Creek Road	Ririe
Bowen Petroleum – Idaho Falls	1550 Jefferson Ave.	Idaho Falls
Busch Agricultural Resources, Inc.	5755 S. Yellowstone Hwy.	Idaho Falls
Conrad and Bishoff, Inc.	2251 N. Holmes Ave.	Idaho Falls
Crop Production Services	3030 E. 49th N.	Idaho Falls
Falls Fertilizer, Inc.	1157 Lindsay Blvd.	Idaho Falls
Forde Johnson Oil Co.	1900 S. Yellowstone Hwy.	Idaho Falls
Frazier Industrial	2255 W. 49th St.	Idaho Falls
Goshen Wind Farm	444 Bone Road	Iona
H-K Contractors, Inc.	6350 S. Yellowstone Hwy.	Idaho Falls
Idaho Barley Elevator	2121 W. 135 N.	Idaho Falls
Idaho Falls Aquatic Center	149 7th St.	Idaho Falls
Idaho Falls Pumphouse #1	981 S. Blvd.	Idaho Falls
Idaho Falls Pumphouse #2	955 I St.	Idaho Falls
Idaho Falls Pumphouse #3	1140 S. Capital Ave.	Idaho Falls
Idaho Falls Pumphouse #4	599 Cleveland	Idaho Falls
Idaho Falls Pumphouse #5	206 W. 21st St.	Idaho Falls
Idaho Falls Pumphouse #6	376 N. Skyline	Idaho Falls
Idaho Falls Pumphouse #7	2251 1st St.	Idaho Falls
Idaho Falls Pumphouse #8	1475 9th St.	Idaho Falls
Idaho Falls Pumphouse #9/10	1515 S.E. Bonneville	Idaho Falls
Idaho Falls Pumphouse #11/14	200 Dale Ave.	Idaho Falls
Idaho Falls Pumphouse #12	2490 N. Holmes Ave.	Idaho Falls
Idaho Falls Pumphouse #13	911 N. Woodruff	Idaho Falls
Idaho Falls Pumphouse #15	2605 Hoopes	Idaho Falls
Idaho Falls Pumphouse #16	635 Butte Road	Idaho Falls
Idaho Falls Pumphouse #17	2345 Energy Place	Idaho Falls
Idaho Falls Wastewater Treatment Plant	4055 Glen Koester Lane	Idaho Falls
Idaho Falls Water Dept. Shop	564 Hemmert Ave.	Idaho Falls
Idaho Fresh Pak (Plant #2)	6140 N. River Road	Idaho Falls
Idaho Transportation Dept.	1504 Foote Drive	Idaho Falls
InteGrow Malt	5005 S. 15th W.	Idaho Falls
Knife River Idaho Falls	4055 S. Professional Way	Idaho Falls

Table 3-38. (continued)

Facility Name	Street	City
Lowe's of Idaho Falls (#1906)	925 E. 17th St.	Idaho Falls
Melaleuca Powder Plant	5075 W. 65th S.	Idaho Falls
Melaleuca UPAK Facility	2020 Heyrend Way	Idaho Falls
Norco, Inc.	3450 N. 25th E.	Idaho Falls
Old Faithful Beverage	714 W. Sunnyside Road	Idaho Falls
Old Castle Precast	2240 South Yellowstone Hwy.	Idaho Falls
PacifiCorp Bonneville Substation	2 mi north of Croft Road and 1 mi east of Idaho Falls	Idaho Falls
PacifiCorp Sugarmill Substation	Northeast side of Idaho Falls	Idaho Falls
Penford Products Co.	1088 W. Sunnyside Road	Idaho Falls
Quadra Chemicals, Inc.	5200 N. 15th E.	Idaho Falls
Qwest – Idaho Falls Central Office	299 Constitution Way	Idaho Falls
Sam's Club (#6345)	700 East 17th St.	Idaho Falls
Simplot Grower Solutions 1	2188 W. 145th N.	Idaho Falls
Simplot Grower Solutions 2	3192 E. 49th N.	Idaho Falls
SkyWest Airlines (Delta/ United Express	2140 N. Skyline Drive	Idaho Falls
Staples, Inc.	3900 South American Way	Idaho Falls
Suburban Propane	1708 E. Lincoln Road	Idaho Falls
Swan Valley Radio	Hwy 31 near Mile Post 3	Swan Valley
Swan Valley Substation	1.5 mi west of Hwy. 26 and 31 Jct at end of High Country Road	Swan Valley
The Home Depot Store (#1802)	2075 S. Holmes Ave.	Idaho Falls
Thomas Petroleum – Idaho Falls Bulk Plant	1550 Jefferson	Idaho Falls
UAP Northwest	3030 E. 49th North	Idaho Falls
V-1 Oil Company – Idaho Falls Prop	1800 N. Holmes Ave.	Idaho Falls
Valley Wide Co-Op #1	3755 N. 15th E.	Idaho Falls
Valley Wide Co-Op #2	4750 S. 15th W.	Idaho Falls
Verizon Wireless (#52170)	325 Briggs #10	Idaho Falls

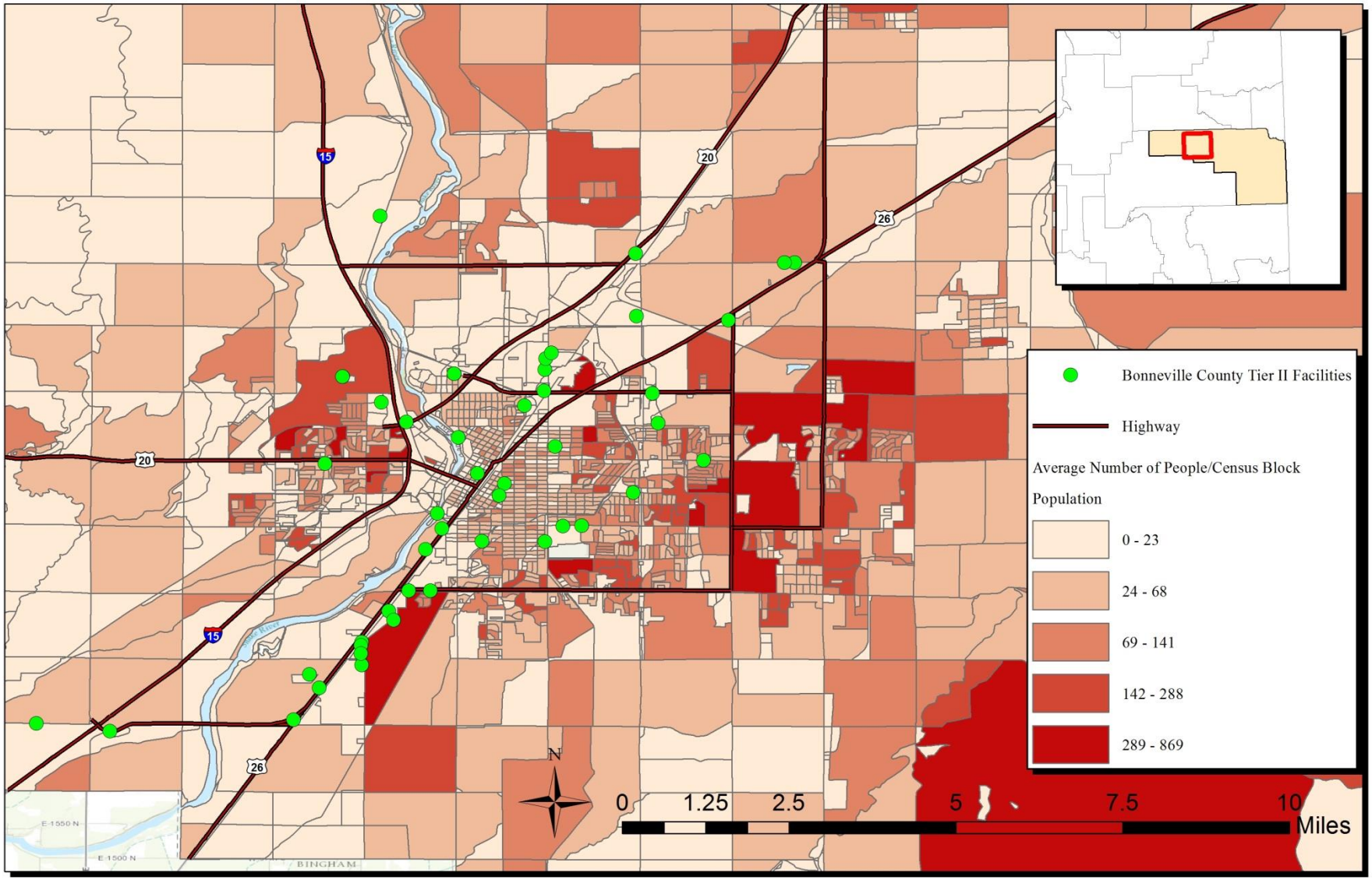

Figure 3-17. Tier II facilities in Bonneville County.

3.4.5.3.2 Extent

There is no magnitude rating for hazardous material events (IBHS 2013).

3.4.5.3.3 Past Occurrences

Past hazardous material events, unless they are properly reported, are difficult to identify and track. Regulations require that hazardous material events be reported. The Pipeline and Hazardous Safety Administration tracks hazardous material releases through a nationwide database. Based on the results of the data search, there were 16 hazardous material events since 1997 that occurred on highways or railways in Bonneville County (Table 3-39). The majority of these occurred in Idaho Falls.

Table 3-39. Past occurrences of hazardous material events.

Date of Incident	Incident City	Fatalities	Serious Injuries	Damages ($)	Transportation Type	Hazardous Class
2/27/1997	Idaho Falls	No	No	252	Highway	Flammable - combustible liquid
4/12/1997	Idaho Falls	No	No	326	Highway	Flammable - combustible liquid
10/31/1997	Idaho Falls	No	No	125	Highway	Flammable - combustible liquid
5/4/1998	Idaho Falls	No	No	150	Highway	Poisonous materials
5/18/1998	Idaho Falls	No	No	50	Highway	Corrosive material
6/30/1998	Idaho Falls	No	No	400	Highway	Poisonous materials
4/6/1999	Idaho Falls	No	No	745	Highway	Flammable - combustible liquid
5/21/2005	Idaho Falls	No	No	0	Highway	Flammable - combustible liquid
8/25/2005	Idaho Falls	No	No	0	Highway	Nonflammable compressed gas
4/12/2006	Idaho Falls	No	No	0	Highway	Corrosive material
8/27/2009	Idaho Falls	No	No	0	Rail	Flammable - combustible liquid
10/2/2009	Irwin	No	No	105,069	Highway	Flammable - combustible liquid
8/17/2010	Idaho Falls	No	No	0	Highway	Corrosive material
8/18/2011	Idaho Falls	No	No	0	Highway	Flammable - combustible liquid
8/25/2011	Idaho Falls	No	No	6,000	Rail	Flammable gas
10/28/2011	Palisades	No	No	2,172,563	Highway	Flammable - combustible liquid
Source: USDOT (2014b)						

Based on the historical frequency data, hazardous material events appear to occur regularly. Many of these events are small and have relatively low damage costs, but the frequencies of these events are considered to be high.

3.4.5.3.4 Future Occurrences

The events that produce a hazardous materials release vary greatly; therefore, future releases are statistically independent of past events. Because these are technological hazards, it is difficult to predict

future events. It can be reasonably assumed, based on recorded observations from 1997 through 2014, that a hazardous material event has occurred once every 1.5 years.

[(Current Year) 2014] – [(Historical Year) 1997] = 17 years

[(Years on Record) 17] / [(Number of Historical Events) 16] = 1.06 years

Based on historical probability, there is a 94% chance that a hazardous material event will occur during any given year in Bonneville County.

There are typically no warning times associated with hazardous material events because they are a technological hazard.

3.4.5.3.5 Vulnerability Assessment

Hazardous material events can have immediate direct impacts, as well as indirect long-term impacts. The degree of the impact is dependent on the material because the properties of the material determine how it will interact after an uncontrolled release. For this reason, impacts from an event are numerous. Possible impacts include water or soil pollution.

Because events are most likely to occur near transportation routes or storage facilities, developments in those areas are more likely to be impacted from an event. Continued growth and development is likely to increase vulnerability and potential loss from a hazardous material event (IBHS 2013).

Hazardous material may also be stored in residential buildings. Residents may be storing fuel, chlorine, or other chemicals that, in a release event, may severely impact the resident's home and neighbors. Because all home storage locations are not reported, their exact locations are unknown.

Although there is potential for a hazardous material event to occur anywhere, large-scale events are relatively rare because potential hazards are mitigated with regular inspections, regulations, codes, and safety procedures. Additionally, even in the event of an incident, emergency response minimizes the extent and impact of that incident.

It is expected that hazardous material use will increase as the population increases and with further economic development. With this increase, the possibility of an event will increase slightly.

Losses due to a hazardous materials event in Bonneville County would be related to response activities, which include evacuation-related business interruption and cleanup costs. Bonneville County has had a significant number of hazardous materials incidents.

Cleanup of releases is the responsibility of the spiller. The cost of response to the event is reimbursed to the responding jurisdiction by the Idaho Bureau of Homeland Security, Hazardous Material Division. Based on data collected from the Pipeline and Hazardous Safety Administration, damages since 1997 are $2,285,680, or $142,855 per year (USDOT 2014a).

3.4.5.3.6 Hazard Summary

Hazardous material events often occur suddenly and with little warning. In the event of a large-scale materials release, the warning time would be longer for people farther away from the incident, but those near the event would have little warning. A warning lead time of minutes was assigned as an average indicator (Magnitude Value = 8). Typically, these events occur near roadways, railways, or storage facilities and only directly impact the area immediately surrounding the incident. In the event of

a large-scale material release, a larger area would be impacted, possibly a number of multiple sections in a geographic area. However, based on recent events and the most likely location of an incident, only a block or group of parcels would be affected (Magnitude Value = 2). Based on the recent cost of damages, approximately $142,855 per year, the loss estimate is in the $100,000s (Magnitude Value = 2). All costs would be the responsibility of the spiller, but the state would provide immediate assistance and then be reimbursed by the spiller (Magnitude Value = 4). Typically, no shelter is required because people will be directed to stay in their homes, unless those whose homes are in immediate danger need to be evacuated (Magnitude Value = 2). Based on recent events, no injuries associated with hazardous material events within the county have been reported. But based the information for the entire state of Idaho, there have been 19 injuries, and any hazardous material event will likely involve some risk of injury or death, so the magnitude value will be higher (IBHS 2013) (Magnitude Value = 2). The total magnitude score is 20 for Bonneville County, which is in the medium range (Table 3-40). Historical records indicate that hazardous material events occur at a high frequency.

