City of Flagstaff Multi-Hazard Mitigation Plan

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EXECUTIVE SUMMARY

City of Flagstaff officials and public servants recognize that natural and human-caused hazards pose a significant threat at varying degrees of magnitude and frequency, to the safety and economic stability of the City and its residents. Often, the potential reality of hazards within the City is not fully understood or realized until a major disaster occurs, and then significant resources are required to respond and recover from the damages. City officials also understand that responding to hazards on a post-incident basis can result in increased costs, in terms of both financial and human losses. Accordingly, the City of Flagstaff has prepared the **City of Flagstaff Multi-Hazard Mitigation Plan** (COFMHMP) with in order to assess the City's vulnerability to natural and human caused hazards, and to develop mitigation strategies that reduce the risks associated with those hazards.

This plan is generally arranged and prepared using the template set forth in the State of Arizona's *Model Local Hazard Mitigation Plan* (AzMLHMP). The AzMLHMP, and hence this plan, are prepared to satisfy recent federal requirements set forth by the Disaster Mitigation Act of 2000 (DMA2K). Compliance with these requirements will enable the City of Flagstaff to maintain eligibility for certain federal and state mitigation funds. Seventy-five (75) percent of the funding for the planning process and plan preparation was provided through a planning grant from FEMA. The State of Arizona, through the Arizona Division of Emergency Management (ADEM), provided the matching twenty-five (25) percent of monies to complete the work. The team of JE Fuller/ Hydrology & Geomorphology, Inc. and Visual Risk Technologies, Inc. was contracted by ADEM to lead and coordinate the planning effort, prepare the final plan documents, and enter the plan data into the Arizona Hazard Mitigation Planning System (an online, web-based planning tool developed by the State of Arizona).

The overall purpose of DMA2K was to establish a national program for pre-disaster mitigation, streamline administration of disaster relief at both the federal and state levels, and control federal costs of disaster assistance. Congress envisioned that implementation of these new requirements would result in the following key benefits:

- Reduction of loss of life and property, human suffering, economic disruption, and disaster costs.
- Prioritization of hazard mitigation planning at the local level, with an increased emphasis placed on planning and public involvement, assessing risks, implementing loss reduction measures, and ensuring critical services/facilities survive a disaster.

- Establishment of economic incentives, awareness and education via federal support to state, tribal, and local governments, that will result in forming community-based partnerships, implementing effective hazard mitigation measures, leveraging additional non-Federal resources, and establishing commitments to long-term hazard mitigation efforts.

In general, the DMA2K legislation requires all local, county, and tribal governments to develop a hazard mitigation plan for their respective communities in order to be eligible to receive certain federal mitigation funds including Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDM), and Flood Mitigation Assistance Program (FMA) funds.

In satisfying the regulatory requirements of DMA2K, the primary purpose of this plan is to identify natural and human-caused hazards that impact the City of Flagstaff, assess the vulnerability and risk posed by those hazards to community-wide human and structural assets, develop strategies for mitigation of those identified hazards, present future maintenance procedures for the plan, and document the planning process. The COFMHMP is divided into six primary sections as follows:

- Section 1 - Introduction
- Section 2 – Jurisdictional Participation Information
- Section 3 – Planning Process Documentation
- Section 4 – Risk Assessment
- Section 5 – Mitigation Strategy
- Section 6 – Plan Maintenance Procedures

Where appropriate, detailed information is documented or provided in appendices. There are also certain data-sets pertaining to the Risk Assessment that are deemed “sensitive” by the City, and are, therefore, made a part of this plan by reference, but are documented in a separate technical binder which will remain at the City of Flagstaff and will not be submitted to FEMA or the State of Arizona for review. General summaries of those specific data are provided in the COFMHMP instead.

The planning process used to develop the COFMHMP included the assembly of a multi-jurisdictional planning team (MJPT) that was comprised of members of each incorporated community, Coconino County staff, and various other public and private entities with interest in the mitigation of hazards. Coconino County Emergency Management functioned as the primary point of contact and the lead agency for the planning effort. The multi-jurisdictional planning team primarily focused on the following objectives:

- ✓ Provide a unified approach to informing the public of hazard mitigation planning efforts.
- ✓ Identify, evaluate, prioritize, and profile the types of hazards impacting the county and its communities.
- ✓ Develop general, county-wide hazard mitigation goals and objectives to use as a starting template for each of the individual community plans.
- ✓ Provide a forum for community and inter-agency communication during the development of mitigation actions/projects, especially for those projects that may involve multiple communities.
- ✓ Capitalize on the experience and institutional knowledge base afforded by a cooperative, multi-agency, multi-community team. Many of the MJPT members are long time residents of Coconino County.

One of the key elements to the hazard mitigation planning process is the risk assessment. In performing a risk assessment, a community determines "what" can occur, "when" (how often) it is likely to occur, and "how bad" the effects could be. According to DMA2K, the primary components of a risk assessment that answer the above questions are generally categorized into the following measures:

- ☑ **Identify Hazards**
- ☑ **Profile Hazard Events**
- ☑ **Assess Vulnerability to Hazards**

The risk assessment for the City of Flagstaff was performed using a county-wide perspective, with much of the information input and development being accomplished by the MJPT. The vulnerability analysis was performed in a way that the results reflect vulnerability at an individual community level, and at a county-wide level. Two categories of hazards, natural and human-caused, and a list of hazards for each category, have been identified by the State of Arizona. Beginning with that list, the MJPT used a systematic process that considered relevance, historical significance and experience, and catastrophic potential, to reduce the list to hazards that are most relevant to Coconino County. The following table summarizes the result of that process, with the top ranked hazards indicated by **bold** text. For the purposes of this planning effort, the flooding/flash flooding and tropical storms/hurricane both result in flooding, and are, therefore, considered together as one category. The italicized human-caused hazards will not be considered further due to resource limitations, however; the MJPT desired to include them in the list due to their relevance to the community.

Natural Hazards	Human-Caused Hazards
• Avalanche • **Drought** • Dust/Sand Storms • Earthquake • Extreme Cold and Heat • **Flooding/Flash Flooding** • Infestations • Landslides/Mudslides • Thunderstorm/High Winds • Tornadoes/Dust Devils • **Tropical Storms/Hurricane** • **Wildfires** • **Winter Storms**	• *Biological* • *Dam/Levee Failure* • *Explosion/Fire* • *Fuel / Resource Shortage* • *Hazardous Materials Incidents* • *Power/Utility Failure* • *Terrorism* • **Transportation Accidents**

Profiles were developed for each of the top ranked hazards by researching and mapping historic hazard events, obtaining other hazard mapping, analysis and studies, and in Arizona, estimating the Calculated Priority Risk Index (CPRI) [1]. The other hazards have been generally profiled by the State of Arizona and are referenced accordingly.

A county-wide vulnerability analysis was performed to assess and evaluate the city's and county's population and critical facility exposure risk to the identified hazards. The risk was tabulated in terms of economic loss estimates and human population exposure. Economic losses include estimates of damage to critical, residential, industrial, and commercial facilities. Critical facilities were individually identified by the MJPT for each community and supplemental residential, commercial, and industrial facility information was obtained from FEMA's HAZUS program. It is estimated that there are at least $5.513 billion dollars[2] worth of critical, residential, industrial, and commercial facilities within the City. The total City population is estimated at 61,030. The following table summarizes the general results of the vulnerability analysis for each of the top ranked hazards in the City.

[1] The CPRI is explained in detail in the State of Arizona's *Model Local Hazard Mitigation Plan*. A digital copy of the plan can be obtained at the following URL or the reader can go to Section 4.2.3 of this plan:

http://www.dem.state.az.us/operations/mitigation/MLHMP_Final_No%20Cover.pdf

[2] This estimate is likely to be incomplete as there were many assets that the community was unable to obtain replacement estimates for given the plan development schedule

Hazard	Potential Economic Loss [a]	Potential Human Exposure [b]
Drought	$200,000	61,030
Flooding	$55.9 million [c]	9,932
Wildfire	$896.7 million [c]	24,314
Winter Storm	$200,000	61,030
Transportation Accident	(No losses estimated)	61,030

[a] – These numbers represent estimates of the losses that may be realized assuming the hazard occurs to all facilities within the hazard impact area.

[b] – These numbers represent the total human population potentially exposed to the hazard.

[c] – These numbers represent a collective community or county-wide exposure. Individual event losses are likely to be a small fraction of these numbers.

The City of Flagstaff planning team developed a strategy for mitigating the hazard risks identified and summarized in the table above. The mitigation strategy provides the "*what, when, and how*" of actions that will reduce or possibly remove the community's exposure to hazard risks, and is generally categorized into the following components:

- ☑ **Capability Assessment**
- ☑ **Goals and Objectives**
- ☑ **Mitigation Actions/Projects**
- ☑ **Implementation Strategy**

The City of Flagstaff planning team assessed the City's capabilities regarding legal, regulatory, technical/staff, and financial resources. The City of Flagstaff planning team then worked with the MJPT to develop a set of draft goals and objectives to establish guidelines for the mitigation of hazards in the county and incorporated communities. The City of Flagstaff planning team then customized the draft goals and objectives to fit the City. The following is a list of the City of Flagstaff goals and objectives:

Goal 1. Promote disaster-resistant future development.

Objective 1.A Update, develop, and support their general plans, ordinances, and codes to limit development in hazard areas or build to standards that will prevent or reduce damage.

Objective 1.B Adopt and support codes that protect assets and new development in hazard areas.

Goal 2. Promote public understanding, support, and demand for hazard mitigation.

Objective 2.A Educate the public to increase awareness of hazards and opportunities for mitigation actions.

Objective 2.B Promote partnerships between the state, counties, local and tribal governments to identify, prioritize, and implement mitigation actions.

Objective 2.C Promote hazard mitigation in the business, residential, and agricultural community.

Objective 2.D Monitor and publicize the effectiveness of mitigation actions implemented community wide.

Goal 3. Build and support local capacity and commitment to become less vulnerable to hazards.

Objective 3.A Improve existing capabilities to warn the public of emergency situations.

Objective 3.B Develop programs to enhance the safety of the residents of each community during an emergency.

Goal 4. Improve hazard mitigation coordination and communication with federal, state, local, and tribal governments.

Objective 4.A Establish and maintain closer working relationships with state agencies and local and tribal governments.

Goal 5. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to floods.

Objective 5.A Implement policies, procedures and regulations which reduce the exposure to flood hazards.

Objective 5.B Decrease vulnerability of community assets, especially critical facilities located in the 100-year floodplain.

Objective 5.C Improve coordination with state and federal flood-related agencies.

Objective 5.D Maintain compliance with the National Flood Insurance Program (NFIP) requirements.

Goal 6. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to wildland fires.

Objective 6.A Develop a comprehensive approach to reducing the level of damage and losses due to wildland fires.

Objective 6.B Protect life, improved property, and natural resources with vulnerability to the effects of wildland fires.

Objective 6.C Improve coordination and support existing efforts to mitigate wildland fire hazards.

Objective 6.D Develop a comprehensive database of information about the vulnerability of life, improved property, and natural resources to wildland fires.

Objective 6.E Educate the public about wildland fire dangers and mitigation measures.

Goal 7. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to winter storms.

Objective 7.A Develop a comprehensive approach to reducing the level of damage and losses due to winter storms.

Objective 7.B Protect life, improved property, and natural resources with vulnerability to the effects of winter storms.

Goal 8. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to drought.

Objective 8.A Develop a comprehensive approach to reducing the level of damage and losses due to drought.

Objective 8.B Protect existing assets with vulnerability to the effects of drought.

Objective 8.C. Coordinate with and support existing efforts to mitigate drought (e.g., Arizona Governor's Arizona Drought Task Force).

Goal 9. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to transportation accidents.

Objective 9.A Develop a comprehensive approach to reducing the level of damage and losses due to transportation accidents.

Objective 9.B Protect existing assets with vulnerability to the effects of transportation accidents.

Objective 9.C Coordinate with rail road companies and federal, state, county, and local transportation departments to develop accident mitigation cooperatives and agreements.

Goal 10. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to thunderstorms/high winds.

Objective 10.A Develop a comprehensive approach to reducing the level of damage and losses due to thunderstorms/high winds.

Objective 10.B Protect life, improved property, and natural resources with vulnerability to the effects of thunderstorms/high winds.

Goal 11. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to intentional human acts (e.g. – civil disobedience, civil disturbance, sabotage, and terrorism).

Objective 11.A Develop a comprehensive approach to reducing the level of damage and losses due to intentional human acts.

Objective 11.B Protect life, improved property, and natural resources with vulnerability to the effects of intentional human acts.

Objective 11.C Facilitate communication of sharing intelligence among all levels of public safety communities and other affected agencies/organizations.

Goal 12. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to other natural hazards.

Objective 12.A Develop a comprehensive approach to reducing the level of damage and losses due to other natural hazards.

Objective 12.B Protect life, improved property, and natural resources with vulnerability to the effects of other natural hazards.

Goal 13. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to other human caused hazards.

Objective 13.A Develop a comprehensive approach to reducing the level of damage and losses due to other human caused hazards.

Objective 13.B Protect life, improved property, and natural resources with vulnerability to the effects of other caused hazards.

Using the vulnerability analysis, capability assessment, and goals and objectives, the City of Flagstaff planning team then developed an initial list of mitigation actions/projects, with each action/project being scored based on a perceived value in the categories of social, technical, administrative, political, legal, economic, and environmental considerations. Once the actions/projects were ranked, an implementation strategy was then developed for the top ten (or less) of each list, to outline the responsible agency, funding source, completion date, and critical or interim activities for each action/project. The following table summarizes the top ten (10) ranked actions/projects proposed by the City of Flagstaff planning team.

Name	Primary Goals Addressed	Description
Water Conservation	8.B	Upgrade existing conservation measures to provide for water during periods of drought.
Rio De Flag & Clay Ave Flood Abatement	5.B	Enhance flood mitigation efforts through channelization and detention
Bark Beetle Project	6.B	Remove bark beetle infested trees that will contribute to catastrophic wildfire.
Water Well Generators	6.B	Install generators for water wells vulnerable to losing power during wildfires.
Thinning Project	6.B	Remove trees that may promote the severity or rapid spread of catastrophic wildfire.
City Bridges	5.B	Reinforce city bridges to maintain critical municipal infrastructure during flood and flood control events.
Transportation Accidents	9.B	Provide equipment and human resources sufficient to handle comprehensive road, air, and railway HAZMAT and mass casualty incidents.
Emergency Operations Center	4.A	Construct & equip a multi-agency EOC to coordinate disasters.
Wildfire Outreach	6.E	Educate the local and regional community (including tourists) about the consequences of catastrophic wildfire and necessary prevention methods.
Rio de Flag Waterlines	5.B	Reinforce waterlines under the Rio de Flag to limit damage due to flooding.

As a final step in the planning process, plan maintenance procedures were developed by the City of Flagstaff planning team to establish guidelines for maintaining, reviewing and updating the COFMHMP over the next five (5) years. The plan will be reviewed on an annual basis and/or following a major disaster. Each review shall include an evaluation of the following:

- ***Public Involvement*** – Public involvement successes and challenges shall be reviewed and noted, with any recommendations for changes.
- ***Risk Assessment*** – The identified hazards and associated risks shall be evaluated with respect to the previous year's events, and any significant differences shall be noted for possible revision during the next planning cycle.
- ***Mitigation Strategy*** – The proposed A/Ps shall be reviewed and updated regarding status and implementation (i.e. – proposed project is now fully complete). Any changes shall be noted along with the successes and/or challenges associated with the implementation of those projects.

The COFMHMP also outlines maintenance responsibilities and continued public involvement activities. Ultimately, the plan will require updating and re-approval from FEMA and the State of Arizona in five years.

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SECTION 1: INTRODUCTION

1.1 General Plan Description

City of Flagstaff officials and public servants recognize that natural and human-caused hazards pose a significant threat at varying degrees of magnitude and frequency, to the safety and economic stability of the city and its residents. Often, the potential reality of hazards within the city is not fully understood or realized until a major disaster occurs, and then significant resources are required to respond and recover from the damages. City officials also understand that responding to disasters on a post-incident basis can result in increased costs, in terms of both financial and human losses. Accordingly, Flagstaff has prepared the **City of Flagstaff Multi-Hazard Mitigation Plan** (COFMHMP) in order to assess the City's vulnerability to natural and human caused hazards, and to develop mitigation strategies that reduce the risks associated with those hazards.

Although this plan is meant to be a *multi-hazard* plan, its primary function is to address mitigation for natural hazards and other environmentally related, human caused events or incidents. One human caused hazard generally known as *terrorism*, is specifically not addressed by this plan with regard to vulnerability, prevention or mitigation of its possible impacts. According to the Model Local Hazard Mitigation Plan[1] (AzMLHMP), the term *terrorism* is defined as encompassing intentional, criminal or malicious acts involving Weapons of Mass Destruction (WMDs), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous material releases; and cyber-terrorism (attacks via computer means). While such terrorist acts may possibly occur, it is not the intent of the COFMHMP to analyze vulnerability and provide effective mitigation measures for these specific events. Instead, mitigation for terrorism related hazards is deferred to other planning efforts sponsored by the Federal Department of Justice and the Arizona Office for Homeland Security.

This plan is generally arranged and prepared using the template set forth in the AzMLHMP. The AzMLHMP, and hence this plan, are prepared to satisfy recent federal requirements set forth by the Disaster Mitigation Act of 2000 (DMA2K). Compliance with these requirements will enable Flagstaff to maintain eligibility for certain federal and state mitigation funds. Interim Final Rule

[1] ADEM, November 2003, *Model Local Hazard Mitigation Plan*, prepared by JE Fuller / Hydrology & Geomorphology, Inc.

citations of DMA2K rules are provided as appropriate in each section. Following this introductory section, the plan is divided into five primary sections as follows:

- Section 2 – Jurisdictional Participation Information
- Section 3 – Planning Process Documentation
- Section 4 – Risk Assessment
- Section 5 – Mitigation Strategy
- Section 6 – Plan Maintenance Procedures

Where appropriate, detailed information is documented or provided in appendices. There are also certain data-sets pertaining to the Risk Assessment that are deemed "sensitive" by the city. Those data are a part of this plan by reference, but are documented in a separate technical binder which will remain at Flagstaff and will not be submitted for FEMA or State of Arizona review. Instead, general summaries of those specific data are provided herein.

1.2 Plan Purpose and Authority

The Disaster Mitigation Act of 2000 (DMA2K), commonly known as the 2000 Stafford Act Amendments, was approved by Congress on October 10, 2000. Section 322 is the DMA2K amendment[2] to the Stafford Act that primarily deals with hazard mitigation planning as it relates to the development of local hazard mitigation plans. The DMA2K legislation was signed into law by the President on October 30, 2000 (Public Law 106-390). The Interim Final Rule for planning provisions (implemented at 44 CFR Part 201) was initially published in the Federal Register on February 26, 2002. The Interim Final Rule was again published on October 1, 2002 to extend the planning deadline to November 1, 2004. Local hazard mitigation planning requirements are implemented in the Interim Final Rule at 44 CFR Part 201.6.

The overall purpose of DMA2K was to amend the Stafford Act in order to establish a national program for pre-disaster mitigation, streamline administration of disaster relief at both the federal and state levels, and control federal costs of disaster assistance. Congress envisioned that implementation of these new requirements would result in the following key benefits:

- Reduction of loss of life and property, human suffering, economic disruption, and disaster costs.

[2] Section 322 is enacted under Section 104 of DMA2K.

- Prioritization of hazard mitigation planning at the local level, with an increased emphasis placed on planning and public involvement, assessing risks, implementing loss reduction measures, and ensuring critical services/facilities survive a disaster.
- Establishment of economic incentives, awareness and education via federal support to state, tribal, and local governments, that will result in forming community-based partnerships, implementing effective hazard mitigation measures, leveraging additional non-Federal resources, and establishing commitments to long-term hazard mitigation efforts.

In general, the DMA2K legislation requires all local, county, and tribal governments to develop a hazard mitigation plan for their respective communities in order to be eligible to receive certain federal mitigation funds including Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDM), and Flood Mitigation Assistance Program (FMA) funds.

In addition to satisfying the regulatory requirements of DMA2K, the primary purpose of this plan is to identify natural and human-caused hazards that impact Flagstaff, assess the vulnerability and risk posed by those hazards to community-wide human and structural assets, develop strategies for mitigation of those identified hazards, present future maintenance procedures for the plan, and document the planning process.

Funding for the development of the COFMHMP was provided through a grant received from the Federal Emergency Management Agency and matching funds were provided by the Arizona Division of Emergency Management (ADEM). JE Fuller/ Hydrology & Geomorphology, Inc. (JEFuller), with Visual Risk Technologies, Inc.(VRisk) as a sub-consultant, were hired by ADEM to assist each of the counties and communities to prepare their respective hazard mitigation plans and to enter the plans into the Arizona Hazard Mitigation Planning System (AzHMPS) [3]

1.3 Community Description

1.3.1 Geography

The City of Flagstaff is located in north-central Arizona, as depicted in Figure 1-1, and is the regional center and county seat for Coconino County. Flagstaff is situated at the southern base of the San Francisco Peaks at an elevation of 7,000 feet. The city is surrounded by pine forests interspersed with large, grassy meadows and occasional stands of aspen and oak. The

[3] AZHMPS is an on-line hazard mitigation planning tool developed by VRisk for ADEM. This system can be accessed by the following URL: https://www.mitigationplan.com

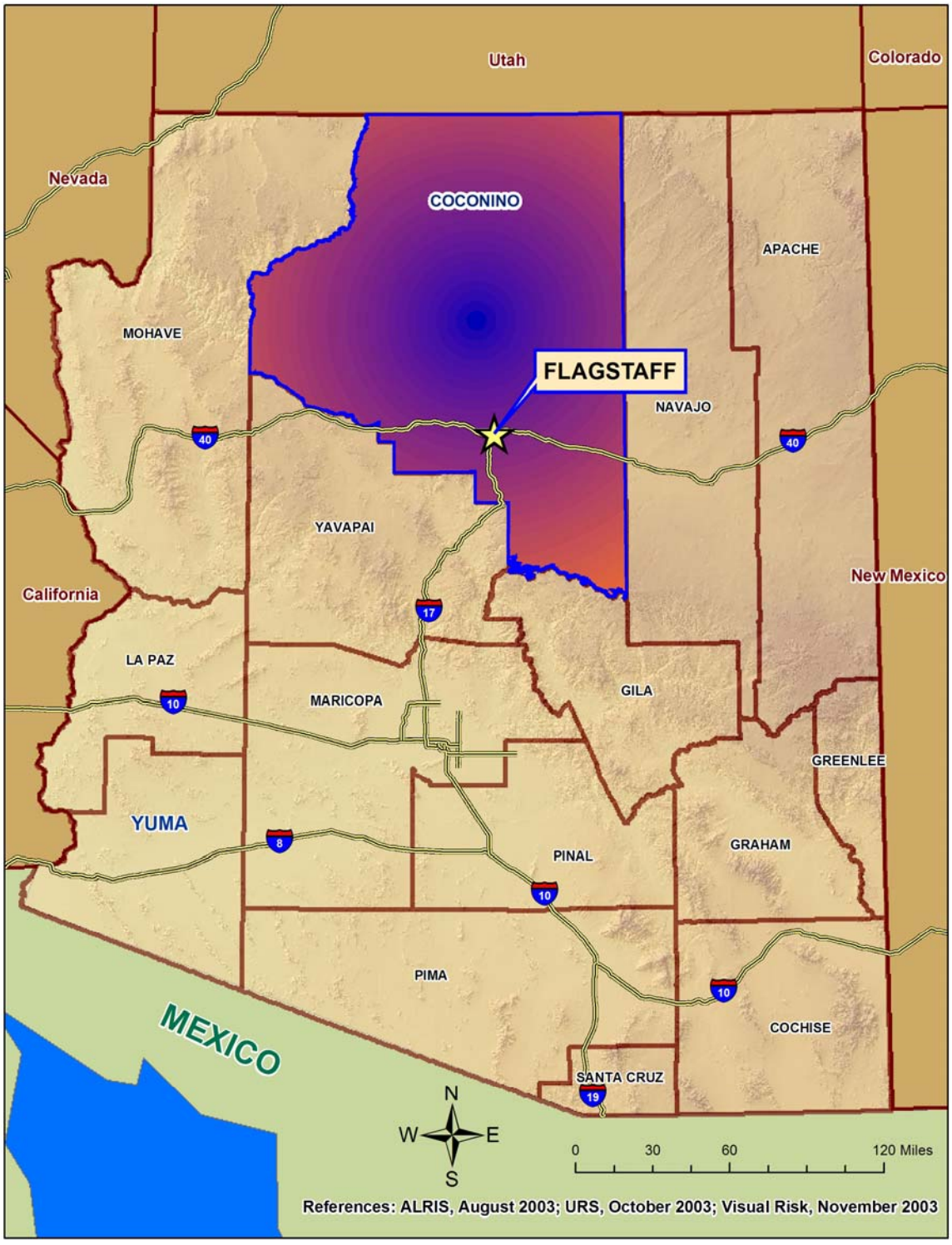

Figure 1-1

Vicinity Map

center of Flagstaff is geospatially located at longitude 111.61 degrees west and latitude 35.18 degrees north. There are several prominent watercourses that pass through Flagstaff including the Rio de Flag, Sinclair Wash, Schultz Creek, and Walnut Creek.

Several major transportation corridors pass through Flagstaff including Interstates 17 and 40 and the Burlington-Northern Santa Fe (BNSF) Railway. AMTRAK also operates on the BNSF lines and maintains depots in Flagstaff and Williams. Other major roadways include U.S. Highways 160 and 89, and State Routes 66 and 89A. The City of Flagstaff also operates Flagstaff-Pulliam Airport, which is the largest commercial airport in Coconino County and northern Arizona. Figure 1-2 depicts the general geographic features and transportation routes within Flagstaff.

