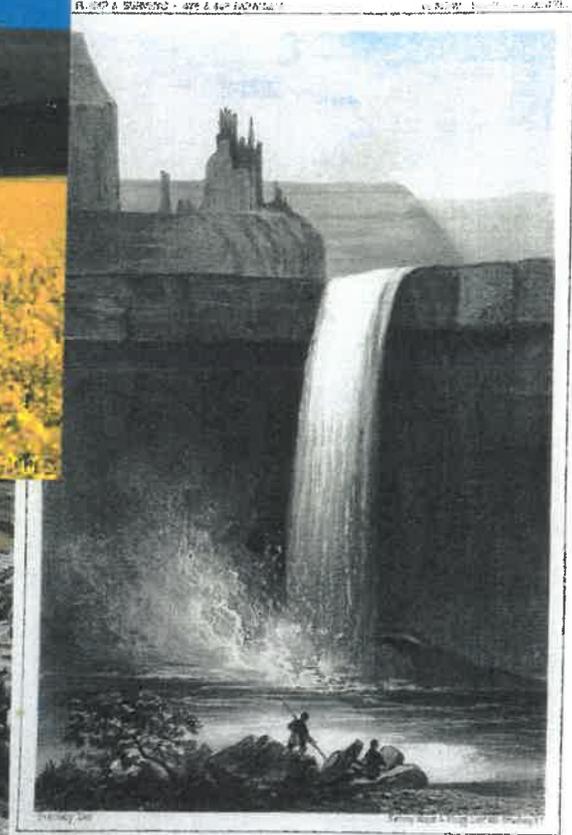


# 2004 Whitman County Hazard Identification and Vulnerability Analysis



VOL 1  
PAGES i TO 3 38





Prepared by  
The Institute for Hazards Mitigation & Planning  
University of Washington  
College of Architecture & Urban Planning  
Department of Urban Design & Planning  
Seattle, Washington  
September 23, 2004

Robert Freitag, Director IHMP  
Dr. Frank Westerlund, Associate Professor  
Glenn B. Coil, Primary Author and Editor

We would also like to thank Fred Hurand at Eastern Washington University for his assistance in reviewing and commenting on this document.

(THIS PAGE LEFT INTENTIONALLY BLANK)

## Table of Contents

<b>1. Introduction .....</b>	<b>1-1</b>
1.1. Background .....	1-1
1.2. Purpose and Mission .....	1-2
1.3. Policy Framework for Washington .....	1-2
1.4. HIVA Criteria .....	1-2
1.5. Document Overview .....	1-3
<b>2. Community Profile .....</b>	<b>2-1</b>
2.1. Introduction .....	2-1
2.2. Historical Overview .....	2-1
2.3. Geographical Setting .....	2-2
Lakes, Rivers and Creeks .....	2-2
Topography .....	2-2
Soils and Geology .....	2-2
Climate .....	2-11
2.4. Demographics .....	2-11
2.5. Economy .....	2-17
Development Trends .....	2-17
Industry .....	2-18
Occupation .....	2-19
2.6. Profile of Whitman County Towns and Cities .....	2-20
2.7. Laws and Ordinances .....	2-22
Federal .....	2-22
State .....	2-23
County .....	2-23
<b>3. Risk Assessment .....</b>	<b>3-1</b>
3.1. Methodology .....	3-1
Assess hazard .....	3-1
Determine exposure .....	3-1
Assess vulnerability .....	3-2
Data sources .....	3-2
3.2. Presidential Declared Disasters .....	3-2
3.3. Critical Facilities and Infrastructure .....	3-3
3.4. Future Trends in Development .....	3-5
3.5. Drought .....	3-7
General Background .....	3-7
Hazard Profile .....	3-9
Exposure and Vulnerability .....	3-10
Scenario .....	3-11
Issues/Recommendations .....	3-12
3.6. Earthquake .....	3-13
Definitions .....	3-13
General Background .....	3-13
Hazard Profile .....	3-16
Exposure and Vulnerability .....	3-19
Scenario .....	3-20

Issues/Recommendations.....	3-20
3.7.    Flood.....	3-23
Definitions.....	3-23
General Background.....	3-26
Hazard Profile.....	3-26
Exposure and Vulnerability.....	3-33
Hazard Profiles for Whitman County Communities and Unincorporated Areas.....	3-39
Scenario.....	3-114
Issues/Recommendations.....	3-114
3.8.    Severe Weather.....	3-117
Definitions.....	3-117
General Background.....	3-117
Hazard Profile.....	3-119
Secondary Hazards.....	3-120
Exposure and Vulnerability.....	3-120
Scenario.....	3-121
Issues/Recommendations.....	3-122
3.9.    Volcano.....	3-123
Definitions.....	3-123
General Background.....	3-124
Hazard Profile.....	3-125
Exposure and Vulnerability.....	3-127
Scenario.....	3-128
Issues/Recommendations.....	3-128
3.10.   Wildland Fire.....	3-129
Definitions.....	3-129
General Background.....	3-129
Hazard Profile.....	3-131
Exposure and Vulnerability.....	3-132
Scenario.....	3-133
Issues/Recommendations.....	3-133
3.11.   Loss Estimation.....	3-137
Drought.....	3-137
Earthquake.....	3-138
Flood.....	3-138
Severe Weather.....	3-138
Volcano.....	3-139
Wildfire.....	3-139
<b>4.    Risk Rating.....</b>	<b>4-1</b>
1.1.    Probability of Occurrence.....	4-1
1.2.    Impact.....	4-1
1.3.    Risk Rating.....	4-2

## List of Figures

Figure 2.1: Physiographic Regions of Washington .....	2-3
Figure 2.2: Geological Map of Whitman County .....	2-5
Figure 2.3: Palouse Falls.....	2-8
Figure 2.4: Missoula Flood.....	2-9
Figure 2.5: Detailed Map of Scablands.....	2-10
Figure 2.6: Annual Precipitation for Washington State.....	2-11
Figure 2.7: Growth Rates 1990-2003.....	2-12
Figure 2.8: Whitman County Age Distribution .....	2-15
Figure 2.9: Whitman County Race Distribution.....	2-16
Figure 2.10: Whitman County Employment 1990-2003 .....	2-18
Figure 2.11: Industry in Whitman County .....	2-19
Figure 2.12: Occupation in Whitman County.....	2-20
Figure 3.1: Earthquakes Sources in Washington State .....	3-15
Figure 3.2: Whitman County NEHRP Soils .....	3-21
Figure 3.3: Floodway Schematic .....	3-24
Figure 3.4: Frequency of Major Flooding, by County.....	3-28
Figure 3.5: Whitman County Floodplains .....	3-31
Figure 3.6: Whitman County Individual Assistance Claims .....	3-37
Figure 3.7: Albion Flood Hazard w/ Aerial.....	3-41
Figure 3.8: Albion Flood Hazard w/ USGS Base Map.....	3-43
Figure 3.9: Colfax Flood Hazard w/ Aerial .....	3-47
Figure 3.10: Colfax Flood Hazard w/ USGS Base Map.....	3-49
Figure 3.11: Colton Flood Hazard w/ Aerial .....	3-53
Figure 3.12: Colton Flood Hazard w/ USGS Base Map.....	3-55
Figure 3.13: Endicott Flood Hazard w/ Aerial.....	3-59
Figure 3.14: Endicott Flood Hazard w/ USGS Base Map .....	3-61
Figure 3.15: Garfield Flood Hazard w/ Aerial.....	3-65
Figure 3.16: Garfield Flood Hazard w/ USGS Base Map .....	3-67
Figure 3.17: Oakesdale Flood Hazard w/ Aerial .....	3-71
Figure 3.18: Oakesdale Hazard w/ USGS Base Map .....	3-73
Figure 3.19: Palouse Flood Hazard w/ Aerial.....	3-77
Figure 3.20: Palouse Flood Hazard w/ USGS Base Map .....	3-79
Figure 3.21: Pullman Flood Hazard w/ Aerial.....	3-85
Figure 3.22: Pullman Hazard w/ USGS Base Map.....	3-87
Figure 3.23: Rosalia Flood Hazard w/ Aerial .....	3-91
Figure 3.24: Rosalia Hazard w/ USGS Base Map .....	3-93
Figure 3.25: St. John Flood Hazard w/ Aerial .....	3-97
Figure 3.26: St. John Flood Hazard w/ USGS Base Map.....	3-99
Figure 3.27: Tekoa Flood Hazard w/ Aerial .....	3-103
Figure 3.28: Tekoa Flood Hazard w/ USGS Base Map.....	3-105
Figure 3.29: Uniontown Flood Hazard w/ Aerial .....	3-109
Figure 3.30: Uniontown Flood Hazard w/ USGS Base Map.....	3-111
Figure 3.31: How Cascade Volcanoes are Formed.....	3-124
Figure 3.32: Past Volcanic Events .....	3-125
Figure 3.33: Location of Cascade Mountains and Volcanoes .....	3-126

Figure 3.34: Annual Probability of Tephra Fall in the Northwest..... 3-127  
Figure 3.35: Wildland Fire Risk Areas ..... 3-135

### List of Tables

Table 2.1: Population of Cities, Towns, and Unincorporated County .....	2-13
Table 2.2: Population Under the Poverty Line .....	2-14
Table 2.3: Disability Status of Non-Institutionalized Population .....	2-17
Table 3.1: Federal Disaster Declarations in Whitman County .....	3-2
Table 3.2: Medical Facilities in Whitman County .....	3-3
Table 3.3: Police Facilities in Whitman County .....	3-3
Table 3.4: Fire Facilities in Whitman County .....	3-4
Table 3.5: Schools in Whitman County .....	3-4
Table 3.6: Airports in Whitman County .....	3-5
Table 3.7: NEHRP Soils Description.....	3-19
Table 3.8: Flood Related Disaster Declarations .....	3-27
Table 3.9: Public Assistance Claims in Whitman County, by Type.....	3-34
Table 3.10: Applicants for Public Assistance in Whitman County .....	3-34
Table 3.11: Amount of IA Grants, by Community .....	3-36
Table 3.12: NFIP Policies by Community .....	3-39
Table 3.13: Pullman Structures in Floodplain .....	3-82
Table 3.14: Recurrence Rates for Severe Weather Events in Whitman County .....	3-120
Table 4.1: Probability of Hazard Occurrence .....	4-1
Table 4.2: Impact to People from Hazards .....	4-2
Table 4.3: Impact in Dollar Losses for Hazards .....	4-2
Table 4.4: Risk Rating .....	4-3

(THIS PAGE LEFT INTENTIONALLY BLANK)

# List of Acronyms

ATSDR	Agency for Toxic Substance and Disease Registry
BNSF	Burlington Northern Santa Fe
BPA	Bonneville Power Administration
CERT	Community Emergency Response Team
DHS	Department of Homeland Security
DMA	Disaster Mitigation Act
DRACs	Disaster Reconstruction Assistance Centers
EERT	Employee Emergency Response Team
EHS	Extremely Hazardous Substances
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
GMA	Growth Management Act
HIVA	Hazard Inventory and Vulnerability Analysis
HMGF	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSEES	Hazardous Substances Emergency Events Surveillance
KCEM	King County Emergency Management
LEPCs	Local Emergency Planning Committees
MMI	Modified Mercalli Intensity
MPH	Miles Per Hour
NEHRP	National Earthquake Hazards Reduction Program
NIBS	National Institute of Building Sciences
NOAA	National Oceanic and Atmospheric Administration
PGA	Peak Ground Acceleration

PSA	Public Service Announcement
RCW	Revised Code of Washington
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SMA	Shoreline Management Act
TPQ	Threshold Planning Quantity
UBC	Uniform Building Code
US	United States
USGS	United States Geological Survey
WSDOE	Washington State Department of Ecology
WAC	Washington Administrative Code
WaDNR	Washington State Department of Natural Resources
WMDEMD	Washington Military Department Emergency Management Division
WRIA	Water Resource Inventory Area
WSDOH	Washington State Department of Health
WSDOT	Washington State Department of Transportation
WWII	World War II

# 1. Introduction

## 1.1. Background

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) commonly known as the 2000 Stafford Act amendments was approved by Congress on October 10, 2000. This Act required state and local governments to develop hazard mitigation plans as a condition of federal grant assistance. Prior to 2000, federal legislation provided funding for disaster relief, recovery, and some hazard mitigation planning. The DMA improves upon the planning process to emphasize the importance of mitigation, encouraging communities to plan for disasters before they occur.

Hazard mitigation can be considered any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural hazards. This is an essential element of emergency management along with preparedness, response and recovery. Disasters can produce a significant impact on communities when they occur. They can destroy or damage life, property and infrastructure, local economies, and the environment.

The Hazard Mitigation Plan (HMP) helps protect the health, safety, economic, and environmental interests of residents. Careful, long-term pre-disaster planning prior to disasters can help to reduce the impacts of natural hazards and increase a community's resilience through planning, awareness and implementation of mitigation actions. Fewer lives, homes and businesses will be lost and the disruption of a disaster event to the community will be lessened. Ultimately, a community that is hazard resilient is more likely to remain intact economically, structurally, socially, and environmentally even when disaster does occur.

The basis of the HMP is the Hazard Inventory and Vulnerability Analysis (HIVA). In June 2004, the Whitman County Department of Emergency Management contracted with TetraTech/KCM Inc. (Tetra Tech) to prepare a HMP for the county. To assist in this process, Tetra Tech subcontracted with the University of Washington's Institute for Hazards Mitigation and Planning (IHMP) to prepare a HIVA.

Hazard identification is the systematic use of all available information to determine what types of disasters may affect a jurisdiction, how often these events can occur, and the potential severity of their consequences. Vulnerability analysis refers to the process used to determine the impact these events and their collateral effects may have on the people, property, environment, economy and lands of a region.

This document provides information associated with all possible disaster events in Whitman County. The processes of hazard identification and vulnerability analysis serve as a foundation for the development of strategies to deal with particular emergencies, for allocating resources, and for helping set priorities and standards in ensuring the safety of the public.

## 1.2. Purpose and Mission

This document will expand upon information from the previous Whitman County HIVA concerning significant natural hazards that have the potential to affect large areas or populations within Whitman County. It is intended to serve as a basis for county-level emergency management plans and programs and to assist municipal jurisdictions, school and fire districts, and private businesses in the development of similar documents focused on local hazards. The HIVA is the foundation for the emergency/disaster management cycle (the four phases of mitigation, preparedness, response and recovery) that forms the core of public safety management in a crisis.<sup>1</sup>

This document will help to make an important first step toward a county that is as resilient as possible, covering each of the hazards affecting Whitman County. The hazards include:

- Natural Hazards
  - Drought
  - Earthquakes
  - Flooding
  - Severe Weather
  - Volcano
  - Wildland Fire

The HIVA defines each hazard, assesses the risk the hazard poses to Whitman County and provides suggestions of long-term mitigation actions the County should consider to reduce loss in the event of a hazard event.

## 1.3. Policy Framework for Washington

Washington State Mitigation Policy identifies a commitment to hazard mitigation planning to reduce the impact of disasters on communities in Washington State. The Washington State Legislature and the Governor have instituted a program to provide matching fund support for eligible applicants of the Hazard Mitigation Grant Program<sup>2</sup>. Other state programs have become available that can aid in mitigation strategies and reduce the impact of disasters.

## 1.4. HIVA Criteria

This plan is designed to meet some of requirements of the DMA 2000 and is intended to be included in the Whitman County Hazard Mitigation Plan. This plan will meet the Act's hazard mitigation-planning regulation that requires jurisdictions to have a completed Risk Assessment that includes:

- Identifying Hazards

---

<sup>1</sup> Snohomish County DEM 2002

<sup>2</sup> Washington Military Department Emergency Management Division. A Mitigation Workbook for Local Jurisdictions. 44 CFR Section 201.6 Planning Requirements. March 2003

- Profiling Hazard events
- Assessing Vulnerability: identifying assets, determining exposure, analyzing vulnerability

For all disasters declared on or after November 1, 2004, all jurisdictions must have adopted a Federal Emergency Management Agency (FEMA)-approved Hazard Mitigation Plan in place to be eligible for future hazard mitigation grant funds.

## **1.5. Document Overview**

This plan is divided into three sections as follows:

Section 1 – Introduction

Section 2 – Community Profile

Section 3 – Risk Assessment

Section 4 – Risk Ranking

The Risk Assessment will be the bulk of the document, discussing, in detail, each hazard that could potentially affect Whitman County. The Risk Ranking will summarize and rank each hazard according to the amount of risk it poses to the County.

(THIS PAGE LEFT INTENTIONALLY BLANK)

## 2. Community Profile

### 2.1. Introduction

Whitman County is an agricultural region in southeast Washington State. It is one of the most productive farming areas in the United States, exporting wheat, barley, peas and lentils to worldwide markets. Whitman County is also home to Washington State University (WSU) located in Pullman, the second largest university in the state.

### 2.2. Historical Overview

The area that is now Whitman County has had human settlement for over 10,000 years. In modern times, the area was inhabited by the Palouse Indians, who were related to the Nez Perce or Noon Nee-mee-Poo Indians. This tribe was renowned for its legal regulations, negotiating skills and horse breeding techniques. The famous Appaloosa horse was bred by the tribe. The first recorded European/Americans in the region were Lewis and Clark, who passed down the Snake River in October of 1805.

American settlement did not begin until the 1860s, when the flatlands along the Palouse River and Union Creek began to be claimed and settled. At first the tall bunchgrass filled land was used for mainly for grazing, but by the 1870s and 80s, Eastern European immigrants, who were used to similarly dry conditions, began to cultivate winter wheat and other field crops.