Table 3-40. Magnitude scoring criteria for hazardous material events.

	Magnitude of Hazardous Material Event					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5.4 Radiological Event

3.4.5.4.1 Types of Radiation

Natural radiation is always present in the environment. It includes cosmic radiation that comes from the sun and stars, terrestrial radiation that comes from the Earth, and internal radiation that exists in all living things. Many variables effect how much cosmic radiation we receive, such as elevation, atmospheric conditions, and variations in the Earth's magnetic field.

Terrestrial radiation is received from radioactive elements (such as uranium and thorium) that exist naturally in the rocks and the soil. Radon, a by-product of uranium decay, is a noble gas and is in the air. All organic matter contains carbon and potassium. We ingest these as part of our diet, the water we drink, or the air we breathe. Other naturally occurring radioactive elements include primordial radionuclides (nuclides that existed or were created during the formation of the earth and have a sufficiently long half-life to be detected today) and their progeny, as well as radionuclides that are continually produced by natural processes other than the decay of the primordial nuclides. Exposure from terrestrial radiation can vary based on geographic location. Some of the variation is linked to location, but factors such as moisture content of soil, the presence and amount of snow cover, the radon

daughter concentration in the atmosphere, the degree of attenuation offered by housing structures, and the amount of radiation originating in construction materials may also account for variation (NCRP 1987).

Exposure from internal radiation comes from naturally occurring radioactive elements present in the living tissue of the body. These elements are primarily potassium -40 (K-40) and carbon -14 (C-14). The average dose due to internal radiation received from person to person is relatively constant. The Nuclear Regulatory Commission states that the typical average individual exposure in the United States from natural background sources is about 300 mrem per year (NRC 2012).

Unnatural sources of radiation are caused by man-made devices or events. Members of the general public receive minimal amounts of radiation every day from televisions, fluorescent lights, smoke detectors, luminous watches, tobacco, and X-ray machines. Other sources of man-made radiation come from the nuclear industry. Nuclear industry sources include the radioisotope production, waste, transportation, mining, and processing of radioactive materials, and atomic weapons testing and nuclear accidents such as at Chernobyl in 1986 and Fukushima in 2011 (NRC 2013; NRC 2014).

A radiological event is an event involving radiological material. The basic hazard associated with radioactive material is the emission of radiation. Radioactive material, whether naturally occurring or man-made, is unstable and is constantly seeking a stable atomic configuration through a process called radioactive decay (FEMA 2005). As radioactive material decays, energy in the form of radiation is emitted. The emitted radiation is either a particle or electromagnetic waveform. The four basic types of radiation are alpha, beta, gamma, and neutron (FEMA 2005). Each type of radiation can have significant impacts on the human body.

3.4.5.4.2 Description and Location

Under certain circumstances, accidents involving radiological materials can have consequences. While in most cases the likelihood of an event is small, the consequences may be severe. There are two primary concerns during an accident event that results in a release of radioactive material. These are:

- The release of radioactive material in a concentration great enough to have harmful effects on human health, wildlife, or the local environment
- The fear caused by such an event or perceived event.

Once released, radioactive material has the potential to travel great distances, and it may collect in concentrations that may be harmful to the ecosystem. Particulate material may eventually be incorporated into the food chain.

Radiological events can occur anywhere in Bonneville County. Like hazardous material events, radiological events are most likely to occur near transportation routes or facilities that produce radiological material. The locations in Bonneville County that have the potential for radiological events include International Isotopes, Qal-Tek Associates, Eastern Idaho Regional Medical Center, other medical imaging facilities located in Bonneville County, and on transportation routes throughout the county.

3.4.5.4.3 Extent

Several factors determine the extent of a radiological hazard. These factors include the type of radiation, the concentration, radioisotopes involved (e.g., uranium-238, cesium-137, cobalt-60, plutionium-238), the composition of surface elements near the location of the incident, the

meteorological conditions, the time of the event, and the duration and nature of the event (e.g., fire, impact accident, spill).

The International Atomic Energy Agency has developed the International Nuclear and Radiological Event Scale to explain the significance of events from a range of activities, including industrial and medical use of radiation sources, operations at nuclear facilities, and transport of radioactive materials (IAEA 2006).

The scale is designed so that the severity of an event is about 10 times greater for each increase in level on the scale (Figure 3-18). Each of the seven levels describes the event as either an accident or an incident (IAEA 2006). A description of each level is found in Appendix E.

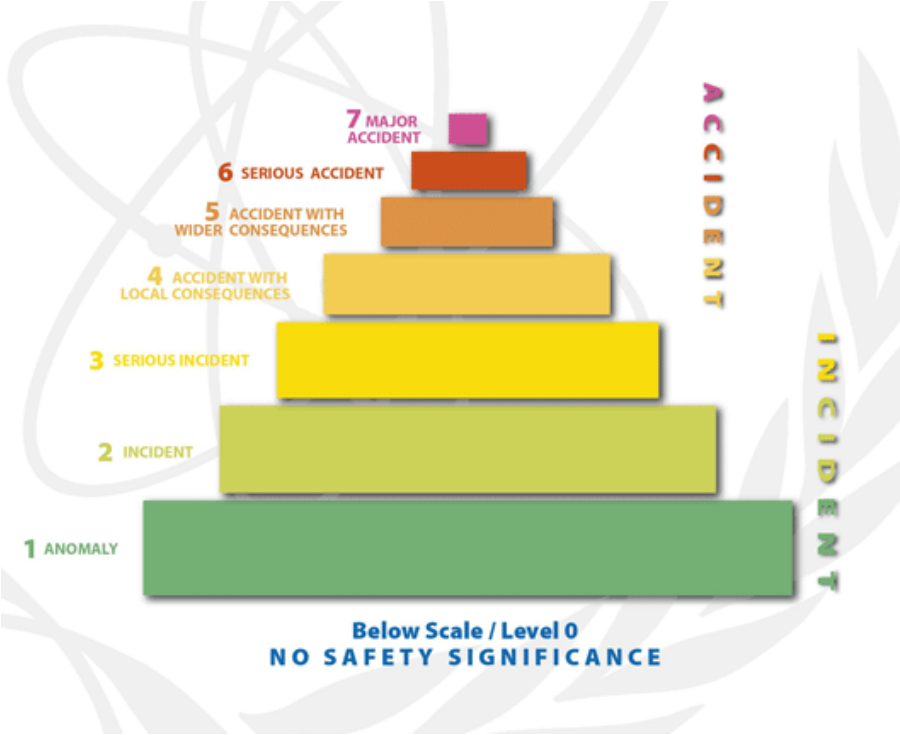

Figure 3-18. International Nuclear and Radiological Event Scale.

3.4.5.4.4 Past Occurrences

There has been one reported radiological event in Bonneville County. On February 29, 2008, a radiological event occurred at a private industry in Idaho Falls. One employee was exposed to strontium-90 inside the facility. Radiological contamination was localized inside the facility. Known events at the Idaho National Laboratory (INL) Site are listed in the Butte County local mitigation plan (IBHS 2013). Furthermore, there have been no unplanned releases that resulted in measurable radioactivity outside the INL Site boundaries (IBHS 2013).

3.4.5.4.5 Future Occurrences

With increased use of radiological materials, the potential for radiological events is likely to increase. New facilities using these materials are likely to open in Bonneville County. These facilities typically have specific hazard mitigation plans for radiological events (IBHS 2013).

3.4.5.4.6 Vulnerability Assessment

Impacts from radiological events are similar to those described for hazardous materials.

The major sources of radiological material at INL are on the INL Site, which is located in adjacent counties. Impacts from events at in-town INL facilities are considered in the Hazard Evaluation subsection below. At the INL's in-town facilities, minimum impacts to Bonneville County may be from emergency response actions.

Impacts from other (non-INL) events that result in a release of radiological material within Bonneville County have the potential to injure or kill residents and harm the environment. These impacts may include:

- Damage and loss of structures
- Soil, surface-water, and possibly groundwater contamination
- Injury or loss of life
- Increased load on medical facilities during response and surveillance.

Direct costs are dependent on the magnitude, location, and type of event. Costs related to accidents could include materials, carrier damage, property damage, response, containment, remediation/cleanup, and recovery. Other potential costs could result from long-term response, health care, human factors, and post de facto litigation.

3.4.5.4.7 Hazard Evaluation

Historical records indicate that radiological events occur at a low frequency. Federal and industry guidelines (U.S. Department of Energy and U.S. Nuclear Regulatory Commission) require facilities and personnel who handle radioactive material to be licensed. As part of these licenses, operators and facilities must have control measures in place to prevent a radiological release. These facilities and operators are also required to have a mitigation and emergency response plan in place to prevent a release to the public or the environment during an event. If an event were to occur, it would do so like other initiating events associated with technological hazards. Thus, the cause could be initiated suddenly and with little warning. During a large-scale materials release, the warning time would be longer for people farther away from the incident, but those near the release would have little warning. A warning lead time of minutes was assigned as a conservative indicator (Magnitude Value = 8). These events have a higher probability of occurrence on transportation routes or within a specific radius of a facility (localized area), possibly impacting multiple sections in a geographic area (Magnitude Value = 4). Because there have been no recent local incidents, the estimated cost is unknown but assumed to be in the $1,000,000 range (Magnitude Value = 4). All recovery costs would be the responsibility of the federal government (Magnitude Value = 8). Typically, little sheltering is required because people will be directed to stay in their homes or away from the affected area, unless those homes are in immediate danger and require evacuation (Magnitude Value = 2). It is anticipated that there would be few or no reported injuries associated with the radiological material during an event (Magnitude Value = 1). However, injuries may occur as a result of the initiating condition (e.g., fire, impact). The total magnitude score is 27 for Bonneville County, which is in the medium range (Table 3-41).

Table 3-41. Magnitude scoring scale of a radiological event.

Value	Magnitude of Radiological Event					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/ a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5.5 Riot/Unlawful Assembly/Civil Disorder

3.4.5.5.1 Description and Location

The following descriptions of riots, unlawful assembly, and civil disorder are from the Idaho Statutes:

Idaho Statue Title 18 – CRIMES AND PUNISHMENTS

Idaho Statute 18-6401. Riot defined. Any action, use of force or violence, or threat thereof, disturbing the public peace, or any threat to use force or violence, if accompanied by immediate power of execution, by two (2) or more persons acting together, and without authority of law, which results in:

(a) physical injury to any person; or
(b) damage or destruction to public or private property; or
(c) a disturbance of the public peace

Idaho Statute 18-6404. Unlawful assembly defined. Whenever two or more persons assemble together to do an unlawful act, and separate without doing or advancing it, or do an lawful act in a violent, boisterous or tumultuous manner, such an assembly is an unlawful assembly.

Idaho Statute 18-81020. "Civil disorder" means any public disturbance involving acts of violence by an assemblage of two (2) or more persons which acts cause an immediate danger of or result in damage or injury to the property or person of any other individual.

Riots are generally thought of as being spontaneous, violent events, whereas unlawful assemblies are usually planned events and are usually intended to be non-violent. Riots often seem to be motivated by frustration and anger, usually over some real or perceived unfair treatment of some group. There are instances, however, when riots have begun during celebrations and other events where the only initiating factor seems to have been the gathering of a crowd of people. The potential for rioting, then,

exists any time people gather. There are a number of factors associated with the increased probability a riot will occur. They include:

- Drug and alcohol use
- Age of crowd members
- Socio-economic status of members
- High level of emotions
- A history of rioting on the same or similar previous occasions
- Initiating event, person, or persons.

Once violent or illegal activity is initiated and escalates, there is little probability that any given individual will be arrested or otherwise suffer consequences. Riots range in scope from very few people in a small area to thousands over an entire city. Once initiated, large riots are very difficult to suppress, particularly in the United States, where law enforcement is constrained by constitutional guarantees as well as personnel limits. Early and decisive action by law enforcement may be effective in suppressing a riot, but police actions may also lead to further escalation.

In Bonneville County, the Bonneville County Sheriff's Office is primarily responsible for law enforcement in the county as a whole. The Bonneville Country Sheriff's Office primarily is responsible for the unincorporated area of the county and the cities of Swan Valley and Irwin. The cities of Idaho Falls, Ammon, Ucon, and Iona have their own police force and are responsible for enforcement activities within their respective jurisdictions.

Riots, unlawful assembly, and civil disorder can occur anywhere people are gathered and with little notice.

3.4.5.5.2 Extent

Because of their spontaneous nature, it is difficult to identify specifics; however, information gathered in advance may warn officials and provide locations of future civil disturbances (IBHS 2013).

3.4.5.5.3 Past Occurrences

There are no recorded riot events in Bonneville County.

3.4.5.5.4 Future Occurrences

It can be assumed that riots, unlawful assembly, and civil disorder will occur in the future, but these events are usually difficult to predict (IBHS 2013). Some forms of disorder are potentially anticipated, and there is some amount of reasonable warning possible to help prepare for them.

There are typically no warning times with riots, unlawful assembly, and civil disorder because they are technological hazards.

3.4.5.5.5 Vulnerability Assessment

Riots, unlawful assembly, and civil disorder may result in loss of life, injury, and permanent disability (participants, bystanders, and law enforcement personnel) as well as looting, vandalism,

setting fires, and other property destruction. Law enforcement, emergency medical services, medical facilities and personnel, firefighting, and other community resources may be overwhelmed and unavailable to the community at-large. Transportation routes may be closed, infrastructure and utilities damaged or destroyed, and public buildings attacked, damaged, or destroyed. Social and psychological effects may also cause great impacts. Lingering fear and resentment can be long-lasting and can greatly impair the ability of a community to function politically, socially, and economically.

Losses from riots, unlawful assembly, or civil disorder come primarily from damage to community and private property. It is difficult to estimate specific losses, but those losses would be consistent with those due to structure fires, vandalism, and similar incidents.