The terrestrial characteristics of Coconino County are quite diverse, ranging from sparsely vegetated shrublands to dense pine forests, with small areas of desert scrub at the lower altitude extremes of the county. The terrestrial and ecological characteristics of Coconino County have been mapped into three terrestrial ecoregions[4], which are depicted in Figure 1-3 and described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, including the Mogollon Rim and the San Francisco Mountains, and covers approximately 40 percent of the county. The forests regions are located along the southern border of the county running diagonally from southeast to northwest, and along the upper regions of the North Kaibab Plateau. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in this ecoregion is comprised largely of a mix of Scrub Grassland, Mogollon Chaparral Scrubland, Great Basin Conifer Woodland, Rocky Mountain Conifer Forest, and Plains Grassland.
- **Colorado Plateau Shrublands** – this ecoregion covers approximately 55 percent of the county with elevations that average around 4,000 to 5,000 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cool winters.
- **Mojave Desert** – this ecoregion covers a very small area of the western-central county, with elevations that range from 1,500 feet to nearly 4,000 feet on some mountain locations. Typically the climate in this ecoregion is very hot and dry during the summer and comparatively warm during the winter.

[4] URS, 2004, *State of Arizona Hazard Mitigation Plan – Interim Draft – Community Profiles and Hazard Identification/Profiles.*

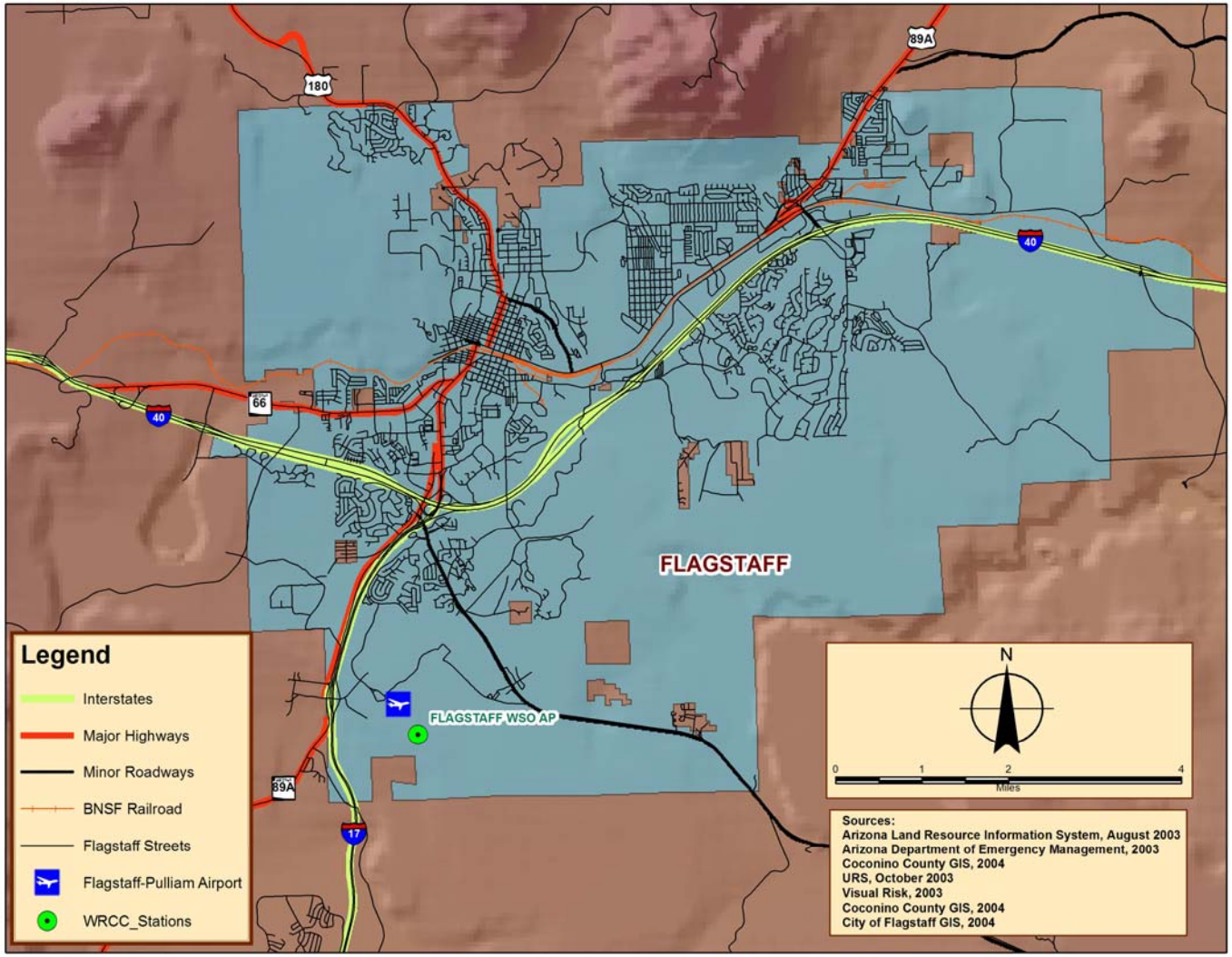

Figure 1-2

Geographic Features and Transportation Routes Map

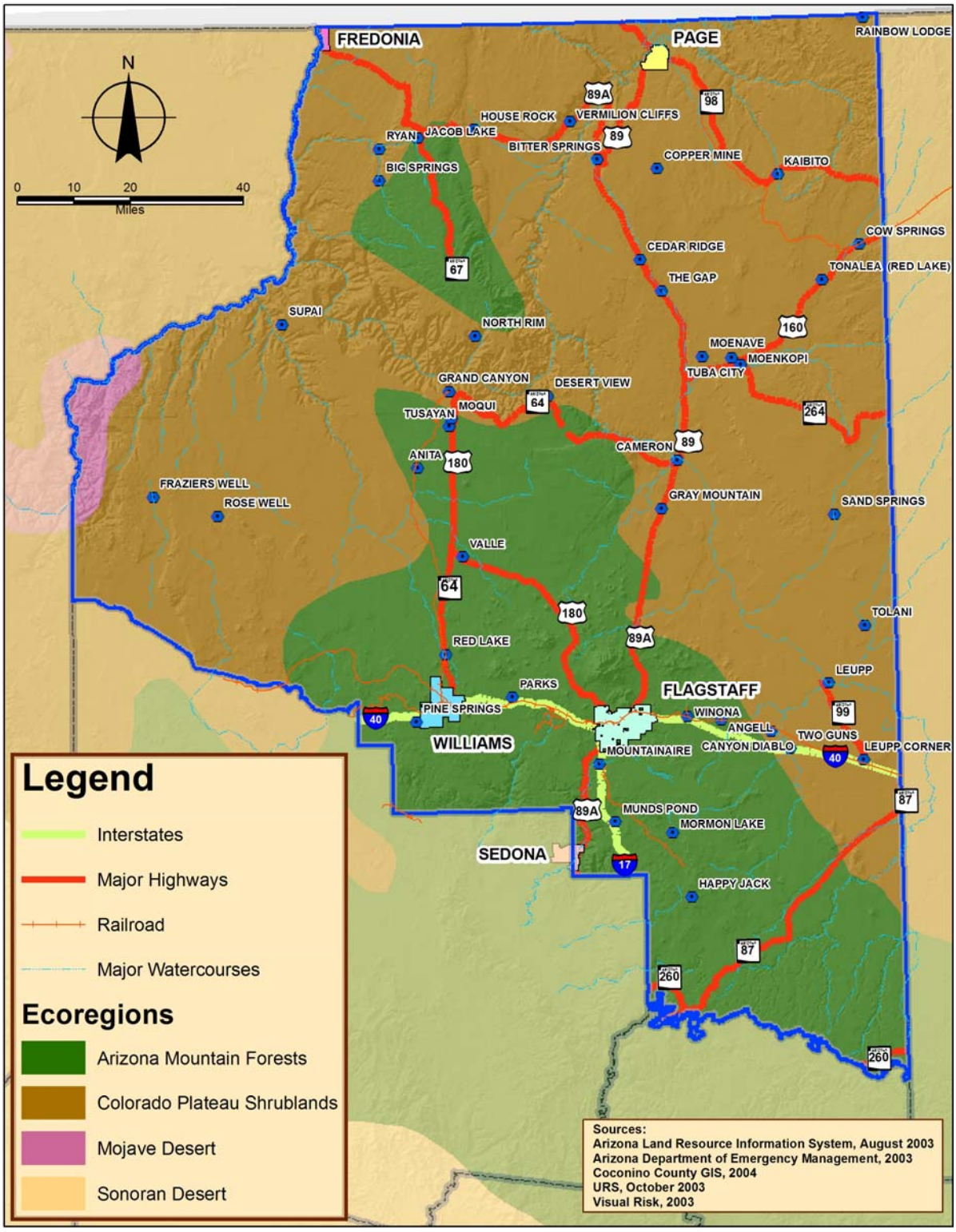

Figure 1-3

Terrestrial Ecoregions Map

As shown of Figure 1-3, the entire City of Flagstaff is located with the Arizona Mountain Forests ecoregion.

1.3.2 Climate

Flagstaff is characterized by four distinct seasons, with moderate summers and freezing winters. Climatic statistics for weather stations within Coconino County are produced by the Western Region Climate Center [5] and span records dating back to the early 1900's. Locations of reporting stations within or near Flagstaff are shown on Figure 1-2. Statistics for the Flagstaff WSO-AP Station are provided in the following discussions.

Average temperatures within Flagstaff vary widely with average temperatures that range from 10 degrees Fahrenheit during the winter months to 80 degrees Fahrenheit during the summer months. Average extreme temperatures can exceed either end of the spectrum by as much as 10 to 15 degrees. Figure 1-4 presents a graphical depiction of temperature variability and extremes throughout the year for the Flagstaff WSO-AP Station, which is situated at an elevation of 7,000 feet. The Flagstaff WSO-AP Station is considered to be fairly representative of the Arizona Mountain Forest ecoregion.

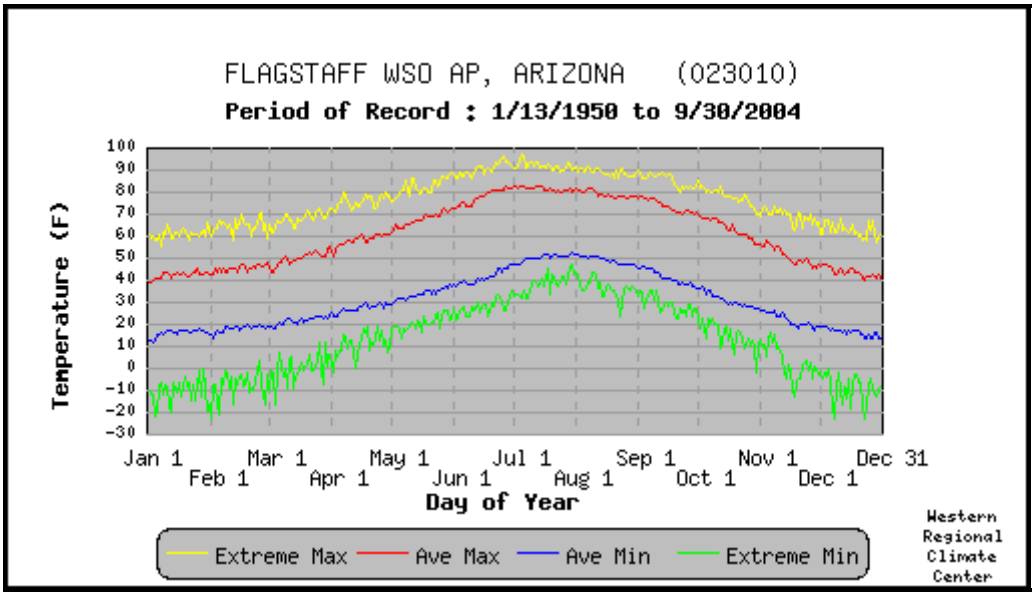

Figure 1-4

Daily Temperatures and Extremes for Flagstaff WSO-AP, Arizona

[5] Most of the data provided and summarized in this plan are taken from the WRCC website beginning at the following URL: http://www.wrcc.dri.edu/CLIMATEDATA.html

Annual precipitation in Flagstaff averages 21 inches a year with nearly 100 inches of annual snowfall. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest (Gulf of California) and aloft from the southeast (Gulf of Mexico). The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thunderstorms are often accompanied by strong winds, blowing dust, and hail storms [6]. Figure 1-5 presents tabular temperature and precipitation statistics for the Flagstaff WSO-AP Station. Statistics for other stations shown on Figure 1-2 will be similar to those presented, and hence are not included herein.

FLAGSTAFF WSO AP, ARIZONA (023010)

Period of Record Monthly Climate Summary

Period of Record : 1/13/1950 to 9/30/2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	42.6	45.2	49.9	58.1	67.7	78.0	81.8	79.1	73.9	63.6	51.1	43.7	61.2
Average Min. Temperature (F)	15.9	18.0	21.8	27.1	33.8	41.1	50.3	49.1	41.3	31.0	22.0	16.3	30.6
Average Total Precipitation (in.)	1.97	2.07	2.21	1.29	0.69	0.49	2.46	2.87	1.97	1.60	1.73	1.91	21.26
Average Total SnowFall (in.)	19.8	18.0	22.3	9.7	1.6	0.0	0.0	0.0	0.1	2.3	10.2	15.5	99.6
Average Snow Depth (in.)	4	4	3	1	0	0	0	0	0	0	1	3	1

Percent of possible observations for period of record.
Max. Temp.: 99.6% Min. Temp.: 99.6% Precipitation: 99.7% Snowfall: 90.1% Snow Depth: 81.1%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Figure 1-5

Monthly Climate Summary for Flagstaff WSO-AP, Arizona

[6] Office of the State Climatologist for Arizona, 2004. Partially taken from the following weblink: http://geography.asu.edu/azclimate/narrative.htm

1.3.3 Demographics

Flagstaff is one of five incorporated communities within Coconino County and is also the county seat. The other incorporated communities include Fredonia, Page, Sedona, and Williams. The Arizona Department of Commerce [7] prepares annual community profiles for individual counties and communities within the state. The 2003 profiles for Flagstaff and Coconino County are provided in Appendix B. Figure 1-6 is a visual depiction of the land ownership within and around Flagstaff. Private land comprises the largest percentage of ownership, with National Forest and State Land being the second and third largest owners.

Table 1-1 summarizes population estimates for Flagstaff, Coconino County and other incorporated communities for 2003 and in 10-year cycles beginning in 1990 and projecting through 2030.

Table 1-1

Summary of population statistics for Flagstaff, Coconino County and other incorporated communities

Jurisdiction	1990	2000	2003	2010	2020	2030
Coconino County	96,591	116,320	128,925	147,352	169,343	189,868
Flagstaff	**45,857**	**52,894**	**61,030**	**71,981**	**81,972**	**91,529**
Fredonia	1,207	1,036	1,105	1,507	1,671	1,811
Page	6,598	6,809	7,150	11,128	13,057	14,841
Sedona	7,720	10,192 (2,963)	10,700 (3,125)	12,380	14,611	16,546
Williams	2,532	2,842	2,910	3,310	3,601	3,925

Notes: Figures for 1990 and 2000 from Arizona Dept. of Commerce.
Figures for 2003 and 2010-2030 from AZ Dept of Economic Security with projections estimated using pre-1997 data.
Sedona figures include both Coconino and Yavapai County portions. Numbers in parenthesis are Coconino County only.

[7] These profiles can be accessed via the web at: http://www.azcommerce.com/Communities/community_profiles.asp

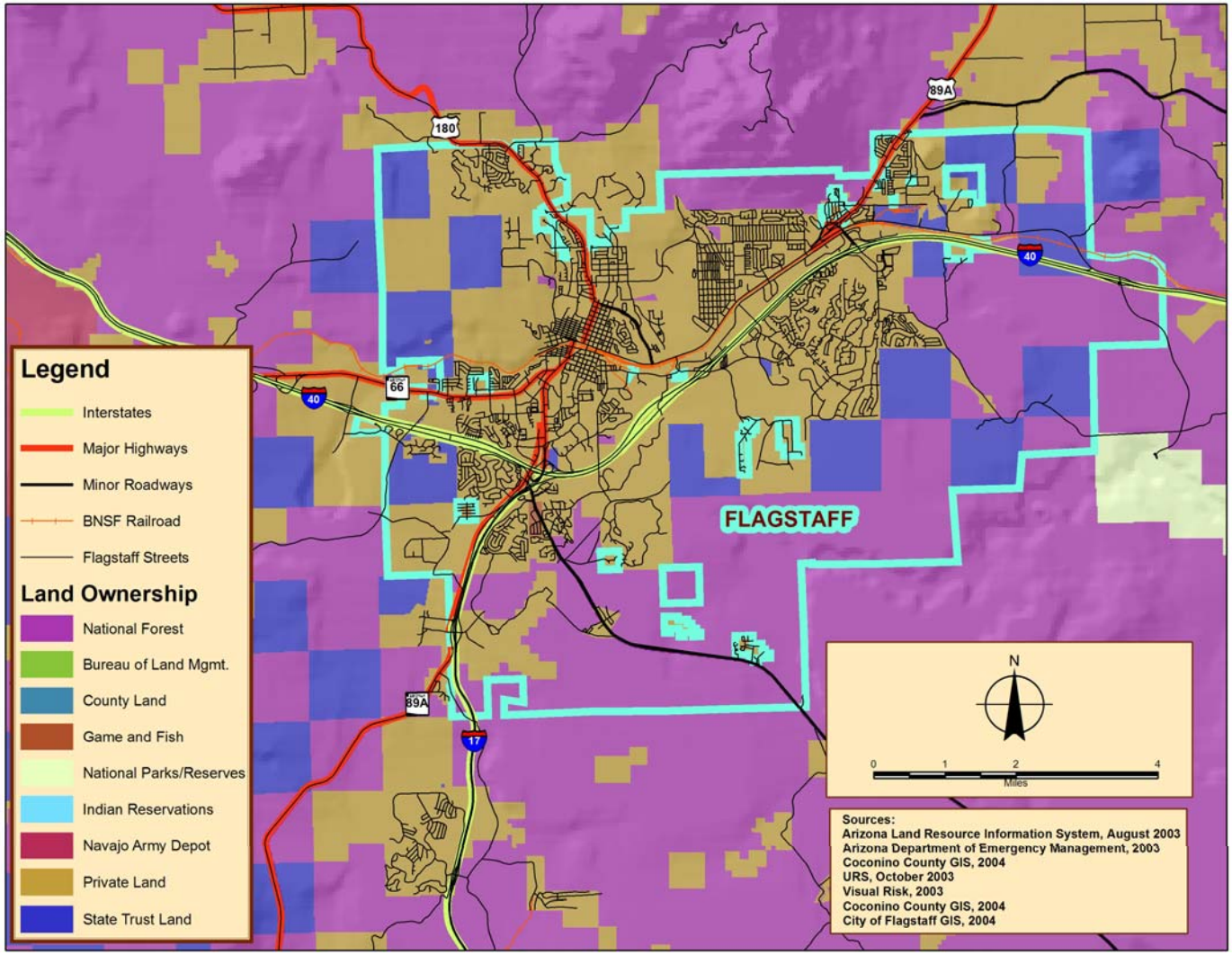

Figure 1-6

Land Ownership and Map for Flagstaff

The Flagstaff civilian labor force in 2003 was 35,998 with an unemployment rate of 5.1 percent. The major industries of the city are government, education, transportation, tourism, services, and retail trade. Flagstaff is home to Northern Arizona University, which is the biggest employer in the city. Tourism also plays a significant role, with the city being a primary hub for such attractions as the Grand Canyon National Park, Oak Creek Canyon, Sunset Crater National Monument, prehistoric Indian ruins at Wupatki, Walnut Canyon, the Navajo National Monument, Snowbowl Ski Area, and Lake Powell.

Other City race and age demographics for 2002 are summarized in the community profiles in Appendix B, as well as general economy and industrial information.

1.3.4 Development History

According to the city's website [8], in 1855 Lieutenant Beale, in surveying a road from the Rio Grande in New Mexico to Fort Tejon in California, passed over the spot where Flagstaff now stands. While camping at the Eastern extremity of the present town, the lieutenant had his men cut the limbs from a straight pine tree in order to fly the United States flag. The town's first recognized permanent settler, Thomas F. McMillan, arrived in 1876 and built a cabin at the base of Mars Hill. Flagstaff drew its name from a very tall pine tree made into a flagpole in 1876 to celebrate our nations centennial. During the 1880's, Flagstaff began to grow, opening its first post office and welcoming the booming railroad industry. The town had timber, sheep and cattle and by 1886, Flagstaff was the biggest city on the main railroad line between Albuquerque and the West Coast. In 1894, Dr. Percival Lowell chose Flagstaff, due to its great visibility, as the site for the now famous Lowell Observatory. Thirty-six years later, Pluto was discovered through the observatory's telescopes. The Arizona Teacher's College began in 1899, later becoming Northern Arizona University in 1966. During the 1920's, Route 66 was built and passed right through town making Flagstaff a popular tourist stop. Flagstaff was incorporated as a city in 1928.

In recent years, Flagstaff has experienced moderate growth and development. In order to address the potential expansion of city boundaries and increased development, the City has identified urban and rural growth areas in the *Flagstaff Area Regional Land Use and*

[8] City of Flagstaff website URL at: http://www.flagstaff.az.gov/index.asp?NID=2

Transportation Plan[9]. Figure 1-7 depicts the limits of these areas. The primary purpose for establishing growth boundaries was to limit sprawl and help protect the open spaces. The Urban Growth Boundary (UGB) is focused on areas where services can be efficiently provided within the city. The Rural Growth Boundaries (RGB) are meant to keep county regional communities from growing together, and to continue to provide access to the adjacent public lands. Other goals for defining these areas include preserving resources of ecological value in the region including washes, canyons, mountains, steeply sloped hillsides and mesas, riparian areas, volcanic cinder cones and calderas, and their protective buffers. This effort at preservation of these features often coincides or parallels hazard mitigation efforts.

[9] City of Flagstaff, 2001, *Flagstaff Area Regional Land Use and Transportation Plan*

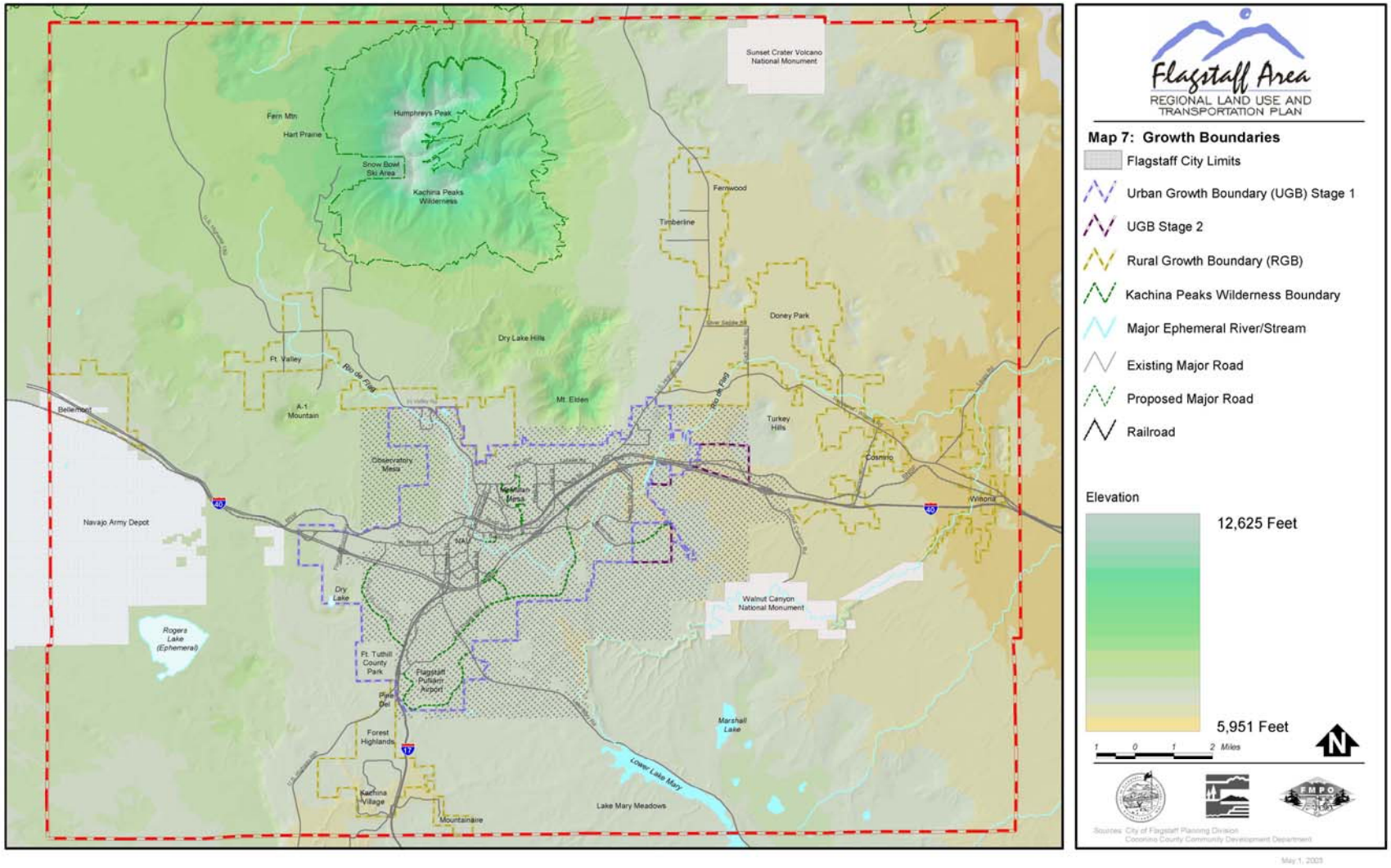

Figure 1-7

Planning Areas within and around Flagstaff

SECTION 2: JURISDICTIONAL PARTICIPATION INFORMATION

The following section provides a summary of key contact information for the city's hazard mitigation planning primary point of contact and primary promulgation authorities.