Whitman County was organized by the territorial legislature on November 29, 1871 by partitioning what was then Stevens County—a huge area covering what are now 13 eastern Washington counties, all of Northern Idaho, and much of western Montana. The county was itself quite large, covering what are now the modern-day counties of Whitman, Franklin, and Adams.<sup>3</sup> The County was named in honor of Dr. Marcus Whitman and his wife Narcissa, missionaries living near Walla Walla, who were massacred in 1847 by the Cayuse Indians who were angry after a measles epidemic decimated the tribe.<sup>4</sup>

In the 1870s, sawmills became an early local industry, supplying building materials for new settlers and producing flour. Many young towns had water-powered sawmills on its small rivers and creeks, although few, if none, exist today.

The 1880s saw the arrival of railroads, which helped further the economic development of the county. In 1890, the State Agricultural College of Washington was founded as a land grant college at Pullman. This college evolved into what is now Washington State University.

Today, at the beginning of the 21st century, Whitman County is still focused around the institutions that helped create and shape its identity back in the 19<sup>th</sup> century: agriculture and the university.

---

<sup>3</sup> Workforce Explorer Washington

<http://www.workforceexplorer.com/article.asp?PAGEID=67&SUBID=116&ARTICLEID=1826&SEGMENTID=1>

<sup>4</sup> Whitman Massacre <http://www.oregonpioneers.com/whitman.htm>

## 2.3. Geographical Setting

Comprising a total land area of 2,159 square miles, Whitman County ranks 10th in size among Washington counties. The county is situated in southeast Washington along the Washington-Idaho border. On the Washington side, it is bordered to the north by Spokane County, to the west by Adams County (and a small part of Franklin County at its southwest corner), and to the south by Columbia, Garfield, and Asotin counties.

### Lakes, Rivers and Creeks

The Snake River is responsible for the county's winding southern border with Columbia, Asotin, and Garfield counties. Along this river-forged border lies the Snake River Canyon—a canyon that cuts a 2,000-foot deep swath through the Palouse Hills. The county's single largest body of water is Rock Lake, located in the northwest corner and is a remnant of the Missoula Floods that formed the scablands of this region. The County's drainage is part of the Palouse River Watershed, listed as a WRIA subbasin of the Snake River. The major river is the Palouse River (which drains to the Snake River) and its two branches. Among the Palouse River's major tributaries are Rock Creek, Pine Creek, Pleasant Valley Creek, Rebel Flat Creek, and Union Flat Creek. In the summer about 75% of the smaller creeks run dry. The rivers of the County originate in the east, in the Moscow Mountains in Idaho, and generally flow east to west. Hangman Creek, flowing through the northeast corner of the County near Tekoa, drains to the Spokane River.

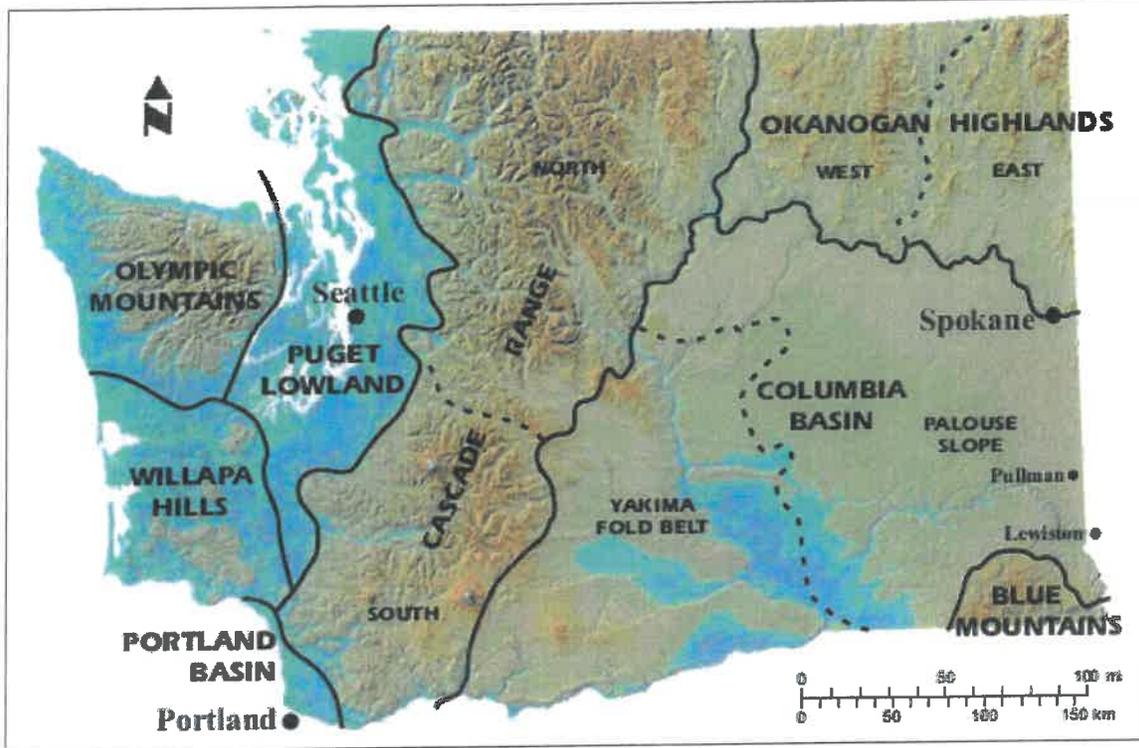
### Topography

Whitman County lies in the heart of the Palouse country on the Columbia Plateau. Its topography is generally that of flat land and rolling hills (the Palouse Hills). Elevations in the region range from 1,100 to 3,400 feet above sea level. At the higher elevations are Tekoa Mountain and a number of prominent rock formations such as Bald Butte, Steptoe Butte, and Kamiak Butte. Various forms of bunchgrass constitute the native vegetation, though most of the dryland has since been converted into a productive wheat farming region.

### Soils and Geology

Whitman County lies on the eastern end of the Columbia Plateau, one of the seven major physiographic regions of Washington State (See Figure 2.1). The Columbia Plateau is generally composed of basalt, volcanic lava floods that have since cooled, that erupted during the Miocene Epoch from 17 - 6 million years ago. Most of the lava flooded during the first 1.5 million years, an extraordinary short time for such as outflow of lava. Numerous eruptions from fissures in the earth's crust eventually led to the lava being hundreds of feet thick in some locations. The only remnants of the pre-Miocene geology are the steptoes, such as Steptoe Butte, which are the severely eroded exposed peaks of high mountains covered in basalt. In between basalt eruptions, sand and gravel deposits left by rivers from the erosion of nearby mountains contributed to the geology of the Palouse region. These porous sedimentary layers between layers of basalt are where most of Whitman County's potable water is found.

Figure 2.1: Physiographic Regions of Washington

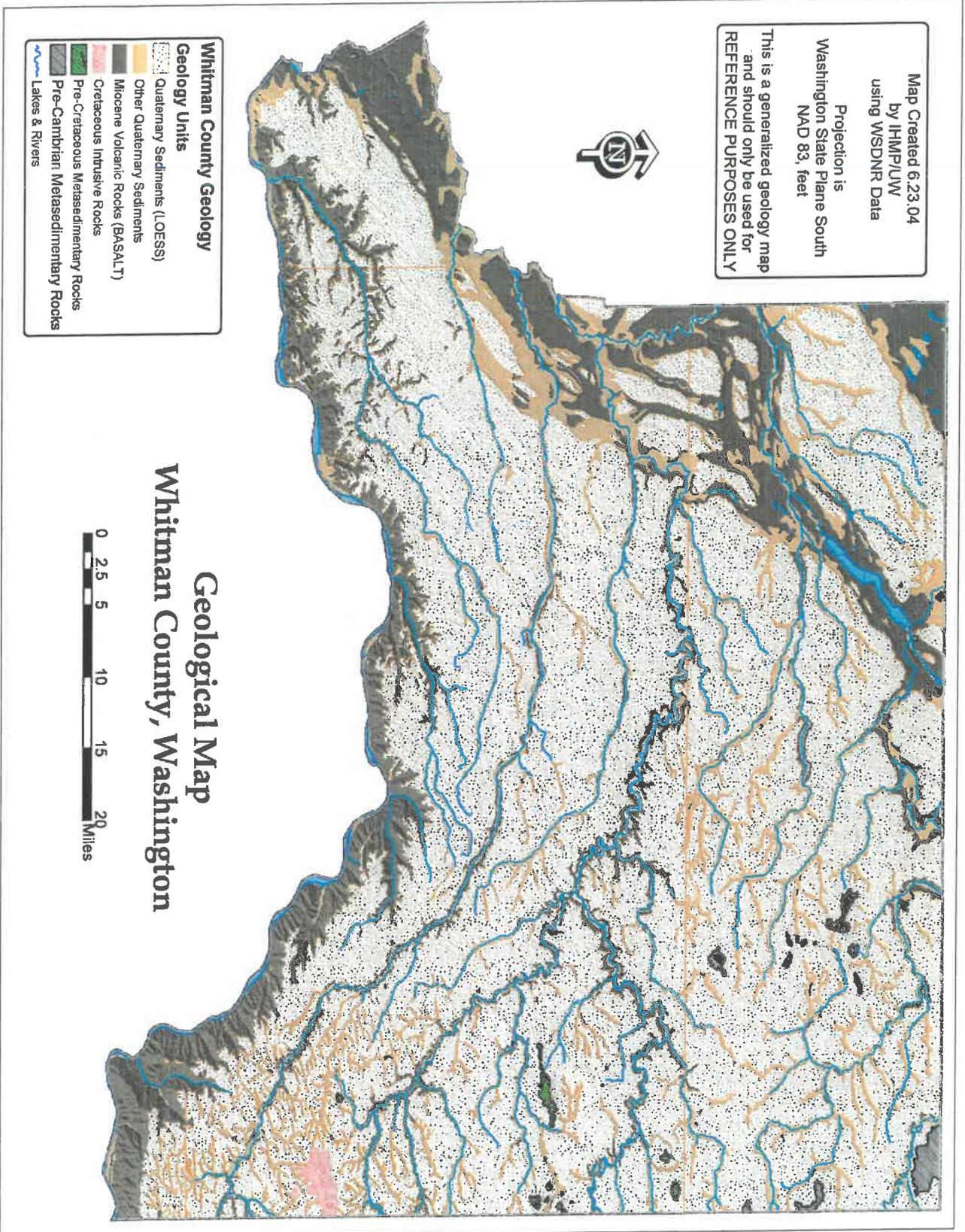


The present landscape of Whitman County was formed relatively recent, beginning during the end of the last ice age about 15,000 years ago. The Palouse region's rich, dark, porous, moisture-retentive soil is composed of loess and volcanic ash overlaying basalt. Figure 2.2 shows a general geological map of Whitman County. Loess was blown in as fine silt and dust during the end of the ice age that settled on the basalt outcrops and formed as rolling hills resembling large dunes. The hills have a distinct look: gentle south facing slopes and steep north facing slopes aligned parallel to the prevailing southwesterly winds. In some places, the loess can be up to 100 feet deep. The fine-grained loess is highly erodible, and scientists believe that much of the loess deposited during the Holocene Epoch (the last 11,000 years of geological time) has been lost.<sup>5</sup>

<sup>5</sup> Geology of the Palouse <http://pwc.org/geonotes/geonote09.html>

(THIS PAGE LEFT INTENTIONALLY BLANK)

Figure 2.2: Geological Map of Whitman County



(THIS PAGE LEFT INTENTIONALLY BLANK)

## *Scablands*<sup>6</sup>

The end of the last glacial period left behind another dramatic feature of terrain. Between 13 and 15 thousand years ago, melting glaciers across the northwest United States and southern Canada filled a huge lake held back by a glacial dam and covered a large area of what is now western Montana. At its largest volume, Glacial Lake Missoula held over 520 cubic miles of water, covered over 3,000 square miles, and was over 2,000 feet deep at the edge of the glacial dam. This huge body of water was an inland sea, filled by the Clark Fork River and glacial melts.

Eventually the water cut underneath the glacial wall and the dam of ice collapsed over an expanse of about 100 miles. The water rushed over the ice and onto the land with incredible force. In about two days the water of Glacial Lake Missoula emptied through the breached dam. The amount of escaping water was equal to ten times the discharge of all the Earth's rivers today. Water several hundred feet deep flooded the region and ripped up hundreds of feet of soil and rock, carrying it inside the torrent of water westward toward the sea. The flood cut channels and carved islands, leaving behind the scarred landscape now called the Channeled Scabland. A striking and dramatic example of this is Palouse Falls. The water falls over two hundred feet into a cirque surrounded by sheer basaltic canyons. Figure 2.3 shows Palouse Falls. Similar canyon walls are frequent throughout Whitman County.<sup>7</sup> The Scablands can be found in the northwest part of Whitman County which SR 23 passes through.

The Channeled Scablands are laden with evidence of repeated Missoula Floods. Some sedimentary deposits are stacked layer upon layer, indicating that dozens of floods escaped from Glacial Lake Missoula. Thin layers of volcanic ash help geologists gauge the approximate time of the floods. Between 17 and 13 thousand years ago, the region was probably repeatedly flooded every few years. All these floods contributed to a landscape that is still recovering from the onslaught. Figure 2.4 shows a map of the extent of Glacial Lake Missoula and the area swept by the Missoula Flood.<sup>8</sup> Figure 2.5 shows a more detailed map of the scablands in the Whitman County area.

---

<sup>6</sup> Oregon Field Guide <http://www.opb.org/programs/ofg/episodes/1001/missoula/index.php>

<sup>7</sup> Colfax City History <http://www.ci.colfax.wa.us/History.htm>

<sup>8</sup> USGS [http://vulcan.wr.usgs.gov/Glossary/Glaciers/IceSheets/Maps/map\\_missoula\\_floods.html](http://vulcan.wr.usgs.gov/Glossary/Glaciers/IceSheets/Maps/map_missoula_floods.html)

**Figure 2.3: Palouse Falls<sup>9</sup>**



---

<sup>9</sup> Pullman Chamber of Commerce <http://www.pullmanchamber.com/gallery.asp>

Figure 2.4: Missoula Flood

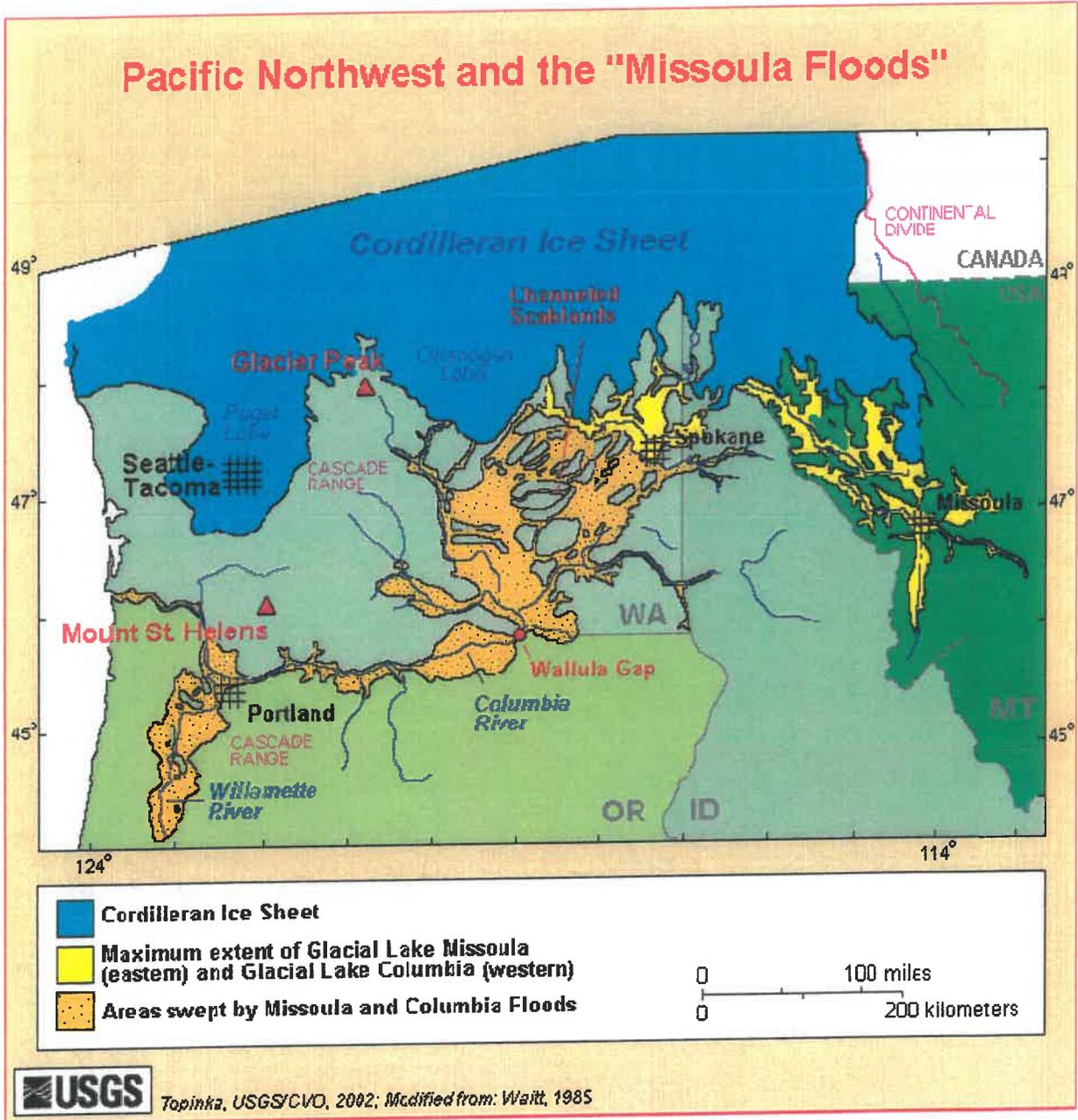
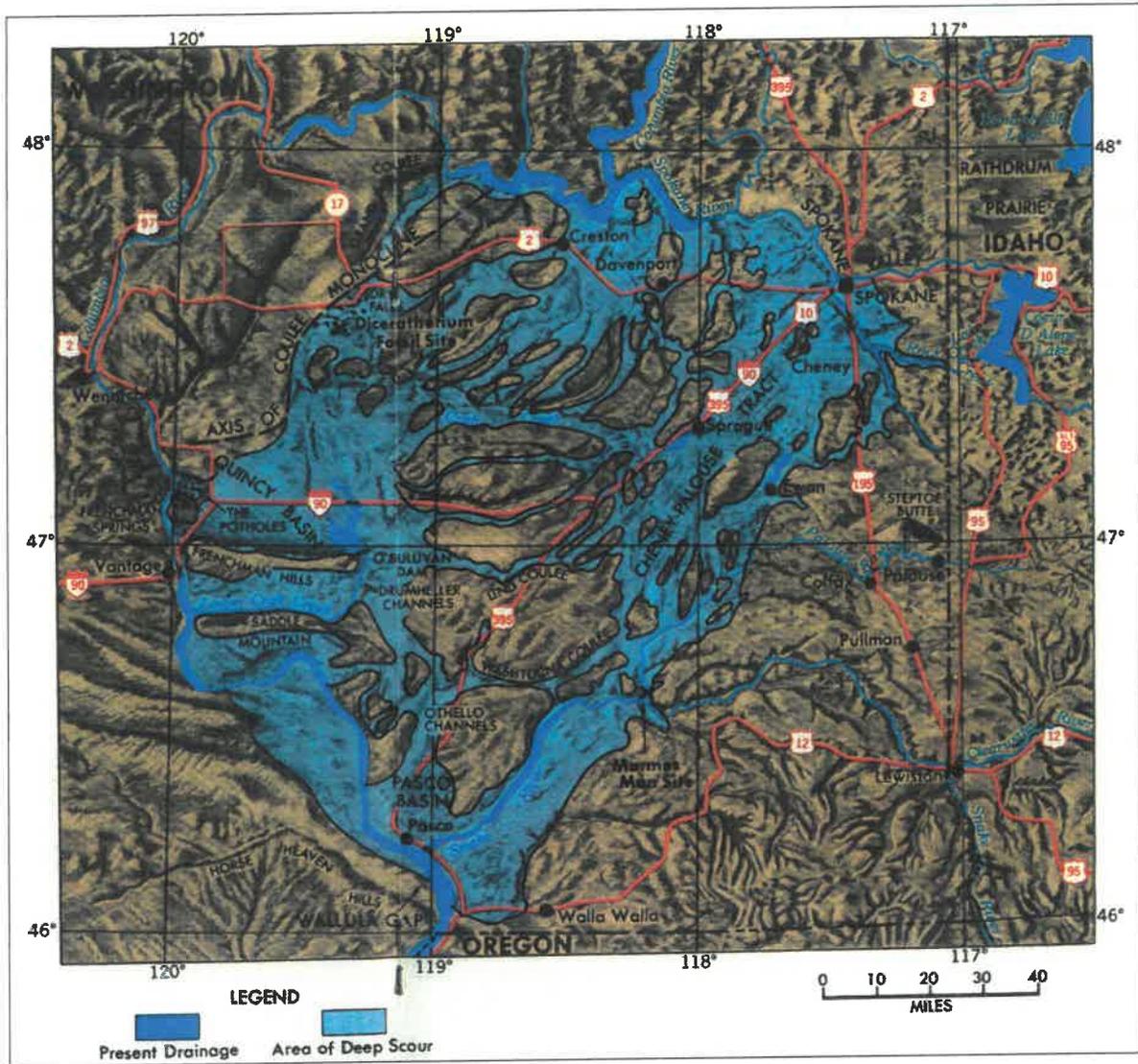