3.4.5.5.6 Hazard Evaluation

Riots, unlawful assembly, and civil disorder often occur suddenly and with little warning. In the event of a large-scale riot, unlawful assembly, and civil disorder, the warning time would be longer for those areas away from the site of disturbance. A warning lead time of hours was assigned as an average indicator (Magnitude Value = 4). The events can occur anywhere and disturb several blocks (Magnitude Value = 2). Because there have been few incidents, the estimated cost is in the $1,000s (Magnitude Value = 1). All costs would be the responsibility of the city government (Magnitude Value = 2). Typically, no shelter is required because people will be directed to stay in their homes, unless those homes are in immediate danger and need to be evacuated (Magnitude Value = 1). There have been no reported injuries associated with these events within the county, but it is anticipated that some injuries would occur (Magnitude Value = 1). The total magnitude score is 11 for Bonneville County, which is in the low range (Table 3-42). Historical records indicate that riots, unlawful assembly, and civil disorder events occur at a low frequency.

Table 3-42. Magnitude scoring criteria for riots, unlawful assembly, and civil disorder.

	Magnitude of Riots/Unlawful Assembly/Civil Disorder					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.4.5.6 Terrorism

3.4.5.6.1 Description and Location

The following descriptions are from federal and state of Idaho Statutes.

U.S. Code: Title 18 Section 2331

(5) the term "domestic terrorism" means activities that –

- *(a) involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State;*
- *(b) appear to be intended to:*
  - *a. intimidate or coerce a civilian population;*
  - *b. influence the policy of a government by intimidation or coercion; or*
  - *c. affect the conduct of a government by mass destruction, assassination, or kidnapping*
- *(c) occur primarily within the territorial jurisdiction of the United States.*

Idaho Statute 18-8102

(5) "Terrorism" means activities that:

- *(a) Are a violation of Idaho criminal law; and*
- *(b) Involve acts dangerous to human life that are intended to:*
  - *a. intimidate or coerce a civilian population;*
  - *b. influence the policy of a government by intimidation or coercion; or*
  - *c. affect the conduct of a government by mass destruction, assassination, or kidnapping*

Terrorists often use threats to create fear among the public, try to convince citizens that their government is powerless to prevent terrorism, and get publicity for their cause.

Acts of terrorism include threats of terrorism, assassinations, kidnapping, hijackings, bomb scares and bombings, cyber attacks, and the use of chemical, biological, and radiological weapons (FEMA 2014).

High-risk targets for acts of terrorism include military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, and corporate centers (FEMA 2014). Furthermore, terrorists are capable of spreading fear by sending explosives or chemical and biological agents through the mail.

Acts of terrorism can occur anywhere and without warning. The entirety of Bonneville County is susceptible to terrorism, but it is more likely that military and civilian government facilities, international airports, large cities, and high-profile landmarks would be targeted.

3.4.5.6.2 Extent

The severity of terrorist incidents depends on the type of method used, the proximity of the device to people, and the duration of exposure to the incident or device. There are no scales or devices to measure the magnitude of a terrorist event.

3.4.5.6.3 Past Occurrences

There have been no large-scale terrorist acts in Bonneville County, except for bomb threats. In 2012, there were four reported bomb threats in Bonneville County. On June 1, 2012, police responded to two bomb threats at both Wal-Mart locations in Bonneville County, based on an anonymous caller (NPG 2012a). On July 6, 2012, police responded to a bomb threat at the Idaho Falls Wal-Mart, based on an anonymous caller (Idaho State Journal 2012a). On September 16, 2012, police responded to bomb threats at the Ammon Wal-Mart and investigated two suspicious packages (Idaho State Journal 2012b). On December, 18, 2012, Taylorview Junior High School was evacuated and classes were dismissed after an early morning bomb threat (NPG 2012b).

3.4.5.6.4 Future Occurrences

The probability of terrorism occurring cannot be quantified with as great a level of accuracy as that of many natural hazards. Terrorism events occur at a specific location rather than encompassing larger areas. Furthermore, terrorist acts, like all technological hazards, occur without warning and are difficult to anticipate.

3.4.5.6.5 Vulnerability Assessment

Since the events of September 11, 2001, awareness of terrorism has come to the forefront. The emotional impacts serve to compound the enormous physical, economic, and social damage. The continuing terrorist threat itself has a profound impact on many aspects of everyday life in the country and the economy.

Because terrorist acts are likely to target specific locations, the cost of the act would be defined by the targeted locations. Because the range of sites throughout the county vary and due to the lack of past occurrences, the overall loss estimate is difficult to determine.

3.4.5.6.6 Hazard Evaluation

Acts of terrorism often occur suddenly and with little warning. A warning lead time of minutes was assigned as an average indicator (Magnitude Value = 8). The events can occur anywhere and disturb several blocks (Magnitude Value = 2). Because there have been few incidents, the estimated cost would be in the $100,000s (Magnitude Value = 2). All costs would be the responsibility of the federal government (Magnitude Value = 8). Typically, no shelter is required because people will be directed to stay in their homes, unless they are in immediate danger may need to be evacuated (Magnitude Value = 1). Based on events in other locations, it is anticipated that major medical care would be required and deaths would occur (Magnitude Value = 2). The total magnitude score is 19 for Bonneville County, which is in the medium range (Table 3-43). Historical records indicate that acts of terrorism occur at a low frequency.

Table 3-43. Magnitude scoring criteria for terrorism.

	Magnitude of Terrorism					
Value	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
1	Family	Parcel	Little to no injury/no death	$1000s	No sheltering	Months
2	City	Block or group of parcels	Multiple injuries with little to no medical care/no death	$10,000s	Little sheltering	Weeks

Table 3-43. (continued)

Value	Magnitude of Terrorism					
	Source of Reconstruction Assistance	Geography (Area) Affected	Expected Bodily Harm	Loss Estimate Range	Population Sheltering Required	Warning Lead Times
2	County	Section or numerous parcels	Major medical care required/minimal death	$100,000s	Sheltering required/neighboring counties help	Days
4	State	Multiple sections	Major injuries/requires help from outside county/a few deaths	$1,000,000s	Long-term sheltering effort	Hours
8	Federal	Countywide	Massive casualties/ catastrophic	$10,000,000s	Relocation required	Minutes

3.5 Community Assets and Vulnerabilities

3.5.1 County- and City-Owned Buildings Replacement Value

Table 3-44 lists the estimated replacement values of county- and city-owned buildings. A total listing for each jurisdiction is found in Appendix F.

Table 3-44. Values of county- and city-owned buildings.

Jurisdiction	Value ($)
Bonneville County	59,234,345
Idaho Falls	256,893,617
Iona	1,180,058
Irwin	No Data
Swan Valley	9,450
Ucon	1,259,393
Ammon	12,476,812
Total	331,053,675

3.5.2 Public Services and Facilities

3.5.2.1 Sewer and Water

With the exception of Irwin and Swan Valley, all incorporated cities in Bonneville County provide their residents with water and sewer utilities. Those living in Irwin, Swan Valley, and unincorporated areas of the county must rely on private wells and septic tanks for these services. For any parcel of land, sewer and water arrangements must meet the standards of the Idaho Department of Health. All septic systems, regardless of size or location, must be approved by the Eastern Idaho Public Health District. Standards may also be required by the IDWR and the Idaho Department of Environmental Quality. In an attempt to protect the groundwater resources, Bonneville County requires large developments to provide a central sewage system if there is not one currently available in the vicinity.

3.5.2.2 Water Sources

Bonneville County is entirely dependent on underground aquifers to provide water for public consumption. There are approximately 173 active public and private drinking water systems in

Bonneville County subject to inspection by the Idaho Department of Environmental Quality (IDEQ 2014). This does not include private wells.

These systems serve communities, schools, churches, and businesses. Four incorporated cities in Bonneville County operate public drinking water systems for their residents. The following paragraphs briefly describe the public water systems in incorporated cities of Bonneville County. Aside from those served by these public water systems, residents in Bonneville County rely on individual wells.

The Ammon drinking water system consists of nine groundwater wells, three of which are backup wells. The system serves approximately 14,019 people through 4,576 connections (IDEQ 2014). The dominant land use outside the city of Ammon is irrigated agriculture. Land use within the immediate area of the wells consists of urban, commercial, and industrial uses, along with transportation corridors and various irrigation canals

The Idaho Falls public drinking water system consists of 19 groundwater sources. The system serves approximately 57,000 people with approximately 24,000 connections (IDEQ 2014). The wells are all located within or immediately adjacent to Idaho Falls. The dominant land use outside the city of Idaho Falls is irrigated agriculture. Land use within the immediate vicinity of the wells consists of urban, commercial, and industrial uses, as well as major transportation corridors (Interstate 15, Highway 26, Highway 91, Highway 20, Highway 91, Eastern Idaho Railroad, and the Union Pacific Railroad), and various irrigation canals.

The public drinking water system for Iona is composed of three groundwater wells that serve approximately 1,803 people through approximately 669 connections (IDEQ 2014). The wells are located within the city limits (Wells 1 and 3) and one mile to the east of the city (Well 2). Land use within the immediate vicinity of the city of Iona wellheads consists of municipal and residential uses, while the surrounding area is predominantly irrigated agriculture.

The public drinking water system for Ucon is composed of two groundwater wells that serve approximately 1,109 people through approximately 422 connections (IDEQ 2014). The wells are located about one-half mile from each other within the city limits. Land use within the immediate vicinity of the Ucon wellheads consists of residential and urban uses, while the surrounding area is predominantly irrigated agriculture.

3.5.2.3 Waste Management

Bonneville County owns and operates two landfills, one for household waste is located at 9449 E. Sunnyside, and one, called the Hatch Pit, for construction waste is located on 33rd North. The county also owns and operates a transfer station located at 2455 Hemmert Drive in Idaho Falls. The cities of Idaho Falls and Ammon provide solid waste collection for their residents. In the rest of Bonneville County, collection is contracted through private companies.

Three private recycling companies in Idaho Falls accept recyclable waste at their facilities, as well as providing locations throughout the community to dispose of recyclable waste.

3.5.2.4 Fire Protection

Bonneville County has four fire districts/departments within its boundaries. These include the Ammon Fire Department, Swan Valley Fire District, Idaho Falls Fire Department/Bonneville District No. 1, and Ucon Fire Department. In addition, three other fire districts/departments located in neighboring counties provide services within Bonneville County: Central Fire District, Alpine Fire District, and Caribou County Fire Department.

The Ammon Fire Department is composed of a municipal and mutual aid fire program. The Ammon Fire Department is headed by a full-time chief and has 34 volunteers. The department's responsibilities include structural fire, terrorist threat, wildfire, and hazardous material (HazMat) scene stabilization (Ammon 2014).

The combined Idaho Falls Fire Department and Bonneville District No. 1 is one of the larger regional fire departments in Idaho, with 102 paid personnel. It is composed of a municipal fire protection district, a HazMat team, and high-angle, confined-space, and swift-water rescue capabilities. Responsibilities include structural fire protection, wildland fire suppression, emergency medical services, HazMat, rescue, and terrorist threat (Idaho Falls 2014a).

The Greater Swan Valley Fire Protection District is a municipal district covering agricultural, range, and heavily forested lands. The district has two fire stations, a paid chief, 27 volunteer firefighters, and 27 paid-per-call firefighters. The area's population swells from about 900 year-round residents to a summer population of 1,800 because of the area's many recreational opportunities. The year-round population is anticipated to increase slightly, with most new residential development consisting of expensive, year-round and summer homes in the wildland/urban interface. A major hydroelectric dam is located about 10 miles upstream from Swan Valley and is considered a possible terrorist target (Fire Departments Network 2014).

The Ucon Fire Department is a municipal program having one station and 18 volunteer firefighters. Ucon is located on Highway 20 north of Idaho Falls. It is a slow-growing community composed mostly of residential and small business areas. There are a few potato warehouses in the community with surrounding agricultural land (Fire Departments Network 2014).

3.5.2.5 Public Safety

The Bonneville County Sheriff's Office is primarily responsible for law enforcement in the county as a whole. The city of Idaho Falls has a police department, and the city of Ucon has a part-time police officer and receives support from the Bonneville County Sheriff's Office. The Bonneville County Sheriff's Office provides law enforcement services for all other jurisdictions.

Emergency communication within the county is handled by Bonneville County Emergency Communications. Their jurisdiction includes the Bonneville County Sheriff's Office; Idaho Falls Police Department; Idaho Falls Fire Department; Volunteer Fire Departments of Ucon, Ammon, and Swan Valley; and the Volunteer Ambulance Agency in Swan Valley.

3.5.2.6 Health Care

There are two hospitals in Idaho Falls. One is the Eastern Idaho Regional Medical Center (EIRMC), which has 330 beds and is the largest medical facility in the region. EIRMC offers helicopter ambulance service to the region and is the only verified trauma center in the eastern Idaho (EIRMC 2014). The other hospital in Idaho Falls is Mountain View Hospital, which has 40 beds and is an acute care hospital. Ambulance service is available throughout the county (Mountain View Hospital 2014).

3.5.2.7 Emergency Management Services

Bonneville Emergency Management Services is staffed by two full-time professional emergency management personnel, the director and a staff assistant. Emergency Management Services manages the Bonneville County Emergency Operations Center, provides ongoing maintenance of the emergency operations plan, directs the Bonneville County Local Emergency Planning Committee, manages the Emergency Management budget and related grant instruments, and provides coordination in other

related aspects of county- and region-wide emergency management programs, including hazard mitigation.

3.5.2.8 Public Utilities

The major public utilities (aside from water and sewer discussed above) are electrical, gas, telecommunications, and irrigation.

City of Idaho Falls Power is a municipal electric utility serving those within the city limits of Idaho Falls. This utility has approximately 20,300 residential and 3,150 commercial customers. The service area encompasses approximately 22.66 square miles and is served by 37.3 miles of transmission and distribution lines (Idaho Falls 2014b).

The Idaho Power Company supplies electric distribution lines for all homes and commercial areas in the northern part of the county.

Rocky Mountain Power supplies electric distribution for all homes and commercial areas in the southern part of the county.

Intermountain Gas Company provides services to cities in the northern part of the county. Most of the outlying unincorporated areas of the county rely on home heating oil, coal, or electric heat.

Propane services are provided by private companies and are used as an energy source in locations not served by Intermountain Gas Company.