2.1 Primary Point of Contact

The primary and secondary points of contact for the City of Flagstaff Multi-Hazard Mitigation Plan are summarized below:

Primary POC:
Fire Chief
Mike Iacona
Flagstaff Fire Department
211 W. Aspen Ave
Flagstaff, AZ 86001
(928) 779-7688 Ext. 7285
Fax: (928) 779-7668
Email: miacona@ci.flagstaff.az.us

Secondary POC:
Assistant Fire Chief
Jim Wheeler
Flagstaff Fire Department
211 W. Aspen Ave
Flagstaff, AZ 86001
(928) 779-7688 Ext. 7287
Fax: (928) 779-7668
Email: jwheeler@ci.flagstaff.az.us

DMA2K Citation

Requirement §201.6(c)(1):

[The plan shall include…:] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

2.2 Promulgation Authority Information

Members of the Flagstaff City Council that are primarily responsible for promulgation of the City of Flagstaff Multi-Hazard Mitigation Plan include:

- Mayor Joseph C. Donaldson
- Vice Mayor Al White
- Council Member Art Babbott
- Council Member Karen K. Cooper
- Council Member Joe Haughey
- Council Member Kara Kelty
- Council Member Libby Silva

SECTION 3: PLANNING PROCESS DOCUMENTATION

DMA2K has placed a high degree of emphasis on the planning process in the development of local hazard mitigation plans. The purpose of Section 3 is to describe and document the plan development, selection of the planning team, public involvement strategies, successes and challenges, and general timeframes of events and milestones. Planning team selection and activities will be documented in Section 3.1. Public involvement processes and activities shall be documented in Section 3.2. Other planning processes are summarized in subsequent sections as they relate to the particular element being discussed.

DMA2K Citation

Requirement §201.6(c)(1):

[The plan shall include…:] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

3.1 Planning Teams

3.1.1 Planning Team Assembly

The planning process used to develop the COFMHMP included the assembly of a multi-jurisdictional planning team (MJPT) that was comprised of members of each incorporated community and various other public and private entities with interest in the mitigation of hazards. The Arizona Division of Emergency Management and JE Fuller/Hydrology & Geomorphology, Inc. (JEF) initiated the planning process with a kick-off meeting on October 7, 2003, wherein a general outline and schedule for the planning process was presented to key emergency management officials from Coconino, Graham, Pinal, and Coconino Counties. The purpose of the MJPT was primarily to provide a holistic and united approach to hazard mitigation planning for all of the communities within Coconino County, to share data and resources for identifying and

DMA2K Citation

Requirement §201.6(b)(2):

[The planning process shall include:] An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.

profiling hazards, and to brainstorm and coordinate the development of mitigation actions/projects. The MJPT met on a regular basis to discuss various aspects of the planning elements and the overall plan progress. Documentation of those meetings and agendas are further discussed later in this section. A subset of this planning team, comprised solely of City of Flagstaff staff, performed the detailed and focused plan development. Table 3-1 lists the individuals that participated at varying levels on the MJPT. Table 3-2 summarizes the individuals from the city staff primarily responsible for developing this plan.

Table 3-1

Summary of multi-jurisdictional planning team members

Name	Agency/Organization/Company	Title
Andy Bertelsen	City of Sedona	Management Assistant
Bill Volk	Blue Ridge Fire Department	Fire Chief
Bob LaPlante	Navajo Generating Station	
Bob Van Belle	National Park Service	Park Ranger
Brad Cheff	Coconino County GIS Department	GIS Analyst
Brent Cooper	Flagstaff Police Department	Department Chief
Cheryl Blume	Red Cross	Director
Dana Cole	City of Sedona	Assistant Engineer
Dana Schmidt	Sedona Police Department	Assistant Chief
Daniel Bulletts	Kaibab Paiute Tribe	Environmental Specialist
Darlene Trammell	Arizona Division of Emergency Management	Program Manager
Dave Huinzenga	Pinewood Fire Department	Fire Chief
David Duggan	Flagstaff Ranch Fire Department	Fire Chief
David Wilcox	City of Flagstaff, Administration	City Manager
Dirch Foreman	Highlands Fire Department	Administrative Captain
Don Howard	Summit Fire Department	Fire Chief
Eric Lobstein	Summit Fire Department	Administrative Captain
Erik Solberg	City of Flagstaff Public Works	Street Support
Erika Wiltenmuth	Coconino County Sheriffs Office	Administrative Operations Manager
J. Ernest Jutte	Coconino County Community Development	Senior Planner
Gary Gefroh	USPHS/HIS	
Glenn Cornwell	City of Williams	Public Works Director
Greg Hill	El Paso Natural Gas	Principal Engineer
Jason Marshall	Americorps / Red Cross	Employee / Volunteer

Table 3-1

Summary of multi-jurisdictional planning team members

Name	Agency/Organization/Company	Title
Jayson Coil	Sedona Fire Department	Wildland Fire Defense Coordinator
Jeff Drayton	Coconino County Sheriffs Office	Captain
Jim Driscoll	Coconino County Sheriffs Office	Chief Deputy
Jim Pond	Highlands Fire Department	Chief
Jim Wheeler	Flagstaff Fire Department	Assistant Chief
John Aber	Coconino County Community Development	Senior Planner
John Davison	City of Flagstaff – Utilities Department	Program Assistant
John Jamison	Williams Police Department	Sergeant
John Lauher	Flagstaff Pulliam Airport	Airport Operations Supervisor
Jonathan Coy	Coconino County GIS Department	GIS Technician
Josh Copley	Flagstaff Police Department	Lieutenant Patrol Division
Kevin Treadway	Flagstaff Police Department	Lieutenant
Larry Clark	City of Page Fire Department	Fire Chief
Malcolm Alter	City of Flagstaff Stormwater	Stormwater Manager
Lori Ann Lane	Arizona Department of Public Safety	Office Coordinator
Mark Young	City of Flagstaff - Planning	Planner
Matt Shobert	Sedona Fire Department	Deputy Chief
Mike Iacona	City of Flagstaff Fire Department	Fire Chief
Patricia Whitted	Ashfork Fire Department	Captain
Ray Varner	City of Page Police Department	Lieutenant/Support Services
Rebecca Sayers	City of Flagstaff Public Works	Environmental Manager
Richard McGaugh	City of Flagstaff Fleet Services	Fleet Supervisor
Sandra White	Arizona Division of Emergency Management	Administrative Assistant
Stacey Brechler-Knaggs	City of Flagstaff Management Services	Grants Manager
Tex Stilwell	Kaibab Fire Department	Chief
Tim Steffen	Summit Fire Department	Captain
Tom Corrigan	Town of Fredonia Fire/Rescue	Town Manager/Captain

Table 3-2

Summary of City of Flagstaff staff involved in plan development

Name	Agency/Organization/Company	Title
Dave Wilcox	City of Flagstaff	City Manager
Mike Iacona	City of Flagstaff, Fire Department	Fire Chief
Ron Doba	City of Flagstaff, Utilities Department	Utilities Director
Bill Menard	City of Flagstaff, Public Works Department	Public Works Director
J. T. McCann	City of Flagstaff, Police Department	Police Chief
Mark Landsiedel	City of Flagstaff, Community Development, Capital Improvements Division	Capital Improvements Director
Mary Jo Jenkins	City of Flagstaff, Management Services Department	Management Services Director
Erik Solberg	City of Flagstaff Public Works Department	Facilities
John Davison	City of Flagstaff, Utilities Department	Program Assistant
Josh Copley	Flagstaff Police Department	Lieutenant Patrol Division
Kevin Treadway	Flagstaff Police Department	Lieutenant
Malcolm Alter	City of Flagstaff, Community Development, Stormwater Division	Stormwater Manager
Mark Young	City of Flagstaff, Planning Department	Planner
Rebecca Sayers	City of Flagstaff, Public Works Department	Environmental Manager
Richard McGaugh	City of Flagstaff, Fleet Services	Fleet Supervisor
Stacey Brechler-Knaggs	City of Flagstaff, Management Services Department	Grants Manager

3.1.2 Planning Team Activities

The multi-jurisdictional planning team primarily focused on the following objectives:

- ✓ Provide a unified approach to informing the public of hazard mitigation planning efforts.
- ✓ Identify, evaluate, prioritize, and profile the types of hazards impacting the county and its communities.
- ✓ Develop general, county-wide hazard mitigation goals and objectives to use as a starting template for each of the individual community plans.

- ✓ Provide a forum for community and inter-agency communication during the development of mitigation actions/projects, especially for those projects that may involve multiple communities.
- ✓ Capitalize on the experience and institutional knowledge base afforded by a cooperative, multi-agency, multi-community team. Many of the MJPT members are long time residents of Coconino County.

The entire MJPT originally met for the first time on December 3, 2003. In that meeting, the overall requirements of DMA2K were presented and discussed. Also during that meeting, a tentative work plan and schedule was developed following guidelines set forth in the *Arizona Model Local Hazard Mitigation Plan* and the various FEMA "How-To" documents[10]. Subsequent meetings followed that initial work plan.

In general, the planning team meetings involved some level of either brainstorming ideas, evaluating the results of the previously assigned work tasks, or deciding upon a planning direction or strategy. Assignments were usually given at each meeting. Table 3-3 summarizes the MJPT meeting dates, agenda items, and a summary of the meeting highlights. Copies of the sign in sheets for each meeting are provided in Appendix C.

Table 3-3

Summary of multi-jurisdictional meeting dates and activities

Meeting Date	Agenda Items	Summary of Highlights
December 3, 2003	• Introductions • Disaster Mitigation Act of 2000 Overview • Scope and Schedule • Planning Team Role and Responsibilities • Public Involvement Strategy • Hazard Assessment Introduction • Hazards and Their Identification • Community Asset Identification • Assignments	☑ Developed a work plan and planning schedule. ☑ Brainstormed various public involvement opportunities and assigned tasks ☑ Brainstormed additional MJPT invitees ☑ Generated an exhaustive list of natural and human-caused hazards that might potentially impact Pinal County ☑ Brainstormed historic hazard events for hazard profiling ☑ Assigned the tasks for the next month: ▪ Research and compile historic hazard data ▪ Collect digital GIS and CAD mapping if available ▪ Identify and catalogue community assets (critical and non-critical facilities and infrastructure) ▪ Review and revise initial hazards identification list

[10] See the Bibliography in Appendix A for a listing of these materials.

Table 3-3

Summary of multi-jurisdictional meeting dates and activities

Meeting Date	Agenda Items	Summary of Highlights
January 14, 2004	• Review & progress check ✓ Public involvement ✓ Historic hazard research ✓ Asset inventory • Hazard selection and prioritization • Capability assessment • Assignments	☑ Received reports on initial public involvement actions ☑ Discussed historic hazard data received to-date ☑ Answered questions and discussed asset inventory needs (i.e. – what is important and what is not?) ☑ Reviewed exhaustive list of hazards, eliminated hazards that were either considered to be of minor concern or that were inappropriate for the county, assigned CPRI [11] values for remaining hazards, and finally ranked hazards based on CPRI score and relative importance to the community ☑ Reviewed requirements for capability assessment and purpose for compiling ☑ Assigned the tasks for the next month: ▪ Same assignments as December ▪ Begin developing hazard profile maps ▪ Complete capability assessment worksheets.
April 13, 2004	• Review & progress check ✓ Public involvement ✓ Asset inventory ✓ Capability assessment • Historic hazard summary • Vulnerability analysis • Goals and objectives • Mitigation Actions/Projects • Assignments	☑ Presented and discussed results of historic hazard research ☑ Presented and discussed initial results of the vulnerability analysis and reviewed the initial hazard profile maps ☑ Brainstormed general hazard mitigation goals and objectives for use as a starting point for each individual community and the county ☑ Presented and discussed the concept of developing mitigation actions/projects based on goals and objectives and known hazard problems ☑ Assigned the tasks for the next month: ▪ Complete capability assessment data ▪ Finalize hazard profile maps ▪ Finalize Asset Inventory Data ▪ Continue work on vulnerability analysis to refine the results based on MJPT discussions and comments ▪ Review goals and objectives and modify as needed for individual communities ▪ Develop initial list of mitigation actions/projects complete with descriptions and cost estimates

[11] Calculated Priority Risk Index. See *Arizona Model Local Hazard Mitigation Plan* pages 4-5 through 4-7 for explanation. This is also further clarified in Section 4.2 of this plan

Table 3-3

Summary of multi-jurisdictional meeting dates and activities

Meeting Date	Agenda Items	Summary of Highlights
May 27, 2004	• Review & progress check ✓ Public involvement ✓ Asset inventory ✓ Capability assessment ✓ Vulnerability analysis • Final hazard profile map review • Mitigation actions/projects ranking and implementation strategy • Assignments	☑ Discussed vulnerability analysis preliminary results and delays ☑ Reviewed hazard profile maps to get MJPT final approvals ☑ Based on schedule concerns, the MJPT collectively decided to move forward with mitigation strategy planning, even though the vulnerability analysis was not finalized ☑ Reviewed and discussed actions/projects developed by each community ☑ Presented the STAPLEE strategy for ranking projects ☑ Presented and discussed data requirements for implementation strategy ☑ Brainstormed mitigation actions/projects that might serve more than one community ☑ Assigned the following tasks for the next month: ▪ Complete vulnerability assessment ▪ Rank and formulate implementation strategies for each mitigation action/project proposed
September 23, 2004 (Final Meeting)	• Review & progress check ✓ Public involvement ✓ Vulnerability analysis ✓ Mitigation actions/projects ranking and implementation strategy • Vulnerability analysis • Plan maintenance procedures • Plan promulgation – Draft resolution and schedules • Assignments	☑ Discussed mitigation action/projects ranking and implementation strategies ☑ Presented results of vulnerability analysis and discussed application of realistic ratios to adjust exposure dollars to estimated loss dollars for each hazard profiled ☑ Presented DMA2K plan maintenance ☑ Brainstormed strategies for meeting DMA2K plan maintenance requirements. Each community represented agreed upon a final plan maintenance strategy for their community to include monitoring and evaluation, plan implementation, and continued public involvement ☑ Developed a draft resolution document for use as a starting point for each community to use in the promulgation effort ☑ Discussed realistic schedules for presenting draft-final plans to the public and final plans to the town and tribal councils and board of supervisors ☑ Assigned the tasks for the next month: ▪ Prepare resolutions ▪ Write, review, and finalize plan ▪ Present plan to board of supervisors or city/town councils

3.2 Public Involvement

An important and valuable aspect of the planning process is public involvement. Members of the community, not specifically participating on the planning team or employed by the community, can prove to be great assets to the hazard mitigation planning process in many ways. The Coconino County MJPT employed the following strategies to solicit public involvement and input to the planning process:

- Sent press releases to all local newspapers, radio stations, and television stations.
- Provided information and interactive discussion at the annual Coconino County Fair held in September 2004.
- Developed a FAQ brochure to post on the Coconino County website (http://www.co.coconino.az.us/) and to distribute with the local community utility bills and newsletters.
- Requested public participation in the public hearing process mandated by state law for city/town councils and county board of supervisors to be able to adopt the promulgation resolution.

DMA2K Citation

Requirement §201.6(b)(1):

[The planning process shall include:] An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval

Copies of the various public announcements and postings and a copy of the FAQ brochure distributed with the newsletters are provided in Appendix C

The public hearing for final approval of the plan was convened on April 5, 2005, and an announcement of the availability of the plan for public review and comment was made in March, 2005.

No written responses or formal comments were received from the general public during the course of the planning effort; however several informal comments were made expressing appreciation for the information and effort.

SECTION 4: RISK ASSESSMENT

One of the key elements to the hazard mitigation planning process is the risk assessment. In performing a risk assessment, a community determines "what" can occur, "when" (how often) it is likely to occur, and "how bad" the effects could be[12]. According to DMA2K, the primary components of a risk assessment that answer these questions are generally categorized into the following measures:

- ☑ **Identify Hazards**
- ☑ **Profile Hazard Events**
- ☑ **Assess Vulnerability to Hazards**

DMA2K Citation

Requirement §201.6(c)(2):

[The plan shall include:…] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

The risk assessment for Flagstaff was performed using a county-wide perspective, with much of the information input and development being accomplished by the MJPT. The vulnerability analysis was performed in a way that the results reflect vulnerability at an individual community level, and at a county-wide level.

4.1 Hazard Identification

Hazard identification is the process of answering the question; *"What hazards can occur in my community or jurisdiction?"* Hazards impacting the city can be placed into two general categories, Natural and Human-Caused. Table 4-1 is a comprehensive, alphabetical listing of specific hazard types sorted by category. Each hazard has been identified by the State of Arizona Enhanced Hazard Mitigation Plan, which is herein referred to as the State Plan (URS, 2004) as a potential threat to Arizona communities. The Coconino County MJPT used this list as a starting

DMA2K Citation

Requirement §201.6(c)(2)(i):

[The risk assessment shall include:…] A description of the type, location, and extent of all natural hazards that can affect the jurisdiction.

[12] National Fire Protection Association, 2000, *Standard on Disaster/Emergency Management and Business Continuity Programs*, NFPA 1600.

Table 4-1

Summary of natural and human-caused hazard threats to Arizona communities

Natural Hazards	Human-Caused Hazards
• Avalanche • Drought • Dust/Sand Storms • Earthquake • Extreme Cold and Heat • Flooding/Flash Flooding • Infestations • Liquefaction • Landslides/Mudslides • Monsoon • Radon • Subsidence • Thunderstorm/High Winds • Tornadoes/Dust Devils • Tropical Storms/Hurricane • Volcanoes • Wildfires • Winter Storms	• Arson • Biological Hazards • Building/Structure Collapse • Civil Disobedience • Civil Disturbance • Civil Unrest • Dam/Levee Failure • Enemy Attack • Explosion/Fire • Extreme Air Pollution • Fuel/Resource Shortage • Hazardous Materials Incidents • Hostage Situation • Hysteria (Mass) • Power/Utility Failure • Radiological Accident • Sabotage • Special Event • Strike • Transportation Accident • Terrorism

point for the hazard identification process. Detailed definitions for each of these hazards are provided in the Glossary of Terms in Appendix D.

As previously discussed, the primary purpose of this hazard mitigation plan is to address natural hazards, and although many of the hazards identified in the human-caused category may certainly pose a risk to Flagstaff and other communities within Coconino County, the mitigation focus of the MJPT and Flagstaff officials was primarily natural hazards and those human-caused hazards with a perceived significant potential to impact the environment. Also, the MJPT recognized that schedule, budget and resources also limited the team's ability to completely analyze all potential hazards, therefore, many of the human caused hazards were eliminated from further consideration for this planning effort. A final list of hazards, summarized in Table 4-2, was arrived at using a systematic process of elimination that considered relevance, historical significance and experience, and catastrophic potential. The hazards given top ranking by the MJPT are indicated by **bold** text. For the purposes of this planning effort, the flooding/flash flooding and tropical storms/hurricane both

result in flooding, and are therefore considered together as one category. Similarly, the Dust/Sand Storms, Thunderstorms/High Winds, and Tornadoes/Dust Devils all typically occur as a result of thunderstorm activity and are all associated with high wind events. The italicized human-caused hazards will not be considered further due to resource limitations; however, the MJPT desired to include them in the list due to their relevance to the community.

Table 4-2

Summary of natural and human-caused hazards most significant to Flagstaff and Coconino County

Natural Hazards	Human-Caused Hazards
• Avalanche • **Drought** • Dust/Sand Storms • Earthquake • Extreme Cold and Heat • **Flooding/Flash Flooding** • Infestations • Landslides/Mudslides • Thunderstorm/High Winds • Tornadoes/Dust Devils • **Tropical Storms/Hurricane** • **Wildfires** • **Winter Storms**	• *Biological* • *Dam/Levee Failure* • *Explosion/Fire* • *Fuel / Resource Shortage* • *Hazardous Materials Incidents* • *Power/Utility Failure* • *Terrorism* • **Transportation Accidents**

4.2 Hazard Profiles

Hazard profiling answers the question; "How bad can it get?"[13] Developing a hazard profile includes researching and mapping historic hazard events, obtaining other hazard mapping, performing analysis and studies, and in Arizona, estimating the parameters used to establish the Calculated Priority Risk Index (CPRI) for each hazard considered.

The State Plan has documented hazard profiles for the following natural and human-caused hazards[14]:

[13] FEMA, 2001, *Understanding Your Risks; Identifying Hazards and Estimating Losses*, FEMA 386-2.

[14] URS, 2004, *Interim Draft of State of Arizona Hazard Mitigation Plan*, draft dated January 22, 2004.

- Dam Failure
- Disease
- Drought
- Earthquake
- Extreme Heat
- Flood
- Hail
- Hazardous Material (HAZMAT)
- Landslide
- Lightning
- Severe Winds
- Subsidence
- Terrorism
- Thunderstorm
- Tornado
- Tropical Cyclone
- Wildfire
- Winter Storm

Copies of those profiles and descriptions are included in Appendix E for reference. The information provided herein is intended to build upon those data sets and further describe the hazard profiles for the top ranked Coconino County hazards.

4.2.1 Historic Hazard Events

Research and mapping of historic hazard events is an important part of the hazard profiling process. These events not only establish a historic basis for mitigating the hazard, but also provide real-world estimates of the economic and human impacts of the hazard. Historic event data with a significant period of record can also be useful in developing probability statistics.

DMA2K Citation

Requirement §201.6(c)(2)(i):

[The risk assessment shall include:…] A description… jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The State of Arizona, in the development of its hazard mitigation plan, compiled a list of historic hazard events for communities across Arizona. The MJPT researched local records and governmental databases to update and add new records of recent hazards to the state compiled list. The list was also divided into two data sets. One data set summarizes historic hazard event and loss data that could be solely attributed to Coconino County. The other data set summarizes general statewide or multi-county, large-scale declarations that included Coconino County. The general data set's reported losses include counties other than Coconino, and therefore could not be attributed solely to Coconino County. The state's criteria for including a historic hazard event were:

- ✓ Reported damages of $50,000 or more
- ✓ At least one injury and/or fatality
- ✓ Historically significant event

Additional hazards records were researched using the same criteria, with the exception that all damages greater than $1 were included. Table 4-3 summarizes the results of the historic hazard research. The top hazards selected by the MJPT are indicated by bold type. Detailed listings of the summarized hazards are provided in Appendix F.

When reviewing Table 4-3, the reader should keep in mind that the numbers reported reflect the availability of such data from the sources researched, and that in reality it is expected that the numbers significantly under-predict the losses actually sustained over the past 30 to 40 years. A more thorough search for historic data in future planning efforts is warranted; however, for this first round of planning, the data sets can be considered representative.

4.2.2 Hazard Descriptions

The following are general summaries of the top hazards (those shown in **bold** print in Table 4-2) chosen by the MJPT as the most relevant and significant hazards impacting Coconino County. Refer to the descriptions in Appendix E for summaries of the other hazards listed.

DMA2K Citation

Requirement §201.6(c)(2)(i):

[The risk assessment shall include:…] A description of the type, location, and extent of all natural hazards that can affect the jurisdiction.

Drought – Currently, the entire State of Arizona is locked in the middle of a drought and has been declared eligible for drought emergency assistance through the U.S. Department of Agriculture. Drought declarations for the entire State have occurred consecutively for the last 6 years, with numerous prior declarations dating back to the time of statehood.

The impacts of a sustained drought affects many aspects of the industry, economy, and natural resources of Flagstaff and the rest of Coconino County. The most direct impacts are to the agricultural community, the development of domestic water supplies, tourism, and hydroelectric generation. Secondary influences include elevation of wildfire hazards and infestation problems.

Table 4-3

Summary of historic hazard research for Coconino County

Hazard	Statewide or Multiple County Declarations That Included Coconino County Communities				Substantially Coconino County Communities			
	No. of Records	Recorded Losses			No. of Records	Recorded Losses		
		Fatalities	Injuries	Damage Costs ($)		Fatalities	Injuries	Damage Costs ($)
Civil Disturbance	4	0	0	$281,000	0	0	0	$0
Drought	**75**	**0**	**0**	**$300,253,000**	**0**	**0**	**0**	**$0**
Earthquake	0	0	0	$0	8	0	0	$0
Flooding/Flash Flooding	**2**	**15**	**0**	**$570,471,000**	**10**	**18**	**10**	**$9,330,000**
Hazardous Materials Incident	1	0	0	$493,000	2	0	3	$54,000
Infestation	17	0	0	$1,042,000	0	0	0	$0
Landslide/Mudslides	0	0	0	$0	1	0	0	$8,000
Power/Utility Failure	2	0	0	$222,000	0	0	0	$0
Strike	1	0	0	$13,000	0	0	0	$0
Terrorism	1	0	0	$6,000	0	0	0	$0
Thunderstorms/High Winds	4	4	34	$11,050,000	10	15	49	$500,000
Transportation Accident	**0**	**0**	**0**	**$0**	**6**	**31**	**33**	**$43,000**
Tropical Storms/Hurricane	1	23	0	$5,800,000	0	0	0	$0
Wildfire	**18**	**0**	**0**	**$39,615,000**	**47**	**0**	**0**	**$100,000**
Winter Storm	**5**	**13**	**0**	**$527,000**	**4**	**15**	**65**	**$1,590,000**

The primary agricultural industry in Coconino County is ranching. According to the county comprehensive plan[15], virtually all the federal and state land in the county, except land under Park Service jurisdiction, is used for cattle grazing. In addition, about three-fourths of the county's private land consists of large ranches used almost exclusively for grazing cattle. Water for the livestock is provided by a

[15] Coconino County, 2003, *Coconino County Comprehensive Plan*

combination of developed springs, groundwater, stock tanks, or perennial streams. When drought conditions persist such as what is currently being experienced statewide, more demand is placed on groundwater supplies and rangeland grasses and other fodder, along with stock tank water supplies, are significantly reduced. This reduction forces ranchers to feed more hay and to truck in water, both of which significantly increase expenses.

From 1995 to 2003, Coconino County farmers and ranchers have received approximately $1.4 million[16] in disaster related assistance funds, and most, if not all, are attributable to drought. Given the prominence of Flagstaff as a center for business and trade in the county, the impacts of these losses are translated into the general economy in the form of higher food and agricultural goods prices, and less tax revenue.

Domestic water supplies also suffer with extended periods of drought. Water supplies for Flagstaff include a combination of surface water stored behind manmade impoundments and groundwater. Most of the individual or smaller domestic water supply companies source water is groundwater. As surface water volumes dwindle, more demand is placed on groundwater supplies. Reduced recharge of groundwater reservoirs results in lower groundwater tables and increased pumping expenses.