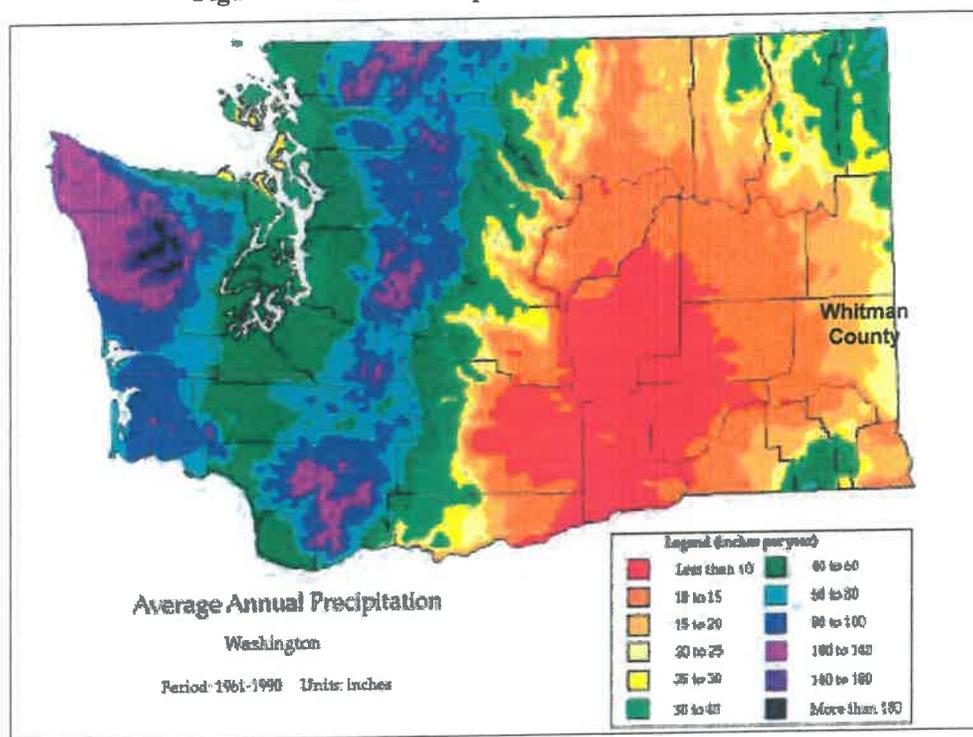
Figure 2.5: Detailed Map of Scablands



## Climate

Whitman County generally experiences seasonable weather patterns characteristic of eastern Washington. Warm, dry summers are usually experienced, although heavy rain and hail infrequently accompanies thunderstorm activity. Mid-summer temperatures range in the middle and upper 80's°F (Fahrenheit), while winter highs are usually in the 30's°F. Extreme temperatures can range from 110°F to -30°F. Snow, the dominant form of precipitation due to winter coinciding with the rainy season, accumulates to a depth of 10 to 15 inches and remains on the ground from December through February. Annual average precipitation increases from west to east, with the western portion of the county receiving less than 12 inches, while the eastern part receives over 24 inches.<sup>10</sup> The average amount of snowfall that Whitman County receives annually is about 28 inches. Figure 2.6 shows the annual precipitation for Washington State. Whitman County is labeled in black.

Figure 2.6: Annual Precipitation for Washington State

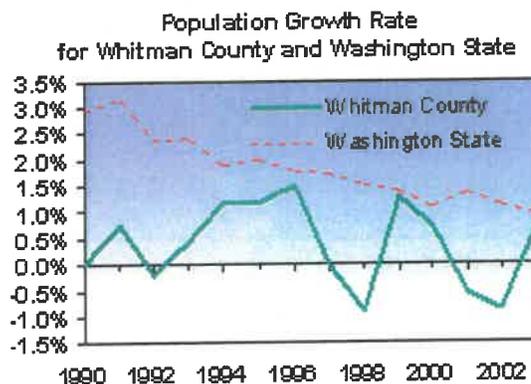


## Whitman County Population Characteristics<sup>11</sup>

The Office of Financial Management estimated Whitman County's population at 41,000 in 2003. That is only 260 more people than the 40,740 reported in the 2000 Census and ranks the county 22nd (out of 39) among Washington counties, according to population size.

Population changes are generally seen as socio-economic indicators. A growing population generally indicates a growing economy while a declining population signifies economic decline. Between 1990 and 2003, Washington State's total population grew by 25.3 percent while Whitman County's population increased by only 5.7 percent. This is indicative of a stable, but slow growing, economy. Figure 2.7 shows the growth rate of Whitman County from 1990 to 2003, compared to Washington State. What is important to note is the fluctuating growth rate in the County. Some years have seen growth while other years (1992, 1997, 2001) have actually seen population loss.

Figure 2.7: Growth Rates 1990-2003



Most Whitman County residents live in incorporated areas. In 2003, only about 15 percent of its 41,000 residents lived outside of incorporated areas. Growth in the incorporated areas was about 8 percent from 1990 to 2003, while in the unincorporated areas the population decreased by about 5 percent.

The county has only three cities with populations over 1000: Colfax, Palouse, and Pullman. Over 60 percent of the county's population resides in Pullman, home of WSU. Table 2.1 below shows the population of incorporated municipalities in the county along with their growth from 1990 to 2003.

<sup>11</sup> Information from this section was gathered from [workforceexplorer.com](http://www.workforceexplorer.com) (<http://www.workforceexplorer.com/article.asp?PAGEID=67&SUBID=116&ARTICLEID=1826&SEGMENTID=2>) using OFM data. OFM data was used to verify accuracy.

**Table 2.1: Population of Cities, Towns, and Unincorporated County**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Whitman</b>	<b>38,775</b>	<b>38,560</b>	<b>38,770</b>	<b>38,909</b>	<b>39,064</b>	<b>39,451</b>	<b>39,590</b>	<b>40,154</b>	<b>40,610</b>	<b>40,842</b>	<b>40,740</b>	<b>40,300</b>	<b>40,600</b>	<b>41,000</b>
Unincorporated	6,629	6,655	6,470	6,379	6,378	6,409	6,357	6,308	6,328	6,319	6,370	6,305	6,348	6,317
Incorporated	32,146	31,905	32,300	32,530	32,686	33,042	33,233	33,846	34,282	34,523	34,370	33,995	34,252	34,683
Albion	632	635	634	629	625	635	631	638	630	624	616	625	610	620
Colfax	2,761	2,699	2,783	2,809	2,821	2,821	2,837	2,842	2,840	2,847	2,844	2,835	2,820	2,825
Colton	325	325	331	343	356	367	370	372	378	383	386	390	385	395
Endicott	320	328	329	336	338	343	345	352	352	361	355	342	350	355
Farmington	126	105	109	105	109	113	117	151	139	151	153	150	150	145
Garfield	544	552	576	567	595	619	634	645	645	645	641	640	625	610
LaCrosse	336	343	338	354	345	356	366	369	376	379	380	380	370	370
Lamont	93	83	87	85	88	97	95	101	104	105	106	105	105	105
Malden	189	210	212	212	212	214	215	215	215	215	215	215	215	210
Oakesdale	346	359	372	385	396	410	438	416	417	419	420	420	420	415
Palouse	915	913	927	936	972	988	988	989	985	1,002	1,011	1,015	1,005	1,010
Pullman	23,478	23,224	23,426	23,493	23,531	23,824	23,932	24,458	24,893	25,069	24,948	24,540	24,910	25,300
Rosalia	552	570	578	590	589	599	606	612	627	644	648	660	645	650
St. John	499	513	510	520	523	532	535	544	548	555	548	513	497	518
Tekoa	750	774	799	861	858	802	796	797	795	784	754	825	820	820
Uniontown	280	272	289	305	328	322	328	345	338	340	345	340	325	335

### *Why Consider Demographics in Hazard Mitigation Plans?*

It is important for hazard-related plans to consider the demographics of the communities they seek to protect. Some populations experience greater risk from hazard events not because of their geographic proximity to the hazard but because of decreased resources and/or physical abilities. Elderly people, for example, may be more likely to be injured in a disaster and are also more likely to require additional assistance after a disaster. Research has shown that people living near or below the poverty line, the elderly and especially older single men, the disabled, women, children, ethnic minorities and renters have all been shown to experience, to some degree, more severe effects from disasters than the general population.

Vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, their capabilities during a hazard, and in access to resources for post-disaster recovery. Despite the fact that they often disproportionately experience the effects of a disaster, vulnerable populations are rarely accounted for in the current hazard planning process. There is a need for increased awareness of these differences.

The remainder of this section will detail the numbers of potentially vulnerable populations residing in Whitman County. The demographic information for Whitman County is based on the 2000 United States (U.S.) Census data and from information supplied by the State of Washington Office of Financial Management (OFM).<sup>12</sup>

## *Income*

Impoverished people are more adversely impacted from disasters than members of the general population. In the United States, individual households are expected to use private resources to prepare for, respond to, and recover from disasters to some extent. This expectation means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy the more poorly built and inadequately maintained housing of any given community. Mobile or modular homes, for example, are more susceptible to damage in hurricanes, tornadoes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of unreinforced masonry, a building type that is particularly susceptible to damage during earthquakes.

The 2000 per capita income in Whitman County was \$15,298, while the median household income was \$28,584. Table 2.2 shows the comparison of income and poverty for the county and state. About 25% of Whitman County residents are below the poverty line (meaning they spend more than 1/3 of income on an economy food budget). Among the population under 18 in Whitman County, 16.5% are below the poverty line. Among those 65 and older, 5.5% fall below the poverty line.

**Table 2.2: Population Under the Poverty Line**

	<b>Median Household Income</b>	<b>Percent of total population below poverty line</b>	<b>Percent of children (18 &amp; under) below poverty line</b>	<b>Percent of elderly (65 &amp; older) below poverty line</b>
Whitman County	\$28,584	25.6	16.5	5.5
Washington State	\$45,776	10.6	13.2	7.5

These numbers may be misleading. Washington State University's student population represents about 44% of the County's population (about 18,000 in 2002), who typically do not work, or work in part-time, low wage service jobs. This situation can deflate the median household income for the County in relation to the rest of the state, while inflating the amount of those who are living below poverty.

## *Age Distribution*

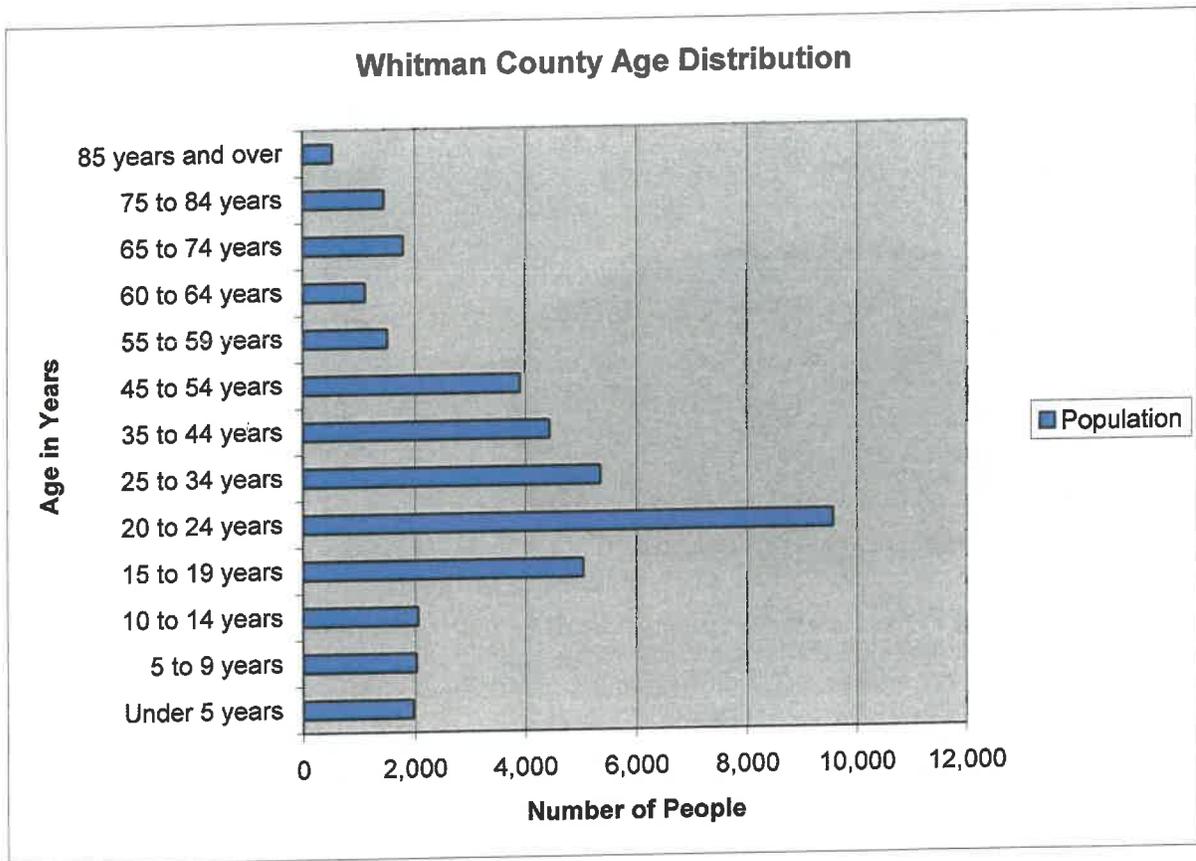
The vulnerability of elderly populations can vary quite significantly based on health, age, and economic security. However, as a group, the elderly are more apt to lack the physical and economic resources necessary for response, and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia.

<sup>12</sup> <http://www.ofm.wa.gov/localdata/whit.htm>

Furthermore, they are more likely to live in assisted-living facilities, where emergency preparedness occurs at the whim of operators. Certainly, the elderly require specific planning attention, an especially important consideration given the current aging of the American population.

According to 2000 US Census Bureau data, 9.2% or 3,765 of Whitman County's population is 65 or older. This is less than the state average of 11.2%. Of this 1,366, or 38% of elderly persons, have disabilities of some kind. Figure 2.8 shows the distribution of age in Whitman County.

Figure 2.8: Whitman County Age Distribution



As noted in the previous section, the largest age cohort are those 20-24, which is the heart of the college age population that makes up 44% of the county's population.