3.5.3 Water Resources

3.5.3.1 Surface Water

The Snake River is the largest river in Bonneville County. It enters the county near Alpine, Wyoming, at the east end of Palisades Reservoir. From there, the river flows northwest through Swan Valley and leaves the county near Ririe. The river continues along the Madison/Jefferson County border until it turns south, re-entering the county north of Idaho Falls and flowing south through Idaho Falls, then leaving the county near Shelley. Other large streams include Gray's Lake Outlet and Willow Creek. Gray's Lake Outlet flows from Gray's Lake northeast to join Willow Creek just north of Bone. The headwaters of Willow Creek are in Bingham County, where it flows north, entering Bonneville County near Bone. It continues northward toward Ririe, where it turns west and then south to the Snake River. In addition, there are nearly 200 smaller streams throughout Bonneville County.

Reservoirs in the county include Palisades Reservoir on the Snake River, Ririe Reservoir on Willow Creek, and Little Valley Reservoir. The Ririe Dam is located in the Willow Creek Drainage, 15 miles northeast of Idaho Falls and about four miles southeast of Ririe. Constructed by the Corps of Engineers, the dam is an earth and rock-fill structure, 253 feet high and 1,070 feet long. The reservoir impounded by the dam has a total capacity of 100,500 acre-feet (active 90,500 acre-feet). The Ririe Dam was constructed to impound and control the waters of Willow Creek for flood control, irrigation, and recreation.

The Palisades Dam, operated by the U.S. Bureau of Reclamation, is a large zoned earth-filled structure 270 feet high. The dam has a crest length of 2,100 feet and contains 13,571,000 cubic yards of material. It creates a reservoir of 1,401,000 acre-feet capacity (active 1,200,000 acre- feet).

Palisades Reservoir is located on the Snake River about 55 miles southeast of Idaho Falls, Idaho. Electrical power generated at the Palisades Dam contributes significantly to the total amount distributed in the northwest United States.

Lakes in the county include Upper Palisades Lake and Lower Palisades Lake. An extensive marsh that was historically a lake called Gray's Lake, and is still referred to as such, sits in the southern portion of the Willow Creek watershed. In 1906, the Bureau of Indian Affairs constructed a diversion from Gray's Lake into the Blackfoot River watershed.

3.5.3.2 Irrigation

Bonneville County has a total of 141,823 acres of irrigated croplands. Table 3-45 lists each irrigation company in Bonneville County, their water sources, and number of irrigated acres.

Table 3-45. Irrigation companies in Bonneville County.

Name	Water Source	Irrigated Acres
Burgess Canal & Irrigating Company	Snake River	19,492
Enterprise Canal Company, Ltd.	Snake River	5,436
Farmers Friend Irrigation Company, Ltd.	Snake River	10,243
Harrison Canal & Irrigation Company	Snake River	12,364
Idaho Irrigation District	Willow Creek	35,995
New Sweden Irrigation District	Snake River	27,920
Osgood Canal Company, Inc.	Snake River	5,780
Progressive Irrigation District	Willow Creek	29,532
The Palisade Irrigation Company, Inc.	Palisades Creek	5,251.8
Woodville Canal Company	Snake River	2,453

3.5.3.3 Groundwater

Groundwater is the sole source of domestic potable water in the county and is, therefore, the subject of efforts to protect that resource. The western portion of Bonneville County lies over the Eastern Snake River Plain Aquifer, perhaps the single most important aquifer in Idaho. Other groundwater aquifers in the eastern portions of the county are shallower than the Snake River Aquifer, making water quality a priority issue for the Swan Valley area.

3.5.4 Transportation

3.5.4.1 Highways and Transportation

Major highways in Bonneville County include Interstate 15, U.S. Highway 91 and U.S Highways 20, 26, and State Highway 31. Interstate 15 is a north-south route that bisects the eastern portion of the county. It enters the county near Shelley and travels through Idaho Falls and continues north before crossing into Jefferson County. U.S Highways 20 and 26 are both east/west routes.

Highway 20 connects Idaho Falls to INL and Butte County to the west. To the east of Idaho Falls, Highway 20 travels northeast to Jefferson, Madison, and Fremont counties.

Highway 26 merges with I-15 at Idaho Falls and connects Blackfoot and Bingham County to the south. Highway 26 runs east from I-15 at Idaho Falls through Swan Valley and into Wyoming at Alpine, Wyoming. Highway 31 travels over the Pine Creek Pass to connect Highway 26 in Swan Valley with Highway 31 in Victor, Idaho, to the north.

3.5.4.2 Bridges

Bonneville County has a total of 103 bridges that exceed 20 feet. Of those bridges, 11 are structurally deficient and qualify for federal bridge replacement funds, and 14 may be eligible for rehabilitation funding based on the ITD sufficiency ratings. The total value of the bridges in Bonneville County is $892,187,946.

3.5.4.3 Airports

Bonneville County has one airport: the Idaho Falls Regional Airport located in the city of Idaho Falls. This airport is served by three commuter airlines with daily nonstop service to Salt Lake City, Utah, and Denver, Colorado, and weekly service to Las Vegas, Nevada, and Phoenix/Mesa, Arizona.

3.5.4.4 Railroads

The Union Pacific Railroad operates the rail line running north and south along Highway 91 through the county. This rail corridor is a major avenue for the movement of freight, including hazardous materials. Short-haul rail services are provided by Eastern Idaho Railroad.

3.5.5 Housing

In Bonneville County in 2012, there were an estimated 40,107 housing units and 35,919 households with a home ownership rate of 73.9 % (U.S. Census Bureau 2013). The majority of housing units are located in the western part of the county, in the Idaho Falls and Ammon area (Figure 3-19). The average value of households is typically higher in the Idaho Falls and Ammon area than other parts of the county (Figure 3-20). Potential events that occur in the western part of the county are more likely to impact a greater amount of residents, and the overall damage would be greater.

3.5.6 Educational Facilities

There are seven private schools and 41 public schools in Bonneville County (Table 3-46). The majority of schools are located in the western part of the county. There are three schools in the eastern part of the county and another in the central part. Public school districts and post-secondary education schools are described below.

School District 91

Idaho Falls School District No. 91, located in Idaho Falls (population 56,813) as of 2012, employs about 480 teachers and has a total student population of about 10,197 students. The district has three high schools, two junior high schools, 12 elementary schools, and one alternative school. The total value of the buildings owned by the school district is $149,331,691. A complete listing of the buildings and the estimated value of the contents of each is found in Appendix F.

School District 93

Bonneville Joint School District No. 93 is located in Bingham and Bonneville counties and includes a portion of the city of Idaho Falls and the incorporated cities of Ammon, Iona, and Ucon. The school district also includes the unincorporated county areas to the north, south, and east of Idaho Falls. As of 2012, the school district employed about 475 teachers and has a total student population of about 10,359 students. The total value of the buildings owned by the school district is $190,716,090. A complete listing of the buildings and the estimated value of the contents of each is found in Appendix F.

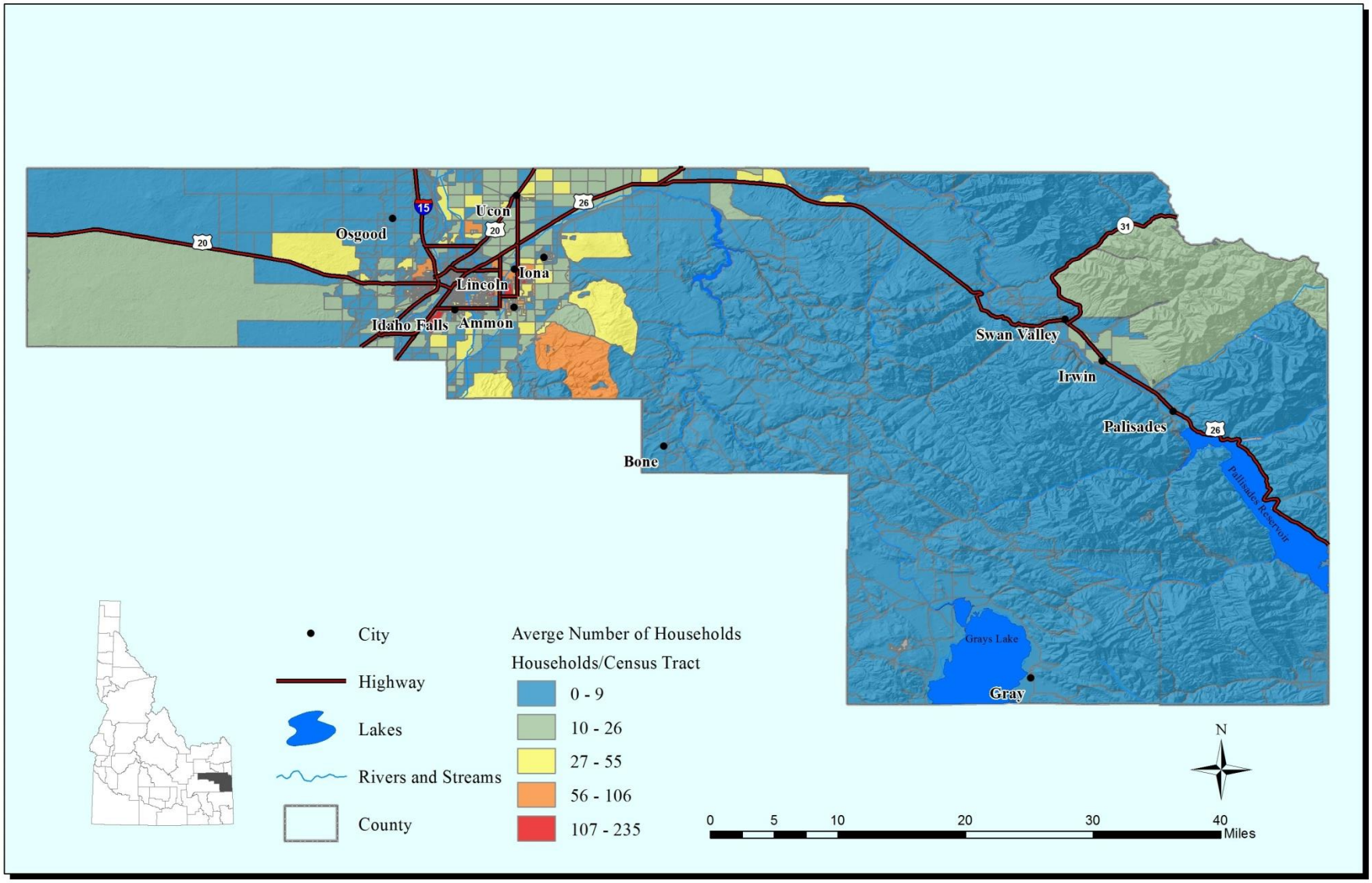

Figure 3-19. Average housing unit per census tract.

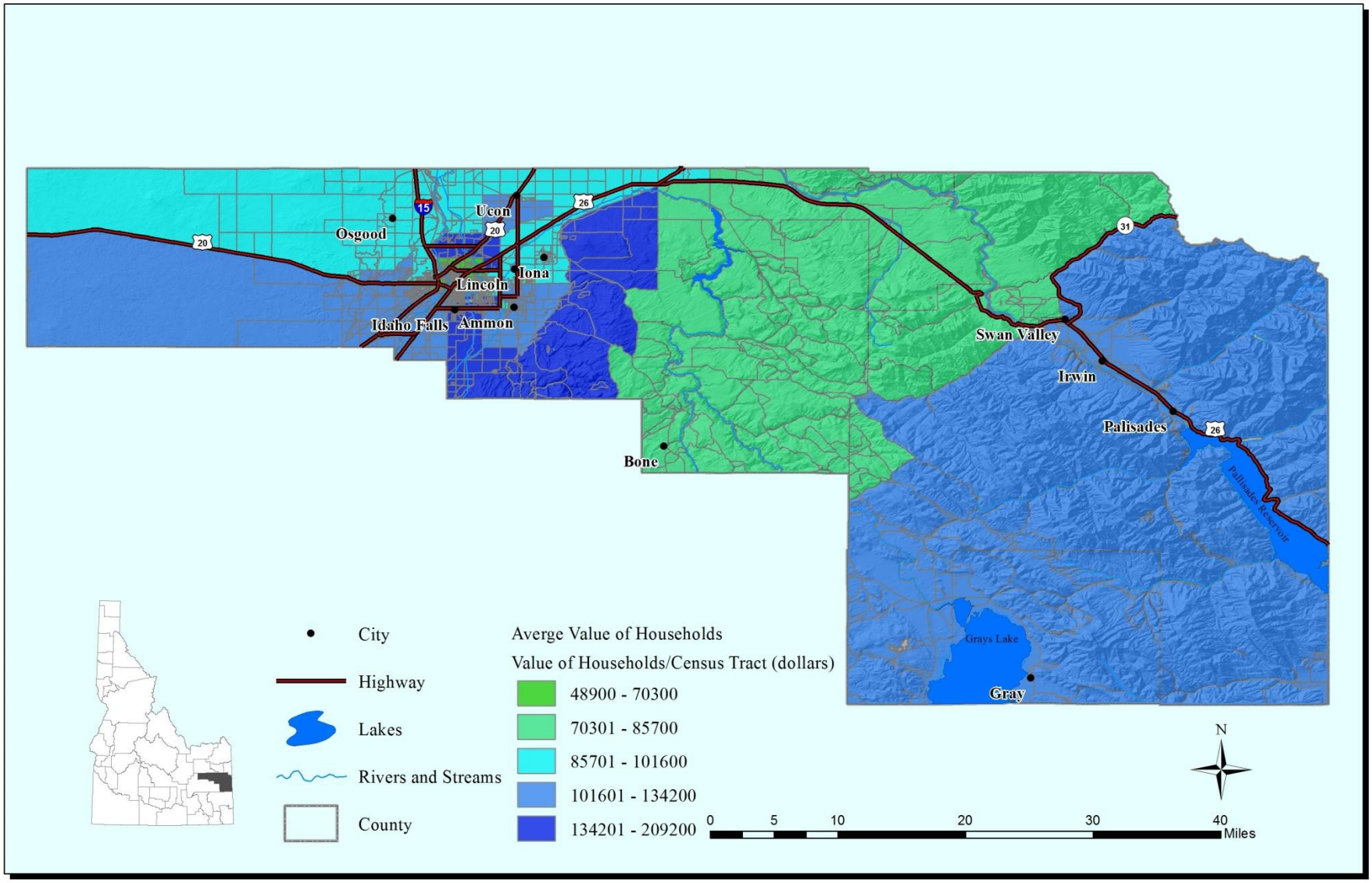

Figure 3-20. Average household value per census tract.