Hydroelectric generation is also threatened by an extended drought as reservoir levels drop below inactive pool levels. Within Coconino County, the primary source of hydroelectricity is Glen Canyon Dam (GCD) which forms Lake Powell. The GCD turbines have a capacity to generate approximately 1.3 million kilowatts of power and the federal government could experience an annual loss of $70 to $90 million in revenues should the turbines cease to operate.

Dust/Sand Storms – Dust or sand storms are typically associated with thunderstorm activity during the monsoon season and are the result of loose dirt and sand being picked up and moved along by turbulent winds. The greatest hazard posed by dust storms occurs when they intersect major transportation corridors, causing motorists to either panic or make poor decisions on stopping locations. This situation is especially true for portions of Interstate 40 and the major highways in the northeastern portion of the county, where normal vehicular speeds routinely exceed 65-75 mph. Other hazards associated with dust storms include

[16] Environmental Working Group, 2004, web link at: http://www.ewg.org/farm/progdetail.php?fips=04005&progcode=total_dis

increased airborne particulate concentrations that cause health problems and structural damages due to the wind.

Flooding/Flash Flooding/Tropical Storms – Flooding or flood related events are the number one hazard impacting Flagstaff and the rest of Coconino County, as documented in Table 4-3. Damaging floods in Flagstaff can be primarily categorized as either riverine or local area flows. Riverine flooding occurs along the established watercourses when the bankfull capacities are exceeded by storm runoff or snowmelt. Erosion is also often associated with damages due to flooding. Local area flooding is often the result of poorly designed or planned development wherein natural flowpaths are altered or obliterated and localized flooding problems result.

The following are highlights of the more prominent flooding events impacting Coconino County:

- In Janunary-February 1993, heavy rain fell over most of north, central and southeastern Arizona resulting in significant flooding along most major watercourses. In Coconino County, considerable damages were experienced in a few problem areas, with most damages occurring to structures built prior to the county's enactment of floodplain ordinances. According to the USACE Flood Damages Report [17], Coconino County had in excess of $5.5 million in public and private losses due to flooding damages. The flooding prompted a federal disaster declaration for almost the entire state.
- In August 1996, eleven hikers and tourists were drowned by a flash flood in Antelope Canyon, a narrow slot canyon five miles southeast of Page. A severe thunderstorm three to five miles upstream produced very heavy rain causing a wall of water to crash down Antelope Canyon. In the area of the flood fatalities the depth and width of Antelope Canyon varies from about 20 feet across and 30 feet deep to points where it is 200 feet deep but only two (2) feet across. A camera recovered after the event reveals a 50 to 80 foot wall of water swept through the canyon. It is a popular site for hiking and photography where access is via rope ladders controlled by Navajo Nation representatives. The eleven who died and a tour guide were warned not to enter the canyon because of the flood potential from an approaching thunderstorm. The tour guide alone survived after being carried several miles downstream by the flood.
- In September 1997, repeat thunderstorms over the Grand Canyon National Park produced some the worst flash flooding seen in years. Severe damage was done to the Bright Angel and North Kaibab hiking trails, forcing their closure for nearly two weeks. Flood waters also undermined a major water supply line to the South Rim. Conservative damage and repair amounts were estimated at $2.5 million. The injuries

[17] US Army Corps of Engineers, Los Angeles District, 1994, *Flood Damage Report – State of Arizona – Floods of 1993*

included one broken leg, and three with lacerations. In addition 26 campers were airlifted out of the canyon due to the trail washouts.

- In December 28, 2004 and January 12, 2005, severe storms caused major flooding to occur over Coconino, Gila, Mohave, Navajo, and Yavapai Counties, the Hopi Tribal Nation, and the portion of the Navajo Tribal Nation within the State of Arizona. On February 17, 2005, President Bush declared a major disaster for the damaged areas. Preliminary storm-wide damage assessments were approximated at $9 million.

For the purposes of this plan, the depiction and severity of flood hazard for Flagstaff is primarily based on the 100-year floodplains delineated on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM). Two designations of flood hazard are used, with "high" hazard areas being any "A" zone and "medium" flood hazard being either a "B" or "Shaded X" zones. All "A" zones (i.e. – A, A1-99, AE, AH, AO, etc.) represent areas with a one percent (1%) probability of being flooded at a depth of one-foot or greater in any given year. All "B" or "Shaded X" zones represent areas with a 0.2 percent (0.2%) probability of being flooded at a depth of one-foot or greater in any given year. These two storms are often referred to as the 100-year and 500-year storm, respectively. Figure 4-1 presents a map of Flagstaff with the FEMA delineated 100-year and 500-year flood limits shown.

Thunderstorms/High Winds – Hazards most typically associated with thunderstorms include lightning, microbursts, hail, dust and sand storms, and flooding. Flooding hazards have been discussed in the previous section. Specific and detailed profiles of the remaining elements are provided in Appendix E or in other areas of this plan. Areas of notable historic impact include the Glen Canyon Recreation Area/Lake Powell, where high wind events associated with thunderstorms transform the lake's water surface into dangerous waves that have proven to be fatal and extremely damaging to the surrounding marinas. Hailstorms frequently accompany late spring and early summer thunderstorms producing hail up to two-inches in diameter. There have also been a number of recorded lightning strike incidents at the Grand Canyon resulting in injuries or fatalities.

Tornado/Dust Devils – Damaging dust devils and tornados have occurred throughout Coconino County, and most were associated with thunderstorm activity. The worst tornado

CITY OF FLAGSTAFF

MULTI-HAZARD MITIGATION PLAN

Legend

- Interstates
- US,State,County Hwys
- Major Arterials
- BNSF Railroad
- Roadways
- Minor Watercourses
- Major Watercourses

Flooding Hazard

- High
- Medium

N

0 2,500 5,000 10,000

Feet

Sources:
Arizona Land Resource Information System, August 2003
Arizona Department of Emergency Management, 2003
URS, October 2003
Visual Risk, 2003
Coconino County GIS, 2004
City of Flagstaff GIS, 2004

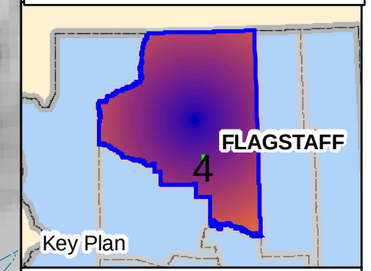

Figure 4-1

Flood Hazard Map
for City of Flagstaff

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documented in available records occurred in October 1992, was an F2 class, and reportedly caused at least $25,000 in damages. In October 2002, a strong dust devil at the Coconino County Fairgrounds caused property damage and personal injuries. The dust devil ripped shingles off two roofs, blew down four large tents, blew over a ticket booth and split the supporting beams on a permanent structure. Two people sustained minor scrapes and bruises and one person reported a back injury (NCDC, 2004).

Wildfire – A large part of Coconino County and all of Flagstaff is characterized by the Arizona Mountain Forest ecoregion, with its large areas of dense pine forests (see Figure 1-3). This region presents the greatest wildfire hazard in the county. Vegetation in other areas of the county is relatively sparse and does not pose much of a threat. The Greater Flagstaff Forests Partnership (GFFP) and Ponderosa Fire Advisory Council (PFAC) combined forces to prepare the Greater Flagstaff Area Community Wildfire Protection Plan[18] (CWPP) for a significant portion of the forested areas within the vicinity of Flagstaff. Figure 4-2 is an excerpt from the CWPP showing the limits of the study area and the extent of communities identified to be within wildland/urban interface areas. Three factors influence the spread of wildfire; fuel, weather, and topography. Only fuel can be managed to reduce the intensity and spread of wildfire. The mountainous regions of Coconino County offer significant sources of fuel and topography favorable to wildfire. The intersection of environmental and economic sectors versus historically natural fire patterns and seasons, has left much of the forested areas in a prime condition to experience extremely destructive fires. In addition, overlap hazards such as bark beetle infestations and extended severe drought conditions only exasperate the wildfire hazard. Figure 4-3 is a map from the CWPP presenting vegetation types within the CWPP study limits. Figure 4-4 presents a map of the greater Flagstaff area depicting various wildfire hazard areas that range from extreme to low. Also depicted on Figure 4-4 are historic fire locations and sizes. The map is based on the data prepared and presented in the State Plan, with slight modifications made by the Coconino County MJPT to correct anomalies in the delineations and provide closer correlation to the CWPP in some locations.

[18] GFFP and PFAC, 2004, *Greater Flagstaff Area Community Wildfire Protection Plan*

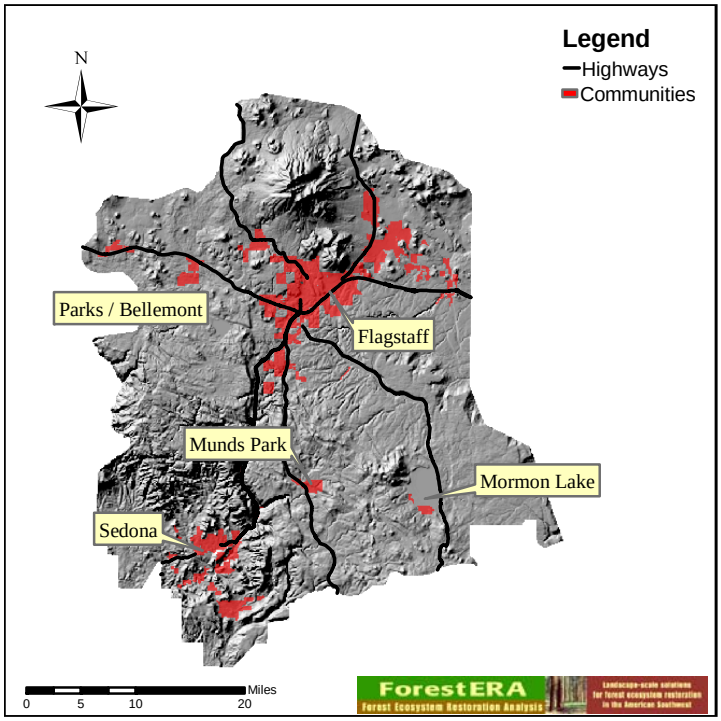


Figure 4-2

Limits of CWPP Study Area

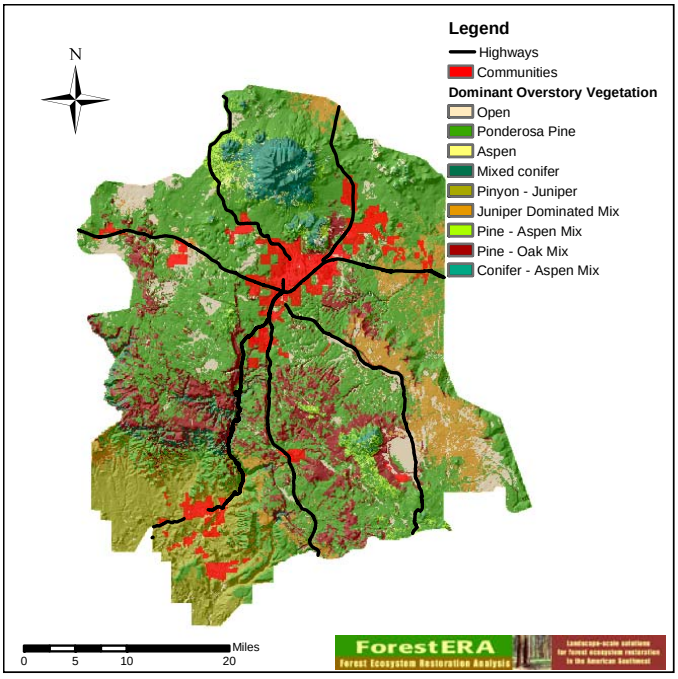


Figure 4-3

Dominant Vegetation Types within the CWPP Study Area

CITY OF FLAGSTAFF

MULTI-HAZARD MITIGATION PLAN

Legend

- Interstates
- US,State,County Hwys
- Major Arterials
- BNSF Railroad
- Roadways
- Minor Watercourses
- Major Watercourses

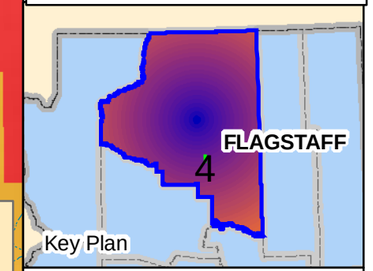
Fire Hazard

- Low
- Medium
- High
- Extreme

Historic Fires

- Less than 10 acres
- 10 - 100 acres
- 100 - 500 acres
- 500 - 5000 acres
- Greater than 5000 acres

Sources:
Arizona Land Resource Information System, August 2003
Arizona Department of Emergency Management, 2003
URS, October 2003
Visual Risk, 2003
Coconino County GIS, 2004
City of Flagstaff GIS, 2004



0

0 2,500 5,000 10,000

Feet

Figure 4-4

Wildfire Hazard Map
for City of Flagstaff

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Winter Storms – Winter snows are the lifeblood of water supplies for Flagstaff and most of Coconino County. However, according to the database summarized in Table 4-3, winter storms are second most costly and deadly natural hazard to impact Coconino County. Severe winter storms affect many aspects of life in the county including; transportation, emergency services, utilities, agriculture and the supply of basic subsistence to isolated communities. Interstates 40 and 17 have produced numerous fatal multi-car accidents due to heavy winter snowfall and icy road conditions. Heavy snowfalls can also leave motorists stranded in their vehicles with potentially disastrous results like hypothermia and carbon-monoxide poisoning. Significant snowstorms can also hinder both ground and air emergency services vehicles from responding to accidents or other emergencies. Remote areas and communities can be easily cut-off from basic resources such as food, water, electricity, and fuel for extended periods during a heavy storm. Extremely heavy snowstorms can produce excessive snowloads that can cause structural damage to under-designed buildings. Agricultural livestock can also be vulnerable to exposure and starvation during heavy snowstorms. The following are highlights of the more prominent flooding events impacting Coconino County:

- In December of 1967 to January of 1968, the worst winter storm to impact Coconino County occurred paralyzing most of northern Arizona and bringing snow to much of the state. The storm was actually two storms, with the second following closely on the heels of the first. During the nine day period, 86.0 inches of snow fell at Flagstaff. On December 14, a one-day state record of 38.0 inches fell at the Heber Ranger Station with reported totals of 91.5 inches at the Heber Ranger Station, 32.5 inches at Sedona, and 31.0 inches at the South Rim of the Grand Canyon. The Navajo Nation was extremely hard hit as two to three feet of snow fell across the community. Window Rock measured 33.5 inches. People on the reservation were instructed to use ashes from their stoves to write distress signals in the snow that could be spotted from the air. Heavy snows isolated Page and other Northern Arizona communities for approximately two weeks. Most roads were closed and emergency food had to be airlifted into the communities. The total disaster cost to the State of Arizona was $2.2 million in 1997 dollars. A total of eight people died of exposure. (ADEM, 2004).
- In January of 1995, heavy snows and wind downed powerlines and caused a 60 foot tree to fall on a mobile home in the Flagstaff area. Storm related damages were estimated at over $50,000. (NCDC, 2003)
- In January of 1997, a heavy winter storm moved through the northern part of the state dropping 34 inches of snow on the Flagstaff are and forcing the closure of Interstates 17 and 40. The total disaster cost to the State of Arizona was $1.6 million in 1997 dollar. (ADEM, 2004)

The National Climatic Data Center[19] has compiled snow climatology statistics for Arizona using historic record data from statewide National Weather Service cooperative observer site for the period of 1948 to 1996[20]. The NCDC used these data sets to develop 1-, 2-, and 3-day, 10-, 25-, 50-, and 100-year recurrence interval statistics for each of the statistically eligible[21] stations. Each station in Arizona and the nearest stations in the surrounding states of California, Nevada, Utah, Colorado, and New Mexico were queried from this data set to establish maps showing statistical projections of the 1- and 3-day, 10- and 100-year snow depths. For each recurrence interval, simplified isohyetals of snow depth were developed using standard contouring methodology and consideration of geographic features such as mountain peaks, the Mogollon Rim, etc. The resultant maps can then be used to conceptually estimate potential snow depths for each of the recurrence intervals at any given location within the state. Figures 4-5, 4-6, 4-7, and 4-8 present the results for the 1-day, 10-year; 1-day, 100-year; 3-day, 10-year; and 3-day, 100-year events. *It is duly noted that the results provided on these maps are for the benefit of hazard mitigation planning only and should not be used for design purposes*.

Transportation Accident – Flagstaff is home to several major transportation elements. Interstate 40 is a major trucking route that nearly spans the entire U.S. from east to west. Interstate 17 connects Interstates 40 and 10 and is the primary truck route south into Phoenix. U.S. Highways 89 and 89A are the primary connectors between Sedona, Flagstaff, and Page. U.S. Highway 180 and State Route 64 provide access to the south rim of the Grand Canyon and U.S. Highway 160 serves as the primary artery across the Navajo and Hopi Nations to the Four Corners area. There are also hundreds of miles of other state and county roadways that comprise the county's transportation infrastructure. The Burlington-Northern Santa Fe (BNSF) Railway extends east-west through the southern portion of the county and passes directly through the hearts of Flagstaff and Williams. AMTRAK also operates on the BNSF lines and maintains passenger depots in Flagstaff and Williams. The City of Flagstaff operates Flagstaff-Pulliam Airport, which is the largest commercial airport in the county.

[19] The NCDC is a part of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

[20] NOAA/National Climatic Data Center, 1998, *United States Snow Climatology*, TD-9641

[21] Those stations with sufficient continuous data.