#### Race, Ethnicity and Language

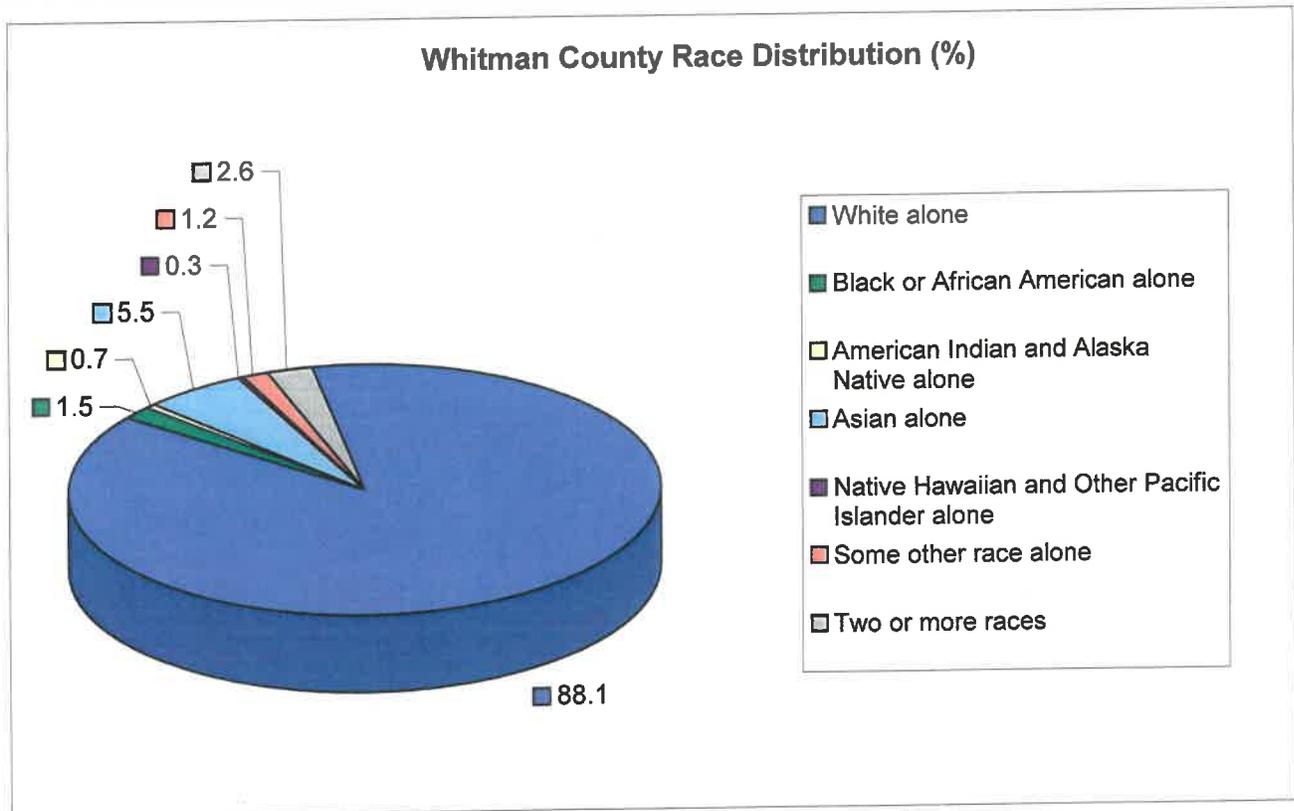
Many researchers have focused on the increased disaster vulnerability that ethnic minorities experience in the United States. As one researcher has pointed out, "History is less likely to count minority victims in death tolls, and to minimize disasters that affect mostly minority victims as 'less disastrous' ".<sup>13</sup> Research shows that minorities are less likely to be involved in pre-disaster planning, experience higher mortality rates during an event, and post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Furthermore,

<sup>13</sup> Steinberg 2000

because higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability.

Racially, Whitman County is a homogenous area; about 88% of the population is listed as White on the 2000 Census. The largest minority population is Asian, followed by Blacks and Native Americans. Figure 2.9 shows the racial distribution of Whitman County.

Figure 2.9: Whitman County Race Distribution



Whitman County has a 7.7% foreign-born population. Approximately 4% or 1,516 of Whitman County’s residents reported speaking English “less than ‘very well’ in the 2000 Census. The largest group of languages spoken, other than English, was Asian and Pacific Island languages.

### ***Disabled Populations***

Because the disabled are significantly more likely to have difficulty responding to a hazard event than the general population, people living with disabilities have a special stake in emergency planning efforts. According to U.S. Census figures, 54 million American, roughly one-fifth of the U.S. population, live with a disability. These numbers are rising; furthermore, disabled populations are increasingly integrated into society.<sup>14</sup> This means that

<sup>14</sup> Bolin 1994

a relatively large segment of the population will require assistance during the 72 hours post-event, the period generally reserved for self-help.<sup>15</sup>

Disabilities can vary greatly in severity and permanence, making populations difficult to define and track. There is no “typical” disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Furthermore, disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard. In fact, in at least one city, census data indicates that disabled populations are concentrated in older, higher-density housing that is more susceptible to earthquake damage.<sup>16</sup>

While the percentage of disabled in Whitman County does not differ much from that of the state as a whole, the overall numbers are significant and warrant special attention from planners and emergency managers (see Table 2.3).

**Table 2.3: Disability Status of Non-Institutionalized Population**

Age	Number	Percent of Age Group
5-20 yrs	726	6.2
21-64 yrs	2,715	11.7
65+ yrs	1,365	37.9

## 2.5. Economy

### Development Trends<sup>17</sup>

In December 2003, the labor force in Whitman County was estimated at 19,586. Figure 2.10 shows the changes from 1990 to 2003. The labor force, overall, grew by over 11 percent during this period, expanding from its 1990 level of 17,420. The state's labor force grew 19 percent over the same period. The county's work force declined during the 1990-91 recession and fluctuated moderately until 2003 when it reached the highest level for the 1990-2003 period. The labor force level is showing a moderate increase from 2002, which may be directly related to the increase in WSU student enrollment for the same period of time.

<sup>15</sup> Tierney et al. 1988

<sup>16</sup> Tierney et al. 1988

<sup>17</sup> WorkforceExplorer.com

<http://www.workforceexplorer.com/article.asp?PAGEID=67&SUBID=116&ARTICLEID=1826&SEGMENTID=4>

Figure 2.10: Whitman County Employment 1990-2003

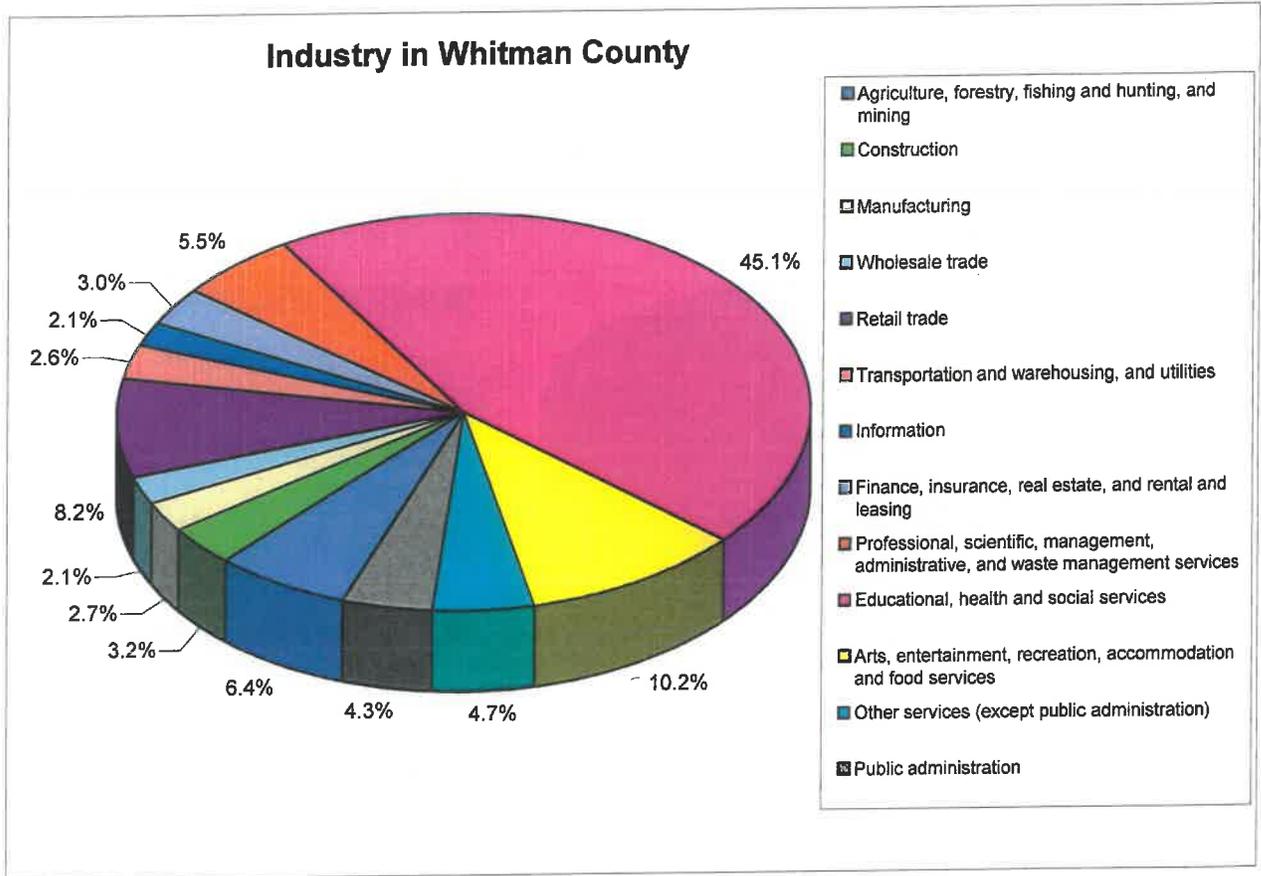


## Industry

The Educational, Health and Social Services industry (namely WSU) in Whitman County is the largest employer, employing about 45.1% of the total working population. Other major employment industries include Arts, Entertainment, Recreation, Accommodation and Food Services, with 10.2% of the working population and Retail Trades, with 8.2%.<sup>18</sup> Agriculture and other related industries make up 6.4% of employment, or about 1,200 jobs (see Figure 2.11).

<sup>18</sup> U.S. Census Bureau 2000

Figure 2.11: Industry in Whitman County

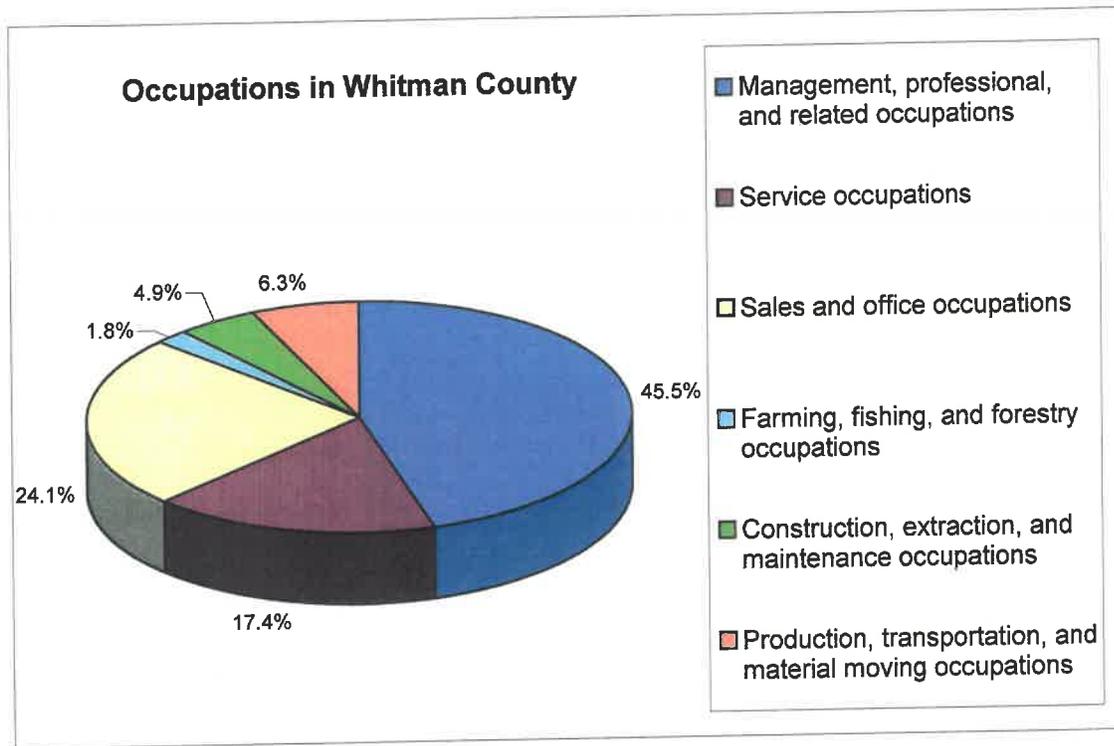


## Occupation

In Whitman County, the top three occupations are management, professional, and related occupations (45.5%), sales and office occupations (24.1%), and service occupations (17.4%).<sup>19</sup> Farming is listed as an occupation for only 334 people, or 1.8% of all occupations. The mean travel time to work is 15 minutes. Figure 2.12 shows percentages for occupations in Whitman County.

<sup>19</sup> U.S. Census Bureau 2000

Figure 2.12: Occupation in Whitman County



## 2.6. Profile of Whitman County Towns and Cities

This section will give a brief overview of the many communities found in Whitman County. Whitman County has 16 incorporated towns and cities, and at least a dozen other, smaller, unincorporated communities.

### *Town of Albion*

Albion, a bedroom community of 620 people, is located about six miles northwest of Pullman on the South Fork of the Palouse River.

### *City of Colfax*

Colfax, the county seat of Whitman County, has 2,825 inhabitants, and is the second largest city in the county after Pullman. It is located at the confluence of the North and South Forks of the Palouse River. Colfax is about 15 miles northwest of Pullman via U.S. Highway 195.

### *Town of Colton*

Colton is a farming community of 395 people located on Union Flat Creek and U.S. Highway 195. It is located in southwest Whitman County, about 16 miles south of Pullman and 4 miles west of the Idaho border.

### ***Town of Endicott***

Endicott is an agricultural community of 355 people located about 14 miles west of Colfax. Rebel Flat Creek passes through the town.

### ***Town of Farmington***

Farmington is a small town of 145 people located at the confluence of the North and South Forks of Pine Creek adjacent to the Idaho border. It is about 30 miles northeast of Pullman.

### ***Town of Garfield***

Garfield is a farming community of 610 located in the northeast part of Whitman County near the Idaho border. It is located about 15 miles northeast of Colfax. The town is located on Silver Creek.

### ***Town of La Crosse***

La Crosse (population 370) is located about one mile north of State Highway 26 in western Pullman County.

### ***Town of Lamont***

Lamont (population 105) is a tiny town located in the scablands of northwest Whitman County, about a mile southwest of State Route 23.

### ***Town of Malden***

Malden (population 210) is a small former railroad town located on the north side of a hill on the south side of Pine Creek.

### ***Town of Oakesdale***

Oakesdale is a farming community of 415 located in northwest Whitman County. It is located approximately 17 miles north of Colfax. It is located on the confluence of McCoy and Spring Creeks.

### ***City of Palouse***

Palouse is an agricultural and farming community of 1,010 people located in eastern Whitman County, about two miles from the Idaho border. It is located on the (North Fork) Palouse River, and is accessible to Pullman, 16 miles to the south, via SR 27.

### ***City of Pullman***

Pullman, located about 15 miles southeast of Colfax, is the largest and principal city of Whitman County. It is home to 25,300 people, over 60% of the County's total population. Of this, about 18,000 attend Washington State University (WSU), which is located in the town. The town also has numerous professional and retail businesses that serve the university and its population. Pullman, originally named Three Forks, lies on rolling hills above the floodplains of the South Fork Palouse River, Paradise Creek and Missouri Flat Creek.

### *Town of Rosalia*

Rosalia is a farming community and commuter suburb to Spokane of 650 people located in north central Whitman County near the Spokane County border. Pine Creek flows north through the town and State Highway 195 passes just east of the town. Spokane is about 35 miles north of Rosalia, and Colfax is about 25 miles south.

### *Town of St. John*

St. John is a town of 518 people located in the Pleasant Valley along Pleasant Valley Creek. SR 23 passes through the town and connects it with US 195 and I-90.

### *City of Tekoa*

Tekoa is an agricultural community of 820 people located in northeast Whitman County near the border with Spokane County and the State of Idaho. Hangman Creek flows through the town, draining into the Spokane River. It is located about 35 miles north of Pullman.

### *Town of Uniontown*

Uniontown has a population of 325. It is located in southeast Whitman County on Union Flat Creek and the South Fork Union Flat Creek. U.S. Highway 195 passes north through the town towards Pullman, which is about 15 miles northwest of Uniontown. The Idaho border is located about 1.5 miles to the east.

### *Unincorporated Whitman County*

The vast majority of Whitman County is unincorporated land used mostly for farming and grazing. About 6,317 people or about 15% of the total County population, live in the unincorporated areas. There are also some small, agriculturally related communities within the unincorporated areas, such as Pine City, Hooper, Winona, Hay, and Elberton. Other towns include Almota, the former port located on the Snake River, Dusty, Ewan, Revere, Riparia, Steptoe and Thornton.

## **2.7. Laws and Ordinances**

### **Federal**

#### *Disaster Mitigation Act (DMA 2000)*

The DMA 2000 is the latest legislation to improve the hazard mitigation planning process. It reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program (HMGP) funds are available to communities.

#### *Endangered Species Act (ESA)*

ESA was enacted in 1973 with the purpose of conserving those species that are facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered, and requires the conservation of the critical habitat in which those species live.