Table 3-46. Schools in Bonneville County.

Name	Address	City	Zip Code	Phone	Status
Little Blessings School	400 W. 13th St.	Idaho Falls	83402	(208) 552-5377	Private
Calvary Chapel Christian School	4250 S. 25th E.	Idaho Falls	83404	(208) 524-4747	Private
Little Peoples Academy	543 North Ridge	Idaho Falls	83402	(208) 523-7615	Private
Adventist Christian School	802 Westhill Ave.	Idaho Falls	83405	(208) 528-8582	Private
Swan Valley Elementary School	3389 Highway 26	Irwin	83428	(208) 483-2405	Public
Iona Elementary School	5338 Owens Ave.	Iona	83427	(208) 525-4440	Public
Fairview Elementary School	979 E. 97 N.	Idaho Falls	83401	(208) 525-4425	Public
Ucon Elementary School	10841 N. 41 E.	Idaho Falls	83401	(208) 525-4430	Public
White Pine Charter School	2959 John Adams Parkway	Idaho Falls	83403	(208) 522-4432	Public
Telford Academy (Alt)	2017 E. 49th N.	Idaho Falls	83401	(208) 542-0283	Public
Rocky Mountain Middle School	3443 N. Ammon Road	Idaho Falls	83401	(208) 525-4403	Public
Bonneville High School	3165 E. Iona Road	Idaho Falls	83401	(208) 525-4406	Public
Special Services Center	3549 N. Ammon Road	Idaho Falls	83401	(208) 525-4414	Public
Lincoln High School (Alt)	3175 E. Lincoln Road	Idaho Falls	83401	(208) 525-4447	Public
Cloverdale Elementary School	3999 Greenwillow Ln.	Idaho Falls	83401	(208) 525-4450	Public
Behavior Health Alternative High School	3175 E. Lincoln Road	Idaho Falls	83401	(208) 525-4400	Public
Tiebreaker Elementary School	3100 First St.	Idaho Falls	83401	(208) 525-4480	Public
Hillcrest High School	2800 Owen St.	Idaho Falls	83406	(208) 525-4429	Public
Ammon Elementary School	2900 Central Ave.	Idaho Falls	83406	(208) 525-4465	Public
Hillview Elementary School	3075 Teton St.	Idaho Falls	83406	(208) 525-4460	Public
Sand Creek Middle School	2955 Owen St.	Idaho Falls	83406	(208) 525-4416	Public
Falls Valley Elementary School	2455 Virlow St.	Idaho Falls	83401	(208) 525-4455	Public
Clair E. Gale Jr High School	955 Garfield St.	Idaho Falls	83401	(208) 525-7720	Public
Dora Erickson Elementary School	850 Cleveland St.	Idaho Falls	83401	(208) 525-7612	Public
3-B Detention Center	950 Environmental Way	Idaho Falls	83402	(208) 542-2947	Public
Linden Park Elementary School	1305 9th St.	Idaho Falls	83404	(208) 525-7642	Public
Edgemont Gardens Elementary School	1240 Azalea Drive	Idaho Falls	83404	(208) 525-7618	Public
Theresa Bunker Elementary School	1385 E. 16th St.	Idaho Falls	83404	(208) 525-7606	Public
Hawthorne Elementary School	1520 S. Blvd. Ave.	Idaho Falls	83402	(208) 525-7636	Public
Longfellow Elementary School	2500 S. Higbee Ave.	Idaho Falls	83404	(208) 525-7648	Public
Idaho Falls Senior High School	601 S. Homes Ave.	Idaho Falls	83401	(208) 525-7740	Public
Westview Alternative Evening	335 5th St.	Idaho Falls	83401	(208) 525-7795	Public
Eastern Id Prof-Tech High Center	690 John Adams Parkway	Idaho Falls	83401	(208) 525-7513	Public
A H Bush Elementary School	380 W. Anderson St.	Idaho Falls	83402	(208) 525-7602	Public
Temple View Elementary School	1500 Scorpius Drive	Idaho Falls	83402	(208) 525-7660	Public
Eagle Rock Junior High School	2020 Pancheri Drive	Idaho Falls	83402	(208) 525-7700	Public

Table 3-46. (continued)

Name	Address	City	Zip Code	Phone	Status
Ethel Boyes Elementary School	1875 Brentwood Drive	Idaho Falls	83402	(208) 525-7630	Public
Skyline Senior High School	1767 Blue Sky Drive	Idaho Falls	83402	(208) 525-7770	Public
Westside Elementary School	2680 Newman Drive	Idaho Falls	83402	(208) 525-7666	Public
Sunnyside Elementary School	165 Cobblestone Ln.	Idaho Falls	83404	(208) 524-7880	Public
Foxhollow Elementary School	2365 Genevieve	Idaho Falls	83404	(208) 524-7890	Public
Taylorview Junior High School	350 Castlerock Ln.	Idaho Falls	83402	(208) 524-7850	Public
Hope Lutheran School	2071 12th St.	Idaho Falls	83404	(208) 529-8080	Private
Holy Rosary Elementary School	161 9th St.	Idaho Falls	83404	(208) 522-7781	Private
Snake River Montessori School	2970 E. 1st St.	Idaho Falls	83401	(208) 524-4730	Private
Source: U.S. Census (2013)					

School District 92

Swan Valley School District 92 consists of Swan Valley Elementary School and serves 57 students in prekindergarten through eighth grade. As of 2014, there are 16 teachers.

Eastern Idaho Technical College

Eastern Idaho Technical College is a state-supported technical college created in 1969 to serve citizens in its 10-county service area by being a minimal-cost, open-door institution championing technical programs, customized industry training, basic skills instruction, work force and community education, on-line distance education, and student services.

Idaho Falls Center for Higher Education (University Place)

The Center for Higher Education Building is located in Idaho Falls and is a state-of-the-art facility built in 1994. Idaho State University and the University of Idaho offer courses and student services in a campus setting along the Snake River in Idaho Falls. Students are able to draw on the resources of these universities, which are working together to provide high-quality higher education.

3.5.7 Recreation Areas

There are multiple recreational sites in Bonneville County, the most significant and high use of which are the Ririe Reservoir, Swan Valley, and Palisades areas. Campgrounds, recreational vehicle parks, and boat launches are found at either end of Ririe Reservoir, along the Snake River, and at Palisades Reservoir. Gray’s Lake National Wildlife Refuge also offers a variety of recreational opportunities, including wildlife viewing, waterfowl hunting, and foot traffic.

Bonneville County is close to several national parks and recreation areas, and many people travel through Idaho Falls to access the Island Park recreation area, Yellowstone National Park, and Grand Teton National Park.

3.5.8 Cultural and Historical Sites

The Museum of Idaho, located at Broadway and Yellowstone Highway in Idaho Falls, is Idaho's premier national traveling exhibit museum and is dedicated to preserving and showcasing the natural and cultural history of Idaho and the Intermountain West. The museum offers permanent displays about the

Columbian mammoth, Lewis and Clark, the race for atomic power, along with the Children's Discovery Room, a reading and reference library, presentations, and educational programs.

Bonneville County has 30 sites listed on the National Register of Historic Places. According to the State Historic Preservation Office, there are a total of 226 archeological or prehistoric sites and 1,439 architectural sites in Bonneville County that are of historical significance.

The National Register of Historic Places includes the following Bonneville County sites:

- Beckman, Andrew and Johanna M. Farm (added 1992 – Building #92001414) U.S. 20, 0.5 miles west of junction with New Sweden Road
- Beckman, Oscar and Christina, Farmstead (added 1991 – Building #91001713) southwest corner of junction of New Sweden-Shelly Road and U.S. 20, Idaho Falls
- Bonneville County Courthouse (added 1979 – Building #79000781) Capital Avenue and C Street, Idaho Falls
- Bonneville Hotel (added 1984 – Building # 84001032) 400 Block West C Street, Idaho Falls
- Douglas-Farr Building (added 1984 – Building #84001035) 493 North Capital Avenue, Idaho Falls
- Eagle Rock Ferry (added 1974 Site #74000734) north of Idaho Falls on Snake River
- Eagle Rock Street Historic District (added 1999 – District #73002267) 353, 357, 361, and 375 Eagle Rock Street, Idaho Falls
- Eleventh Street Historic District (added 1997 – District #97000863) roughly bounded by South Boulevard, 13th, 10th, and 9th Streets., South Emerson and South Lee Avenues, Idaho Falls
- Farmers and Merchants Bank Building (added 1984 – Building 84001037) 383 West A Street, Idaho Falls
- First Presbyterian Church (added 1978 – Building 78001052) 325 Elm Street, Idaho Falls
- Hasbrouck Building (added 1984 – Building #84001039) 362 Park Avenue, Idaho Falls
- Holy Rosary Church (added 2002 – Building #02000802) 288 East 9th Street, Idaho Falls
- Hotel Idaho (added 1984 – Building #84001042) 482 West C Street, Idaho Falls
- I.O.O.F. Building (added 1984 – Building #84001090) 393 North Park Avenue, Idaho Falls
- Idaho Falls Airport Historic District (added 1997 – District #97001126) also known as Fanning Field; Red Baron Hangar, 2381 Foote Drive, Idaho Falls
- Idaho Falls City Building (added 1984 – Building #84001092) 303 West C Street, Idaho Falls
- Idaho Falls Public Library (added 1984 – Building #84001093) Elm and Eastern Streets, Idaho Falls

- Iona Meetinghouse (added 1973 – Building #73000681) in Iona
- Kress Building (added 1984 – Building #84001095) 451 North Park Avenue, Idaho Falls
- Montgomery Ward Building (added 1984 – Building #84001096) 504 Shoup Avenue, Idaho Falls
- New Sweden School (added 1991 – Building #91001714 also known as 016981) southwest corner of junction of New Sweden School Road and Mill Road, Idaho Falls
- Ridge Avenue Historic District (added 1993 – District #93000388) roughly bounded by North Eastern Avenue, Birch Street, South Boulevard, Ash Street, West Placer Avenue, and Pine Street, Idaho Falls
- Rocky Mountain Bell Telephone Company Building (added 1984 – Building #84001099) also known as Faber Hall; Labor Temple 246 West Broadway Avenue, Idaho Falls
- Sealander, Carl S. and Lizzie, Farmstead (added 1992 – Building #92000414) a lso known as Sealander, Claus and Edith, Farmstead west end of St. John Road, Idaho Falls
- Shane Building (added 1984 – Building #84001101) 381 North Shoup Avenue, Idaho Falls
- Shelton L.D.S. Ward Chapel (added 1979 – Building #79000783) Southwest of Ririe on Shelton Road, Ririe
- Snake River Ranger Station (added 1993 – District #83000297) also known as Snake River Administrative Site, U.S. 26, Swan Valley
- Trinity Methodist Church (added 1977 – Building #77000458)
- U.S. Post Office (added 1979 – Building #79000782) also known as Federal Office Building, 581 Park Avenue, Idaho Falls
- Underwood Hotel (added 1984 – Building #84001102) 343-349 West C Street, Idaho Falls
- Wasden Site (Owl Cave) (added 1976 – Site #76000669) address restricted, Idaho Falls.

3.5.9 Bonneville County Asset Inventory Summary

Table 3-47 is a summary inventory of Bonneville County assets.

Table 3-47. Bonneville County assets.

Asset Type	Asset	Quantity
General	Geographical area	1,194,286 acres
	Households	35,919 (2012)
	Population	104,234 (2012 estimate)
	Housing units	40,107 (2012)
	Total building replacement value of local government owned (excluding contents)	679,920,011
Essential facilities	Hospitals	2
	Schools	48
	Fire stations	8
	Police stations	4
	Emergency operations facility	1
High potential loss facilities	Dams	15 (three are high risk)
	Hazardous materials sites	63
	Military installations	0
	Nuclear power plants	0
Transportation lifeline systems	Highways	5
	Railways	2
	Light rail	0
	Bus	4
	Airports	1
Utility lifeline systems	Potable water	130
	Wastewater	
	Natural gas	1
	Electric power	3
	Communications	1

3.6 Vulnerability and Risk Assessment Summary

3.6.1 Purpose

This subsection summarizes the hazards and risk assessment discussed in Subsection 3.4 and relates them to the vulnerabilities in order to identify the most significant risks and vulnerabilities in the county and each jurisdiction. In Subsection 3.4, each hazard description discusses the likely location of occurrence, the extent of the hazard, past occurrences, and the possibility of a future event with warning times. Each description also has a vulnerability assessment that identifies potential impacts to humans, the environment, buildings and infrastructures, and the potential economic loss from the event. The hazard summary attempts to quantify the relative risk and determine the hazard frequency.

The relative risk is quantified by estimating the overall magnitude of a hazard event and the frequency of occurrence. The magnitude value is determined by using the scoring system described in Subsection 1.7.4.2. The scoring systems use information from the hazard description and vulnerability assessment and estimate the source of reconstruction assistance, the size of the affected area, potential injuries/deaths, economic loss, potential sheltering needs, and warning lead times. The magnitude of each

hazard event was assigned a relative level (Table 3-48). The frequency level was assigned based on the past occurrences and the potential for a future occurrence (Table 3-49).

Table 3-48. Hazard magnitude scoring.

Ranking	Description
High	21 to 48
Medium	13 to 20
Low	6 to 12

Table 3-49. Hazard frequency scoring.

Ranking	Description
High	Multiple times a year to 5 years
Medium	5 to 25 years
Low	25 years or has yet to occur

Table 3-50 is a summary of hazards magnitude scores and frequencies for Bonneville County.

Table 3-50. Summary of hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
36	Earthquake	Medium
32	River/stream flooding	High
28	Wildfire	High
27	Radiological	Low
20	Hazardous materials	High
19	Terrorism	Low
18	Tornado/high winds	High
18	Pandemic	Low
17	Extended utility outage	Low
16	Structure fire	High
15	Hail	High
14	Winter storm	High
13	Drought	High
13	Landslide	Low
13	Avalanche	Low
12	Extreme cold	High
12	Extreme heat	Medium
11	Riot/civil disobedience	Low
7	Lightning	High

3.6.2 Severity Ranking

The severity ranking determines priorities for risk reduction activities. The severity ranking for Bonneville County is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-21 summarizes the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

Frequency \ Magnitude	Low	Medium	High
Low	Riot/Unlawful Assembly/Civil Disorder	Pandemic, Extended Utility Outage, Landslide, Avalanche, Terrorism	Radiological Event
Medium	Extreme Heat	-	Dam Failure, Earthquake
High	Extreme Cold, Lightning	Hazardous Materials, Tornado/High Winds, Structure Fire, Hail, Winter Storm, Drought	Flooding, Wildfire

Figure 3-21. Severity ranking for Bonneville County (green = low risk, yellow = medium risk, red = high risk).