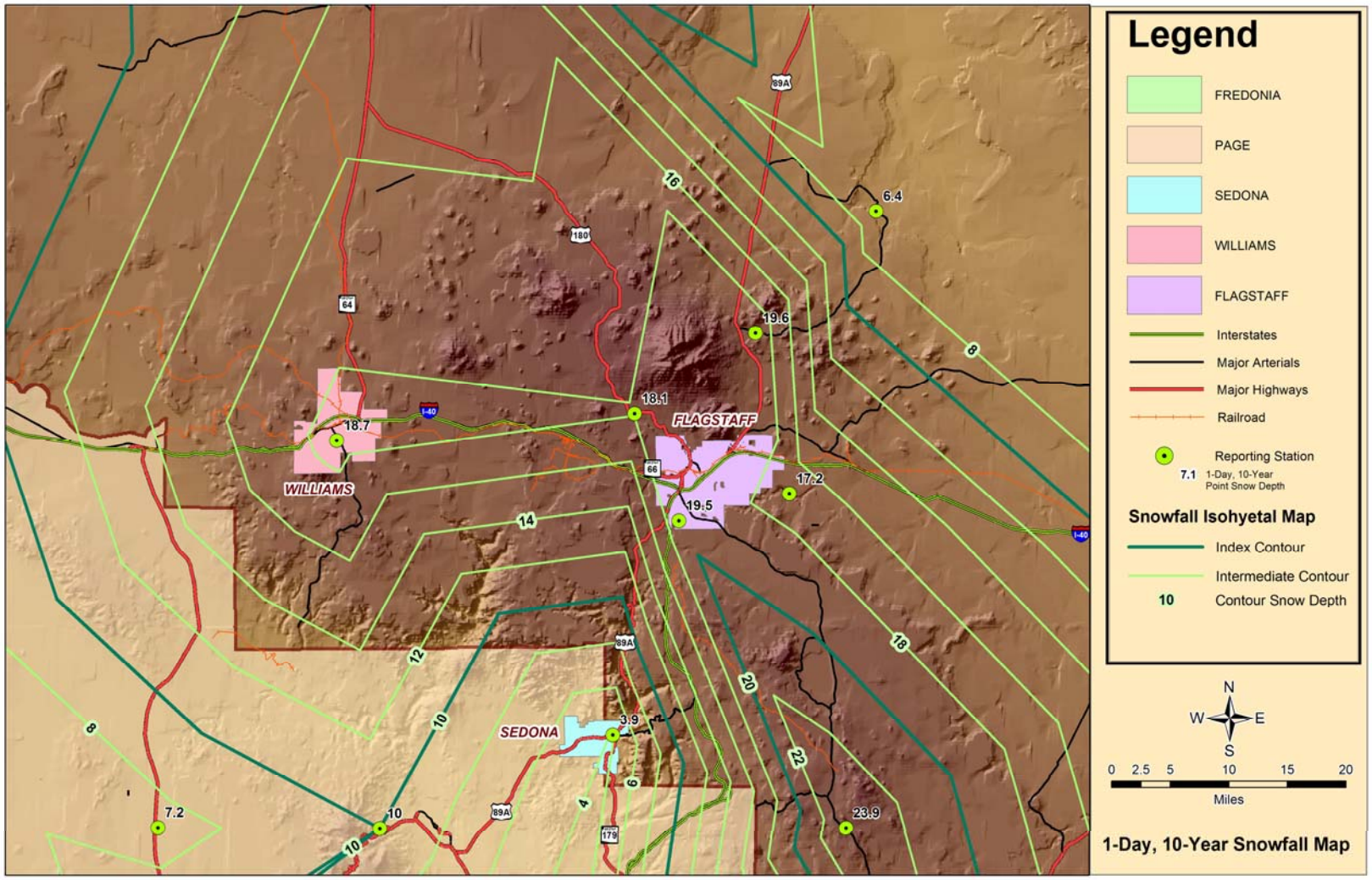

Figure 4-5

1-Day, 10-Year Snow Depth Map for the Greater Flagstaff Area

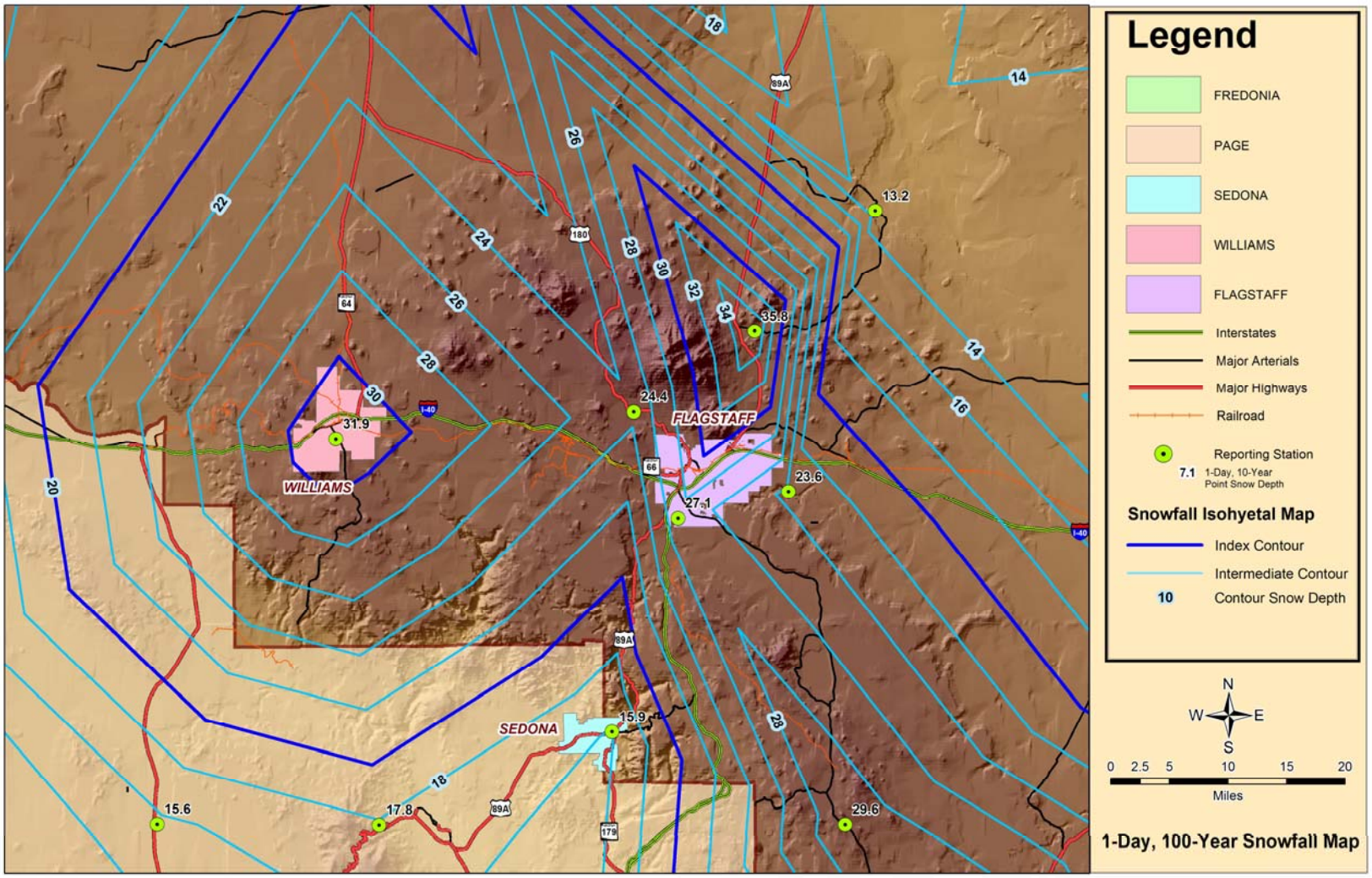

Figure 4-6

1-Day, 100-Year Snow Depth Map for the Greater Flagstaff Area

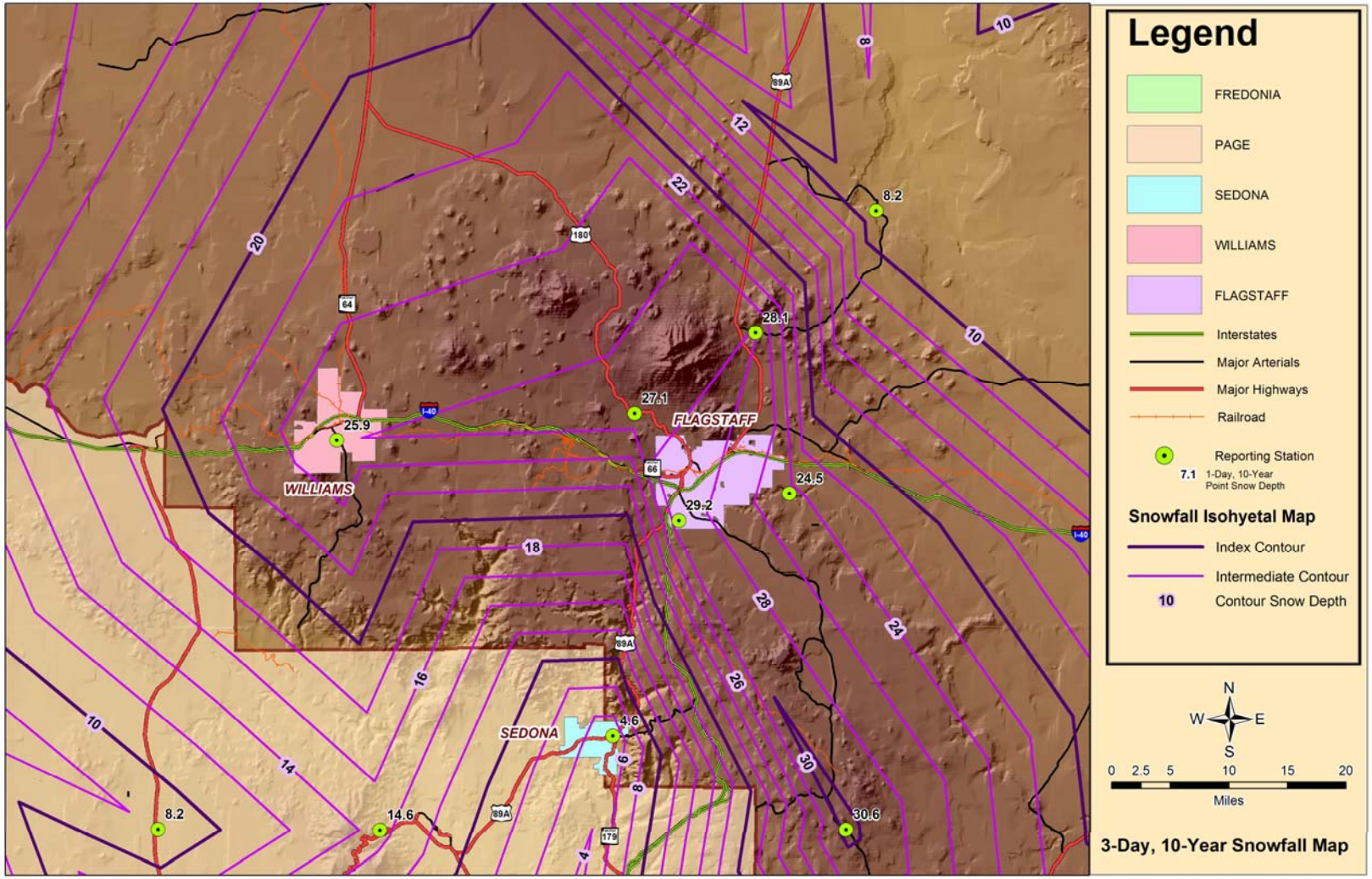

Figure 4-7

3-Day, 10-Year Snow Depth Map for the Greater Flagstaff Area

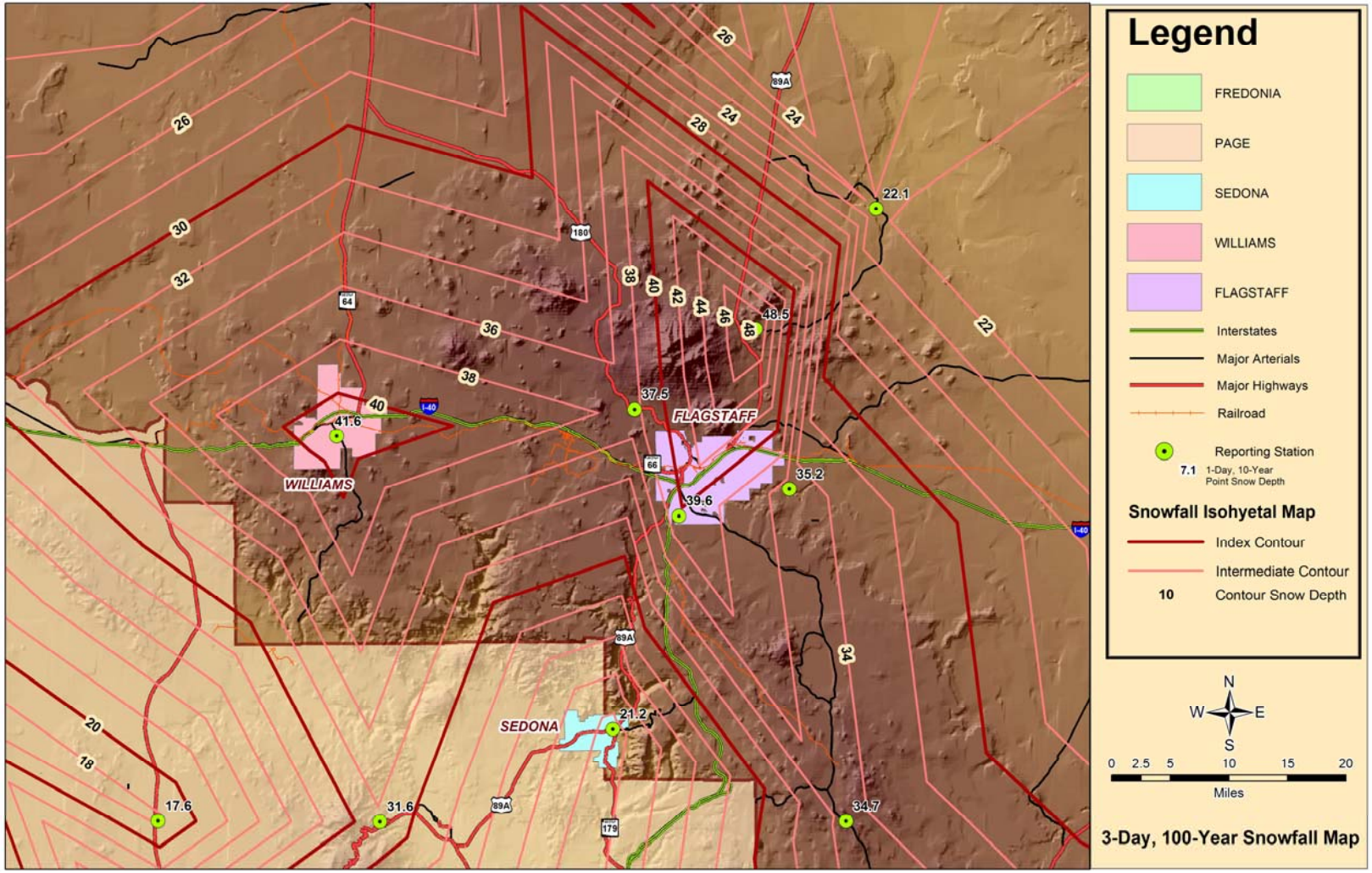

Figure 4-8

3-Day, 100-Year Snow Depth Map for the Greater Flagstaff Area

Other commercial airports are located in Grand Canyon National Park and Page. Smaller, public-use airports are located in Tuba City, Williams, and Valle, and there are several other private airstrips scattered across the county. The combined impact of all the air, roadway, and railway traffic presents an appreciable hazard potential to Flagstaff and other urbanized areas of the county. Major transportation routes for the Flagstaff area are shown on Figure 1-2.

In the past, Flagstaff area residents have been exposed to several train derailments, train/vehicle and train/pedestrian accidents, multiple car accidents due to winter storms and icy roadways, and airplane crashes. In most cases, the actual property damages at an incident level are limited to the vehicles involved. The greatest losses are manifested in fatalities and injuries. Associated consequences may include hazardous material releases, emergency response capacity limitations, freeway/highway closures, and wildfire ignition.

4.2.3 Hazard CPRI Ranking

Within the Arizona Hazard Mitigation Planning System (AzHMPS), the state has incorporated a tool (CPRI) by which individual hazards can be evaluated and even ranked according to an indexing system. The CPRI value is obtained by assigning varying degrees of risk to four (4) categories for each hazard, and then calculating an index value based on a weighting scheme per Table 4-4 [22]. Table 4-5 summarizes the CPRI element assignments and resulting value for each hazard summarized in Table 4-2, with the MJPT top ranked hazards indicated by ***italicized bold*** text.

[22] Table 4.3 from the AzMLHMP

Table 4-4

Summary of Calculated Priority Risk Index (CPRI) categories and risk levels

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	• Extremely rare with no documented history of occurrences or events. • Annual probability of less than 0.001.	1	45%
	Possibly	• Rare occurrences with at least one documented or anecdotal historic event. • Annual probability that is between 0.01 and 0.001.	2	
	Likely	• Occasional occurrences with at least two or more documented historic events. • Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	• Frequent events with a well documented history of occurrence. • Annual probability that is greater than 0.1.	4	
Magnitude/ Severity	Negligible	• Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). • Injuries or illnesses are treatable with first aid and there are no deaths. • Negligible quality of life lost. • Shut down of critical facilities for less than 24 hours.	1	30%
	Limited	• Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). • Injuries or illnesses do not result in permanent disability and there are no deaths. • Moderate quality of life lost. • Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	• Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). • Injuries or illnesses result in permanent disability and at least one death. • Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	• Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). • Injuries or illnesses result in permanent disability and multiple deaths. • Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self explanatory.	4	15%
	6 to 12 hours	Self explanatory.	3	
	12 to 24 hours	Self explanatory.	2	
	More than 24 hours	Self explanatory.	1	
Duration	Less than 6 hours	Self explanatory.	1	10%
	Less than 24 hours	Self explanatory.	2	
	Less than one week	Self explanatory.	3	
	More than one week	Self explanatory.	4	

Table 4-5

Summary of CPRI values for each hazard

Hazard	Probability	Magnitude Severity	Warning Time	Duration	CPRI
Natural Hazards					
Avalanche	Possible	Limited	Less than 6 hours	Less than 6 hours	2.20
Drought	***Likely***	***Limited***	***24+ Hours***	***More than one week***	***2.50***
Dust/Sand Storms	Possible	Limited	Less than 6 hours	Less than 6 hours	2.20
Earthquake	Possible	Critical	Less than 6 hours	Less than 6 hours	2.50
Extreme Cold	Likely	Limited	6-12 Hours	Less than one week	2.70
Extreme Heat	Likely	Limited	24+ Hours	Less than one week	2.40
Flooding/Flash Flood	***Likely***	***Limited***	***Less than 6 hours***	***Less than one day***	***2.75***
Infestations	Possible	Limited	Less than 6 hours	More than one week	2.50
Landslides/Mudslides	Possible	Limited	Less than 6 hours	Less than 6 hours	2.20
Thunderstorms/ High Winds	Likely	Limited	Less than 6 hours	Less than 6 hours	2.65
Tornadoes/Dust Devil	Possible	Limited	Less than 6 hours	Less than 6 hours	2.20
Tropical Storms/Hurricanes	***Likely***	***Limited***	***6-12 Hours***	***Less than one day***	***2.60***
Wildfires	***Likely***	***Critical***	***Less than 6 hours***	***More than one week***	***3.25***
Winter Storms	***Likely***	***Limited***	***12-24 Hours***	***Less than one week***	***2.55***
Human-Caused Hazards					
Biological Hazards	Possible	Limited	Less than 6 hours	More than one week	2.50
Dam/Levee Failure	Possible	Critical	6-12 Hours	Less than one day	2.45
Explosion/Fire	Possible	Limited	Less than 6 hours	Less than one day	2.30
Fuel/Resources Shortage	Possible	Limited	24+ Hours	More than one week	2.05
Hazardous Materials Incidents	Possible	Limited	Less than 6 hours	Less than one week	2.40
Power/Utility Failure	Possible	Limited	Less than 6 hours	More than one week	2.50
Terrorism	Possible	Limited	Less than 6 hours	Less than one week	2.40
Transportation Accident	***Likely***	***Limited***	***Less than 6 hours***	***Less than one day***	***2.75***

4.3 Vulnerability Assessment

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends and intersecting them with the hazard profiles to assess the potential amount of damage that could be caused by each hazard event. This concept is generally illustrated by Figure 4-9.

DMA2K Citation

Requirement §201.6(c)(2)(ii):

[The risk assessment shall include:…] (ii) A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

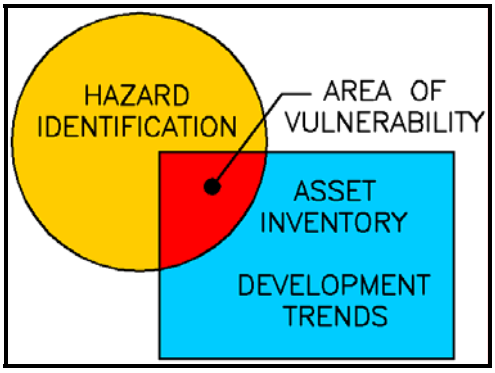

Figure 4-9
Conceptual depiction of a vulnerability analysis

For the City of Flagstaff Multi-Hazard Mitigation Plan, the following tasks were performed as a part of the vulnerability assessment:

- ☑ **Assets Inventory**
- ☑ **Potential Loss Estimations**
- ☑ **Development Trends Analysis**

The following sections summarize the MJPT efforts to assemble and analyze the data needed for the vulnerability assessment, and present the results.

4.3.1 Asset Inventory

The State of Arizona Hazard Mitigation Plan defines assets as:

Any natural or human-caused feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

DMA2K Citation

Requirement §201.6(c)(2)(ii)(A):

The plan should describe vulnerability in terms of: (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;

Assets identified by the MJPT for Coconino County and the incorporated communities are classified as either critical or non-critical facilities and infrastructure. Critical facilities and infrastructure are those systems within a community whose incapacity or destruction would have a debilitating impact on the community's ability to recover following a major disaster, or to defend the people and structures of the community from further hazards. Following the criteria set forth by the Critical Infrastructure Assurance Office (CIAO), the State of Arizona has adopted eight general categories[23] that define critical facilities and infrastructure:

1. **Telecommunications Infrastructure:** Telephone, data services, and Internet communications, which have become essential to continuity of business, industry, government, and military operations.
2. **Electrical Power Systems:** Generation stations and transmission and distribution networks that create and supply electricity to end-users.
3. **Gas and Oil Facilities:** Production and holding facilities for natural gas, crude and refined petroleum, and petroleum-derived fuels, as well as the refining and processing facilities for these fuels.
4. **Banking and Finance Institutions:** Banks, financial service companies, payment systems, investment companies, and securities/commodities exchanges.
5. **Transportation Networks:** Highways, railroads, ports and inland waterways, pipelines, and airports and airways that facilitate the efficient movement of goods and people.

[23] Instituted via Executive Order 13010, which was signed by President Clinton in 1996.

6. **Water Supply Systems:** Sources of water; reservoirs and holding facilities; aqueducts and other transport systems; filtration, cleaning, and treatment systems; pipelines; cooling systems; and other delivery mechanisms that provide for domestic and industrial applications, including systems for dealing with water runoff, wastewater, and firefighting.
7. **Government Services:** Capabilities at the federal, state, and local levels of government required to meet the needs for essential services to the public.
8. **Emergency Services:** Medical, police, fire, and rescue systems.

Other assets such as public libraries, schools, museums, parks, recreational facilities, historic buildings or sites, churches, residential and/or commercial subdivisions, apartment complexes, and so forth, are classified as non-critical facilities and infrastructure, as they are not necessarily "critical" per the definition set forth in Executive Order 13010. They are however, very important to the city and the reader should not construe critical and non-critical to equate to important and non-important.

The MJPT performed a detailed asset inventory for each of the participating communities including Flagstaff, Page, Sedona, Williams, and Unincorporated Coconino County. The community of Fredonia opted to not participate in the planning process. Information collected included the facility's physical location and/or mailing address, description, contact information, replacement cost, potential economic loss, and size. Table 4-6 summarizes the number of facilities identified by category and community and Table 4-7 summarizes the total replacement costs and economic impact categorized by community. Replacement costs were generally estimated using tax assessor, insurance, or current market value estimates. The City of Flagstaff data sets are compiled in Appendix H, which is a separately bound technical appendix that for security reasons, will not be generally distributed to the public. Appendix H may be viewed upon appointment with, and the supervision of, City of Flagstaff officials.

Potential annual economic loss values are based on an estimate of the annual revenue attributed to each facility. It should be noted that replacement costs and economic loss values were not estimated for all structures and will require further investigation and estimates during future planning efforts.

Table 4-6

Summary of critical and non-critical facilities in Coconino County

Facility Type	Flagstaff	Page	Sedona[24]	Williams	Unincorporated Coconino County	Coconino County Totals
Critical Facilities and Infrastructure						
Telecommunications Infrastructure	**0**	1	0	0	61	62
Electrical Power Systems	**3**	5	0	0	6	14
Gas and Oil Facilities	**3**	3	0	3	0	9
Banking and Finance Institutions	**0**	4	0	2	0	6
Transportation Networks	**3**	4	0	2	3	12
Water Supply Systems	**63**	8	13	1	17	102
Government Services	**11**	6	0	6	27	50
Emergency Services	**11**	3	4	5	12	35
Non-Critical Facilities and Infrastructure						
Residential	**3**	0	0	0	0	3
Educational	**65**	10	0	6	19	100
Cultural	**17**	8	0	15	12	52
Flood Control	**0**	0	0	0	0	0
Commercial Business	**2**	9	0	16	1	28

Table 4-7

Summary of estimated replacement and potential economic loss costs

Participating Community	Number of Facilities	Percent of All Coconino County Facilities	Total Estimated Replacement Cost	Potential Annual Economic Loss
All Coconino County	**473**	**100%**	**$10,621,319,462**	**$210,461,178**
Flagstaff	**181**	**38%**	**$140,588,070**	**$210,461,178**
Page	61	13%	$10,393,049,999 [a]	$0
Sedona	17	4%	$2,090,000	$0
Williams	56	12%	$7,705,000	$0
Unincorporated County	158	33%	$77,886,393	$0

[a] – This number includes an estimated $10 billion replacement cost for Glen Canyon Dam and associated facilities

[24] Portion of Sedona within Coconino County Only

4.3.2 Loss Estimations

DMA2K Citation

Requirement §201.6(c)(2)(ii)(B):

[The plan should describe vulnerability in terms of: …] (B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate;

Economic and human loss estimates for each of the major hazards identified in Section 4.2 begins with an assessment of the potential exposure of critical and non-critical assets and human populations to those hazards. Estimates of exposure to critical and non-critical assets identified by Coconino County communities is accomplished by intersecting the hazard profiles with the assets identified in Section 4.3.1. Human or population exposures are estimated by intersecting the same hazards with 2000 Census Data population statistics that have been re-organized into GIS compatible databases and distributed with HAZUS®-MH [25]. *It is duly noted that the HAZUS Data population statistics may not exactly equate to the population statistics provided in Section 1.3.3 due to GIS positioning anomalies and the way HAZUS depicts certain census block data. However, the results are representative of the general magnitude of population exposures to the various hazards discussed.* Additional loss estimations for general residential, commercial, and industrial building stock inventories compiled in the HAZUS®-MH databases also represent a further depiction of the potential exposure.

Due to limited resources and time, the detailed vulnerability analysis for this planning effort is limited to the top hazards indicated in Tables 4-2 and 4-5. With regard to the community assets and population, exposure risk for drought is not readily or easily defined geographically. Instead, exposure risks to these hazards are considered to be equal across the entire county. The top hazards identified in Tables 4-2 and 4-5 fitting this category include drought and thunderstorm/high winds.

Table 4-7 summarizes the county-wide exposure potential of all specific critical and non-critical facilities identified by the MJPT participants and communities. Table 4-8 summarizes the county-wide potential exposure for the human population and general

[25] U.S. Department of Homeland Security, Federal Emergency Management Agency, HAZUS®-MH, build 31

Table 4-8

Summary of county-wide potential exposure for human population and general residential, commercial, and industrial sector structures

Coconino County HAZUS Summary by Community	Population Exposed	Population Over 65	Incomes Under $20K	Residential Building Count	Residential Building Value (x1000)	Residential Content Value (x1000)	Residential Potential Economic Impact (x1000)	Commercial Building Count	Commercial Building Value (x1000)	Commercial Content Value (x1000)	Commercial Potential Economic Impact (x1000)	Industrial Building Count	Industrial Building Value (x1000)	Industrial Content Value (x1000)	Industrial Potential Economic Impact (x1000)	Total of All Building and Content Exposure (x1000)
Totals	**116312**	**7659**	**9480**	**42891**	**$ 6,134,559**	**$ 3,067,276**	**$ 9,201,835**	**499**	**$ 901,366**	**$ 954,010**	**$ 1,855,376**	**19**	**$ 97,484**	**$ 121,720**	**$ 219,204**	**$ 11,276,415**
Flagstaff	53536	2772	4809	14541	$ 2,684,319	$ 1,342,160	**$ 4,026,479**	315	$ 585,922	$ 626,698	**$ 1,212,620**	11	$ 59,459	$ 75,218	**$ 134,677**	**$ 5,373,776**
Page	6809	377	459	2377	$ 253,964	$ 126,965	**$ 380,929**	45	$ 61,332	$ 63,011	**$ 124,343**	2	$ 4,023	$ 4,516	**$ 8,539**	**$ 513,811**
Sedona	2955	918	263	1545	$ 272,058	$ 136,015	**$ 408,073**	36	$ 64,163	$ 65,855	**$ 130,018**	1	$ 3,748	$ 5,106	**$ 8,854**	**$ 546,945**
Williams	2842	308	269	945	$ 137,651	$ 68,799	**$ 206,450**	18	$ 24,297	$ 25,622	**$ 49,919**	0	$ 1,058	$ 1,399	**$ 2,457**	**$ 258,826**
Unincorporated Areas	50170	3284	3680	23483	$ 2,786,567	$ 1,393,337	**$ 4,179,904**	85	$ 165,652	$ 172,824	**$ 338,476**	5	$ 29,196	$ 35,481	**$ 64,677**	**$ 4,583,057**

Coconino County HAZUS Summary by Community	% Population Exposed	% Population Over 65	% Incomes Under $20K	% Residential Building Count	% Residential Building Value ($)	% Residential Content Value ($)	% Residential Potential Economic Impact ($)	% Commercial Building Count	% Commercial Building Value ($)	% Commercial Content Value ($)	% Commercial Potential Economic Impact ($)	% Industrial Building Count	% Industrial Building Value ($)	% Industrial Content Value ($)	% Industrial Potential Economic Impact ($)
Totals	**100%**	**7%**	**8%**	100%	100%	100%	**100%**	100%	100%	100%	**100%**	100%	100%	100%	**100%**
Flagstaff	**46%**	**2%**	**4%**	34%	44%	44%	**44%**	63%	65%	66%	**65%**	58%	61%	62%	**61%**
Page	**6%**	**0%**	**0%**	6%	4%	4%	**4%**	9%	7%	7%	**7%**	11%	4%	4%	**4%**
Sedona	**3%**	**1%**	**0%**	4%	4%	4%	**4%**	7%	7%	7%	**7%**	5%	4%	4%	**4%**
Williams	**2%**	**0%**	**0%**	2%	2%	2%	**2%**	4%	3%	3%	**3%**	0%	1%	1%	**1%**
Unincorporated Areas	**43%**	**3%**	**3%**	55%	45%	45%	**45%**	17%	18%	18%	**18%**	26%	30%	29%	**30%**

residential, commercial, and industrial sectors. Specific loss estimates for each of the top hazards in Tables 4-2 and 4-5, and descriptions of the estimation methodology, are summarized according to hazard in the following paragraphs.

Drought – The impacts of drought to critical and non-critical facilities and building stock is generally indirect, in that drought is often a contributing factor to other hazards such as wildfire, infestation and flooding. Extended drought may weaken and dry the grasses, shrubs, and trees of wildfire areas, making them more susceptible to ignition and destruction by infestation. Drought also tends to reduce the vegetative cover in watersheds, and hence decreases the interception of rainfall and increases the flooding hazard. The sectors in Flagstaff most directly impacted by drought are potable water supplies, and recreation/tourism, with indirect impacts from agriculture/ranching.

According to the Arizona Agricultural Statistics Service, which is a branch of the National Agricultural Statistic Service (NASS) and the U.S. Department of Agriculture (USDA), the estimated 2002 cash receipts [26] for crops and livestock in Coconino County was $967,000 and $13.98 million. It is plausible to assume that all of the Coconino County agriculture is vulnerable to drought, and in 2002, Coconino County farmers and ranchers received approximately $459,000 [27] in USDA disaster assistance, with most of it directly attributable to drought. Table 4-9 provides a summary of total cash receipts versus federal disaster assistance for 1998 through 2002. All dollars are adjusted to 2002 value for direct comparison. As previously discussed, 1997 to 1998 is believed to be the beginning of the current drought cycle. The results in Table 4-9 clearly indicate the increased federal disaster assistance with each consecutive year of drought, contrasted to decreased cash receipts on the part of the agricultural community, and especially the ranchers. Given this direct correlation, it is assumed that 100 percent of the disaster money is directly attributable to drought relief. Using the 2002 data, it is very reasonable to assume that continued drought could easily result in an annual county-wide agricultural disaster cost of $0.5 million. Of this, it is estimated that at least $100,000 is directly attributable to the City of Flagstaff.

[26] U.S Department of Agriculture, Arizona Agricultural Statistics Service, 2004, *2002 Annual Statistics Bulletin*, as posted at the following URL: http://www.nass.usda.gov/az/03bul/main.htm

[27] Environmental Working Group, 2004, URL: http://www.ewg.org:16080/farm/progdetail.php?fips=04005&progcode=total_dis&page=

Table 4-9

Summary of agricultural economic and disaster assistance statistics for Coconino County

Year	Cash Receipts			Inflation Adjustment Factor	Inflation Adjusted Total	Disaster Dollars Received	Inflation Adjusted Disaster Dollars
	Crops	Livestock	Total				
All Dollar Amounts in Thousands of Dollars (x $1,000)							
1998	1,717	34,550	36,267	1.09	39,500	0.0	0.0
1999	3,268	35,062	38,330	1.07	41,000	0.0	0.0
2000	1,273	27,128	28,401	1.04	29,500	41.9	43.6
2001	1,046	28,238	29,284	1.02	29,900	227.0	231.5
2002	967	13,989	14,956	1	15,000	459.3	459.3

References: Cash Receipts: USDA Arizona Agricultural Statistics Service, 2004
Inflation Adjustments: Consumer Price Index
Disaster Dollars: Environmental Working Group, 2004

According to 2004 financial information published by the city[28], operating budgets for the Lake Mary Water Treatment Plant have increased over the past several years. The most marked increase is in well field operation costs. According to the report, most of the increases are primarily due to "power for use of new town wells and increased use of the Woody Mountain Wellfield." The line item cost increases related to wells over the two fiscal years was nearly $300,000. Assuming that half of this cost was in part due to increased pumping demands because of lack of surface water supplies, then it is reasonable to estimate a net average annual expense of $75,000 is directly attributable to drought.