## State

### *Growth Management Act (GMA)*

In 1990, the Washington State Legislature adopted the Growth Management Act (Chapter 36.70A RCW). The Growth Management Act (GMA) mandates that local jurisdictions adopt ordinances that classify, designate, and regulate land use in order to protect critical areas. According to the code, "critical areas" include the following areas and ecosystems: (a) wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas (RCW 36.70A.030).

Whitman County is not required to plan under the GMA. Nonetheless the County has a Comprehensive Plan that emphasizes maintaining its rural agricultural environment, while allowing for growth around Pullman

### *Shoreline Management Act (SMA)*

The Shoreline Management Act (RCW 90.58) was enacted in 1971, and is meant to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, plus rivers, streams and lakes above a certain size. It also regulates "wetlands" associated with these shorelines.

### *Washington Administrative Code (WAC 118-30-060(1))*

The Washington Administrative Code (WAC 118-30-060 (1)) requires each political subdivision to base its comprehensive emergency management plan on a hazard analysis.

## Hazards

1. Hazards are conditions that have the potential to threaten human life and they are the result of three main factors.
  1. Natural conditions such as weather and seismic activity.
  2. Human interference with natural processes such as a levee that displaces the natural flow of floodwaters.
  3. Human activity and its products such as homes on a floodplain.
2. The definitions for hazard, hazard event, hazard identification, and flood hazard include related concepts.
  1. A hazard may be connected to human activity.
  2. Hazards are extreme events.
  3. Hazards generally pose a risk of damage, loss, or harm to people and/or their property.

## County

### *Whitman County Code*

Chapter 19 of Whitman County Code deals with Zoning. Chapter 19.50 defines a Flood Management Overlay District. This is an overlay district referenced to the Flood Insurance

Rate Maps (FIRMS) that does not add to land uses allowed by the underlying zoning, but may restrict certain uses. The zoning code also requires compliance with all Critical Areas Ordinances. Critical Areas Ordinances are found in Chapter 9 of the County Code and include:

Chapter 9.03 Wetlands

Chapter 9.20 Whitman County Fish and Wildlife Habitat Conservation Areas Ordinance

Chapter 9.40 Critical Aquifer Recharge Area Designation and Protection

The Building and Fires Codes (find reference) guide development with regards to steep slopes and geologically hazardous soils. Structures located slopes 33% or greater are subject to additional Building Code Provisions.

### ***Whitman County Comprehensive Plan***

Although not required to plan under the GMA, Whitman County has prepared a Comprehensive Plan to deal with growth and future development. It was first prepared in 1978, and has been updated and amended periodically. Changes include language relating to the adoption of critical areas and aquifer recharge areas, and changes in zoning, especially along the Pullman –Moscow corridor. The Comprehensive Plan has a section entitled “Environmental Quality and Conservation Element” that deals with flood hazard areas and other sensitive areas.

## **3. Risk Assessment**

This section will describe the risks facing the Whitman County from each of 6 hazards designated as significant. This section will also elaborate upon the hazard definition, vulnerabilities and probable event scenarios. Taken as a whole, this section assesses the risk that Whitman County is likely to experience from hazard events.

The following process was used to define risk of each hazard, which is reflected in the organization of each hazard section:

- Identify and profile each hazard
- Determine exposure to each hazard
- Assess the vulnerability of exposed infrastructure and facilities
- Scenarios of worse case probable events were developed to add a face to likely disasters and aid in the development of future estimates of cost

The six hazard sections are listed in alphabetical order and are as follow:

3.5 Drought

3.6 Earthquake

3.7 Flood

3.8 Severe Weather

3.9 Volcano

3.10 Wildfire

### **3.1. Methodology**

#### **Assess hazard**

This assessment includes the following information for each hazard:

- Geographic areas most affected by hazard
- Event frequency estimates
- Severity
- Warning time likely to be available for response

#### **Determine exposure**

Exposure was determined by overlaying hazards with an inventory of potentially vulnerable structures, facilities, and systems to determine which of them would be exposed to each hazard. Much of this information came from USGS quad maps, Washington State

Department of Transportation (DOT) GIS data, Washington State Department of Natural Resources GIS data, FEMA Flood Insurance Studies and Maps, FEMA's HAZUS Risk Assessment Mapping program, and information supplied by Whitman County.

## Assess vulnerability

Vulnerability of the exposed structures and infrastructure were then assessed. Vulnerability was determined by interpreting the probability of occurrence of each event and assessing structures, facilities and systems that were exposed to each hazard.

## Data sources

This information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. To the extent possible, the hazard location was mapped using ArcGIS 8.3. Most map related data sources were those mentioned above and include USGS quad maps and digital elevation models (DEMs), Washington State Department of Transportation (DOT) GIS data, Washington State Department of Natural Resources GIS data, FEMA Flood Insurance Studies and Maps, FEMA's HAZUS Risk Assessment Mapping program, and information supplied by Whitman County..

## 3.2. Presidential Declared Disasters

Presidential Declared Disasters are disaster events that cause more damage than state and local governments/resources can handle without federal assistance. There is not generally a specific dollar threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities. A Presidential Emergency Declaration can also be declared, but assistance is only limited to specific emergency needs.<sup>20</sup> Historically (records date back to 1956), Whitman County has had 8 Presidential Declared Disasters and 1 Presidential Emergency Declaration.

Table 3.1 below shows the disasters that have affected the County. Six events have been flooding related, one event related to winds/firestorms, one drought, and one state-wide event caused by the eruption of Mt. Saint Helens in 1980.

Table 3.1: Federal Disaster Declarations in Whitman County<sup>21</sup>

Federal Disaster Declarations in Whitman County		
<i>date</i>	<i>type</i>	<i>event*</i>
March, 1963	Flooding	Maj # 146
January, 1972	Severe Storms/Flooding	Maj # 322
January, 1974	Severe Storms/Snowmelt/Flooding	Maj # 414

<sup>20</sup> FEMA, <http://www.fema.gov/library/dproc.shtm>

<sup>21</sup> Washington EMD <http://emd.wa.gov/6-rr/disaster-declarations.htm>

March, 1977	Drought	Emerg # 3037
December, 1977	Severe Storms/Flooding	Maj # 545
May, 1980	Volcano/Mt. St. Helens Eruption	Maj # 623
March, 1989	Heavy Rains/Sheet Flooding	Maj # 822
October, 1991	"Firestorm 91"/Wind	Maj # 922
February, 1996	Flooding	Maj #1100

\* Maj: Presidential Major Disaster Declaration

\* Emerg: Presidential Emergency Declaration

### 3.3. Critical Facilities and Infrastructure

Critical facilities and infrastructure are those structures that are essential to the health and welfare of the whole population and are especially important after any hazard event. The potential consequences of losing them are so great they need to be carefully inventoried. The vulnerability of these structures is not based just on the physical aspects, but also on the potential interruption of services they provide.

Critical facilities include hospitals and other medical facilities, police and fire stations, emergency operation centers and evacuation shelters, and schools.

Critical infrastructure include airports, highways, railroads, and waterways.

This section will detail the critical facilities and infrastructure found in Whitman County. Most of the inventory was identified using HAZUS-MH and verified with County officials. Table 3.2 shows medical facilities in Whitman County. Two were identified and are located in the major cities.

Table 3.2: Medical Facilities in Whitman County

Medical Facilities					
Name	Address	City	State	Zip Code	
WHITMAN HOSPITAL AND MED CNTR	1200 WEST FAIRVIEW	COLFAX	WA	99111	
PULLMAN MEMORIAL HOSPITAL	NE 1125 WASHINGTON AVENUE	PULLMAN	WA	99163	

Table 3.3 shows police facilities located in Whitman County. Ten facilities have been identified, three of which are found in Colfax, the county seat. The County jail is also located in Colfax.

Table 3.3: Police Facilities in Whitman County

Police Facilities				
Name	Address	City	State	Zip Code
Rosalia Police Dept	105 W 5th St	Rosalia	WA	99170-0000
Palouse Chief Of Police	120 E Main St	Palouse	WA	99161-0000
Pullman Police Dept	260 SE Kamiaken St	Pullman	WA	99163-2664
Whitman County Crime Victims	400 N Main St	Colfax	WA	99111-2031
Colfax Police Station	400 N Mill St	Colfax	WA	99111-2035
Garfield Chief Of Police	405 W California St	Garfield	WA	99130-0000

Whitman County Sheriff	411 N Mill St	Colfax	WA	99111-2034
Colton Marshall	706 Broadway	Colton	WA	99113-0000
Uniontown Police Business Ofc	PO Box 87	Uniontown	WA	99179-0087
Tekoa Police Dept	South 129 Crosby	Tekoa	WA	99033-0000

Table 3.4 shows the 14 fire and emergency facilities in Whitman County. No Emergency Operation Centers (EOCs) were identified in Whitman County.

**Table 3.4: Fire Facilities in Whitman County**

Fire Facilities				
Name	Address	City	State	ZipCode
Lacrosse City Fire Dept	107 S Main	Lacrosse	WA	99143-0000
Tekoa Fire Dept	109 W Poplar St	Tekoa	WA	99033-9796
Uniontown Fire Dept	110 Montgomery St	Uniontown	WA	99179-9700
Rosalia City Ambulance Svc	110 W 5th Ave	Rosalia	WA	99170-0000
Sprague City Fire Dept	119 W 2nd St	Sprague	WA	99032-0000
Dusty Fire Department	121 Dusty Rd	Lacrosse	WA	99143-9742
Pullman Fire Dept	325 SE Paradise St	Pullman	WA	99163-2631
Endicott Fire Dept	326 E St	Endicott	WA	99125-0000
Colfax Fire Dept	400 N Mill St	Colfax	WA	99111-2035
Thornton Fire Station	4706 Old Thornton Hwy	Thornton	WA	99176-9797
Rosalia Fire Dept	607 S Whitman St	Rosalia	WA	99170-9556
Lamont Fire District	823 Main St	Lamont	WA	99017-8720
St John Fire Station	Front St	St John	WA	99171-0000
Hay Fire Dept	Main St	Lacrosse	WA	99143-0000

Table 3.5 shows the schools located in Whitman County. There are 24 elementary, middle and high schools. This table does not list Washington State University, which is located in Pullman and has about 18,000 students.

**Table 3.5: Schools in Whitman County**

Schools					
Name	Address	City	State	ZipCode	Phone
GUARDIAN ANGEL/ST BONIFACE SCH	BOX 48	COLTON	WA	99113	509-229-3579
FARMINGTON SDA SCHOOL	P O BOX 187	FARMINGTON	WA	99128	509-287-2601
PULLMAN CHRISTIAN SCH	345 SW KIMBALL ST	PULLMAN	WA	99163	509-332-3545
MONTESSORI SCHOOL OF PULLMAN	N.W. 115TH STATE ST	PULLMAN	WA	99163	509-334-1049
COLFAX HIGH SCHOOL	1110 N MORTON ST	COLFAX	WA	99111-2198	509-397-4368
LEONARD M JENNINGS ELEMENTARY	1207 N MORTON ST	COLFAX	WA	99111-2157	509-397-2181
COLTON SCHOOL	706 UNION	COLTON	WA	99113-0109	509-229-3386
ENDICOTT/ST JOHN ELEM AND MIDD	MAIN ST	ENDICOTT	WA	99125-0327	509-657-3524
GARFIELD ELEMENTARY	810 N THIRD ST	GARFIELD	WA	99130-0398	509-635-1331
GARFIELD/PALOUSE MIDDLE SCHOOL	600 E ALDER	PALOUSE	WA	99161-9721	509-878-1921
GARFIELD SCHOOL DIST 302	810 N THIRD ST	GARFIELD	WA	99130-0398	509-635-1331
LACROSSE ELEMENTARY SCHOOL	100 HILL ST	LACROSSE	WA	99143-0218	509-549-3591

Schools					
LACROSSE SCHOOLS	100 HILL ST	LACROSSE	WA	99143-0218	509-549-3591
LAMONT MIDDLE SCHOOL	602 MAIN ST	LAMONT	WA	99017-8769	509-257-2463
OAKESDALE ELEMENTARY SCHOOL	FIRST & MCCOY	OAKESDALE	WA	99158-0228	509-285-5296
OAKESDALE HIGH SCHOOL	1ST AND MCCOY ST	OAKESDALE	WA	99158	509-285-5281
OAKESDALE SCHL DIST	FIRST & MCCOY	OAKESDALE	WA	99158-0228	509-285-5296
PALOUSE ELEMENTARY	600 E ALDER ST	PALOUSE	WA	99161-8780	509-878-1921
FRANKLIN ELEMENTARY	850 SE KLEMGARD ST	PULLMAN	WA	99163-5447	509-334-5641
JEFFERSON ELEMENTARY	1150 NW BRYANT ST	PULLMAN	WA	99163-3361	509-332-3581
LINCOLN MIDDLE SCHOOL	315 SE CRESTVIEW ST	PULLMAN	WA	99163-2298	509-334-3411
PULLMAN HIGH SCHOOL	510 NW LARRY ST	PULLMAN	WA	99163-3578	509-332-1551
SUNNYSIDE ELEMENTARY	425 SW SHIRLEY ST	PULLMAN	WA	99163-2763	509-334-1800
PULLMAN SCHOOL DIST 267	510 NW LARRY ST	PULLMAN	WA	99163-3585	509-332-3581

Whitman County's critical infrastructure include three railroads: the Camas Prairie Railroad, the Burlington Northern RR and the Union Pacific RR; four highways: U.S. Route 195, and State routes 23, 26 and 27; and seven airports. The airports are listed in Table 3.6.

**Table 3.6: Airports in Whitman County**

Airports
LACROSSE MUNI
GOSSARD FIELD
LOWER GRANITE STATE
WHITMAN CO MEMORIAL
PULLMAN/MOSCOW REGIONAL
ROSALIA MUNI
WILLARD FIELD

### 3.4. Future Trends in Development

Whitman County does not expect much growth in the future. The rural unincorporated areas will continue to see decline, while the urban, incorporated towns, especially Pullman, will see slight growth. Much of this growth will be due to the growth of Washington State University. The County has planned for much of this growth to take place in the Pullman-Moscow Corridor, which has also recently been re-zoned to accommodate this growth. This area is also parallel to Paradise Creek, one of the major sources of flooding in the County. Diligence needs to be maintained to ensure that the flood hazard is not increased by development in this area.

(THIS PAGE LEFT INTENTIONALLY BLANK)

## 3.5. Drought

### General Background<sup>22</sup>

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Droughts are a natural part of the climate cycle. In the past century, Washington State has experienced a number of drought episodes, including several that lasted for more than a single season – 1928 to 1932, 1992 to 1994, and 1996 to 1997.

Unlike most states, Washington has a statutory definition of drought (Revised Code of Washington Chapter 43.83B.400). According to state law, an area is in a drought condition when:

- The water supply for the area is below 75 percent of normal.
- Water uses and users in the area will likely incur undue hardships because of the water shortage.

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters.

The National Drought Mitigation Center at the University of Nebraska-Lincoln uses three categories to describe likely drought impacts:

- Agricultural – Drought threatens crops that rely on natural precipitation.
- Water supply – Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard – Drought increases the threat of wildfires from dry conditions in forest and rangelands.

Additionally, drought also threatens the supply of electricity in Washington. Hydroelectric power plants generated nearly three-quarters of the electricity produced in Washington State in 2000. When supplies of locally generated hydropower shrink because of drought, utilities seek other sources of electricity, and energy for power generation, which can drive up prices as well as reduce supply.

Unlike most disasters, droughts normally occur slowly but last a long time. Drought conditions occur every few years in Washington. The droughts of 1977 and 2001, the worst and second worst in state history, provide good examples of how drought can affect the state.

---

<sup>22</sup> Washington State Hazard Mitigation Plan, Drought <http://emd.wa.gov/3-map/mit/mit-pubs-forms/hazmit-plan/Tab%207.1.2%20Drought%20final.pdf>

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between \$6 billion and \$8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. About 16,000 drinking water systems in Washington get water from the ground; these systems serve about 5.2 million people. Reduced replenishment of ground water affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

A drought directly or indirectly affects all people and all areas of the state. A drought can result in farmers not being able to plant crops or the failure of the planted crops. This results in loss of work for farm workers and those in related food processing jobs. Other water or electricity dependent industries are commonly forced to shutdown all or a portion of their facilities resulting in further layoffs. A drought can spell disaster for recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) and for landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them. Also, people could pay more for water if utilities increase their rates. With much of Washington's energy coming from hydroelectric plants, a drought means less inexpensive electricity coming from dams and probably higher electric bills.

### **Probability of Future Occurrence**

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

In temperate regions, including Washington, current long-range forecasts of drought have limited reliability. In the tropics, empirical relationships have been demonstrated between precipitation and El Niño events, but few such relationships have been demonstrated above the 30° north latitude are yet understood; Washington sits between 45.30° and 49° north

latitude. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

Based on the state's history with drought from 1895 to 1995 the state as a whole can expect severe or extreme drought at least 5 percent of the time in the future. All of Eastern Washington (including Whitman County), except for the Cascade Mountain's eastern foothills, can expect severe or extreme drought 10 to 15 percent of the time. The sections below will profile the drought hazard for Whitman County in detail

Eastern Washington (including Whitman County) is experiencing a change in climate, as is much of the world. Research conducted by the Climate Impacts Group at the University of Washington<sup>23</sup> indicates that the temperature of the region is increasing. As temperatures increase there will be less water stored as ice and snow. This reduction may not result in a net change in annual precipitation, but it will result in lower late spring and summer river flows. Accordingly there will be increased competition between power, sport fishing and environmentalists, and farmers dependent on irrigation.

## **Hazard Profile**

Whitman County does not experience the vulnerability to drought that other central and eastern Washington counties face although it is one of the drier counties in the state and is one of the leading agricultural producers. This is true in spite of the fact that Whitman County has had drought for at least 10-15% of the time over the last 100 years. The main reason for this low vulnerability is a minimal reliance on irrigation for its crops and water supplies. Most potable water in the County comes from deep aquifers found in the layers of basalt beneath the County. The County also has a low population and does not expect much growth, so there is not expected to be an increase in demand for water that could possibly diminish the supply of water in the aquifers.