Based on the risk severity ranking, flooding and wildfire hazards are the highest.

3.6.3 Jurisdiction Risk Severity and Vulnerability Summary

The Bonneville County AHM has been developed as a multi-jurisdictional plan; therefore, each jurisdiction risk must be ranked independently from the county and other jurisdictions. The magnitude and frequency of each hazard, as it is associated to each individual jurisdiction, is determined using the hazard description and vulnerability assessment. The magnitude for each hazard uses the same scoring criteria used in each hazard description. Then the risk severity is summarized using the same method as for Bonneville County.

3.6.3.1 City of Idaho Falls – Summary

The city of Idaho Falls is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location, population size, and urban development. In most cases, the increase in magnitude is due to an increase in the estimated loss. A decrease in magnitude is due likely locations of events. Table 3-51 summarizes the magnitude and frequency of each hazard as it is associated with Idaho Falls.

Table 3-51. Summary of Idaho Falls hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
32	Earthquake	Low
32	Flooding	Medium
27	Radiological	Low
24	Wildfire	Low
21	Hazardous materials	High
21	Extended utility outage	Low
21	Tornado/high winds	High
20	Pandemic	Low

Table 3-51. (continued)

Magnitude	Hazard	Frequency
19	Terrorism	Low
18	Structure fire	High
15	Hail	High
15	Drought	High
14	Winter storm	High
14	Extreme cold	High
12	Landslide	Low
12	Extreme heat	Medium
12	Riot/civil disobedience	Low
8	Lightning	High
No data	Avalanche	No data

The severity ranking for Idaho Falls is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-22 provides a summary of the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

		Magnitude		
		Low	Medium	High
Frequency	Low	Riot/Unlawful Assembly/Civil Disorder, Landslide	Pandemic, Terrorism	Earthquake, Radiological Event, Wildfire, Extended Utility Outage
	Medium	Extreme Heat	-	Dam Failure, Flooding
	High	Lightning	Extreme Cold, Winter Storm, Drought, Hail, Structure Fire	Hazardous Materials, Tornado/High Winds

Figure 3-22. Severity ranking of Idaho Falls hazards (green = low risk, yellow = medium risk, red = high risk).

Based on the risk severity ranking, hazardous materials and tornado/high winds are the highest.

3.6.3.2 City of Ammon – Summary

The city of Ammon is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location, population size, and urban development. In most cases, the increase in magnitude is due to an increase in the estimated loss. A decrease in magnitude is due to the likely location of the events. Table 3-52 summarizes the magnitude and frequency of each hazard as it is associated with Ammon.

Table 3-52. Summary of Ammon hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
32	Earthquake	Low
32	Flooding	High
28	Wildfire	Low
27	Radiological	Low
21	Hazardous materials	High
21	Extended utility outage	Low
21	Tornado/high winds	High
20	Pandemic	Low
19	Terrorism	Low
18	Structure fire	High
15	Hail	High
15	Drought	High
14	Winter storm	High
14	Extreme cold	High
12	Landslide	Low
12	Extreme heat	Medium
12	Riot/civil disobedience	Low
8	Lightning	High
No data	Avalanche	No data

The severity ranking for Ammon is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-23 summarizes the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

		Magnitude		
		Low	Medium	High
Frequency	Low	Riot/Unlawful Assembly/Civil Disorder, Landslide	Pandemic, Terrorism	Earthquake, Radiological Event, Wildfire, Extended Utility Outage
	Medium	Extreme Heat	-	Dam Failure
	High	Lightning	Extreme Cold, Winter Storm, Drought, Hail, Structure Fire	Hazardous Materials, Tornado/High Wind, Flooding

Figure 3-23. Severity ranking of Ammon hazards (green = low risk, yellow = medium risk, red = high risk).

Based on the risk severity ranking, hazardous materials, tornado/high winds, and flooding are the highest.

3.6.3.3 City of Iona – Summary

The city of Iona is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location and urban development. In most cases, the increase in magnitude is due to an increase in the estimated loss. A decrease in magnitude is due to the likely location of events. Table 3-53 summarizes the magnitude and frequency of each hazard as it is associated with Iona.

Table 3-53. Summary of Iona hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
32	Earthquake	Low
32	Flooding	High
28	Wildfire	Low
27	Radiological	Low
21	Hazardous materials	High
21	Extended utility outage	Low
21	Tornado/high winds	High
20	Pandemic	Low
19	Terrorism	Low
18	Structure fire	High
15	Hail	High
15	Drought	High
14	Winter storm	High
14	Extreme cold	High
12	Landslide	Low
12	Extreme heat	Medium
12	Riot/civil disobedience	Low
8	Lightning	High
No data	Avalanche	No data

The severity ranking for Iona is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-24 provides a summary of the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

Frequency \ Magnitude	Low	Medium	High
Low	Riot/Unlawful Assembly/Civil Disorder, Landslide	Pandemic, Terrorism	Earthquake, Radiological Event, Wildfire, Extended Utility Outage
Medium	Extreme Heat	-	Dam Failure
High	Lightning	Extreme Cold, Winter Storm, Drought, Hail, Structure Fire	Hazardous Materials, Tornado/High Wind, Flooding

Figure 3-24. Severity ranking of Iona hazards.

Based on the risk severity ranking, hazardous materials, tornado/high winds and flooding are the highest.

3.6.3.4 City of Ucon – Summary

The city of Ucon is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location, population size, and urban development. In most cases, the increase in magnitude is due to an increase in the estimated loss. A decrease in magnitude is due to the likely location of events. Table 3-54 summarizes the magnitude and frequency of each hazard as it is associated with Ucon.

Table 3-54. Summary of Ucon hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
32	Earthquake	Low
32	Flooding	Medium
27	Radiological	Low
24	Wildfire	Low
21	Hazardous materials	High
21	Extended utility outage	Low
21	Tornado/high winds	High
20	Pandemic	Low
19	Terrorism	Low
18	Structure fire	High
15	Hail	High
15	Drought	High
14	Winter storm	High
14	Extreme cold	High

Table 3-54. (continued)

Magnitude	Hazard	Frequency
12	Landslide	Low
12	Extreme heat	Medium
12	Riot/civil disobedience	Low
8	Lightning	High
No data	Avalanche	No data

The severity ranking for Ucon is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-25 summarizes the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

		Magnitude		
		Low	Medium	High
Frequency	Low	Riot/Unlawful Assembly/Civil Disorder, Landslide	Pandemic, Terrorism	Earthquake, Radiological Event, Wildfire, Extended Utility Outage
	Medium	Extreme Heat	-	Dam Failure, Flooding
	High	Lightning	Extreme Cold, Winter Storm, Drought, Hail, Structure Fire	Hazardous Materials, Tornado/High Winds

Figure 3-25. Severity ranking of Ucon hazards.

Based on the risk severity ranking, hazardous materials and tornado/high winds are the highest.

3.6.3.5 City of Swan Valley – Summary

The city of Swan Valley is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location. In most cases, the increase in magnitude is due to an increase or decrease in the estimated loss. A decrease in magnitude is due to the likely location of events. Table 3-55 summarizes the magnitude and frequency of each hazard as it is associated with Swan Valley.

Table 3-55. Summary of Swan Valley hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
36	Earthquake	Medium
32	Flooding	High
32	Wildfire	High
25	Radiological	Low

Table 3-55. (continued)

Magnitude	Hazard	Frequency
20	Hazardous materials	Medium
19	Terrorism	Low
18	Tornado/high winds	Medium
18	Pandemic	Low
17	Extended utility outage	Medium
16	Structure fire	High
16	Winter storm	High
15	Hail	Low
13	Drought	Medium
13	Landslide	Low
12	Extreme cold	High
12	Extreme heat	Low
11	Riot/civil disobedience	Low
7	Lightning	High
No data	Avalanche	No data

The severity ranking for Swan Valley is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-26 summarizes the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

		Magnitude		
		Low	Medium	High
Frequency	Low	Riot/Unlawful Assembly/Civil Disorder, Extreme Heat	Pandemic, Terrorism, Landslide, Hail	Radiological Event
	Medium	-	Drought, Extended Utility Outage, Hazardous Materials, Tornado/High Winds	Dam Failure, Earthquake
	High	Extreme Cold, Lightning	Structure Fire, Hail	Wildfire, Flooding

Figure 3-26. Severity ranking of Swan Valley hazards.

Based on the risk severity ranking, wildfire and flooding are the highest.

3.6.3.6 City of Irwin – Summary

The city of Irwin is subject to same hazards as the rest of Bonneville County. The magnitude and frequency of hazard events are different because of the location. In most cases, the increase in magnitude

is due to an increase or decrease in the estimated loss. A decrease in magnitude is due to the likely location of events. Table 3-56 summarizes the magnitude and frequency of each hazard as it is associated with Irwin.

Table 3-56. Summary of Irwin hazards.

Magnitude	Hazard	Frequency
40	Dam failure	Medium
36	Earthquake	Medium
32	Flooding	High
32	Wildfire	High
25	Radiological	Low
20	Hazardous materials	Medium
19	Terrorism	Low
18	Tornado/high winds	Medium
18	Pandemic	Low
17	Extended utility outage	Medium
16	Structure fire	High
16	Winter storm	High
15	Hail	Low
13	Drought	Medium
13	Landslide	Low
12	Extreme cold	High
12	Extreme heat	Low
11	Riot/civil disobedience	Low
7	Lightning	High
No data	Avalanche	No data

The severity ranking for Irwin is based on the frequency and magnitude scores derived in the hazard description and assessment section. Figure 3-27 summarizes the county's hazards by magnitude and frequency. Boxes highlighted in red indicate the high-risk hazards, boxes highlighted in yellow indicate the medium-risk hazards, and green boxes indicate the low-risk hazards.

		Magnitude		
		Low	Medium	High
Frequency	Low	Riot/Unlawful Assembly/Civil Disorder, Extreme Heat	Pandemic, Terrorism, Landslide, Hail	Radiological Event
	Medium	-	Drought, Extended Utility Outage, Hazardous Materials, Tornado/High Winds	Dam Failure, Earthquake
	High	Extreme Cold, Lightning	Structure Fire, Hail	Wildfire, Flooding

Figure 3-27. Severity ranking of Irwin hazards.

Based on the risk severity ranking, wildfires are the highest.

4. MITIGATION STRATEGY

A mitigation strategy is a long-term plan for reducing the potential losses identified in the hazard description and vulnerability assessment. The strategy describes how Bonneville County and participating jurisdictions will integrate the plan through existing programs and resources, maintain the AHMP, define mitigation priorities, and develop mitigation plans or actions.

This 2014 AHMP update examines how the 2008 AHMP plan was implemented, evaluates and updates mitigation plans, and redefines mitigation priorities.

4.1 Implementation

Implementation of the AHMP into local planning efforts is an important way to establish disaster resistance in Bonneville County and associated jurisdictions. The AHMP and the associated hazard research, local knowledge, and documentation of hazard conditions have been coalesced in this document to serve as a tool for decision-makers as new policies, plans, and projects are evaluated.

The most effective way for the document to be used is for it to be implemented into daily government operation plans and procedures. Local plans, such as comprehensive plans and those addressing storm water management, sustainability, economic development, land use, and emergency operation are plans that present an opportunity to address hazard mitigation that can support long-term community objectives.

New local plans that are developed by Bonneville County and participating jurisdictions will be added to the document as amendments at the AHMP yearly reviews and included in the document at the 5 year review and update.

The 2008 AHMP recommended that Bonneville County and associated jurisdictions update comprehensive planning and that land use/zoning ordinances be updated to reflect the hazards and risk severity outlined in the AHMP. The following describes the current status of land use/comprehensive planning in Bonneville County.

4.1.1 Bonneville County Comprehensive Plan

The *Bonneville County Comprehensive Land Use Plan* was reviewed and updated in 2013. That plan supports the tenets and goals of the AHMP. Several of the hazard mitigation projects in the 2008 AHMP were included in the 2013 comprehensive plan. It is recommended that the county update its comprehensive plan to reflect the hazards and risk severity ranking found in this updated AHMP.

4.1.2 Bonneville County Land Use/Zoning Ordinances

Bonneville County first developed and adopted its building/zoning ordinance in 1959. It has been updated and revised over the years, with the last revision in 2011. Bonneville County has an extremely comprehensive zoning ordinance. The County Subdivision Ordinance, as developed, appears to be adequate but does not provide conditions for WUI protection.

The following recommendations are made to revise, improve, or develop new ordinances:

1. Develop and adopt a WUI ordinance

2. Examine construction of buildings on hillsides and areas of known landslides

3. Examine the need for dual access in subdivisions

4. Provide for fire-suppression water supplies in rural subdivisions.

4.1.3 City of Idaho Falls Comprehensive Plan and Zoning Ordinance

The city of Idaho Falls updated its comprehensive plan in 2000. The plan sets forth requirements to manage construction and development in hazard-prone areas; however, it does not specifically have a hazard section in the plan. During the next revision of the Idaho Falls comprehensive plan, it is recommended that a hazard section be included that is specifically designed to discuss the risk severity for Idaho Falls included in this AHMP. The city does have an aggressive urban forestry program, which should also include some discussion on defensible space between trees and structures. These types of controls may also be appropriate in the transitional riparian areas.

It is recommended that the city update its comprehensive plan to reflect the hazards and risk severity ranking found in the AHMP.

The city's zoning ordinance was last updated in 2007. The ordinance is provides complete coverage for construction and development within the city limits. The ordinance refers to the Uniform Building Code. It is recommended that the city also adopt the International Building Code if it has not already and revise the ordinance.

4.1.4 City of Ammon Comprehensive Plan and Zoning Ordinance

The city of Ammon completed a comprehensive plan in 2012. The plan discusses how to mitigate the effects of potentially dangerous natural conditions within the city of Ammon. The plan identifies naturally occurring hazards within the city and develops specific policies that would minimize impacts.