Other economic losses associated with drought could include impacts to tourism. According to the Arizona Office of Tourism [29], Flagstaff's Snowbowl ski area attracted 90,000 visitors during the 2002-2003 season. The average annual attendance for the ski area is estimated at 125,000. Assuming a conservatively low gross expenditure of $40 per person, the average gross seasonal expenditure would then be approximately $5 million. Using the local tax rate of 8 percent, the average tax revenues from the ski area would be around $400,000. Using the 2002-2003 season as an example, the state and county experienced a

[28] City of Flagstaff, 2004, *Annual Budget and Financial Plan – Fiscal Year 2003-2004*, Utilities Department

[29] Arizona Office of Tourism, 2003, *Arizona Monthly Tourism Indicators, February 2003.*

loss of $100,000 in tax revenues due to the ski season being limited, with the likely cause being drought.

Combining the potential losses from each of these sectors, it is easily conceivable that annual costs due to drought for the city as a whole could add up to $0.2 million or more.

Floods – The estimation of potential exposure to flooding was accomplished by intersecting the human and facility assets with the FEMA delineated 100-year and 500-year floodplain limits. Digital floodplain mapping was obtained from the Federal Emergency Management Agency (FEMA), Coconino County, and the Cities of Flagstaff and Sedona. Most of the delineated floodplains are based on FEMA Flood Insurance Rate Maps (FIRM) for Flagstaff and associated communities. The 100-year floodplains (A Zones) are assumed to be high hazard areas. The 500-year (Zone B and Shaded Zone X) floodplains are assumed to be of medium hazard. Everything else is considered as low hazard. Loss estimates to all facilities located within the 100-year and 500-year floodplains were made based on the loss estimation tables published by FEMA[30]. Most of the assets located within high hazard flood areas will be subject to three feet or less of flooding. Using the FEMA tables, it is assumed that all specifically identified assets located within the high hazard areas will have a loss-to-exposure ratio of 0.20 (or 20%). A loss to exposure ratio of 0.05 (5%) is assumed for the HAZUS exposure data to account for the spatial variability of those data sets within the identified floodplain hazard areas. Similarly, loss to exposure ratios of 0.025 (2.5%) and 0.01 (1%) are used for the MJPT identified assets and HAZUS structures located in the medium hazard areas. For economic losses (where reported), it is assumed that high and medium flood hazard facilities will be unproductive for 30 and 7 days, respectively. Table 4-10 summarizes the MJPT identified assets that are potentially exposed to 100-year and 500-year flood events, and the corresponding estimates of losses. Table 4-11 summarizes the HAZUS human population exposure to the 100-year and 500-year flooding. Table 4-12 summarizes estimates of the county-wide exposure of HAZUS residential, commercial and industrial building stock.

[30] FEMA, 2001, *Understanding Your Risks; Identifying Hazards and Estimating Losses*, FEMA Document No. 386-2

Table 4-10

Summary of Flagstaff and county-wide asset inventory loss estimates due to flooding

Community	Impacted Facilities	Impacted Facility Percentages	Estimated Replacement Cost	Potential Economic Loss	Estimated Structure Loss	Estimated Economic Loss	Total Loss Estimate
High Flood Hazard (100-Year)							
County-Wide Totals	31	100.00%	$40,878,797	$171,712,272	$8,175,759	$14,113,337	$22,289,097
Flagstaff	**16**	**51.61%**	**$32,653,797**	**$171,712,272**	**$6,530,759**	**$14,113,337**	**$20,644,097**
Medium Flood Hazard (500-year Flood)							
County-Wide Totals	41	100.00%	$4,629,813	$0	$231,491	$0	$231,491
Flagstaff	**15**	**36.59%**	**$2,500,000**	**$0**	**$125,000**	**$0**	**$125,000**

Table 4-11

Summary of Flagstaff and county-wide population sectors exposed to flooding

Community	Total Population	Population Exposed	Percent of Population Exposed	Total Population Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed	Total Incomes Under $20K	Incomes Under $20K Exposed	Percent of Incomes Under $20K Exposed
High Flood Hazard (100-Year)									
County-Wide Totals	116312	5998	5.16%	7659	286	3.73%	9480	616	6.50%
Flagstaff	**53536**	**5201**	**9.71%**	**2772**	**176**	**6.35%**	**4809**	**543**	**11.29%**
Medium Flood Hazard (500-year Flood)									
County-Wide Totals	116312	5954	5.12%	7659	458	5.98%	9480	516	5.44%
Flagstaff	**53536**	**4731**	**8.84%**	**2772**	**318**	**11.47%**	**4809**	**416**	**8.65%**

Table 4-12

Summary of HAZUS population and building exposure by hazard

Coconino County HAZUS Summary	Population Exposed	Population Over 65	Incomes Under $20K	Residential Building Count	Residential Building Value (x$1000)	Residential Content Value (x$1000)	Residential Potential Economic Impact (x$1000)	Commercial Building Count	Commercial Building Value (x$1000)	Commercial Content Value (x$1000)	Commercial Potential Economic Impact (x$1000)	Industrial Building Count	Industrial Building Value (x$1000)	Industrial Content Value (x$1000)	Industrial Potential Economic Impact (x$1000)	Total of All Building and Content Exposure (x$1000)	Total Estimated Loss (x$1000)
County-Wide Totals	**116312**	**7659**	**9480**	**42891**	**$ 6,134,559**	**$ 3,067,276**	**$ 9,201,835**	**499**	**$ 901,366**	**$ 954,010**	**$ 1,855,376**	**19**	**$ 97,484**	**$ 121,720**	**$ 219,204**	**$ 11,276,415**	
Flood																	
High Risk	5998	286	616	2123	$ 383,679	$ 191,835	**$ 575,514**	31	$ 59,258	$ 60,777	**$ 120,035**	0	$ 2,865	$ 3,617	**$ 6,482**	**$ 702,031**	**$ 35,102**
Medium Risk	5954	458	516	1728	$ 282,794	$ 141,384	**$ 424,178**	39	$ 86,318	$ 88,241	**$ 174,559**	0	$ 5,754	$ 7,518	**$ 13,272**	**$ 612,009**	**$ 6,120**
Wildfire																	
Extreme Risk	32366	3036	2215	18038	$ 2,418,209	$ 1,209,095	**$ 3,627,304**	85	$ 178,468	$ 184,016	**$ 362,484**	9	$ 33,987	$ 38,799	**$ 72,786**	**$ 4,062,574**	**$ 2,031,287**
High Risk	19006	1092	924	7322	$ 1,167,514	$ 583,758	**$ 1,751,272**	27	$ 59,938	$ 65,204	**$ 125,142**	1	$ 6,472	$ 7,532	**$ 14,004**	**$ 1,890,418**	**$ 378,084**
Medium Risk	23070	1524	2089	7016	$ 939,689	$ 469,852	**$ 1,409,541**	83	$ 134,776	$ 138,671	**$ 273,447**	3	$ 11,226	$ 14,170	**$ 25,396**	**$ 1,708,384**	**$ 85,419**

Coconino County HAZUS Summary	% Population Exposed	% Population Over 65	% Incomes Under $20K	% Residential Building Count	% Residential Building Value	% Residential Content Value	% Residential Potential Economic Impact	% Commercial Building Count	% Commercial Building Value	% Commercial Content Value	% Commercial Potential Economic Impact	% Industrial Building Count	% Industrial Building Value	% Industrial Content Value	% Industrial Potential Economic Impact
Flood	**10.28%**	**9.71%**	**11.94%**	**8.98%**	**10.86%**	**10.86%**	**10.86%**	**14.03%**	**16.15%**	**15.62%**	**15.88%**	**0.00%**	**8.84%**	**9.15%**	**9.01%**
High Risk	5.16%	3.73%	6.50%	4.95%	6.25%	6.25%	6.25%	6.21%	6.57%	6.37%	6.47%	0.00%	2.94%	2.97%	2.96%
Medium Risk	5.12%	5.98%	5.44%	4.03%	4.61%	4.61%	4.61%	7.82%	9.58%	9.25%	9.41%	0.00%	5.90%	6.18%	6.05%
Wildfire	**64.00%**	**73.80%**	**55.15%**	**75.48%**	**73.77%**	**73.77%**	**73.77%**	**39.08%**	**41.40%**	**40.66%**	**41.02%**	**68.42%**	**53.02%**	**49.71%**	**51.18%**
Extreme Risk	27.83%	39.64%	23.36%	42.06%	39.42%	39.42%	39.42%	17.03%	19.80%	19.29%	19.54%	47.37%	34.86%	31.88%	33.20%
High Risk	16.34%	14.26%	9.75%	17.07%	19.03%	19.03%	19.03%	5.41%	6.65%	6.83%	6.74%	5.26%	6.64%	6.19%	6.39%
Medium Risk	19.83%	19.90%	22.04%	16.36%	15.32%	15.32%	15.32%	16.63%	14.95%	14.54%	14.74%	15.79%	11.52%	11.64%	11.59%

In summary, $22.5 million in county-wide flood losses to MJPT identified are estimated for all communities within Coconino County. Of those losses, $20.7 million are attributed to Flagstaff. An additional $41.2 million in damages is estimated using the HAZUS data for general residential, commercial and industrial sectors. Using the population exposure counts reported in Table 4-11 for the 100-year and 500-year floods, it is estimated that approximately 86.7 percent[31] and 79.5 percent[32]of the $35.1 million and $6.1 million, or $30.4 million and $4.8 million, is attributable to Flagstaff. Assuming no overlap between the HAZUS data set and the asset inventory, a total of potential loss exposure of $55.9 million is estimated for flood losses. This amount seems reasonable, especially when compared to historic flooding damages experienced during major storms. Regarding human vulnerability, a total population of 5,201 people, or 9.7 percent of the total city population, are potentially exposed to a 100-year flood hazard. Similarly, a total population of 4,731 people, or 8.8 percent of the total city population, are potentially exposed to a 500-year flood hazard. Given the historic record, it is feasible to assume that at least one fatality and multiple injuries are plausible. It is very likely that with a significant flood like the 100-year event, a large percentage of exposed population could be displaced for a period of time.

Wildfire – Estimates of human and asset exposure to wildfire is accomplished by intersecting the asset inventory and HAZUS data with wildfire hazards presented in Section 4.2. Exposure to three wildfire hazard types; extreme, high, and medium, were estimated for each data set. Since no common methodology is available for estimating losses from the exposed values, estimates of the loss-to-exposure ratios were assumed based on the perceived intensity of a fire hazard. The resultant losses were then compared to historic records for a level of indirect verification. The loss-to-exposure ratios for the extreme, high, and medium wildfire hazard areas were estimated to be 0.5, 0.2, and 0.05, respectively. Economic losses are estimated assuming that the facility will be unproductive for 30 days for all scenarios. Table 4-13 summarizes the asset exposures to each of the three categories and to wildfire as a whole. Table 4-14 summarizes the HAZUS human population exposure to the various wildfire hazards. HAZUS building inventories impacted by wildfire are summarized in Table 4-12.

[31] Percentage is estimated by dividing the total population exposure for Flagstaff (5201) by the total population exposure for the county (5998), or 5201/5998 = 0.8671

[32] Percentage is estimated by dividing the total population exposure for Flagstaff (4731) by the total population exposure for the county (5954), or 4731/5954 = 0.7946

Table 4-13

Summary of Flagstaff and county-wide asset inventory loss estimates due to wildfire

Community	Impacted Facilities	Impacted Facility Percentages	Estimated Replacement Cost	Potential Economic Loss	Estimated Structure Loss	Estimated Economic Loss	Total Loss Estimate
Extreme Wildfire Hazard							
County-Wide Totals	246	100.00%	$137,667,564	$210,103,806	$68,833,782	$17,268,806	$86,102,588
Flagstaff	**81**	**32.93%**	**$93,891,519**	**$210,103,806**	**$46,945,760**	**$17,268,806**	**$64,214,565**
High Wildfire Hazard							
County-Wide Totals	19	100.00%	$54,200,000	$0	$10,840,000	$0	$10,840,000
Flagstaff	**15**	**78.95%**	**$2,800,000**	**$0**	**$560,000**	**$0**	**$560,000**
Medium Wildfire Hazard							
County-Wide Totals	62	100.00%	$10,124,411,999[a]	$0	$6,220,600[b]	$0	$6,220,600
Flagstaff	**1**	**1.61%**	**$0**	**$0**	**$0**	**$0**	**$0**

[a] – Includes $10 billion for Glen Canyon Dam; [b] – Does not includes any losses for Glen Canyon Dam

Table 4-14

Summary of Flagstaff and county-wide population sectors exposed to wildfire hazard

Community	Total Population	Population Exposed	Percent of Population Exposed	Total Population Over 65	Population Over 65 Exposed	Percent of Population Over 65 Exposed	Total Incomes Under $20K	Incomes Under $20K Exposed	Percent of Incomes Under $20K Exposed
Extreme Wildfire Hazard									
County-Wide Totals	116312	32366	27.83%	7659	3036	39.64%	9480	2215	23.36%
Flagstaff	**53536**	**8272**	**15.45%**	**2772**	**481**	**17.35%**	**4809**	**680**	**14.14%**
High Wildfire Hazard									
County-Wide Totals	116312	19006	16.34%	7659	1092	14.26%	9480	924	9.75%
Flagstaff	**53536**	**16042**	**29.96%**	**2772**	**887**	**32.00%**	**4809**	**821**	**17.07%**
Medium Wildfire Hazard									
County-Wide Totals	116312	23070	19.83%	7659	1524	19.90%	9480	2089	22.04%
Flagstaff	**53536**	**0**	**0.00%**	**2772**	**0**	**0.00%**	**4809**	**0**	**0.00%**

In summary, $103.2 million in wildfire losses to MJPT identified assets is estimated for all communities within Coconino County. Of those losses, $64.8 million are attributed to Flagstaff. An additional $2.49 billion in county-wide damages are estimated using the HAZUS data for general residential, commercial and industrial sectors. Using the population exposure counts reported in Table 4-14 for the extreme and high wildfire hazard categories, it is estimated that approximately 25.6 percent[33] and 84.4 percent[34] of the $2.03 billion and $378.1 million, or $512.8 million and $319.1 million, is attributable to Flagstaff. Assuming no overlap between the HAZUS data set and the asset inventory, a total potential loss exposure of $896.7 million is estimated for wildfires. It is highly unlikely that any fire would burn across the entire county in a given event, and the incident specific damage costs are likely to be only a fraction of those presented. However, as a collective evaluation, the loss estimates seem reasonable. Regarding human vulnerability, a total population of 24,314 people, or 45.4 percent of the total Flagstaff population, is potentially exposed to at least a high wildfire hazard. Typically, deaths and injuries related to firefighting activities are rare. However, it is feasible to assume that at least one death and/or injury is plausible. There is also a high probability of some population displacement during a wildfire event, and especially in the urban wildland interface areas.

Winter Storms – All of Flagstaff is exposed to some level of winter storm hazard. Figures 4-5 through 4-8 depict the geographically varying levels of exposure to winter storm snow depths for various recurrence intervals. The National Weather Service in Flagstaff [35], uses the following criteria for issuing warnings about winter storm weather:

1. **Blizzard Warning:** Sustained winds or frequent gusts of 35 mph or more, AND visibility frequently below 1/4 mile in considerable snow and/or blowing snow, AND above conditions are expected to prevail for 3 hours or longer.

2. **Winter Storm Warning:** Issued when more than one winter hazard is involved producing life threatening conditions, such as a combination of heavy snow, strong winds producing widespread blowing and drifting snow, freezing rain, or wind chill.

[33] Percentage is estimated by dividing the total population exposure for Flagstaff (8272) by the total population exposure for the county (32366), or 8272/32366 = 0.2556

[34] Percentage is estimated by dividing the total population exposure for Flagstaff (4731) by the total population exposure for the county (5954), or 4731/5954 = 0.7946

[35] Based on information posted at the following NWS URL: http://www.wrh.noaa.gov/fgz/safety/criteria.php?wfo=fgz

3. **Heavy Snow Warning Criteria:**

Above 8500 ft	12 inches/12 hrs	18 inches/24 hrs
7000 to 8500 ft*	8 inches/12 hrs	12 inches/24 hrs
5000 to 7000 ft	6 inches/12 hrs	10 inches/24 hrs
Below 5000 ft	2 inches/12 hrs	4 inches/24 hrs

*(Flagstaff is in this range)

4. **Snow Advisory Criteria:**

Above 8500 ft	6 to 12 inches/12hrs	12 to 18 inches/24 hrs
7000 to 8500 ft*	4 to 8 inches/12 hrs	8 to 12 inches/24 hrs
5000-7000 ft	3 to 6 inches/12 hrs	6 to 10 inches/24 hrs
Below 5000 ft	1 to 2 inches/12 hrs	2 inches/24 hrs**

*(Flagstaff is in this range)
**or snow accumulation in any location where it is a rare event.

5. **Blowing Snow Advisory Criteria:** Visibility frequently at or below 1/4 mile.

6. **High Wind Warning Criteria:** Issued for strong winds not associated with severe local storms. These include: gradient, mesoscale, and channeled winds; Foehn/Chinook/downslope winds; and winds associated with tropical cyclones. The criteria:

Sustained winds	40 mph or greater	last 1 hr or longer
Wind gusts	58 mph or greater	for any duration

7. **Wind Advisory:** Issued for the same types of wind events as a High Wind Warning, but at lower speed thresholds. The criteria:

Sustained winds	30-39 mph	last 1 hr or longer
Wind gusts	40-57 mph	for any duration

8. **Visibility Hazards:** Visibility reduced to 1/4 mile or less by fog, blowing dust/sand, and smoke.

9. **Wind Chill:** Issued for a wind chill factor of minus 20 degrees Fahrenheit or colder

10. **Freezing Rain/Drizzle, or Sleet:** widespread, dangerous, and damaging accumulations of ice or sleet.

11. **Frost or Freeze Warning:** Issued when temperatures are critical for crops and sensitive plants. Criteria is season dependent, but usually a freeze warning is appropriate when temperatures are expected to fall below freezing for at least 2 hours.

Inspection of Figure 4-5 would indicate that for much of Flagstaff, there is a 10 percent probability that a heavy snow warning could be issued for a one day snowstorm in any given year.

According to recent budget reports[36], the City of Flagstaff spends between $350,000 to $650,000 each year to perform snow removal and control operations. During the recent years of drought, the expenditures have been closer to the lower end of the range. Alternatively, heavy snow years can result in costs that exceed the upper end of the range. It is concluded that heavy winter storms can add approximately $200,000 per year in expenditures to the city.

In summary, all of the city population and assets are exposed to winter storm. Given the historic record and previously documented costs, it is estimated that an annual loss of $200,000 could be expected. It is also anticipated that at least one fatality and multiple injuries will result due to extreme winter weather.

Transportation Accidents – Potential losses and damages due to major transportation accidents are difficult to estimate without extensive research, compilation, and statistical analysis of often hard to obtain data. No such studies currently exist for Flagstaff, therefore, no detailed estimates of potential human and property losses and damages will be made. In many instances, transportation accidents are often caused by a combination of weather related events such as high winds, dust/sand storms, rain, snow, or ice and the corresponding human reactions to them. In Flagstaff, the two primary categories of accident potential are either ground based or air based. Ground based incidents include roadway and railway accidents.

[36] City of Flagstaff, 2004, *Annual Budget and Financial Plan – Fiscal Year 2003-2004*, Public Works Department

Air based incidents involve the failure of aircraft during take-off, flight, and/or landing sequences. For both types of incidents, it is reasonable to project that the entire city assets and population are potentially exposed to an accident in one form or another, although the risks are greatly diminished with distance from the major transportation corridors.

High risk vehicular corridors specifically impacting Flagstaff include Interstates 17 and 40, U.S. Highways 89, 89A, and 160, and State Routes 66 and 89A. The higher speeds and greater numbers of vehicles along these corridors combine to create an increased risk for major accidents, and especially around the city population centers. Figure 4-10 is an excerpt from vehicular crash statistics published for Coconino by the Motor Vehicle Division of the Arizona Department of Transportation[37]. It is interesting to note that the most number of crashes resulting in fatalities occur on the State and Other Rural Roads This is likely due to the higher rates of speed and increased potential for multiple vehicle accidents. The largest volume of crashes is tabulated for Flagstaff.

High risk railway corridors are generally the areas where railroads pass through the more densely populated towns and cities. In Flagstaff, the BNSF railroad passes directly through the heart of the city and parallels one of the busiest corridors affecting traffic and noise levels. According to the Flagstaff Area Regional Land Use and Transportation Plan, approximately 60 to 85 trains pass through the city each day depending on the season. There

COUNTIES Cities	Total	Number of Crashes			No. of Persons		Alcohol-Related		
		Fatal	Injury	Property Damage	Killed	Injured	Crashes	Killed	Injured
COCONINO COUNTY									
Flagstaff	1,945	5	521	1,419	5	799	98	0	62
Fredonia	6	0	4	2	0	4	0	0	0
Page	101	1	28	72	1	38	15	1	7
Sedona	288	3	74	211	3	108	18	2	11
Williams	98	0	24	74	0	46	2	0	1
State Rural Roads	1,336	28	431	877	34	753	73	2	83
Other Rural Roads	361	14	125	222	14	197	32	3	22
TOTAL	**4,135**	**51**	**1,207**	**2,877**	**57**	**1,945**	**238**	**8**	**186**

Figure 4-10

2003 Crash Statistics for Coconino County

[37] ADOT, MVD, 2003, *2003 Motor Vehicle Crash Facts for the State of Arizona*

has also been a trend for trains to get longer, with total lengths of one-mile or more. Railroad incidents typically involve either vehicular or pedestrian contact with moving trains or train derailments. Often, train related collisions result in fatalities to those struck by the train. For Flagstaff, there have been a number of reported vehicle/train and pedestrian/train incidents resulting in fatalities, as reported in the historic hazard database (see Appendix F and Table 4-3). Flagstaff has also experienced historic derailments. It is therefore, realistic to expect that future fatalities will occur and may possibly increase with future population growth. Other hazards associated with the potential for future derailments could include hazardous material spills and ignition of wildfires.

The highest risk areas associated with aviation corridors are the areas typically identified as runway protection zones (RPZ). These trapezoidal areas extend from either end of the runway for a sufficient distance to allow safe take-off and approach angles. They are also the areas with the highest risk of aircraft accidents outside of the runway itself. Figure 4-11 presents a depiction of the RPZs for the Flagstaff-Pulliam Airport. The RPZ areas were obtained from Flagstaff-Pulliam Airport Layout Plan[38].

4.3.3 Development Trend Analysis

Flagstaff has experienced moderate growth over the last five years, with much of the growth occurring around existing population centers. As indicated in Table 1-1, nearly half of the county population is located in Flagstaff. Future growth and development is anticipated and planned for in Flagstaff Area Regional Land Use and Transportation Plan.expected to continue in the same general population areas and will likely be limited to the availability of infrastructure and land.

Drought – Water for domestic purposes in Flagstaff is very dependent upon seasonal replenishment of surface and groundwater supplies by rain and snow-pack. The City of Flagstaff is acutely aware of the limited water supply and has taken a very proactive approach to formulating conservation and re-use practices. Future growth will result in increased demands for existing water supplies, which will likely be satisfied through expansion of groundwater resources. Drought planning will remain a critical component any water system

[38] Coffman Associates, Inc., 2000, *Flagstaff Pulliam Airport Layout Plan*

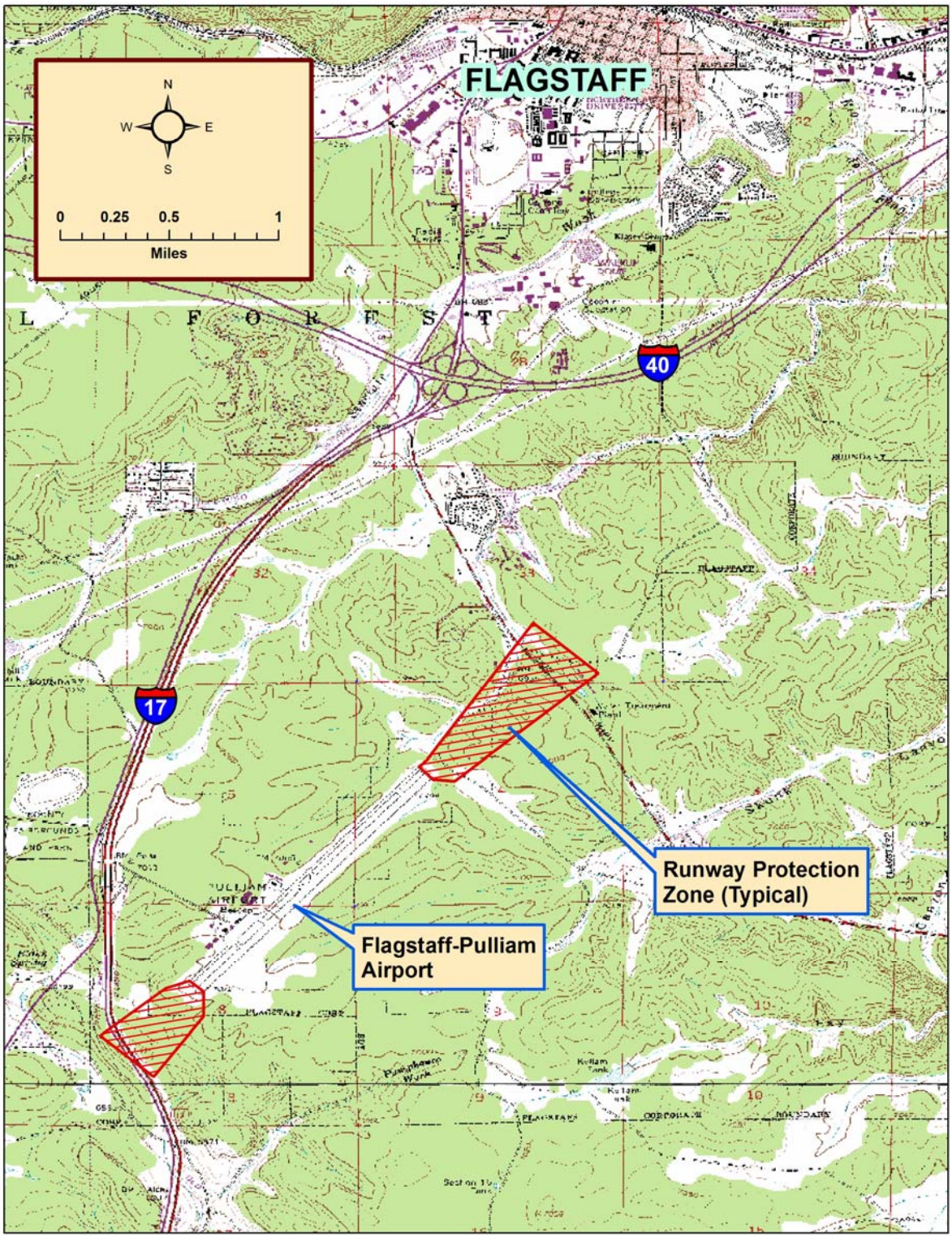

Figure 4-11

Runway Protection Zones for Flagstaff-Pulliam Airport

expansions or future growth planning. It is unlikely that significant growth will occur in the ranching and farming sectors given the current constraints on grazing rights and available range land.