### ***Past Events***

Droughts are part of the climatic cycle and recur every few years. Unlike a flood or an earthquake, droughts are hard to define as "events." Over the last 30 years there have been at least two defined major droughts affecting the state and Whitman County: The 1977 drought and the 2001 event. It is not known what effect these droughts had on Whitman County.

### ***Location***

A drought is a climatic condition of less than average rainfall. Eastern Washington and Whitman are areas that generally receive low amounts of rainfall compared to western Washington, but generally speaking every part of the County is exposed to drought. The few areas and farms that rely on irrigation are more exposed to the effects of drought as is the eastern part of the county, which receives slightly more precipitation than the western part, and thus drought conditions become more noticeable.

---

<sup>23</sup> <http://www.cses.washington.edu/cig/>

## *Frequency*

The Washington State Hazard Mitigation Plan has determined that from the period of 1895 to 1995, Whitman County has experienced serious or extreme drought at least 10-15% of the time. Thus it can be said that Whitman County can experience the effects of drought at least once every decade. This might be changing though. For the period of 1985 to 1995, Whitman County experienced the effects of drought at least 30% of the time and during the 1977 drought, the county experienced its effect at least 30-40%. There is no data available of how much of an effect the 2001 drought had on the county.

## *Severity*

Due to its dry farming practices and reliance on ground water, Whitman County does not experience the severity of drought found in the central parts of the state that rely heavily on irrigation.

## *Warning Time*

As stated above, droughts are climatic patterns that occur over long periods of time. They are also caused by numerous variables that scientists have not pieced together well enough to make accurate predictions. At best, meteorologists can predict the onset of a drought about a month in advance.

## **Exposure and Vulnerability**

Whitman County is one of the most exposed Counties in Washington State to the effects of drought, but at the same time is one of the least vulnerable. The Washington State Hazard Mitigation plan defines vulnerability to drought if it meets at least five of the following criteria:

- History of severe or extreme drought conditions:

The county must have been in serious or extreme drought at least 10-15 percent of the time from 1895 to 1995.

- Demand on water resources based on:

2. Acreage of irrigated cropland. The acreage of the county's irrigated cropland must be in top 20 in the state.
3. Percentage of harvested cropland that is irrigated. The percentage of the county's harvested cropland that is irrigated must be in top 20 in the state.
4. Value of agricultural products. The value of the county's crops must be in the top 20 in the state.
5. Population growth greater than the state average. The county's population growth in 1990– 2000 must be greater than state average of 21.2 percent.

- A County's inability to endure the economic conditions of a drought, based on:

6. The county's median household income being less than 75 percent of the state median income of \$45,776 in 1999.

7. The county being classified as economically distressed in 2003 because its unemployment rate was 20 percent greater than the state average from January 2000 through December 2002.

Whitman County only meets four of the seven requirements. These are explained below:

#### Past Events

Whitman County has been in serious or extreme drought at least 10-15% of the time from 1895 to 1995.

#### Water Demand

Whitman County ranks 19<sup>th</sup> in the state in the amount of irrigated cropland, with 5,469 acres.

Whitman County ranks 38<sup>th</sup> (out of 39) in percentage of harvested cropland that is irrigated. Only 0.7% is irrigated. Thus the County does not meet this criterion.

Whitman County ranks 8<sup>th</sup> in value of crops, with a value of about \$173,483,000.

Whitman County's growth rate of 5.1% is well below the criteria 21.2% or greater. It does not meet this criterion.

#### Ability to Endure a Drought

Whitman County's median household income is below 75% of the state's median household income of \$45,776.

Whitman County is not considered a distressed county because its unemployment was not 20% or greater than the state average from 2000 to 2002. Disregarding the large student population, Whitman County has one of the lower unemployment rates in the state, and thus does not qualify under this criterion.

To summarize, Whitman County is extremely exposed to drought, but nonetheless is not very vulnerable due to the fact that it is not reliant on irrigated water. If conditions change, such as aquifer depletion, then the vulnerable may increase if the farms and towns begin to rely on irrigation for water supply.

## Scenario

Whitman County may experience a period of prolonged drought. This lack of precipitation would not affect crops or water supplies for towns, but may increase the risk to wildfires. Also affected would be electric rates.

Over the long term though, the region may experience greater drought. This would be the result of less water stored as ice and snow in the mountains to the east. This would result in decreased stream flows in the spring in local rivers. Competition for water will increase. Whitman County farmers and residents may be less affected than those depending on irrigation for their water source.

## **Issues/Recommendations**

Whitman County farmers are generally resilient to drought. Crop insurance has provided the cushion to mitigate the most adverse impacts of drought in the County.

As the effects of regionally based changes in climate begin to be felt, the county may consider building structures that compensate for the expected reduction in natural storage, and to help let the aquifers recharge.

## 3.6. Earthquake

### Definitions

Benioff Earthquake: Sometimes called “deep quakes,” these occur in the Pacific Northwest when the Juan de Fuca plate breaks up underneath the continental plate, approximately 30 miles beneath the earth’s surface.

Crustal Earthquake: Crustal quakes occur at a depth of 5 to 10 miles beneath the earth’s surface and are associated with fault movement within a surface plate.

Earthquake: An earthquake is the shaking of the ground caused by an abrupt shift of rock along a fracture in the earth such as a fault or a contact zone between tectonic plates. Earthquakes are measured in both magnitude and intensity.

Intensity: Intensity is a measure of the effects of an earthquake. It is measured by the Modified Mercalli scale and is expressed in Roman numerals.

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Subduction Zone Earthquake: This type of quake occurs along two converging plates, attached to one another along their interface. When the interfaces between these two plates slips, a sudden, dramatic release of energy results, propagated along the entire fault line.

### General Background<sup>24</sup>

An earthquake is the sudden release of stored energy; most earthquakes occur along a fracture within the earth, called a fault. The shaking caused by this sudden shift is often very small, but occasionally large earthquakes produce very strong ground shaking. It is this strong shaking and its consequences – ground failure, landslides, liquefaction – that damages buildings and structures and upsets the regional economy.

Washington, especially the Puget Sound basin, has a history of frequent earthquakes. More than 1,000 earthquakes occur in the state each year. A dozen or more are strong enough that people feel ground shaking; occasionally, earthquakes cause damage. Large earthquakes in 1946 (magnitude 5.8), 1949 (magnitude 7.1) and 1965 (magnitude 6.5) killed 15 people and

---

<sup>24</sup> Washington State HIVA Draft, 2004

caused more than \$360 million (2004 dollars) in damage throughout several counties. The state experienced at least 20 damaging events in the last 125 years.

The Nisqually earthquake on February 28, 2001, was a deep, 6.8 magnitude earthquake 10 miles northeast of Olympia. One person died of a heart attack, more than 700 people were injured, and various estimates place damage at between \$1 billion and \$4 billion; exact figures are not available, as insurance claims information is not available.

The earthquake threat in Washington is not uniform. While most earthquakes occur in Western Washington, some damaging events, such as the 1872 magnitude 6.8 earthquake, do occur east of the Cascades. Geologic evidence documents prehistoric magnitude 8 to 9.5 earthquakes along the outer coast, and events of magnitude 7 or greater along shallow crustal faults in the urban areas of Puget Sound.

Washington's earthquake hazards reflect its tectonic setting. The Pacific Northwest is at a convergent continental margin, the collisional boundary between two tectonic plates of the Earth's crust. The Cascadia subduction zone, the fault boundary between the North America plate and the Juan de Fuca plate, lies offshore from northern California to southern British Columbia. The two plates are converging at a rate of about 2 inches per year. In addition, the northward-moving Pacific plate is pushing the Juan de Fuca plate north, causing complex seismic strain to accumulate. The abrupt release of this slowly accumulated strain causes earthquakes. Figure 3.1 shows this process.

As a result of the subduction process, the state is vulnerable to earthquakes originating from three sources: in the subducting plate (called an Intraplate or Benioff Zone quake); between the colliding plates (Subduction Zone quake); and in the overriding plate (Shallow Crustal quake).

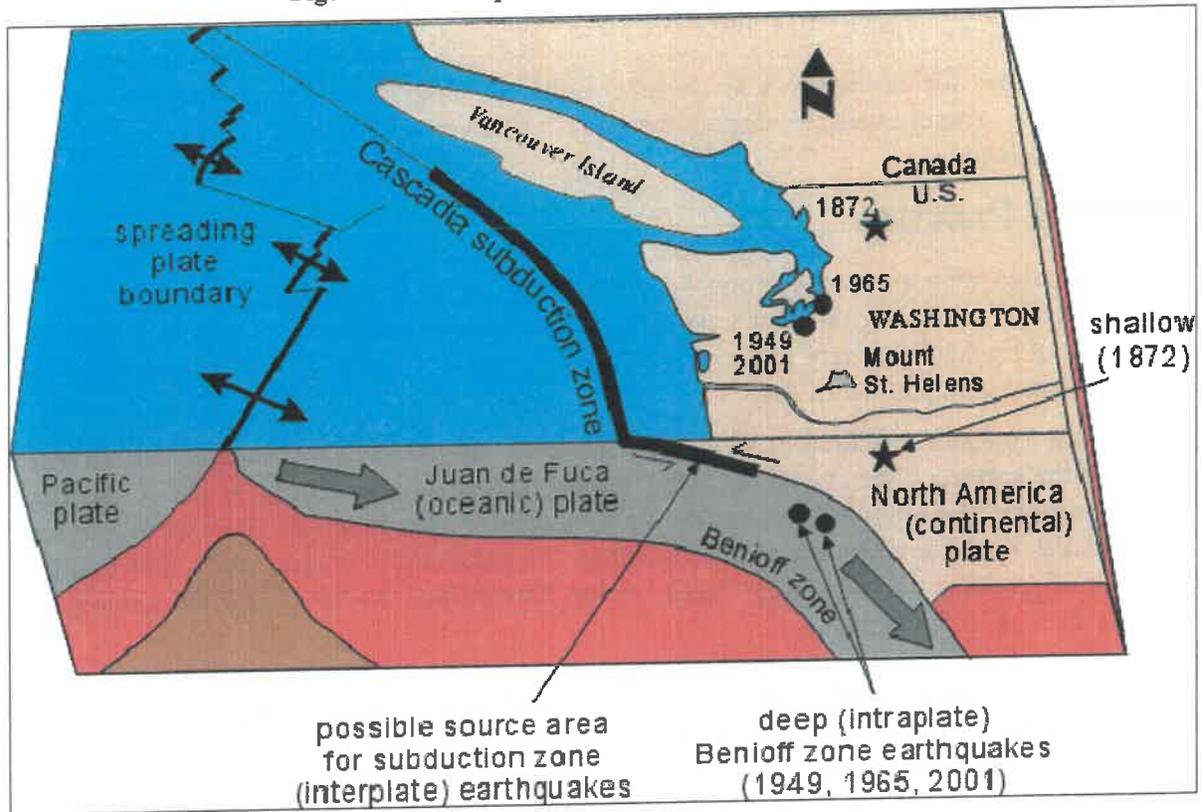
### **Intraplate or Benioff Zone Earthquakes**

Intraplate or Benioff Zone earthquakes occur within the subducting Juan de Fuca plate at depths of 15 to 60 miles, although the largest events typically occur at depths of about 25 to 40 miles. The largest recorded event was the magnitude 7.1 Olympia quake in 1949. Other significant Benioff zone events include the magnitude 6.5 Seattle-Tacoma quake in 1965, the magnitude 5.8 Satsop quake in 1999, and the magnitude 6.8 Nisqually quake of 2001. Strong shaking during the 1949 Olympia earthquake lasted about 20 seconds; during the 2001 Nisqually earthquake, about 15 to 20 seconds.

Since 1900, there have been five earthquakes in the Puget Sound basin with measured or estimated magnitude of 6 or larger, and one of magnitude 7.

The approximate recurrence rate for earthquakes similar to the 1965 magnitude 6.5 Seattle-Tacoma event and the 2001 magnitude 6.8 Nisqually event is once every 35 years. The approximate recurrence rate for earthquakes similar to the 1949 magnitude 7.1 Olympia earthquake is once every 110 years.

Figure 3.1: Earthquakes Sources in Washington State<sup>25</sup>



## Subduction Zone (Interplate) Earthquakes

Subduction zone or interplate earthquakes occur along the interface between tectonic plates. Scientists have found evidence of great-magnitude earthquakes along the Cascadia Subduction Zone. These earthquakes were very powerful (magnitude 8 to 9 or greater) and occurred about every 400 to 600 years; this interval, however, has been irregular, as short as 100 years and as long as 1,100 years. The last of these great earthquakes struck Washington in 1700.

## Shallow Crustal Earthquakes

Shallow crustal earthquakes occur within about 20 miles of the surface. Recent examples occurred near Bremerton in 1997, near Duvall in 1996, off Maury Island in 1995, near Deming in 1990, near North Bend in 1945, just north of Portland in 1962, and at Elk Lake on the St. Helens seismic zone (a fault zone running north-northwest through Mount St. Helens) in 1981. These earthquakes had a magnitude of 5 to 5.5. Scientists believe the 1872 magnitude 6.8 earthquake near Lake Chelan was shallow, and may be the state's most widely felt earthquake. The 1936 magnitude 6.1 earthquake near Walla Walla also was shallow.

<sup>25</sup> Washington Department of Natural Resources, Division of Geology and Earth Resources, <<http://www.wa.gov/dnr/htdocs/ger/quakes.htm>>, (February 25, 2003).

Because of their remote locations and the relatively small population in the region, though, damage was light from these two quakes.

Recurrence rates for earthquakes on surface faults are unknown; however, four magnitude 7.0 or greater events occurred during the past 1,100 years, including two since 1918 on Vancouver Island.

## **Hazard Profile**

The state's two largest crustal earthquakes felt by European settlers occurred in Eastern Washington – the 1872 quake near Lake Chelan and the 1936 earthquake near Walla Walla. Residents of Spokane strongly felt a swarm of earthquakes in 2001; the largest earthquake in the swarm had a magnitude of 4.0.

The recent Spokane earthquakes were very shallow, with most events located within a few miles of the surface. The events occurred near a suspected fault informally called the Latah Fault; however, the relation between the fault and the swarm is uncertain. Geologists have mapped the Spokane area, but none confirmed the presence of major faults that might be capable of producing earthquakes. State geologists continue to investigate the geology and earthquake risk in Spokane.

Elsewhere in Eastern Washington, geologists have uncovered evidence of a number of surface faults; however, they have not yet determined how active the faults are, nor determined the extent of the risk they pose to the public. One fault, Toppenish Ridge, appears to have been the source of two earthquakes with magnitudes of 6.5 to 7.3 in the past 10,000 years.

### ***Past Events***

Although at least 1000 earthquakes occur in Washington each year, only two major earthquakes have occurred in Eastern Washington since the beginning of European settlement. Of these two, only the State Line (or Walla Walla) Earthquake of 1936 caused any damage in Whitman County.

### **Lake Chelan, December 14, 1872**

The magnitude 6.8 (estimated) earthquake occurred about 9:40 p.m.

This earthquake was felt from British Columbia to Oregon and from the Pacific Ocean to Montana. It occurred in a wilderness area, which in 1872 had only a few inhabitants – local Indian tribes, trappers, traders, and military men. Because there were few man-made structures in the epicenter area near Lake Chelan, most of the information available is about ground effects, including huge landslides, massive fissures in the ground, and a 27-foot high geyser.

Extensive landslides occurred in the slide-prone shorelines of the Columbia River. One massive slide, at Ribbon Cliff between Entiat and Winesap, blocked the Columbia River for several hours. A field reconnaissance to the Ribbon Cliff landslide area in August 1976

showed remnants of a large landslide mass along the west edge of Lake Entiat (Columbia River Reservoir), below Ribbon Cliffs and about 3 kilometers north of Entiat. Although the most spectacular landslides occurred in the Chelan-Wenatchee area, slides occurred throughout the Cascade Mountains.

Most of the ground fissures occurred in the following areas: at the east end of Lake Chelan in the area of the Indian camp; in the Chelan Landing-Chelan Falls area; on a mountain about 12 miles west of the Indian camp area; on the east side of the Columbia River (where three springs formed); and near the top of a ridge on a hogback on the east side of the Columbia River. These fissures formed in several locations. Slope failure, settlements, or slumping in water-saturated soils may have produced the fissures in areas on steep slopes or near bodies of water. Sulfurous water was emitted from the large fissures that formed in the Indian camp area. At Chelan Falls, "a great hole opened in the earth" from which water spouted as much as 27 feet in the air. The geyser activity continued for several days, and, after diminishing, left permanent springs.

In the area of the epicenter, the quake damaged one log building near the mouth of the Wenatchee River. Ground shaking threw people to the floor, waves observed in the ground, and loud detonations heard. About two miles above the Ribbon Cliff slide area, the logs on another cabin caved in.

Damaging ground shaking of intensity VI extended to the west throughout the Puget Sound basin and to the southeast beyond the Hanford Site. Individuals in Idaho, Montana, Oregon, and Canada felt the earthquake. Aftershocks occurred in the area for two years.

### **State Line (Walla Walla) Earthquake, July 15, 1936**

The earthquake, magnitude 6.1, occurred at 11:05 a.m. The epicenter was about 5 miles south-southeast of Walla Walla. It was widely felt through Oregon, Washington and northern Idaho, with the greatest shaking occurring in Northeast Oregon. Property damage was estimated at \$100,000 (about \$1.35 million in 2004 dollars) in this sparsely populated area.

The earthquake moved small objects, rattled windows, and cracked plaster in the communities of Colfax, Hooper, Page, Pomeroy, Prescott, Touchet, Wallula, and Wheeler; most of the impact and damage was in the Walla Walla area.