The city of Ammon follows specific hazard-related provisions and uses them as city policies for all future growth. Some of the policies include mitigation for potential flood-related losses and working with the Bonneville County Office of Emergency Management and follow the Emergency Management Operations Program. It is recommended that the city update its comprehensive plan to reflect the hazards and risk severity ranking found in this updated AHMP.

The city has adopted the International Building Code, the International Fire Code, and other relevant protective codes. The city ordinances manage construction and development within hazardous areas in a comprehensive manner.

4.1.5 Greater Swan Valley Comprehensive Plan Zoning Ordinance

The *Greater Swan Valley Comprehensive Plan* is a general guide for development for Swan Valley and Irwin. The plan was approved at the end of 2006. Wildfires, earthquakes, landslides, avalanches, and floods are identified as potential hazards that may affect the Swan Valley area. The established policy encourages incentives to reduce the threat of wildfire, and it sets regulations that reduce potential damage from floods. The implementation of these goals includes adopting a wildfire mitigation plan, identifying hazardous areas, educating landowners to the threats associated with flooding, and enacting subdivision and zoning ordinances for areas with unstable slopes, floodplains, and avalanche-prone areas. The city of Swan Valley has adopted the comprehensive plan into their zoning ordinance.

It is recommended that the cities of Swan Valley and Irwin update their comprehensive plan to reflect the hazards and risk severity ranking found in the updated AHMP.

4.1.6 Cities of Ucon and Iona

It is recommended that the city of Ucon and Iona planning and zoning reflect the hazards and risk severity ranking found in this updated AHMP in any future land use planning efforts.

4.1.7 Adoption of 2014 AHMP Update

It is recommended that Idaho Falls, Ammon, Iona, Ucon, Swan Valley, and Irwin replace the 2008 AHMP and adopt the 2014 AHMP Update. In annual reviews and the 5-year review and update include information about existing or planned mitigation projects, changes in building and infrastructure replacement values, and any new comments or suggestions from the planning committee and community members.

4.2 Plan Maintenance

As described in Section 1, the AHMP should be reviewed annually by the planning committee to review and update mitigation plans, estimated values, and hazard occurrences. The Bonneville County Office of Emergency Management should be responsible for the scheduling, publicizing, and leadership of the annual review meeting. During the meeting, committee members should report the status of mitigation projects and identify changes and updates to the existing plan. Maintenance of the plan should be detailed at this meeting, documented, and attached to the formal plan as an amendment. Every five years, any changes should be incorporated into the five-year update. Below is a proposed committee meeting agenda for yearly reviews and five-year update reviews.

4.2.1 Annual Review Agenda

The focus of the planning committee at the annual review should include some of the following topics:

- Update hazard past occurrences based on any event in the past year
- Review the county profile and individual community assessment for each hazard, and note any major changes or mitigation projects that have altered the vulnerability of each jurisdiction
- Add a section to note accomplishments or current mitigation projects
- Address updated local planning efforts (comprehensive plans, emergency management plans, etc.).

4.2.2 Five-Year Update Review Agenda

- Update county demographic and socioeconomic data
- Address new planning documents, ordinances, codes, etc., that have been developed by the county or associated jurisdictions
- Review hazards, and address risk assessments that have changed in the past five years
- Update county and associated jurisdiction hazard risk severities

- Incorporate new methods for analyzing risk and vulnerabilities.

4.3 Hazard Mitigation

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

- Those that keep the hazard away from people, property, and structures
- Those that keep people, property, or structures away from the hazard
- Those that reduce the impact of the hazard on victims, i.e., insurance.

The AHMP identifies three key strategies: (1) practicality, (2) cost effectiveness, and (3) culturally, environmentally, and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the anticipated damages.

The primary focus of the AHMP is to be tool for decision-makers for new policies, plans, and projects in the development of mitigation plans and actions. Mitigation actions are proposed and prioritized based on risk assessment that takes into account the magnitude of hazards, their frequency of occurrence, and the vulnerabilities of the community to them. This helps to ensure that risk reduction efforts, whether for homes, roads, public utilities, pipelines, power plants, public works, or other projects, are both necessary and cost effective.

In the past, hazard mitigation has been one of the most neglected emergency management programs. Because disaster events are generally infrequent and the nature and magnitude of the threat are often ignored or poorly understood, the priority to fund and implement mitigation measures is low. Mitigation success can be achieved, however, if accurate information is portrayed to decision-makers and the public through complete hazard identification and impact studies, followed by effective mitigation management.

4.4 Prioritization Process

Initial prioritization of the mitigation projects will occur when representatives from the county and associated jurisdictions come together to review mitigation goals, risk-severity ranking, and any proposed mitigation projects. Mitigation projects are those that can potentially prevent a hazard from occurring, or reduce the magnitude or frequency of that hazard. These projects are selected based on the mitigation goals and related objectives of the AHMP. The basic tenets of the process, as discussed in the scope and mission statement of the AHMP, was (1) life safety, (2) protection of critical infrastructure, and (3) reduction of repetitive loss.

4.5 Future Prioritization Process

Differing prioritization processes will occur within the county and associated jurisdictions after the AHMP update is adopted and then becomes a living document with annual evaluation and updating.

The prioritization process will continue to be based on the four basic tenants of Mitigation Planning: (1) life safety, (2) protection of existing buildings and infrastructure, (3) protection of new buildings and infrastructure, and (4) reduction of repetitive loss.

The process will reflect that a key component in funding a decision is a determination that the project will provide an equivalent or more in benefits over the life of the project when compared with the costs. Projects will be administered by the county and associated jurisdictions with overall coordination provided by the county emergency management coordinator.

County commissioners and the elected officials of all jurisdictions may evaluate opportunities and establish their own unique priorities to accomplish mitigation activities where existing funds and resources are available and there is community interest in implementing mitigation measures. If no federal funding is used in these situations, the prioritization process may be less formal. Often the types of projects that the county can afford to do on its own are in relation to improved codes and standards, department planning and preparedness, and education. These types of projects may not meet the traditional project model, selection criteria, and benefit/cost model. The county will consider all pre-disaster mitigation proposals brought before the county commissioners by department heads, city officials, fire districts, and local civic groups.

When federal or state funding is available for hazard mitigation, the requirements that establish a rigorous benefit/cost analysis as a guiding criterion in establishing project priorities will be followed. The county will understand the basic federal grant program criteria, which will drive the identification, selection, and funding of the most competitive and worthy mitigation projects.

4.6 Prioritization Scheme

The following numerical scoring system developed by Northwest Management, Inc., may be helpful and used to prioritize projects (King and Bloch 2011). The system was modified slightly to represent the basic mitigation tenets chosen by Bonneville County. This prioritization serves as a guide for the county and jurisdictions when developing mitigation activities. This project prioritization scheme has been used in other counties within Idaho and is designed to rank projects on a case-by-case basis. The county and individual jurisdictions mitigation program does not want to restrict funding to only those projects that meet the high priorities because what may be a high priority for a specific community may not be a high priority at the county level.

Regardless, the project may be just what the community needs to mitigate disaster. The flexibility to fund a variety of diverse projects based on varying reasons and criteria is a necessity for a functional mitigation program at the county and community level.

To implement this case-by-case concept, a more detailed process for evaluating and prioritizing projects has been detailed below. Any type of project, whether county- or city-specific, will be prioritized in this more formal manner.

To prioritize projects, a general scoring system has been developed. This prioritization scheme has been used in state-wide AHMPs. These factors range from benefit/cost ratios, to details on the hazard being mitigated, to environmental impacts.

The factors for the non-planning projects include:

- Hazard magnitude/frequency

- Potential for repetitive loss reduction benefit/cost
- Vulnerability to the community population benefit
- Property benefit
- Economic benefit
- Project feasibility (environmentally, politically, socially)
- Potential project effectiveness and sustainability potential to mitigate hazards to future development.

Because some factors are considered more critical than others, two ranking scales have been developed. A scale of 1 to 10, with 10 being the best, has been used for hazard magnitude/frequency; potential for repetitive loss reduction, cost, and vulnerability to the community; population benefit; and property benefit. Economic benefit, project feasibility, potential to mitigate hazards to future development, and potential project effectiveness and sustainability are all rated on a 1-to-5 scale, with 5 being the best. The highest possible is 65.

The guidelines for each category are as described below.

4.6.1 Hazard Magnitude/Frequency

The hazard magnitude/frequency rating is a combination of the recurrence period and magnitude of a hazard. The severity of the hazard being mitigated and the frequency of that event must both be considered. For example, a project mitigating a 10-year event that causes significant damage would receive a higher rating than one that mitigates a 500-year event that causes minimal damage. For a ranking of 10, the project mitigates a high-frequency, high-magnitude event. A ranking of 1 is for a low-frequency, low-magnitude event. Note that only the damages being mitigated should be considered here, not the entire losses from that event.

4.6.2 Potential for Repetitive Loss Reduction

Projects that mitigate repetitive losses receive priority consideration here. Common sense dictates that losses that occur frequently will continue to do so until the hazard is mitigated. Projects that will reduce losses that have occurred more than three times receive a rating of 10. Those that do not address repetitive losses receive a rating of 1.

4.6.3 Benefit/Cost

The analysis process will include summaries as appropriate for each project but will include benefit/cost analysis results. Projects with a negative benefit/cost analysis result will be ranked as a 0. Projects with a positive benefit/cost analysis will receive a score equal to the projects' benefit/cost analysis results divided by 10. Therefore, a project with a benefit/cost ratio of 50:1 would receive 5 points; a project with a benefit/cost ratio of 100:1 (or higher) would receive the maximum points of 10.

4.6.4 Vulnerability of the Community

A community that has a high vulnerability with respect to other jurisdictions to the hazard or hazards being studied or planned for will receive a higher score. To promote participation by the smaller

or less vulnerable communities in the county, the score will be based on the relationship to other communities being considered. A community that is the most vulnerable will receive a score of 10, and one that is the least, a score of 1.

4.6.5 Population Benefit

Population benefit relates to the ability of the project to prevent the loss of life or injuries. A ranking of 10 has the potential to impact 90% or more of the people in the municipality (county, city, or district). A ranking of 5 has the potential to impact 50% of the people, and a ranking of 1 will not impact the population. The calculated score will be the percent of the population impacted positively multiplied by 10. In some cases, a project may not directly provide population benefits but may lead to actions that do, such as in the case of a study. Those projects will not receive as high of a rating as one that directly effects the population but should not be considered to have no population benefit.

4.6.6 Property Benefit

Property benefit relates to the prevention of physical losses to structures, infrastructure, and personal property. These losses can be attributed to potential dollar losses. Similar to cost, a ranking of 10 has the potential to save $1,000,000 or more in losses. Property benefit of less than $1,000,000 will receive a score of the benefit divided by $1,000,000 (a ratio below $1 million). Therefore, a property benefit of $300,000 would receive a score of 3. In some cases, a project may not directly provide property benefits but may lead to actions that do, such as in the case of a study. Those projects will not receive as high of a rating as one that directly effects property but should not be considered to have no property benefit.

4.6.7 Economic Benefit

Economic benefit is related to the savings from mitigation to the economy. This benefit includes reduction of losses in revenues, jobs, and facility shutdowns. Because this benefit can be difficult to evaluate, a ranking of 5 would prevent a total economic collapse, a ranking of 3 could prevent losses to about half the economy, and a ranking of 1 would not prevent any economic losses. In some cases, a project may not directly provide economic benefits but may lead to actions that do, such as in the case of a study. Those projects will not receive as high of a rating as one that directly affects the economy but should not be considered to have no economic benefit.

4.6.8 Project Feasibility (Environmentally, Politically, and Socially)

Project feasibility relates to the likelihood that such a project could be completed. Projects with low feasibility would include projects with significant environmental concerns or public opposition. A project with high feasibility has public and political support without environmental concerns. Those projects with very high feasibility would receive a ranking of 5, and those with very low feasibility would receive a ranking of 1.

4.6.9 Potential to Mitigate Hazards to Future Development

Proposed actions that can have a direct impact on the vulnerability of future development are given additional consideration. If hazards can be mitigated at the onset of the development, the county will be less vulnerable in the future. Projects that will have a significant effect on all future development receive a rating of 5. Those that do not affect development should receive a rating of 1.

4.6.10 Potential Project Effectiveness and Sustainability

Two important aspects of all projects are effectiveness and sustainability. For a project to be worthwhile, it needs to be effective and actually mitigate the hazard. A project that is questionable in its effectiveness will score lower in this category. Sustainability is the ability for the project to be maintained. Can the project sustain itself after grant funding is spent? Is maintenance required? If so, are or will the resources be in place to maintain the project. An action that is highly effective and sustainable will receive a ranking of 5. A project with effectiveness that is highly questionable and not easily sustained should receive a ranking of 1.

4.6.11 Final Ranking

Upon ranking a project in each of these categories, a total score can be derived by adding together each of the scores. The project can then be ranking high, medium, or low based on the non-planning project thresholds of:

Project Ranking Priority Score

- High 40–65
- Medium 25–39
- Low 9–24

4.7 Mitigation Projects

Mitigation actions and projects for Bonneville County and participating jurisdictions (Idaho Falls and Ammon) from the 2008 AHMP are described below. Committee members from Bonneville County, Idaho Falls, and Ammon updated the 2008 mitigation actions and projects and included new actions that are planned in the 2014 AHMP Update. Iona adopted the 2008 AHMP, but did not add any mitigation projects to 2014 AHMP update. Ucon, Swan Valley, and Irwin did not include any actions or projects in the 2014 AHMP update, but will be asked to participate in upcoming AHMP annual reviews and 5 year updates.

Bonneville County and participating jurisdictions followed the prioritization scheme described in section 4.6 to identify the project's priority for implementation. Projects that were not identified by the prioritization scheme will be analyzed prior to implementation.

Listed below are mitigation projects that were described in the 2008 AHMP (Bonneville County in Table 4-1; city of Idaho Falls in Table 4-2; and city of Ammon in Table 4-3). The statuses of projects are discussed. For projects that have not been completed, a description of the relevance of the project is included. Iona, Ucon, Irwin, and Swan Valley did not provide potential mitigation projects for the 2008 AHMP or the 2014 AHMP update.

Table 4-1. Bonneville County mitigation projects.