Flooding – The City of Flagstaff has initiated work on a comprehensive Stormwater Master Plan (SMP). The purpose of the SMP is to provide detailed hydrology and floodplain mapping of all regional watercourses and smaller problematic watercourses in an effort to identify flood hazards and to provide for mitigation. The SMP will make watershed specific recommendations for the management of stormwater in order to remove Flagstaff citizens from the Regulatory floodplain and to mitigate the effects of localized flooding. One primary product of the SMP will be a prioritized list of drainage improvements to be funded through a Capitol Improvement Program. Proposed projects may be structural or non-structural and shall be designed in accordance with community values and water quality considerations. An extensive public outreach program is also proposed. The SMP shall consider the information and recommendations of this document when planning and programming drainage projects.

Recent (2004/2005) flood events have demonstrated that existing drainage facilities are lacking or undersized for common runoff events. In order to provide immediate, localized relief from flooding, the city is proposing a Drainage Spot Improvement Program to quickly mitigate these flooding concerns. It is anticipated that this program will begin in FY05/06.

Wildfire – As previously discussed, wildfire risks are very significant for Flagstaff. Any future development will only increase the urban/wildland interface (UWI) areas and expand the potential exposure of structures to wildfire hazards. The CWPP addresses mitigation opportunities for expanding UWI areas and provides recommended guidelines for safe building and land-use practices in wildfire hazard areas.

Winter Storm – All future development in Flagstaff will be impacted by winter storms. The city and county currently implements design standards that include provisions for snow-loads on structures and natural ventilation.

Transportation – Any future development will require some level of expansion of the transportation systems, and will certainly increase traffic in the growth areas. Proposed development adjacent to the more heavily use corridors should strive to limit the human exposure to potential accidents through the use of setbacks and clear zones. The city has also

looked at various alternatives to eliminate train/vehicle accident potential and will continue to consider those options as opportunity and funding allow.

Other hazards identified will obviously have some impact on any future development or growth; however, none warrant any special considerations beyond those generally discussed in the vulnerability assessment sections of this plan.

SECTION 5: MITIGATION STRATEGY

The following section summarizes the strategy developed by Flagstaff for mitigating hazard risks identified and summarized in Section 4. The mitigation strategy provides the "*what, when, and how*" of actions that will reduce or possibly remove the community's exposure to hazard risks. According to DMA2K, the primary components of the mitigation strategy are generally categorized into the following components:

- ☑ **Capability Assessment**
- ☑ **Goals and Objectives**
- ☑ **Mitigation Actions/Projects**
- ☑ **Implementation Strategy**

DMA2K Citation

Requirement §201.6(c)(3):

[The plan shall include:…] (3) A mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

5.1 Capability Assessment

A formal capability assessment is not required for local hazard mitigation plans under the DMA2K legislation; however, the assessment does provide information that is helpful to assessing a community's ability to mitigate against hazards. The City of Flagstaff staff reviewed and evaluated the city's resources and capabilities in the following general areas:

- **Existing Plans, Policies, and Ordinances**
- **Technical/Staff Resources**
- **Financial Resources**

A summary of the legal and regulatory capabilities of Flagstaff, including existing plans, ordinances, and policies, is provided in Table 5-1. A summary of the administrative and technical resources available to the city is provided in Table 5-2. Financial capabilities, including taxing authority and grant eligibilities, are summarized in Table 5-3.

Table 5-1

Summary of Flagstaff legal and regulatory capabilities

Regulatory Tools (Ordinances, Codes, and Plans)	Local Authority (Y/N)	Does State Prohibit? (Y/N)	Higher Level of Jurisdictional Authority (Y/N)	Comments
Building Code	Y	N	N	Provided within Title 4 of City Code (UBC 1997)
Zoning Ordinance	Y	N	N	Provided within Title 10 of City Code
Subdivision Ordinance or Regulations	Y	N	N	Provided within Title 10 of City Code
Special Purpose Ordinances	Y	N	N	Floodplain Management Code (Title 12 of City Code) Stormwater Management Utility (Title 12 of City Code) Fire Code (Title 5 of City Code)
Growth Management Ordinances	Y	N	N	Flagstaff Area Regional Land Use and Transportation Plan
Site Plan Review Requirements	Y	N	N	Provided within Title 10 of City Code
General or Comprehensive Plan	Y	N	N	Flagstaff Area Regional Land Use and Transportation Plan
Capital Improvements Plan	Y	N	N	Five year CIP
Economic Development Plan	Y	N	N	Plans are developed specific to projects
Emergency Response Plan	Y	N	Y	Emergency Management Plan
Post-Disaster Recovery Plan	Y	N	Y	Emergency Management Plan
Post-Disaster Recovery Ordinance	Y	N	Y	Emergency Management Plan
Real Estate Disclosure Statement	Y	N	Y	

Table 5-2

Summary of City of Flagstaff technical staff and personnel capabilities

Staff/Personnel Resources	☑	Department/Agency - Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	✓	Community Development – Planner
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	✓	Community Development, Development Services Division – City Engineer, Building Inspectors, Plans Examiners Community Development, Community Improvement Division – Traffic Engineers, Drainage Engineers Utilities – Water and Wastewater Engineers and Operators
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	✓	Community Development, Development Services Division – City Engineer Community Development, Community Improvement Division – Drainage Engineers, Hydrologists Public Works Department, Environmental Services Fire Department – Fire Chief Police Department – Police Chief
Floodplain Manager	✓	Community Development, Community Improvement Division – Stormwater Manager
Surveyors	✓	Community Development, Development Services Division – Surveyor
Staff with education or expertise to assess the community's vulnerability to hazards	✓	Community Development (Planning and Zoning Div.): Planners; Public Works: County Engineer, Hydrologist, Emergency Services Coordinator
Personnel skilled in GIS and/or HAZUS	✓	Management Services Department – GIS group
Scientists familiar with the hazards of the community		Not on city staff, but other agencies include NAU (various depts.), USFS, USGS, NRCS, NWS, and possibly others.
Emergency manager	✓	Fire Department – Fire Chief
Grant writer(s)	✓	Administration Department – Grants Administrator

Table 5-3

Summary of City of Flagstaff fiscal capabilities

Financial Resources	Accessible or Eligible to Use (Yes, No, Don't Know)
Community Development Block Grants	Yes
Capital Improvements Project funding	Yes
Authority to levee taxes for specific purposes	Yes
Fees for water, sewer, gas, or electric service	Yes – water and sewer
Impact fees for homebuyers or new developments/homes	Yes, but not currently used
Incur debt through general obligation bonds	Yes
Incur debt through special tax bonds	Don't Know
Incur debt through private activity bonds	Don't Know
Withhold spending in hazard-prone areas	Yes

Table 5-4 provides a summary of existing plans and studies with elements of hazard mitigation that have been prepared by and for Flagstaff in the past.

In summary, Flagstaff currently has in place several regulatory mechanisms for mitigation of hazards, with most being directed at new construction and development. Staff resources are available for the identification, development and implementation of mitigation measures with some overlap of expertise in the various categories. Financially, the city has the ability to incur debt through tax and bond obligations and also to levy taxes for specific purposes. However, all of these mechanisms require political approval and are often difficult to implement. The greatest challenge faced by the city is to try and stay ahead of the rapid development growth with regulatory, planning and review resources that lag the needs by several years.

Table 5-4

Summary of existing plan and study documents for Flagstaff

Plan/Study Name	Description	Plan/Study Author	Date Completed or Implemented	Plan/Study Owner
Flagstaff Area Regional Land Use and Transportation Plan	General planning document addressing past and future growth related goals and objectives to provide a foundation for long term growth and development in the County	City of Flagstaff Community Development	November, 2001	City of Flagstaff
Emergency Action Plan for Upper Lake Mary Dam	Agency signoff, Emergency notification chart, emergency detection, evaluation and classification, general responsibilities of agencies, preparedness, flood maps, due to floods, failure of the upper lake dam due to structural failure or terrorism acts	City of Flagstaff – Randy Pellatz, P.E.	September, 1999	City of Flagstaff – Utilities Department
Integrated Emergency Operations Plan	This is a comprehensive emergency management plan for Coconino County and the Cities of Flagstaff, Williams, Page and Tuba City. It is composed of a Basic Plan, a guide for Managing Incidents using Emergency Support Functions and Annexes for Recovery, Terrorism, Administration, Damage Assessment and Radiological Protection.	TriData Corporation, Arlington, VA	January, 2005	Coconino County
Emergency Operations and Response Plan	Submitted to EPA in compliance with Section 1433(b) of the Safe Drinking Water Act and the Bioterrorism Preparedness And Response Act of 2002 (Public Law 107-188, Title IV Drinking Water And Safety)	Tetra Tech EM, Inc. – Bob Marley	April, 2004	City of Flagstaff – Utilities Department
Chlorine Risk Management Plan	North Reservoir Filtration Plant Submitted to EPA in compliance with Section 112(r) of the Accidental Release Prevention Rule (40 CFR Part 68) of the Clean Air Act	Black & Veatch Corporation – Kyle Lucas	June 2004	City of Flagstaff – Utilities Department
Concept Plan for the Flagstaff West Study Area	Development plan for 5.5 square miles west of the city limits	HNTB	1989	City of Flagstaff – Planning Division
North Central Arizona Regional Water Study	Evaluation of water needs for North Central Arizona	ADWR – NCARWS Planning Group	1998	ADWR – NCARWS Planning Group

Table 5-4

Summary of existing plan and study documents for Flagstaff

Plan/Study Name	Description	Plan/Study Author	Date Completed or Implemented	Plan/Study Owner
Water System Improvement Program	Evaluation of capital needs for growth	Brown & Caldwell	1980	City of Flagstaff – Utilities Department
Water System Vulnerability Assessment	EPA mandated assessment to counter act terrorism	Tetra Tech EM, Inc.	2003	City of Flagstaff – Utilities Department
Greater Flagstaff Area Community Wildlife Protection Plan	A plan jointly prepared by the Greater Flagstaff Forests Partnership (GFFP) and the Pondera Fire Advisory Council (PFAC) to address wildfire hazards and mitigation strategies for the subject planning region	GFFP and PFAC (of which Coconino County is a member)	November, 2004	GFFP and PFAC
Flagstaff City Code	Comprehensive codes and guidelines for the City of Flagstaff including; Building Safety, Development and Zoning, Floodplain Management, etc.	City of Flagstaff	Constantly Updated	City of Flagstaff

5.2 Goals and Objectives

As a part of the mitigation strategy, DMA2K requires that each community prepare a list of mitigation goals. The State Plan defines goals and objectives as follows:

> ***Goals*** – General guidelines that explain what you want to achieve. Goals are usually broad statements with long-term perspective.
>
> ***Objectives*** – Defined strategies or implementation steps intended to attain the identified goals. Unlike goals, objectives are specific, measurable, and have a defined time horizon.

DMA2K Citation

Requirement §201.6(c)(3)(i):

[A mitigation strategy … section shall include:] (i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The MJPT met to develop and initial draft a set of common goals and objectives that could have application county-wide. The MJPT started with the goals and objectives developed by the State of Arizona for its hazard mitigation plan, and modified or revised the goals and objectives to

better fit the desires of Coconino County communities. Each community then took those draft goals and objectives and further customized them to fit the individual community's needs and vision for hazard mitigation. The following is a list of the City of Flagstaff goals and objectives:

Goal 1. Promote disaster-resistant future development.

Objective 1.A Update, develop, and support their general plans, ordinances, and codes to limit development in hazard areas or build to standards that will prevent or reduce damage.

Objective 1.B Adopt and support codes that protect assets and new development in hazard areas.

Goal 2. Promote public understanding, support, and demand for hazard mitigation.

Objective 2.A Educate the public to increase awareness of hazards and opportunities for mitigation actions.

Objective 2.B Promote partnerships between the state, counties, local and tribal governments to identify, prioritize, and implement mitigation actions.

Objective 2.C Promote hazard mitigation in the business, residential, and agricultural community.

Objective 2.D Monitor and publicize the effectiveness of mitigation actions implemented community wide.

Goal 3. Build and support local capacity and commitment to become less vulnerable to hazards.

Objective 3.A Improve existing capabilities to warn the public of emergency situations.

Objective 3.B Develop programs to enhance the safety of the residents of each community during an emergency.

Goal 4. Improve hazard mitigation coordination and communication with federal, state, local, and tribal governments.

Objective 4.A Establish and maintain closer working relationships with state agencies and local and tribal governments.

Goal 5. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to floods.

Objective 5.A Implement policies, procedures and regulations which reduce the exposure to flood hazards.

Objective 5.B Decrease vulnerability of community assets, especially critical facilities located in the 100-year floodplain.

Objective 5.C Improve coordination with state and federal flood-related agencies.

Objective 5.D Maintain compliance with the National Flood Insurance Program (NFIP) requirements.

Goal 6. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to wildland fires.

Objective 6.A Develop a comprehensive approach to reducing the level of damage and losses due to wildland fires.

Objective 6.B Protect life, improved property, and natural resources with vulnerability to the effects of wildland fires.

Objective 6.C Improve coordination and support existing efforts to mitigate wildland fire hazards.

Objective 6.D Develop a comprehensive database of information about the vulnerability of life, improved property, and natural resources to wildland fires.

Objective 6.E Educate the public about wildland fire dangers and mitigation measures.

Goal 7. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to winter storms.

Objective 7.A Develop a comprehensive approach to reducing the level of damage and losses due to winter storms.

Objective 7.B Protect life, improved property, and natural resources with vulnerability to the effects of winter storms.

Goal 8. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to drought.

Objective 8.A Develop a comprehensive approach to reducing the level of damage and losses due to drought.

Objective 8.B Protect existing assets with vulnerability to the effects of drought.

Objective 8.C. Coordinate with and support existing efforts to mitigate drought (e.g., Arizona Governor's Arizona Drought Task Force).

Goal 9. **Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to transportation accidents.**

Objective 9.A Develop a comprehensive approach to reducing the level of damage and losses due to transportation accidents.

Objective 9.B Protect existing assets with vulnerability to the effects of transportation accidents.

Objective 9.C Coordinate with rail road companies and federal, state, county, and local transportation departments to develop accident mitigation cooperatives and agreements.

Goal 10. **Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to thunderstorms/high winds.**

Objective 10.A Develop a comprehensive approach to reducing the level of damage and losses due to thunderstorms/high winds.

Objective 10.B Protect life, improved property, and natural resources with vulnerability to the effects of thunderstorms/high winds.

Goal 11. **Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to intentional human acts (e.g. – civil disobedience, civil disturbance, sabotage, and terrorism).**

Objective 11.A Develop a comprehensive approach to reducing the level of damage and losses due to intentional human acts.

Objective 11.B Protect life, improved property, and natural resources with vulnerability to the effects of intentional human acts.

Objective 11.C Facilitate communication of sharing intelligence among all levels of public safety communities and other affected agencies/organizations.

Goal 12. **Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to other natural hazards.**

Objective 12.A Develop a comprehensive approach to reducing the level of damage and losses due to other natural hazards.

Objective 12.B Protect life, improved property, and natural resources with vulnerability to the effects of other natural hazards.

Goal 13. Reduce the level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to other human caused hazards.

Objective 13.A Develop a comprehensive approach to reducing the level of damage and losses due to other human caused hazards.

Objective 13.B Protect life, improved property, and natural resources with vulnerability to the effects of other caused hazards.

5.3 Mitigation Actions/Projects

DMA2K Citation

Requirement §201.6(c)(3)(ii):

[A mitigation strategy … section shall include: …] (ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Mitigation actions/projects (A/P) are those activities identified by a community, that when implemented, will have the effect of reducing the community's exposure and risk to the particular hazard or hazards being mitigated. Using the results of the vulnerability analysis, the capability assessment, and the goals and objectives, the City of Flagstaff planning team formulated a list of A/Ps for mitigation of the identified hazards within the city. The A/Ps identified can be generally classified as either structural or non-structural. Structural A/Ps typify a traditional "bricks and mortar" approach where physical improvements are provided to effect the mitigation goals. Examples may include channels, culverts, bridges, detention basins, dams, emergency structures, and structural augmentations of existing facilities. Non-structural A/Ps deal more with policy, ordinance, and administrative changes, buy-out programs, and legislative actions.

The mitigation A/Ps developed for Flagstaff include information for the following categories:

- **Identification and Description** – Each A/P is provided with a unique identifier and a description that summarizes the type, scope, and characteristics of the A/P, and the goal or goals addressed with the A/P.
- **Estimated Percent of Hazard or Hazards Mitigated** – Some A/Ps are directly associated with the mitigation of at least one or more hazards, and a subjective estimate of A/P effectiveness can be made in terms of the percent of hazard(s) mitigated. This percentage is then used for estimating the Benefit/Cost (B/C) ratio for that A/P. An "N/A" is coded for the A/Ps that do not apply.

- **Total A/P Cost** – For each A/P, a conceptual cost was estimated to assess the economic viability. For structural A/Ps, a conceptual construction cost estimate was made. For non-structural A/Ps, the cost was derived by estimating the approximate man-hour cost of staff time needed to implement the A/P.
- **Simplified Benefit/Cost Analysis** – The simplified B/C ratio methodology outlined in the Arizona Model Local Hazard Mitigation Plan will be employed to assess the economic viability of an A/P. For cases in which the application of this procedure is difficult or impractical, an arbitrary B/C ratio of 1.0 is assigned.
- **Evaluation and Local Prioritization** – The City of Flagstaff planning team evaluated and ranked each A/P using the STAPLEE [39] procedure outlined in Step 2 of FEMA 386-3.

The mitigation A/Ps for Flagstaff are summarized in Table 5-5, with each set of projects being tabulated in ranked order.

[39] FEMA, 2003, *Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies*, FEMA 386-3, pp 2-12 through 2-21 and Worksheet #4.

Table 5-5
Summary of Coconino County mitigation actions/projects

ID	Name	Description	Cost	Estimated Losses Due to Hazard	Percent of Hazard Mitigated	B/C Ratio	Social	Technical	Administrative	Political	Legal	Economic	Environmental	TOTAL
8.B.1	Water Conservation	Upgrade existing conservation measures to provide for water during periods of drought.	$2,000,000	$200,000	5.0%	0.01	4.4	3.9	3.4	4.6	3.3	3.9	4.1	28
5.B.4	Rio De Flag & Clay Ave Flood Abatement	Enhance flood mitigation efforts through channelization and detention	$2,000,000	$55,900,000	5.0%	1.40	4.0	4.1	3.5	4.3	3.8	3.4	3.8	27
6.B.1	Bark Beetle Project	Remove bark beetle infested trees that will contribute to catastrophic wildfire.	$750,000	$896,700,000	1.0%	11.96	4.4	3.5	3.1	4.6	3.3	3.3	4.6	27
6.B.3	Water Well Generators	Install generators for water wells vulnerable to losing power during wildfires.	$3,500,000	$896,700,000	1.0%	2.56	4.1	4.0	3.4	4.0	3.4	4.1	3.5	27
6.B.2	Thinning Project	Remove trees that may promote the severity or rapid spread of catastrophic wildfire.	$1,500,000	$896,700,000	5.0%	29.89	4.1	3.6	3.3	4.3	3.0	3.4	4.3	26
5.B.3	City Bridges	Reinforce city bridges to maintain critical municipal infrastructure during flood and flood control events.	$9,000,000	$55,900,000	5.0%	0.31	4.0	4.0	3.3	4.3	3.9	2.9	3.6	26
9.B.1	Transportation Accidents	Provide equipment and human resources sufficient to handle comprehensive road, air, and railway HAZMAT and mass casualty incidents.	$250,000	N/A	N/A	1.00	4.0	3.9	3.6	3.6	4.0	3.4	3.1	26
4.A.1	Emergency Operations Center	Construct & equip a multi-agency EOC to coordinate disasters.	$2,000,000	N/A	N/A	1.00	4.6	3.3	3.3	4.1	3.6	3.0	3.6	26
6.E.3	Wildfire Outreach	Educate the local and regional community (including tourists) about the consequences of catastrophic wildfire and necessary prevention methods.	$750,000	$896,700,000	1.0%	11.96	4.3	3.3	3.4	4.1	3.4	3.5	3.6	26
5.B.2	Rio de Flag Waterlines	Reinforce waterlines under the Rio de Flag to limit damage due to flooding.	$500,000	$55,900,000	1.0%	1.12	3.6	3.5	3.3	3.5	3.4	3.1	4.4	25
7.B.2	Winter Storm Resources	Provide additional equipment and operators to increase the ability to plow & remove snow and care for streets.	$500,000	$200,000	N/A	1.00	4.3	3.6	3.5	3.5	3.8	3.6	3.0	25
5.B.1	Manhole Project	Raise existing and future manholes above flood lines.	$750,000	$55,900,000	2.0%	1.49	3.5	3.8	3.5	3.1	3.5	3.3	4.3	25
9.A.2	HAZMAT Training	Train a minimum of once per year with local, county, state, and federal response agencies.	$50,000	N/A	N/A	1.00	3.6	3.9	3.6	3.5	3.6	3.0	2.9	24

Table 5-5
Summary of Coconino County mitigation actions/projects

ID	Name	Description	Cost	Estimated Losses Due to Hazard	Percent of Hazard Mitigated	B/C Ratio	Social	Technical	Administrative	Political	Legal	Economic	Environmental	TOTAL
8.B.2	Water Buffalo Acquisition	Acquire sufficient water buffalos to deliver potable water to affected neighborhoods	$500,000	$200,000	10.0%	0.04	4.1	3.6	3.4	3.3	3.1	3.1	3.5	24
7.B.3	Pre-paid Fuel Contract	Provides a pre-paid emergency fuel contract that gives prioritization to City snow removal equipment during winter storms.	$100,000	$200,000	10.0%	0.20	3.4	2.9	3.0	3.1	3.6	3.3	2.4	22
5.B.6	Barricades and Transport Equipment	Provide sufficient barricades (250) and a trailer to deliver barricades throughout the City	$100,000	$55,900,000	1.0%	5.59	3.3	3.6	3.1	3.4	3.8	3.0	2.4	23
8.A.1	Ecosystem Improvements	Provide for the removal of trees to enhance watersheds and to make remaining trees more vigorous and resistant to drought.	$2,000,000	$200,000	2.0%	0.00	3.8	2.9	2.6	3.5	2.8	2.9	4.0	22
7.B.1	Winter Storm Infrastructure	Provide for sufficient resources to park, house, and care for large numbers of people trapped by winter storms.	$150,000	$200,000	10.0%	0.13	3.5	2.9	2.9	3.8	3.4	3.0	2.8	22
6.B.4	Evacuation Signage	Provides the capability to transport and operate self-contained evacuation messaging signs on City road systems to direct evacuation activities.	$150,000	$896,700,000	1.0%	59.78	3.5	3.4	2.8	3.3	3.5	3.1	2.8	22
7.B.4	AVL for Snow Removal Vehicles	Provides automatic vehicle location system for all snow removal equipment with tie-in to the City's emergency communications center.	$2,000,000	$200,000	N/A	1.00	3.1	3.5	2.9	2.6	3.3	3.1	2.8	21
9.A.1	Arterial Roadways and Equipment	Construct sufficient arterial roadways and equipment to provide alternate transportation routes during a disaster.	$5,000,000	N/A	N/A	1.00	3.5	2.9	2.4	3.4	3.1	2.6	2.8	21

5.4 Implementation Strategy

The implementation strategy outlines the *"how, when, and by whom?"* questions related to implementing an identified A/P. The City of Flagstaff planning team developed an implementation strategy for the top 10 ranked projects in Table 5-4, by providing the following information:

DMA2K Citation

Requirement §201.6(c)(3)(iii):

[A mitigation strategy … section shall include: …] (iii) An action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

- **Lead Agency** – For each A/P, a lead agency was identified. This agency will be responsible for the A/P's ultimate development and implementation.
- **Funding Source Identification** – Sources of funding for each A/P were identified.
- **Implementation Schedule** – For each A/P, an implementation schedule was developed to specify the anticipated completion dates. For cases in which the A/P completion is tied to the receipt of federal or state grant funds, the dates may be unknown.
- **Critical Interim or Pilot Activities** – Where necessary, information was provided to identify any activities that should be performed or investigated on an interim basis.

Table 5-6 summarizes the implementation strategy for the city's ten (10) or less top ranked A/Ps.