The earthquake alarmed residents of Walla Walla, many of whom fled their homes for the street. People reported hearing moderately loud rumbling immediately before the first shock. Standing pictures shook down, some movable objects changed positions, and doors partially opened. The earthquake was more noticeable on floors higher than the ground floor. It knocked down a few chimneys and many loose chimney brick; damaged a brick home used by the warden at the State Penitentiary that was condemned and declared unsafe; and damaged the local railroad station. Several homes moved an inch or less on their foundations. Five miles southwest of Walla Walla, the quake restored the flow of a weakened

600-foot deep artesian well to close to original strength; the flow had not diminished after several months.

Walla Walla residents reported about 15 or 20 aftershocks.

## *Location*

Earthquakes in Eastern Washington are typically shallow, crustal type, and are the least understood of all earthquake types. The Columbia Plateau of Eastern Washington contains many minor faults, but scientists are not too sure about the relationship between the faults and earthquakes. Generally speaking, Whitman County is located in one of the least hazardous earthquake areas in the State.

## *Frequency*

Recurrence rates for crustal zone earthquakes are unknown. The best estimate for a major crustal earthquake to occur is once every 1000 years.

## *Severity*

Past events have indicated that an earthquake in the Whitman County area would cause little or no damage. Most crustal earthquakes are in 5.0-5.5 magnitude range, and do not occur in the County proper. Nonetheless severity can increase in areas that have softer soils, such as the Palouse River Valley. The National Earthquake Hazard Reduction Program (NEHRP) has mapped and classified the different soil types of Whitman County into categories of risk to ground shaking. These classifications range from NEHRP E soils, which are the softest, most vulnerable soils, to NEHRP A soils, which are the hardest, least vulnerable soils. See Table 3.7 for a description of NEHRP classifications. See Figure 3.2 for a map of NEHRP soils classification for Whitman County. The NEHRP map of Whitman County indicates that the Loess dominated soil is classified as NEHRP D, while the river and creek valleys are classified as E soils. Although this may seem bad, two things must be kept in mind:

The loess and river valley soils are underlain by hard basalt and other volcanic rocks. This rock would effectively dampen any shaking.

Whitman County is in a low risk earthquake area, and does not contain any major infrastructure or development that could be affected.

The HAZUS Earthquake risk model (a GIS-based hazard computer modeling program produced by FEMA) was run for Whitman County for a probabilistic 100-year event. The results show a peak ground acceleration ranging from .03 to .075 (factoring in Soil Amplification Factors for PGA). This translates to there being a 1 per cent chance in any given year of County structures receiving light to moderate damage. Structures built on the more consolidated soils (NEHRP soils classes A, B, and C) soils will receive lighter damage. Structures built on softer soils such as those deposited by rivers (NEHRP soils classes D, E and F) would be subject to moderate damage. Light and moderate is defined as:

*Light* - Shaking will be felt by nearly every one. Persons sleeping would be awakened. Liquids disturbed, some spilled. Unstable objects will be displaced or upset. Doors will

swing, and shutters and pictures will move. Plaster may fall along with some un-reinforced masonry chimneys cracked.

*Moderate* - Shaking will be felt by most. Damage would be negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys will break. The event would also be noticed by persons driving cars. Unreinforced masonry structures and the unreinforced chimneys of homes will be damaged. Nonstructural damage caused by falling and swinging objects may be considerable. Some of the older, more fragile bridges and land failure causing minor landslides along highways may isolate some residents.

**Table 3.7: NEHRP Soils Description**

<b>NEHRP Soils Classification</b>		
<i>NEHRP Soil Type</i>	<i>Average Shear Wave Velocity in the Upper 100 Feet</i>	<i>Rock or Soil Category</i>
A	Greater than 5000 feet/second	Hard rock
B	2500 to 5000 feet/second	Rock
C	1200 to 2500 feet/second	Very stiff soil or soft rock
D	600 to 1200 feet/second	Stiff soil
E	Less than 600 feet/second	Soft soil
F	Special category indicating a geotechnical evaluation should be performed to assess amplification. Shear wave velocities are generally less than 600 feet/second	Soils susceptible to potential failure under seismic loading, such as liquefiable soils or sensitive clays, peats or organic clays thicker than 10 feet; thick sections of clay

## **Warning Time**

There is presently no current method to accurately determine when and where an earthquake may occur. This is even more so in the case of crustal zone earthquakes, which are the least understood of all earthquake types.

## **Exposure and Vulnerability**

The whole population of 41,000 people in Whitman County is potentially exposed to earthquakes. Although the vulnerability is low, Whitman County's towns are at more risk than rural areas due to the higher density. The towns are also more vulnerable because they are typically located in small valleys alongside streams, which typically have softer soils (NEHRP D and E soils). Many of these towns also contain older buildings built during the beginning of the 20<sup>th</sup> century and were not subject to the building codes implemented over the last 30 years that require that structures be able to withstand earthquakes. Ornamentation (such as parapets) and chimneys may be shaken loose and fall on people walking below.

## Scenario

Due to the scarcity of past events to rely upon, it is difficult to imagine a reasonably possible worse-case scenario for an earthquake event in Whitman County. There are numerous crustal faults found throughout the Columbia Plateau and in areas north and south. These have not been mapped sufficiently for scientists to make any conclusions about the effect they can have on earthquakes, but it is possible that a fault near Whitman County could rupture causing a shallow crustal earthquake in the County. Damage would most likely occur to older structures located in the downtowns of some communities located on softer (NEHRP D and E) soils. Injuries may occur from debris, such as parapets and chimneys, that could topple or be shaken loose and fall on those walking or driving below. An earthquake may also cause minor landslides along unstable slopes. This would even more likely if the earthquake occurred during the rainy/snowy winter and early spring months.

## Issues/Recommendations

Presently more research needs to be conducted to determine the exposure and vulnerability Whitman County and the Columbia Plateau region in general have to earthquakes. Right now the County and its communities should inventory and assess its older structures and retrofit those that are determined most likely to be damaged during any earthquake.

Risk reduction measures to consider include.

Retrofitting unreinforced masonry structures on NEHRP "E" and "D" soils by securing vulnerable non structural features such as parapets.

Brace masonry chimneys.

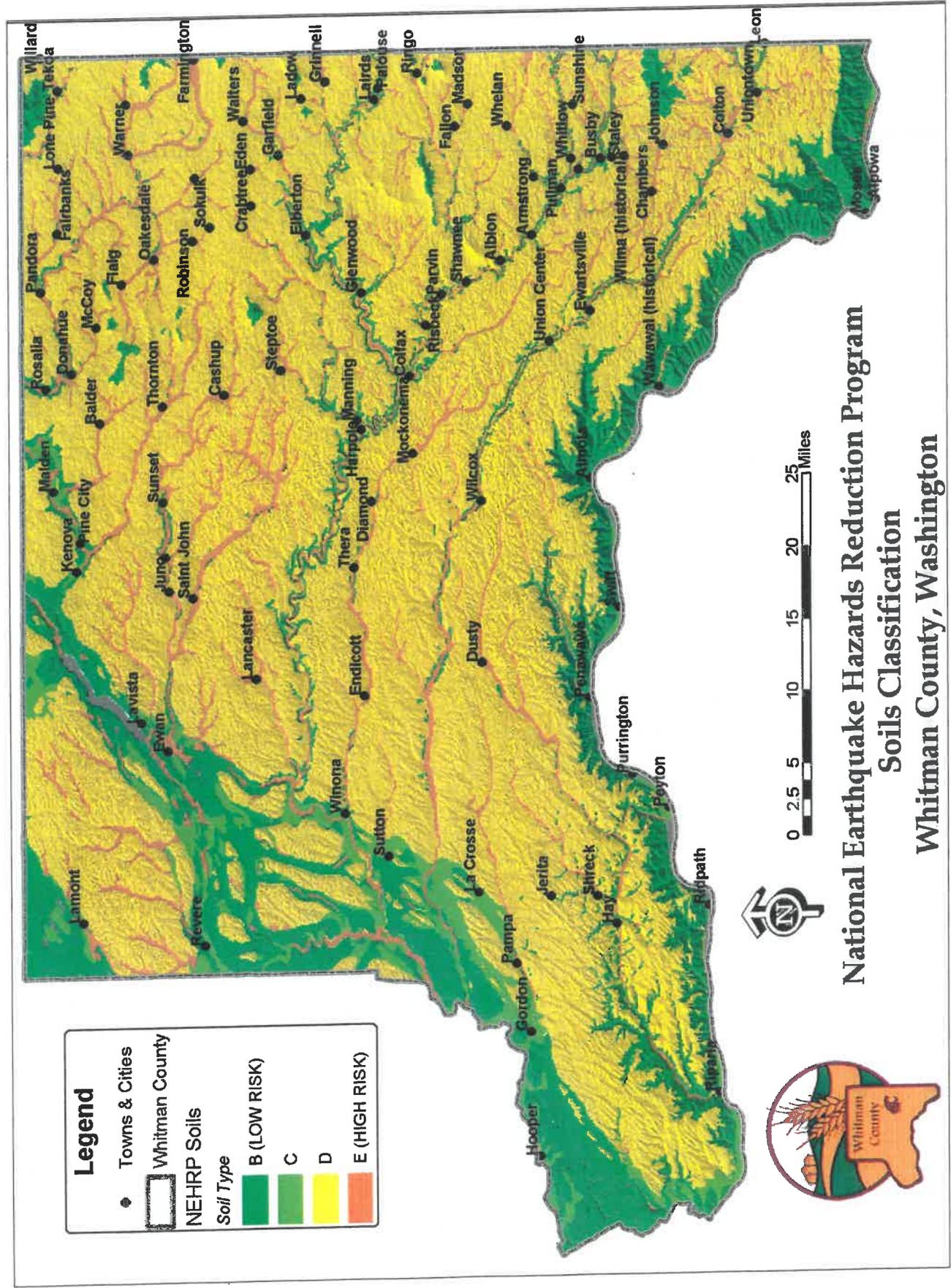
Encourage nonstructural retrofitting with special emphasis given to:

Buildings located on NEHRP "E" and "F" soils.

Hazardous materials stored in all buildings (e.g. acids on shelves in vehicles repair establishments).

Materials necessary for critical functions. (e.g. Medicines).

Figure 3.2: Whitman County NEHRP Soils



(THIS PAGE LEFT INTENTIONALLY BLANK)

## 3.7. Flood

### Definitions

**Base Flood Elevation:** The base flood elevation is the elevation of a 100 year flood event, or a flood, which has a 1% chance of occurring in any given year.

**Basin:** A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Basins are also referred to as **Watersheds** or **Drainage Basins**.

**Cubic Feet per Second (cfs):** Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

**Flood Insurance Rate Map (FIRM):** FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

**Floodplain:** Floodplains are the land area along the sides of rivers that becomes inundated with water during a flood. Floodplain can be defined in different ways, but is commonly defined as the area that is also called the 100 year floodplain. The term 100 year flood is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100 year flood could occur more than once in a relatively short period of time. Because this term is misleading, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program.<sup>26</sup>

**Floodway:** Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than one-foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

**Floodway Fringe:** Floodway fringe areas are those lands that are in the floodplain but outside of the floodway. Some development is generally allowed in these areas with a variety of different restrictions.

**Flood Zone Designations:** These are the different flood hazard zones FEMA uses for FIRMs. These designations may be found on the flood hazard maps for Whitman County's communities.

**Zone A:** An area inundated by 100-year flooding, for which no Base Flood Elevations (BFEs) have been determined.

**Zone AE:** An area inundated by 100-year flooding, but for which BFEs have been determined.

---

<sup>26</sup> Definition from: FEMA, [http://www.fema.gov/fhm/fq\\_gen23.shtm](http://www.fema.gov/fhm/fq_gen23.shtm)

**Zone ANI:** An area that is located within a community or county that is not mapped on any published FIRM.

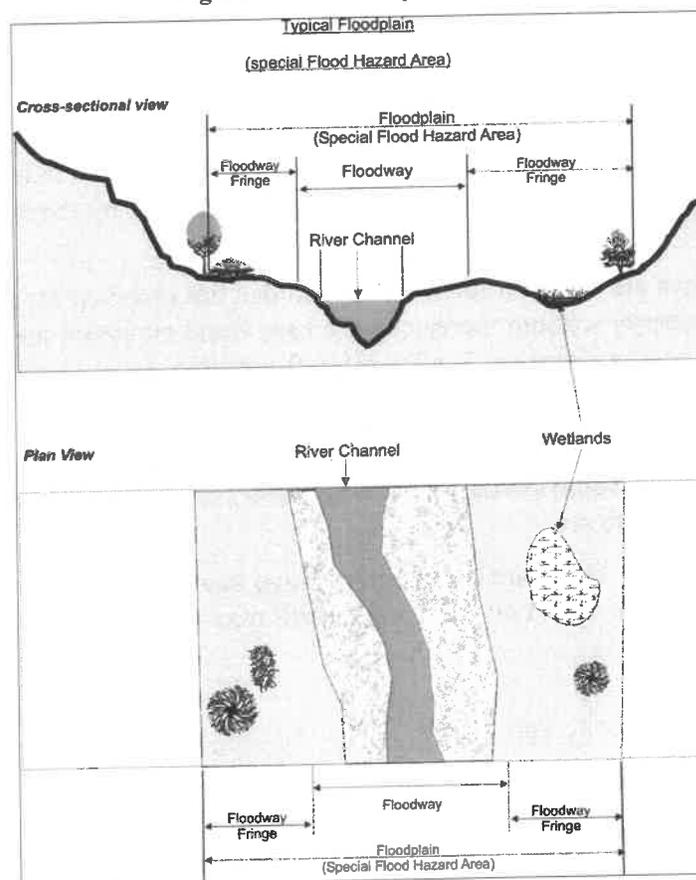
**Zone X500:** An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from the 100-year flooding.

National Flood Insurance Program<sup>27</sup>: In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods.

The Mitigation Division is a section of the Federal Emergency Management Agency (FEMA) manages the NFIP, and oversees the floodplain management and mapping components of the Program. Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.

FEMA contracted the Army Corps of Engineers to map the floodplains, floodways, and floodway fringes. Figure 3.3 depicts the relationship among the three designations.

**Figure 3.3: Floodway Schematic**



<sup>27</sup> Definition from FEMA: <http://www.fema.gov/nfip/whonfip.shtm>

Pre and Post FIRM rates<sup>28</sup>: Category of rates published in the National Flood Insurance Program Manual, applying to buildings located in a community qualifying for the regular flood program. Post-FIRM rates are used on building construction that started after December 31, 1974, or after the community's initial Flood Insurance Rate Map was published, whichever is later. These rates are lower than pre-FIRM rates.

Repetitive Loss Properties<sup>29</sup>: Any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced:

Four or more paid flood losses in excess of \$1000.00 or

Two paid flood losses in excess of \$1000.00 within any 10-year period since 1978 or

Three or more paid losses that equal or exceed the current value of the insured property.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems.

Stream Bank Erosion<sup>30</sup>: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair.

Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Subbasin: A subbasin is a tributary basin of a larger basin or watershed.

Water Resource Inventory Area (WRIA): WRIAs were formalized under WAC 173-500-040 and authorized under the Water Resources Act of 1971, RCW 90.54. Washington State Department of Ecology was given the responsibility for the development and management of these administrative and planning boundaries. These boundaries represent the administrative under pinning of this agency's business activities. The original WRIA boundary agreements and judgments were reached jointly by Washington's natural resource agencies (Ecology, Natural Resources, Fish and Wildlife) in 1970.

Wild and Scenic River: A federal designation that is intended to protect the natural character of rivers and their habitat without adversely affecting surrounding property.

Zero-Rise Floodway: A 'zero-rise' floodway is an area reserved to carry the discharge of a flood without raising the base flood elevation. Some communities have chosen to implement zero-rise floodways because they provide greater flood protection than the floodway described above, which allows a one foot rise in the base flood elevation.

<sup>28</sup> Definition from: <http://insurance.cch.com/rupps/post-firm-rates.htm>

<sup>29</sup> Definition from FEMA: <http://www.fema.gov/nfip/replps.shtm>

<sup>30</sup> Definition from: <http://washtenawcd.org/az/streambankeros.php>

## General Background

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. It is a natural geologic process that shapes the landscape, provides habitat and creates rich agricultural lands. Human activities and settlements tend to use floodplains, frequently competing with the natural processes and suffering inconvenience or catastrophe as a result. Human activities encroach upon floodplains, affecting the distribution and timing of drainage, and thereby increasing flood problems. The built environment creates often localize flooding problems outside natural floodplains by altering or confining drainage channels. This increases flood potential in two ways: 1) it reduces the stream's capacity to contain flows; and 2) increases flow rates downstream. Floods also cause erosion and landslides, and can transport debris and toxic substances that can cause secondary hazards.

The next three sections will profile the hazard, and determine exposure and vulnerability for the County in general. Following that, a more detailed analysis of the flood hazard and risk will be made for each of the towns and unincorporated areas in County.

## Hazard Profile

The principal cause of flooding in Whitman County is heavy rainfall brought in with warm Chinook winds, usually in combination with snowmelt over a frozen impermeable ground during the winter or early spring months. The sudden increase in water run-off overwhelms rivers and creeks, which typically overtop. The South Fork Palouse, for instance, has an average annual flow of about 40 cfs, but can experience peak flows of 3000-5000 cfs.<sup>31</sup> Floods can also be intensified by ice jams against low clearance railroad and road bridges. Floods in Whitman County are of short duration, usually less than one day, and flood stages rise and fall rapidly.<sup>32</sup>

Erosion and transported sediment is a major secondary hazard of flooding. The intense run-off can strip away topsoil, and deposit it elsewhere, usually where it is impeded, such as bridge abutments. Sediment deposits have been a major effect of flooding in Pullman. The erosion can deposit sediment in river and creek beds, decreasing their capacity to transport water.