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
Weather-related events	*Mitigation* – Prioritize the protection of people, structures, infrastructures, and unique ecosystems that contribute to the socio-economic composition of the county and jurisdictions.	Develop methods to mitigate losses due to severe weather.	Install road closure gates on Highway 26 at the Wyoming border and at the Ririe junction.	High	ITD/Emergency Management Services	Not complete by 2016	Project is still relevant. Dependent on ITD budget and available grant funding Will examine PDM availability.
	Planning – Continue participating in the NFIP, community wildfire protection plans, and other plans/ programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop methods to mitigate losses due to severe weather.	Provide education regarding notification of all types of weather related incidents.	Not ranked	NWS/Emergency Management Services	Ongoing 2014 - 2015	Continually active project by both NWS and BCEM. Will expand efforts as EMPG funding allows from year to year.
	Mitigation – Prioritize the protection of	Develop methods to mitigate losses	Plant living windbreaks/snow fences.	Not ranked	Private property owners	Ongoing 2014-2015	Will examine PDM funding as a possible source to assist with this project.

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	people, structures, infrastructures, and unique ecosystems that contribute to the socio-economic composition of the county and jurisdictions.	due to severe weather.					
Flooding	*Planning* – Continue participating in the NFIP, community wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop actions to reduce damage to infrastructure due to flooding.	Seek Community Rating System (CRS) Status for Bonneville County. The CRS is a voluntary program for recognizing and encouraging community floodplain management activities exceeding the minimum standards.	Not ranked	Floodplain administrator	Not complete 2014 - 2015	The project was not complete due to a lack of funding, but it is still relevant. Seek possible funding from FMA program
	Planning – Continue participating in the NFIP, community	Develop actions to reduce damage to infrastructure	Request updates of the Flood Insurance Rate Maps.	Not ranked	Floodplain administrator	Ongoing 2014 - 2015	The county has the latest flood maps and will obtain new ones once

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	due to flooding.					they are available.
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding	Ririe Dam Failure Mitigation Project	High	Emergency Management Services/Bureau of Reclamation/County GIS Department/ITD	Ongoing 2015 - 2016	Parts of this project have been completed. Project is still relevant. FMA, PDM, HSGP HMGP (when applicable)
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation	Develop actions to reduce damage to infrastructure due to flooding.	Palisades Dam Failure Mitigation Project	High	Emergency Management Services/Bureau of Reclamation/County GIS Department/ITD	Ongoing 2015 - 2016	Parts of this project have been completed. Project is still relevant. FMA, PDM, HSGP HMGP (when applicable)

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments	
	techniques.							
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding	Investigate raising I-15 north of the Idaho Falls Airport (at the "thumb" of the floodplain) to act as a natural dike to the Snake River	Not ranked	Emergency Management Services/ITD	Not Complete 2015 - 2016	The status of this project is unknown, but it is still relevant FMA, PDM, HSGP	
Geologic	*Mitigation* – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Develop a listing of schools and public buildings that need to be seismically retrofitted.	Not ranked	Emergency Management Services/school districts/city governments	Ongoing 2015 - 2016	Building and Safety has completed an assessment of school buildings in Bonneville County, which would contribute to this project. Project is still relevant.	PDM, NEHRP, HMGP (when applicable)
	Mitigation – Develop methods to prevent loss or damage to	The county and jurisdictions will reduce potential damage to	Earthquake protection or hardening at Bonneville County critical	Not ranked	Emergency Management Services	Not complete 2015 - 2016	Project is still relevant and will continue with appropriate	PDM, HEHRP, HMGP (when applicable)

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	county infrastructure and structures through the implementation of mitigation techniques.	associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	facilities (Dispatch Center, Court House, Court House Annexes, critical county facilities).				funding.
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Place restraining hardware on the library shelves in the school districts.	Not ranked	School districts	Ongoing 2015 - 2016	The status of this project is unknown, but it is still relevant. PDM, NEHRP, HMGP (when applicable)
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation	Provide public education on home protection and preparedness for seismic events.	Not ranked	Emergency Management Services	Ongoing 2014 - 2015	HSGP, EMPG

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
		techniques.					
	Planning – Adopt codes and standards for construction in areas that are prone to specific hazards.	Reduce the potential damage to property from landslides by adopting codes and standards for construction in landslide-prone areas.	Develop an ordinance that places restrictions on building in landslide prone areas	Not ranked	Planning and zoning administrator	Completed	
Wildfire	*Planning* – Adopt codes and standards for construction in areas that are prone to specific hazards.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Adopt the International Wildland Urban Interface Fire Code.	Not ranked	WUI Working Group/planning and zoning administrator	Not complete 2014 - 2015	The county commissioners chose not to adopt the International Wildland Urban Interface Fire Code and its enforcement costs. The project is still relevant and may be pursed in the future.

PDM, HSGP, EMPG

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments	
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Protect power supply lines that run across INL in Bonneville County.	Not ranked	Emergency Management Services/INL/Rocky Mountain Power	Ongoing 2014 - 2015	The status of this project is unknown, but it is still relevant. PDM BLM Community Assist.	
	Planning – Adopt codes and standards for construction in areas that are prone to specific hazards.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Provide for fire-suppression water supplies in rural subdivisions.	Not ranked	Fire districts/planning and zoning administrator	Ongoing 2014 - 2015	As part of the approval of new subdivisions, fire water is required by either tank storage or a water system for fire hydrants.	BLM Community Assist. PDM, HMGP (when applicable)
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Increase fire district coverage in rural areas of Bonneville County.	Not ranked	Fire districts	Ongoing 2014 - 2015		BLM Community Assist.

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	of mitigation techniques.						
	Planning – Adopt codes and standards for construction in areas that are prone to specific hazards.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Review the Subdivision Ordinance to determine where dual access/egress may be required.	Not ranked	Fire districts/planning and zoning administrator	Ongoing 2014 - 2015	Work with local developers and building/zoning offices to develop firewise and firesafe communities
	Mitigation – Develop methods to prevent loss or damage to county infrastructure and structures through the implementation of mitigation techniques.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Construct a bridge over the Snake River below Palisades Dam.	High	Bureau of Reclamation	Completed 2012 - 2013	Done
	Planning – Adopt codes and standards for construction in areas that are prone to specific	The county will continue to implement mitigation measures outlined in the Community Wildfire	Develop a standard practice for roadside vegetation management.	Not ranked	Wildfire Working Group/Emergency Management Services	Completed 2014 - 2015	PDM, BLM Community Assist., USFS/IDL Community Fire Protection and BLM Partnership funds, Western States Fire Manager's Grant Program.

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	hazards.	Protection Plan.					
	Planning – Adopt codes and standards for construction in areas that are prone to specific hazards.	The county will continue to implement mitigation measures outlined in the Community Wildfire Protection Plan.	Designate WUI areas as a special land use category in the county comprehensive plan.	Not ranked	Planning and zoning administrator	Not complete 2014 - 2015	The county commissioners chose not to adopt a special land use category in the county comprehensive plan. The project is still relevant and may be pursed in the future.
Biological	*Mitigation* – Prioritize the protection of people, structures, infrastructures, and unique ecosystems that contribute to the socio-economic composition of the county and jurisdictions.	The county will seek to protect humans and animals from communicable disease outbreaks.	Maintain a public education program for general health.	Not ranked	Health district/Emergency Management Services	Ongoing	

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
Structural fire	*Planning* – Adopt codes and standards for construction in areas that are prone to specific hazards.	The county and jurisdictions will continue to work with property owners in an effort to prevent or reduce losses from structure fires.	Develop an agreement with developers and private landowners for access to and use of water sources for fire protection.	Not ranked	Fire districts/planning and zoning administrator	Ongoing 2014 - 2015	All new subdivisions are required to provide a source of water for fire suppression.
	Planning – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The county and jurisdictions will continue to work with property owners in an effort to prevent or reduce losses from structure fires.	Determine situations where individual residence sprinkler systems or alternative fire-suppression capabilities may be required in the county.	Not ranked	Planning and zoning administrator/fire districts/building official	Ongoing	Completed as needed during property development before construction in areas outside fire districts.
Radiological Event	*Planning* – Continue to examine the risks associated with technological (human-caused)	The county will continue to examine the risks from radiological events within or near the county limits.	Provide public education information on ingestion pathway planning to those residing in the county.	Not ranked	Emergency Management Services/INL Oversight Office	Ongoing	

PDM, BLM Community Assist., USFS/IDL Community Fire Protection and BLM Partnership funds

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	hazards associated with the operations within and surrounding the county.						
Hazardous Material Event	*Planning* – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The County will assess hazardous material flow through the county and storage facilities within the county.	Conduct a hazardous materials flow study for interstate, highways, and the railroad line running through the county.	Not ranked	Emergency Management Services	Completed	Completed in 2009. Plans for another flow study following this adoption of the 2014 AHMP update.
	Planning – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding	The county will assess hazardous material flow through the county and storage facilities within the county.	Develop an education program on the rules and regulation of home fuel storage.	Not ranked	Emergency Management Services	New project	

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	the county.						
Riot/unlawful assembly/civil disorder	*Planning* – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The county and jurisdictions will continue using methods for managing civil disorder activities.	Conduct a public education program to assist the citizens of the county in recognizing and reporting civil disobedience event to county law enforcement.	Not ranked	Sheriff's Office	Ongoing	
Terrorism	*Planning* – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The county and jurisdictions will continue using methods for identifying and preventing acts of terrorism.	Conduct a county terrorism assessment.	Not ranked	Sheriff's Office/local law enforcement/ Emergency Management Services	Ongoing	

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	Planning – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The county and jurisdictions will continue using methods for identifying and preventing acts of terrorism.	Protect critical infrastructure based on the assessment.	Not ranked	Sheriff's Office/local law enforcement/ Emergency Management Services	Completed	
Other	*Planning* – Continue to examine the risks associated with technological (human-caused) hazards associated with the operations within and surrounding the county.	The county will assess hazardous material flow through the county and storage facilities within the county.	Update Hazard Section on the comprehensive plan based on the severity ranking of the AHMP.	Not ranked	Planning and zoning administrator	Completed	The comprehensive plan addresses all hazards identified in the 2008 AHMP.
	Mitigation – Develop methods to prevent loss or damage to	-	Install a backup diesel and gasoline fuel supply for county vehicles.	Not ranked	Road and Bridge	Completed	

Table 4-1. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	county infrastructure and structures through the implementation of mitigation techniques.						

Table 4-2. Idaho Falls mitigation projects.

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
Weather related events	*Mitigation* – Prioritize the protection of people, structures, infrastructures, and unique ecosystems that contribute to the socio-economic composition of the county and jurisdictions.	Develop methods to mitigate losses due to severe weather.	Provide public education on water line freezing.	Not ranked	Public Works	Ongoing	
	Planning – Continue participating in the NFIP, community wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop methods to mitigate losses due to severe weather.	Provide public education on snow removal.	Not ranked	Public Works	Ongoing	
	Mitigation – Prioritize the protection of people, structures, infrastructures, and unique ecosystems that contribute to the socio-economic composition of the county and	Develop methods to mitigate losses due to severe weather.	Provide mobile power sources to lift stations.	Not ranked	Public Works	Ongoing	

Table 4-2. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	jurisdictions.						
Flooding	*Mitigation* – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding.	Install aboveground water storage tanks.	Not ranked	Public Works	Ongoing	
	Planning – Continue participating in the NFIP, community wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop actions to reduce damage to infrastructure due to flooding.	Participate in the Ririe Dam Failure Vertical Evacuation Planning Project, including the light detection and ranging (LIDAR) data acquisition.	Not ranked	Mayor/Public Works	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding.	Participate in the development of a vertical evacuation plan for the Ririe Dam failure scenario.	Not ranked	Mayor/law enforcement/Fire Department/Public Works	Ongoing	

Table 4-2. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding	Participate in the development of an evacuation plan for the Palisades Dam Failure scenario	Not ranked	Mayor/Law Enforcement/Fire Department/Public Works	Ongoing	
	Planning – Continue participating in the NFIP, community wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop actions to reduce damage to infrastructure due to flooding	Seek CRS Community Rating	Not ranked	Floodplain Administrator	Ongoing	
Geologic	*Mitigation* – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Develop a listing of public buildings that need to be seismically retrofitted.	Not ranked	Building and Zoning	Ongoing	

Table 4-2. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Place restraining hardware on the city library shelves.	Not ranked	City librarian	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Protect water and sewer lines from damage, and assess alternative routing in case of damage.	Not ranked	Public Works	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Retrofit existing sewer pipes to protect city wastewater infrastructure.	Not ranked	Public Works	New Project	

Table 4-3. Ammon mitigation projects.

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
Flooding	*Planning* – Continue participating in the NFIP, community wildfire protection plans, and other plans/programs that offer pre-disaster mitigation and post-disaster mitigation.	Develop actions to reduce damage to infrastructure due to flooding.	Participate in the Ririe Dam Failure Vertical Evacuation Planning Project, including the LIDAR data acquisition.	Not ranked	Mayor/Public Works	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding.	Participate in the development of a vertical evacuation plan for the Ririe Dam failure scenario.	Not ranked	Mayor/law enforcement/Fire Department/Public Works	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	Develop actions to reduce damage to infrastructure due to flooding	Participate in the development of an evacuation plan for the Palisades Dam failure scenario.	Not ranked	Mayor/law enforcement/Fire Department/Public Works	Ongoing	
	Planning – Continue participating in the NFIP, community wildfire protection plans, and other	Develop actions to reduce damage to infrastructure due to flooding.	Seek CRS status for City of Ammon. The CRS is a voluntary program for recognizing and	Not ranked	Floodplain administrator	Ongoing	

Table 4-3. (continued)

Hazard	Mitigation Goal	Objective	Project	2008 Priority Ranking	Responsible Entity	2014 Project Status	Comments
	plans/programs that offer pre-disaster mitigation and post-disaster mitigation.		encouraging community floodplain management activities exceeding the minimum standards.				
Geologic	*Mitigation* – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Develop a listing of public buildings that need to be seismically retrofitted.	Not ranked	Building and Zoning	Ongoing	
	Mitigation – Develop methods to prevent loss or damage to city infrastructure and structures through the implementation of mitigation techniques.	The county and jurisdictions will reduce potential damage to associated infrastructure and structures through the implementation of earthquake-mitigation techniques.	Protect water and sewer lines from damage, and assess alternative routing in case of damage.	Not ranked	Public Works	Ongoing	

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