Table 5-6

Summary of City of Flagstaff action/project implementation strategies

Mitigation Action/Project		Implementation Strategy			
ID	**Name**	**Lead Agency**	**Funding Source(s)**	**Completion Date**	**Critical Interim or Pilot Activities**
8.B.1	Water Conservation	Water Utilities	Pending Grant award plus internal funds	on-going	• Moniter Water Usage • Establish thresholds for use and capacity
5.B.4	Rio De Flag & Clay Ave Flood Abatement	Capital Improvements	Army Corps of Engineers	2008	• Bid Process • State and Local Permits
6.B.1	Bark Beetle Project	Fire Department	Pending Grant award plus internal funds	2 years after award	• Identify and mark infected trees • RFP for outside contractor
6.B.3	Water Well Generators	Water Utilities	Pending Grant award plus internal funds	1 year after award	• RFP and Bid Document • Load Test System
6.B.2	Thinning Project	Fire Department	Pending Grant award plus internal funds	5 years after award	• Plan and mark areas needing thinning • Obtain State and Local Permits
5.B.3	City Bridges	Capital Improvements	Pending Grant award plus internal funds	2008	• Bid and RFP Process • State and Local Permitting
9.B.1	Transportation Accidents	Fire Department	Pending Grant award plus internal funds	1 year after award	• Identify product & establish vendor list • Develop RFP for purchases
4.A.1	Emergency Operations Center	Fire Department	Combined with City Bond funds and Grant award	2013	• Conduct scoping process Secure land purchase
6.E.3	Wildfire Outreach	Fire Department	Pending Grant award plus internal funds	on-going	• Develop informational material/multi-media • Hire Public Information contract person
5.B.2	Rio de Flag Waterlines	Water Utilities	Pending Grant award plus internal funds	1 year after award	• Design project & issue RFP • Secure USACOE permits

SECTION 6: PLAN MAINTENANCE PROCEDURES

According to the DMA2K requirements, each plan must define and document processes or mechanisms for maintaining and updating the hazard mitigation plan within the established five-year planning cycle. Elements of this plan maintenance section include:

- ☑ **Monitoring, Evaluating, and Updating the Plan**
- ☑ **Implementing the Plan by Incorporation into Other Agency or Jurisdictional Planning Mechanisms**
- ☑ **Continued Public Participation**

The City of Flagstaff recognizes that this hazard mitigation plan is intended to be a "living" document with regularly scheduled monitoring, evaluation, and updating.

DMA2K Citation

Requirement §201.6(c)(4):

[The plan shall include the following: …] (4) A plan maintenance process that includes: (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle. (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate. (iii) Discussion on how the community will continue public participation in the plan maintenance process.

6.1 Monitoring and Evaluation

The City of Flagstaff has established the following monitoring and evaluation procedures:

- **Schedule** – Each plan shall be reviewed on at least an annual basis or following a major disaster. An informal, brief memorandum documenting the review findings shall be prepared and included in Appendix G. Each review shall include an evaluation of the following:
  - ***Public Involvement*** – Public involvement successes and challenges shall be reviewed and noted, with any recommendations for changes.
  - ***Risk Assessment*** – The identified hazards and associated risks shall be evaluated with respect to the previous year's events, and any significant differences shall be noted for possible revision during the next planning cycle.

- ***Mitigation Strategy*** – The proposed A/Ps shall be reviewed and updated regarding status and implementation (i.e. – proposed project is now fully complete). Any changes shall be noted along with the successes and/or challenges associated with the implementation.

A summary of the annual review shall also be presented as an informational item to the Flagstaff City Council on an annual basis.

- **Responsibility** – The responsibility for ensuring that the plan monitoring and evaluation is performed at the scheduled interval shall come under the auspices of the Primary Point of Contact listed in Section 2.

6.2 Plan Implementation

At this time, the COFMHMP will function as a stand-alone document and is not planned for incorporation into any other planning documents administered by the city. However, since many of the elements discussed within this plan directly and indirectly relate to the planning efforts of the county and several other incorporated communities within the county, future opportunities to partner with those communities shall be investigated whenever appropriate.

6.3 Continued Public Involvement

The City of Flagstaff is committed to keeping the public informed about the City's hazard mitigation planning efforts, actions and projects. In order to accomplish this goal, the City of Flagstaff will pursue the following opportunities for public involvement and dissemination of information whenever possible and appropriate:

- ✓ Provide periodic summary updates of hazard mitigation A/P measures being implemented using local media.
- ✓ Conduct an annual presentation of hazard mitigation planning discoveries, progress, and/or proposed A/P measures at the Flagstaff City Council meetings.
- ✓ Participate in annual events such as the County fair and other public events.
- ✓ Perform public outreach and mitigation training meetings for targeted populations known to be in higher risk hazard areas (i.e. – floodplain residents).

Appendix A

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Appendix B

Arizona Department of Commerce 2003 Community Profiles

Appendix C

Public Involvement Records

Appendix D

Glossary of Terms

GLOSSARY OF TERMS

GENERAL TERMS

Asset
Any natural or human-caused feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Building
A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Critical Facilities and Infrastructure
Systems or facilities whose incapacity or destruction would have a debilitating impact on the defense or economic security of the nation. The Critical Infrastructure Assurance Office (CIAO) defines eight categories of critical infrastructure, as follows:

1. **Telecommunications infrastructure**: Telephone, data services, and Internet communications, which have become essential to continuity of business, industry, government, and military operations.
2. **Electrical power systems**: Generation stations and transmission and distribution networks that create and supply electricity to end-users.
3. **Gas and oil facilities**: Production and holding facilities for natural gas, crude and refined petroleum, and petroleum-derived fuels, as well as the refining and processing facilities for these fuels.
4. **Banking and finance institutions**: Banks, financial service companies, payment systems, investment companies, and securities/commodities exchanges.
5. **Transportation networks**: Highways, railroads, ports and inland waterways, pipelines, and airports and airways that facilitate the efficient movement of goods and people.
6. **Water supply systems**: Sources of water; reservoirs and holding facilities; aqueducts and other transport systems; filtration, cleaning, and treatment systems; pipelines; cooling systems; and other delivery mechanisms that provide for domestic and industrial applications, including systems for dealing with water runoff, wastewater, and firefighting.
7. **Government services**: Capabilities at the federal, state, and local levels of government required to meet the needs for essential services to the public.
8. **Emergency services**: Medical, police, fire, and rescue systems.

Department of Homeland Security (DHS)
Following the September 11, 2001 terrorist attacks, President George W. Bush created a new federal government department in order to bring 22 previously separate domestic agencies together. The new department's first priority is protecting the nation against further terrorist attacks. Component agencies analyze threats and intelligence, guard borders and airports, protect critical infrastructure,

and coordinate the response for future emergencies. The new department is organized into five major directorates: Border and Transportation Security (BTS); Emergency Preparedness and Response (EPR); Science and Technology (S&T); and Information Analysis and Infrastructure Protection (IAIP); Management. In addition, several other critical agencies have been folded into the new department or are newly created. The Federal Emergency Management Agency (FEMA) is the foundation of the Emergency Preparedness and Response (EPR) Directorate.

Disaster Mitigation Act of 2000 (DMA2K)
A law signed by the President on October 30, 2000 that encourages and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening statewide mitigation planning.

Emergency Preparedness and Response (EPR) Directorate
One of five major Department of Homeland Security Directorates which builds upon the formerly independent Federal Emergency Management Agency (FEMA). EPR is responsible for preparing for natural and human-caused disasters through a comprehensive, risk-based emergency management program of preparedness, prevention, response, and recovery. This work incorporates the concept of disaster-resistant communities, including providing federal support for local governments that promote structures and communities that reduce the chances of being hit by disasters.

Emergency Response Plan
A document that contains information on the actions that may be taken by a governmental jurisdiction to protect people and property before, during, and after a disaster.

Federal Emergency Management Agency (FEMA)
Formerly independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery. As of March 2003, FEMA is a part of the Department of Homeland Security's Emergency Preparedness and Response (EPR) Directorate.

Flood Insurance Rate Map (FIRM)
Map of a community, prepared by FEMA, that shows the special flood hazard areas and the risk premium zones applicable to the community.

Frequency
A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Fujita Scale of Tornado Intensity
Rates tornadoes with numeric values from F0 to F5 based on tornado winds peed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while an F5 indicates severe damage sustained.

Geographic Information Systems (GIS)
A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

Hazard
A source of potential danger or adverse condition. Hazards include both natural and human-caused events. A natural event is a hazard when it has the potential to harm people or property and may include events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. Human-caused hazard events originate from human activity and may include technological hazards and terrorism. Technological hazards arise from human activities and are assumed to be accidental and/or have unintended consequences (e.g., manufacture, storage and use of hazardous materials). While no single definition of terrorism exists, the Code of Federal Regulations defines terrorism as "…unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."

Hazard Event
A specific occurrence of a particular type of hazard.

Hazard Identification
The process of identifying hazards that threaten an area.

Hazard Mitigation
Cost effective measures taken to reduce or eliminate long-term risk associated with hazards and their effects.

Hazard Profile
A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent.

HAZUS
A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.

Mitigate
To cause to become less harsh or hostile; to make less severe or painful. Mitigation activities are actions taken to eliminate or reduce the probability of the event, or reduce its severity of consequences, either prior to or following a disaster/emergency.

Mitigation Plan
A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in a defined geographic area, including a description of actions to minimize future vulnerability to hazards.

Modified Mercalli Intensity Scale
The Modified Mercalli Intensity Scale is commonly used in the United States by seismologists seeking information on the severity of earthquake effects. Intensity ratings are expressed as Roman numerals between I at the low end and XII at the high end. The Intensity Scale differs from the Richter Magnitude Scale in that the effects of any one earthquake vary greatly from place to place, so there may be many Intensity values (e.g.: IV, VII) measured from one earthquake. Each earthquake,

on the other hand, should have just one Magnitude, although the several methods of estimating it will yield slightly different values (e.g.: 6.1, 6.3).

100-Hundred Year Floodplain
Also referred to as the Base Flood Elevation (BFE) and Special Flood Hazard Area (SFHA). An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year.

Planning
The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.

Probability
A statistical measure of the likelihood that a hazard event will occur.

Promulgation
To make public and put into action the Hazard Mitigation Plan via formal adoption and/or approval by the governing body of the respective community or jurisdiction (i.e. – Town or City Council, County Board of Directors, etc.).

Q3 Data
The Q3 Flood Data product is a digital representation of certain features of FEMA's Flood Insurance Rate Map (FIRM) product, intended for use with desktop mapping and Geographic Information Systems technology. The digital Q3 Flood Data are created by scanning the effective Flood Insurance Rate Map (FIRM) paper maps and digitizing selected features and lines. The digital Q3 Flood Data are designed to serve FEMA's needs for disaster response activities, National Flood Insurance Program activities, risk assessment, and floodplain management.

Repetitive Loss Property
A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.

Richter Magnitude Scale
A logarithmic scale devised by seismologist C.F. Richter in 1935 to express the total amount of energy released by an earthquake. While the scale has no upper limit, values are typically between 1 and 9, and each increase of 1 represents a 32-fold increase in released energy.

Risk
The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage beyond a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Substantial Damage
Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage.

Vulnerability
Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power–if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Vulnerability Analysis
The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability analysis should address impacts of hazard events on the existing and future built environment.

Vulnerable Populations
Any segment of the population that is more vulnerable to the effects of hazards because of things such as lack of mobility, sensitivity to environmental factors, or physical abilities. These populations can include, but are not limited to, senior citizens and school children.

Goals
General guidelines that explain what you want to achieve. Goals are usually broad statements with long-term perspective.

Objectives
Defined strategies or implementation steps intended to attain the identified goals. Objectives are specific, measurable, and have a defined time horizon.

Actions/Projects
Specific actions or projects that help achieve goals and objectives.

Implementation Strategy
A comprehensive strategy that describes how the mitigation actions will be implemented.

NATURAL HAZARDS

Avalanche
Avalanches are massive downward and outward movements of slope-forming materials. These masses may range from car-size to entire mountainsides and includes movement of snow, ice, and debris moving rapidly enough to threaten life. Snow avalanches are caused by the added weight of fresh snow or by gradual weakening of older snow and are often triggered by recreational activity or the impact of small masses of snow or ice falling from above. Three main factors determine whether avalanches are likely to occur - the weather, snow pack, and terrain. There are two principal types of avalanches: a loose snow avalanche gathers more and more snow as it descends a mountainside; a slab avalanche consists of more compact, cohesive snow and ice that breaks away from the slope in a discrete mass. The latter type is responsible for the great majority of accidents.

Drought
A drought occurs when water supplies cannot meet established demands. "Severe" to "extreme" drought conditions endanger livestock and crops, significantly reduce surface and ground water supplies, increase the potential risk for wildland fires, increase the potential for dust storms, and cause significant economic loss. Humid areas are more vulnerable than arid areas. Drought may not be

constant or predictable and does not begin or end on any schedule. Short term droughts are less common due to the reliance on irrigation water in arid environments.

Dust / Sand Storms

A dust or sand storm is a severe windstorm that sweeps clouds of dust across an arid region. They can be hazardous to transportation and navigation and to human health. Severe or prolonged dust and sand storms can result in disasters causing extensive economic damage over a wide area and personal injury and death. In Arizona, dust or sand storms are generally associated with the advance of a thunderstorm.

Earthquake

An earthquake is a naturally-induced shaking of the ground, caused by the fracture and sliding of rock within the Earth's crust. The magnitude is determined by the dimensions of the rupturing fracture (fault) and the amount of displacement that takes place. The larger the fault surface and displacement, the greater the energy. In addition to deforming the rock near the fault, this energy produces the shaking and a variety of seismic waves that radiate throughout the Earth. Earthquake magnitude is measured using the Richter Scale and earthquake intensity is measured using the Modified Mercalli Intensity Scale.

Extreme Cold

Extreme cold is associated with either polar regions or extreme winter storms. Communities in polar regions are less threatened as they are normally prepared to cope with extreme cold. The extreme cold associated with winter storms is a deceptive killer as it indirectly causes injury and death resulting from exhaustion and overexertion, hypothermia and frostbite from wind chill, and asphyxiation.

Extreme Heat

Extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. Humid conditions may also add to the discomfort of high temperatures. Excessively dry and hot conditions can provoke dust storms and low visibility.

Flooding / Flash Flooding

Flooding is an overflowing of water onto normally dry land and is one of the most significant and costly of natural disasters. Flooding tends to occur in Arizona during anomalous years of prolonged, regional rainfall (typical of an El Nino year), and is typified by increased humidity and high summer temperatures.

Flash flooding is caused by too much rain falling in a small area in a short time and are a critical natural hazard in Arizona, often a result of summer monsoon thunderstorms or the remnants of a tropical storm. Several factors contribute to flash flooding: rainfall intensity and duration, topography, soil conditions, and ground cover. Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area and can occur within a few minutes or hours of excessive rainfall, or a quick release from a dam or levee failure. Thunderstorms produce flash flooding, often far from the actual storm and at night when natural warnings may not be noticed.

Infestations

An infestation consists of an invasion or spreading of a living organism (plant, animal, etc.) that has an adverse (unwanted) effect on the population or the environment. The effect may range from a simple nuisance to an infectious disease or destructive parasite or insect. Infestations may result from non-indigenous plants, rodents, weeds, parasites, insects, and fungi, and may adversely affect people, animals, agriculture, economy (e.g., tourism), and property.

Liquefaction
The phenomenon that occurs when ground shaking (earthquake) causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Landslides / Mudslides
Landslides, like avalanches are massive downward and outward movements of slope-forming materials. The term landslide is restricted to movement of rock and soil and includes a broad range of velocities. Slow movements, although rarely a threat to life, can destroy buildings or break buried utility lines. A landslide occurs when a portion of a hill slope becomes too weak to support its own weight. The weakness is generally initiated when rainfall or some other source of water increases the water content of the slope, reducing the shear strength of the materials. A mud slide is a type of landslide referred to as a flow. Flows are landslides that behave like fluids: mud flows involve wet mud and debris.

Monsoon
A monsoon is any wind that reverses its direction seasonally. In the Southwestern U.S., for most of the year the winds blow from the west/northwest. Arizona is located on the fringe of the Mexican Monsoon which during the summer months turns the winds to a more south/southeast direction and brings moisture from the Pacific Ocean, Gulf of California, and Gulf of Mexico. This moisture often leads to thunderstorms in the higher mountains and Mogollon Rim, with air cooled from these storms often moving from the high country to the deserts, leading to further thunderstorm activity in the desert. A common misuse of the term monsoon is to refer to individual thunderstorms as monsoons.

Radon
Radon is a naturally occurring radioactive gas that is odorless and tasteless. It is formed from the radioactive decay of uranium. Uranium is found in small amounts in most rocks and soil. It slowly breaks down to other products such as radium, which breaks down to radon. Radon also undergoes radioactive decay. Radon enters the environment from the soil, from uranium and phosphate mines, and from coal combustion. Radon has a radioactive half-life and about 4 days; this means the one-half of a given amount of radon will decay to other products every 4 days. Some of the radon produced in the soil will move to the surface and enter the air. Radon also moves from the soil and enters the groundwater.

Subsidence
Land subsidence occurs when large amounts of ground water have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rocks falls in on itself.

Thunderstorms / High Winds
Thunderstorms are characterized as violent storms that typically are associated with high winds, dust storms, heavy rainfall, hail, lightning strikes, and/or tornadoes. The unpredictability of thunderstorms, particularly their formation and the rapid movement to new locations heightens the possibility of floods. Thunderstorms, dust/sand storms and the like are most prevalent in Arizona during the monsoon season, which is a seasonal shift in the winds that causes an increase in humidity capable of fueling thunderstorms. The monsoon season in Arizona typically is from late-June or early-July through mid-September.

Tornadoes / Dust Devils
A tornado is a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds in excess of 250 mph.

Damage paths can exceed a mile wide and 50 miles long. Tornadoes are one of nature's most violent storms. In an average year, 800 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The damage from tornadoes is due to high winds. The Fujita Scale of Tornado Intensity measures tornado / high wind intensity and damage.

A dust devil is a small but rapidly rotating column of wind made visible by the dust, sand, and debris it picks up from the surface. They typically develop best on clear, dry, hot afternoons and are common during the summer months in the desert portions of Arizona. While resembling tornadoes, dust devils typically do not produce damage, although in Arizona they have done so occasionally.

Tropical Storms / Hurricane

A tropical system in which the maximum sustained surface wind ranges from 34 to 63 knots (39 to 73 mph). Tropical storms are associated with heavy rain, high wind, and thunderstorms. High intensity rainfall in short periods is typical.

A tropical storm is classified as a hurricane when its sustained winds reach or exceed 74 mph (64 knots). These storms are medium to large in size and are capable of producing dangerous winds, torrential rains, and flooding, all of which may result in tremendous property damage and loss of life, primarily in coastal populated areas. The effects are typically most dangerous before a hurricane makes landfall, when most damage occurs. However, Arizona has experienced a number of tropical storms that caused extensive flooding and wind damage.

Volcanoes

A volcano is a vent in the Earth from which molten rock (magma) and gas erupt. The molten rock that erupts from the volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles. Volcanic eruptions can be placed into two general categories: those that are explosive and those that are effusive resulting in gently flowing lava flows, spatter cones, and lava fountains. Many eruptions are highly explosive in nature. They produce fragmental rocks from erupting lava and surrounding area rock and may produce fine volcanic ash that rises many kilometers into the atmosphere in enormous eruption columns. Explosive activity can also cause widespread ash fall, pyroclastic flows, debris avalanches, landslides, pyroclastic surges, and lahars.

Wildfires

Wildfire is a rapid, persistent chemical reaction that releases heat and light, especially the exothermic combination of a combustible substance with oxygen. Wildfires present a significant potential for disaster in the southwest, a region of relatively high temperatures, low humidity, low precipitation, and during the spring moderately strong daytime winds. Combine these severe burning conditions with people or lightning and the stage is set for the occurrence of large, destructive wildfires.

Winter Storms

Winter storm is defined as a cold wind accompanied by blowing snow; freezing rain or sleet, cold temperatures, and possibly low visibility and drifting snow. The storms often make roads impassable. Residents, travelers, and livestock may become isolated or stranded without adequate food, water, and fuel supplies. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are considered deceptive killers as they indirectly cause transportation accidents, and injury and death resulting from exhaustion/overexertion, hypothermia and frostbite from wind chill, and asphyxiation.

HUMAN-CAUSED HAZARDS

Arson
The act of willfully and maliciously burning of property, especially with criminal or fraudulent intent.

Biological Hazards
A hazard caused by the presence of any micro-organism, virus, infectious substance, or biological product that may be engineered as a result of biotechnology or any naturally occurring micro-organism, virus, infectious substance, or biological product, capable of causing death, disease, or other biological malfunction.

Building / Structure Collapse
The failure and downfall of a structure. The collapse may result from a variety of natural causes such as hurricanes, earthquakes, tornadoes, floods, or from manmade circumstances such as construction deficiencies, neglect, aging infrastructure, or acts of terrorism.

Civil Disobedience
The refusal to obey civil laws or decrees, usually taking the form of passive resistance. People practicing civil disobedience break a law because they consider the law unjust, want to call attention to its justice, and hope to bring about its repeal or amendment. They are also willing to accept a penalty for breaking the law.

Civil Disturbance
When individuals or segments of the population create a situation, often a result of civil unrest, requiring a response from the emergency response community to protect lives and property. The disturbance may be small and isolated to a small area or be of a larger scale and exceeding the response capabilities of a jurisdiction. Activities are normally active (demonstrations, looting, riots) rather than passive (public speeches, sit-downs, marches).

Civil Unrest
When a segment of the civil population indicates its discontent or dissatisfaction with existing political, social, or religious issues. The unrest may materialize as a civil disturbance or civil disobedience. Activities may be passive (public speeches, sit-downs, marches) or active (demonstrations, looting, riots).

Dam / Levee Failure
Dam/levee failure can be caused by natural occurrences such as floods, rock slides, earthquakes, or the deterioration of the foundation or the materials used in construction. Usually the changes are slow and not readily discovered by visual examination. Such a failure presents a significant potential for a disaster in that significant loss of life and property would be expected in addition to the possible loss of power and water resources.

Enemy Attack
The use of aggressive action against an opponent in pursuit of an objective. An "enemy attack" is considered an attack of one sovereign government against another as either a declared or undeclared act of war.

Explosion/Fire
An explosion is the sudden loud release of energy and a rapidly expanding volume of gas that occurs when a gas explodes or a bomb detonates. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials/chemicals, dust, and bombs. While an explosion surely may cause death, injury and property damage, a fire routinely follows which may cause further damage and inhibit emergency response.

Extreme Air Pollution
Pollution is the contamination of the earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems. Air pollution is the addition of harmful substances to the atmosphere. It makes people sick, causing breathing problems and sometimes cancer, and it harms plants, animals, and the ecosystems in which they live. Some pollutants return to earth in the form of acid rain and snow that corrodes structures, damages vegetation, and makes streams and lakes unsuitable for life. "Extreme air pollution" exceeds established thresholds resulting in the need to take corrective actions and cause the public to take precautions.

Fuel / Resource Shortage
A fuel/resource shortage is defined as an actual or potential shortage of natural gas, crude and refined petroleum, petroleum-derived fuels, or other critical commodities that significantly impacts the ability to: render essential government and emergency services (medical, fire, safety); and threatens the health and safety of the public.

Hazardous Materials Incidents
A spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment of a hazardous material, but excludes: (1) any release which results in exposure to poisons solely within the workplace, with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Hostage Situation
A situation in which people are held hostage and negotiations take place for their release. The situation may range from a simple domestic or isolated criminal act to an attempt to impose will on a national or international scale to intimidate or coerce a government to further a political, social, or religious objective.

Hysteria (Mass)
Also known as "mass psychogenic illness" and "hysterical contagion," mass hysteria is a situation in which a symptom or set of symptoms for which there is no physical explanation spreads quickly among a group. It may occur as a reaction to an incident of domestic terrorism.

Power / Utility Failure
A power/utility failure is defined as an actual or potential shortage of electric power or the interruption of electrical power that significantly threatens health and safety. Many communities are vulnerable to many localized, short and long-term energy emergencies. Power shortages or failures do

occur and may be brought on by severe weather conditions, such as blizzards, ice storms, extreme heat, thunderstorms, or events such as war, or civil disturbance.

Radiological Accident
A radiological accident is a release of radioactive materials. It can occur where radioactive materials are used, stored, or transported. Potentially nuclear power plants (fixed nuclear facilities), hospitals, universities, research laboratories, industries, major highways, railroads, or shipping yards could be the site of a radiological accident.

Sabotage
Sabotage is the deliberate destruction of property, dismantling of technology or other interference or obstruction of normal operations. "Sabotage" is normally considered an act related to war; similar acts during "non-war" conditions would be considered a terrorist act.

Special Events
An event of such a magnitude, media visibility, or importance that may require extraordinary preparations by government and possible response by emergency response agencies. Such events may be considered an opportunity or target for activist or terrorist activities.

Strike
A strike is an organized work stoppage carried out by a group of employees for the purpose either of enforcing demands relating to employment conditions on their employer or of protesting unfair labor practices. A strike may be engaged to obtain improvement in work conditions, higher wages or shorter hours, to forestall an adverse change in conditions of employment, or to prevent the employer from carrying out actions viewed by workers as detrimental to their interests.

Transportation Accident
A transportation accident is an incident related to a mode of transportation (highway, air, rail, waterway, port, harbor) where an emergency response is necessary to protect life and property.

Terrorism (Economic, Cyber, Nuclear, Biological, and Chemical)
"Terrorism is the unlawful use of force or violence, or threatened use of force or violence, against persons and places for the purpose of intimidation and/or coercing a government, its citizens, or any segment thereof for political or social goals." (Department of Justice, Federal Bureau of Investigation).

Terrorism can include computer-based (cyber) attacks and the use of weapons of mass destruction (WMD) to include chemical, biological, radiological, nuclear, or explosive (CBRNE) agents.

Appendix E

Miscellaneous Report Excerpts
and
State of Arizona Hazard Profiles

Appendix F

Detailed Historic Hazard Records

Appendix G

Plan Maintenance Review Memorandums