Most of the watercourses in Whitman County are intermittent drainages containing water only in the wetter winter and spring months. Few of these drainages have naturally armored channels and if not fully vegetated become major contributors to erosion. These drainages and the loess sediment they transport are particularly problematic to downstream developments if vegetation has been removed from the upstream watershed and floodplains. In Whitman County brush fires, tilling and the grazing of large animals can remove vegetation from these critical areas. Such transported sediment has contributed to the flood hazard in most County communities. Of particular concern are Pullman and Colfax, located on the South Fork Palouse; Palouse located on the North Fork of the Palouse River; Colton

---

<sup>31</sup> USGS Stream Flow Data for South Fork Palouse

[http://nwis.waterdata.usgs.gov/wa/nwis/peak?site\\_no=13348000&agency\\_cd=USGS&format=html](http://nwis.waterdata.usgs.gov/wa/nwis/peak?site_no=13348000&agency_cd=USGS&format=html)

<sup>32</sup> Flood Insurance Study, Whitman County Unincorporated, FEMA, 1979 p. 10

and Uniontown located on Union Flat Creek; Endicott, located on Rebel Flat Creek; and Rosalia, located on Pine Creek.

In the specific watersheds transporting sediment into these communities extra-ordinary measures should be taken to manage agricultural and grazing practices. Every effort should be taken to maintain a vegetative cover especially along the floodplains of these intermittent streams and to reduce velocity.

### *Past Events*

Since its initial settlement in the 1870s, Whitman County, and more specifically, its small farming communities, has experienced frequently recurring flooding. Efforts have been made over the last century to mitigate flooding, but nonetheless these efforts have often proven to be environmentally detrimental over the long term (river channelization in Colfax) or expensive to maintain (dredging and maintenance in Pullman). Six of the eight Presidential Declared Disasters in Whitman County have been related to flooding. Table 3.1 on page 3-2 shows a list of Federal Disaster Declarations in Whitman County. Table 3.8 below summarizes the declarations related to flooding in Whitman County.

**Table 3.8: Flood Related Disaster Declarations**

Federal Disaster Declarations in Whitman County	
<i>date</i>	<i>event*</i>
March, 1963	Maj # 146
January, 1972	Maj # 322
January, 1974	Maj # 414
December, 1977	Maj # 545
March, 1989	Maj # 822
February, 1996	Maj #1100

\* Maj: Presidential Major Disaster Declaration

### *Location*

Flooding in Whitman County typically occurs in the floodplains of the major rivers draining the county. See Figure 3.5. Flooding does not occur on the Snake River, the southern border of the county, due to its location in a deep, steep gorge and two control structures: the Little Goose Dam, and the Lower Granite Dam. The rivers that have caused the greatest flood damage are the South Fork Palouse, the North Fork Palouse, Paradise Creek and Pine Creek. Union Flat Creek may also experience flooding. Although these streams can potentially overtop anywhere, they typically cause damaging flooding in the communities that have development and infrastructure in the floodplains. The most severe flooding, in terms of economic costs and damages, occur in Pullman, the largest city in the County. Most of the floodplain in this city is developed, and includes the downtown business district. There are also numerous structures, such as buildings and bridges, which constrict the flow of water during storms, and can aggravate flooding. Palouse, where much of its downtown lies in a

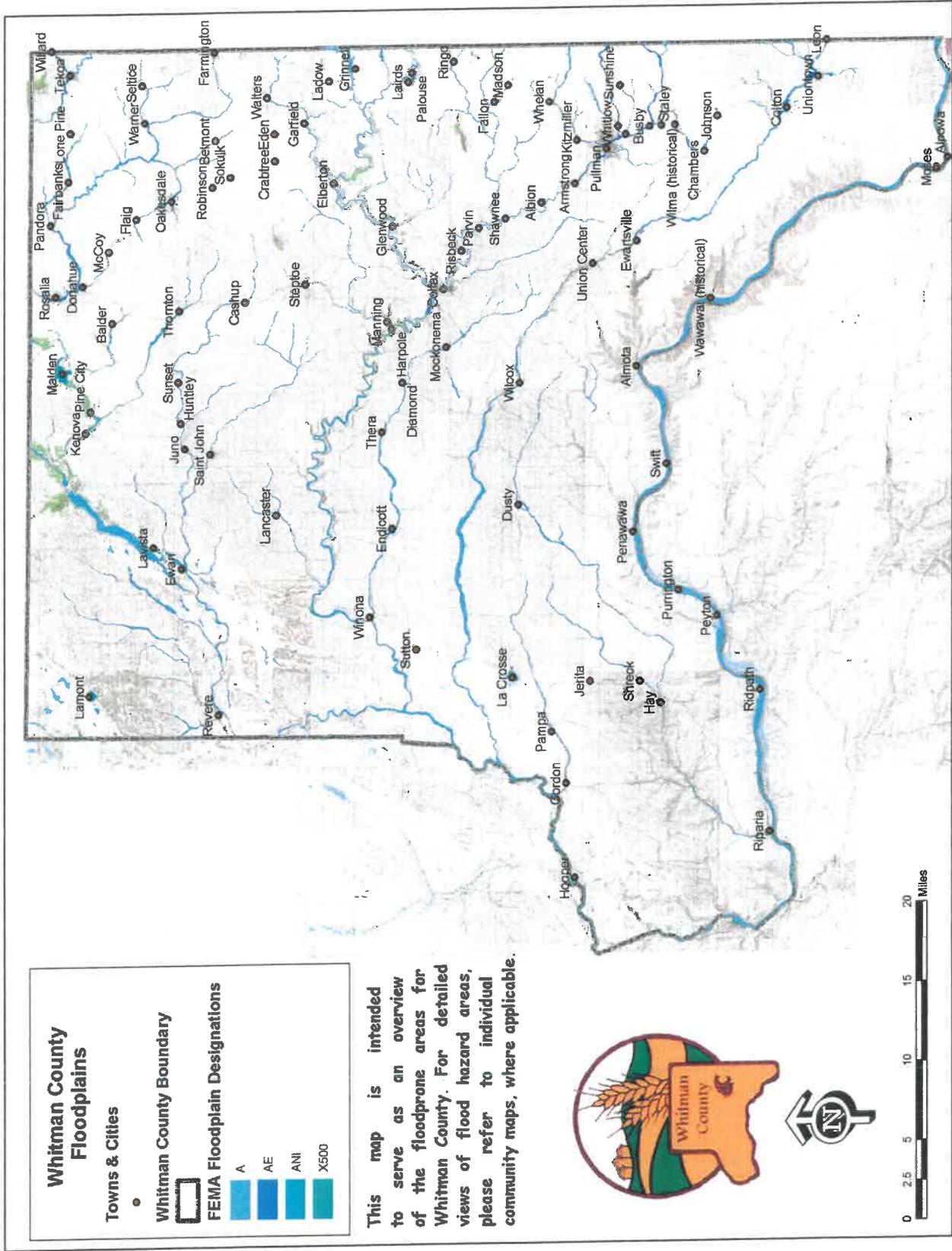


## *Warning Time*

Flooding in Whitman County tends to occur as flash flooding, when warm Chinook winds drop rain on frozen snow cover, and cause massive wash-off, quickly filling the small creeks and rivers beyond capacity. Potentially severe storms can be predicted days in advance, but actual flooding may be predicted only hours in advance. Previous flood damage in Pullman was usually caused by lack of warning time for preparedness.

(THIS PAGE LEFT INTENTIONALLY BLANK)

Figure 3.5: Whitman County Floodplains



(THIS PAGE LEFT INTENTIONALLY BLANK)

## Exposure and Vulnerability

Exposure will be dealt with in more detail below within the hazard profiles for specific communities. This section will be a general overview of the exposure to flooding in the County. Generally, any property or infrastructure located in the 100-year floodplain is exposed to flooding. To determine vulnerability, past events data, such as damage reports, need to be examined. This will be done by examining FEMA supplied 1996 Federal Assistance data.. Public Assistance grants and Individual Assistance awards for damage to property were examined to determine general areas exposed to flooding. FEMA flood insurance policies were also examined. Ideally every property owner who has a structure within the 100-year floodplain should have flood insurance. In reality property owners who have taken out a new loan or have receive assistance from the Federal government are most likely to own flood insurance. This can serve as a good indicator of which communities are most exposed to flooding and where the vulnerabilities are.

### *Public Assistance Data*

The 1996 floods in Whitman County was a federally declared disaster (DR 1100) that allowed the County and its agencies to apply for Federal disaster assistance. Analyzing the claims can depict a good picture of where the exposure and more importantly, the vulnerabilities to flooding, are located.

In 1996 Whitman County had almost \$2 million dollars in damages to public facilities: structures and lifelines. Analysis of the public assistance data found:

1. Most of the damage was to relatively small damaged sites scattered throughout the county.

There were 92 separate scope of work Damage Survey Reports (DSRs) written for this disaster. The average DSR amount was \$19,000 dollars with the larger scopes of work including clusters of small damaged sites. With exception of the damage to the Colfax sewer treatment plant (\$102,000) and a Pullman sports field (\$70,000) all scopes of work over \$45,000 were for clusters of small damage sites involving damaged roads and bridges. Damage includes overtopping of various roadways, washouts of various roadways, shoulder washout/erosion, washout or undermining of culverts and silt accumulation on roads located throughout the County.

2. The majority of the damage was to facilities located outside of the incorporated communities.

52% of the scopes of work were to damage sites located in unincorporated areas of the County.

3. The majority of the repair costs were for many small project sites involving roads and bridges scattered through the County.

54% of the scopes of work prepared as a result of this disaster were for repairing roads and bridges. The repair costs for individual damaged road and bridge work were aggregated making it difficult to determine the average project size. However, from discussion with the County Public Works staff it can be assumed that the repair work probably averaged only several thousand dollars per site.

4. Most damage was caused by the water-borne sediment eroded off the land.

Sediments in floodwaters typically increases the damage caused by flooding. Sediment adds mass increasing the impacts of water velocity, abrasiveness to the floodwaters that can increase damage to machinery and will remain on the land after the floodwaters have resided and increase the cost by having to be removed. 7% of the reconstruction costs went to clean up the debris left by or caused by the flood. Most of this was sediment. All road and bridge scopes of work referenced erosion as the cause or contributing cause to the damage. The large scopes of work including the repair to the sewer treatment facility and the sports field mentioned erosion and the effects of sediment as a contributing cause of the damage. Table 3.9 shows Public Assistance claims by damage types and amount. Table 3.10 shows the applicants for disaster assistance, by amount claimed.

**Table 3.9: Public Assistance Claims in Whitman County, by Type**

<b>Public Assistance Claims, by Type, Amount and Percentage of Total Amount</b>		
<i>Scope of Work Category (DSR)</i>	<i>Dollar Amount</i>	<i>Percentage</i>
A Emergency Work Debris Clearance	\$123,114	7%
B Emergency Work Protective Measures	\$120,028	7%
C Roads and Bridges	\$926,501	54%
D Water Control Facilities	\$21,169	1%
E Buildings and Equipment	\$95,539	6%
F Public Utilities	\$231,359	13%
G Other Parks	\$200,572	12%
<b>Total</b>	<b>\$1,718,282</b>	<b>100%</b>
DSRs average	\$18,677	
Cat C average	\$29,887	

**Table 3.10: Applicants for Public Assistance in Whitman County**

<b>Applicants for Public Assistance, by Amount and Percentage of Total Amount</b>		
<i>Applicant</i>	<i>Dollar Amount</i>	<i>Percentage</i>
ALBION (TOWN OF)	\$37,294	2%
COLFAX (CITY OF)	\$241,066	14%

COLUMBIA COUNTY	\$109,613	6%
INLAND POWER AND LIGHT	\$43,210	3%
PORT OF WHITMAN CO.	\$5,179	0%
PULLMAN (CITY OF)	\$249,459	15%
PULLMAN AIRPORT (MOSCOW REGIONAL AIRPORT)	\$2,452	0%
PALOUSE (CITY OF)	\$121,642	7%
ROSALIA (TOWN OF)	\$5,971	0%
TEKOA (TOWN OF)	\$7,550	0%
WASHINGTON STATE PARKS & REC.	\$3,063	0%
WHITMAN COUNTY	\$891,783	52%
<b>Total</b>	<b>\$1,718,282</b>	<b>100%</b>

### *Individual Assistance Data*

Data for individual claims for DR 1100 resulting from damage from the 1996 flood were analyzed to determine generalized areas of exposure and vulnerability. Whitman County residents received almost \$300,000 dollars in Individual Assistance grants to repair homes and property, and to help out with rental payments. The findings include:

1. Very few residents living outside of incorporated communities received assistance. There did not appear to be isolated populations not living in communities that needed assistance.

Only about 6 of the 105 Whitman County residents who receive an Individual Assistance lived outside of communities.

2. Most of those receiving Individual Assistance lived in one of three cities:

- a. Colfax – 22 %
- b. Palouse – 23 %
- c. Pullman – 35 %

Total - 80 %

3. The average Individual Assistance grant was small.

The average award was \$2800 dollars; only 18 grants were for amounts above \$5,000 and all but one of these higher awards were to residents of Colfax, Palouse or Pullman.

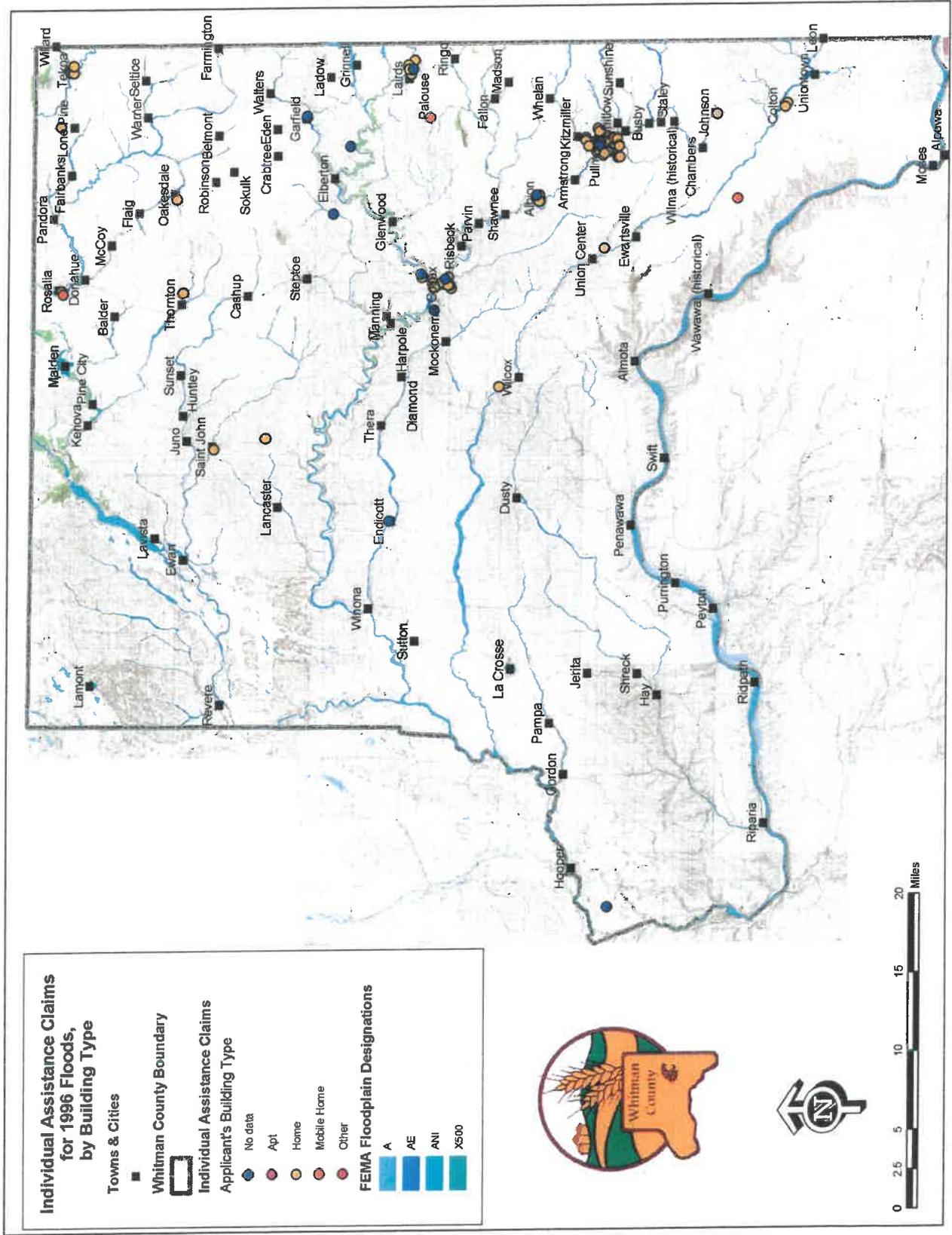
4. Many of the flood impacted residents were renters.

20% of those receiving assistance were renters. This is a high percentage considering that there are few renters in the County. All but two of the renters receiving grants were from one of the three most impact communities of Colfax, Palouse, and Pullman. Table 3.11 shows the amount of Individual Assistance Grants given by community, and also what percentage of all grants were to owners or renters. Figure 3.6 shows the location of IA claims.

**Table 3.11: Amount of IA Grants, by Community**

<b>Communities Receiving Individual Assistance Grants</b>		
<i>Community</i>	<i>Awards</i>	<i>Percentages</i>
OAKESDALE	1	1%
ALBION	5	5%
COLFAX	22	21%
COLTON	4	4%
ENDICOTT	1	1%
GARFIELD	4	4%
MOSCOW	1	1%
PALOUSE	24	23%
PULLMAN	37	35%
ROSALIA	0	0%
SAINT JOHN	2	2%
TEKOA	4	4%
<b>Total</b>	<b>105</b>	<b>100%</b>
<i>Occupancy</i>	<i>Number</i>	<i>Percentage</i>
Owner	84	80%
Renter	21	20%
<b>Total</b>	<b>105</b>	<b>100%</b>

Figure 3.6: Whitman County Individual Assistance Claims



(THIS PAGE LEFT INTENTIONALLY BLANK)