

Volume II: Hazard Annex

Flood

Causes and Characteristics of Floods

Oregon has a detailed history of flooding with flood records dating back to the 1860s. There are over 250 flood-prone communities in Oregon.

The principal types of flood that occur in Marion County include:

Riverine floods

Riverine floods occur when water levels in rivers and streams overflow their banks. Communities in Marion County that are located along such water bodies have the potential to experience this type of flooding after spring rains, heavy thunderstorms or rapid runoff from snow melt. Riverine floods can be slow or fast-rising, but usually develop over a period of days.

The danger of riverine flooding occurs mainly during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with melting of snow in the Coast Range.

Shallow area floods

These floods are a special type of riverine flooding. FEMA defines a shallow area flood hazard as an area that is inundated by a 100-year flood with a flood depth between one to three feet. Such areas are generally flooded by low velocity sheet flows of water.

Urban floods

Urban flooding occurs where land has been converted from fields or woodlands to developed areas consisting of homes, parking lots, and commercial, industrial and public buildings and structures. In such areas the previous ability of water to filter into the ground is often prevented by the extensive impervious surfaces associated with urban development. This in turn results in more water quickly running off into watercourses which causes water levels to rise above pre-development levels. During periods of urban flooding streets can rapidly become swift moving rivers and basements and backyards can quickly fill with water. Storm drains often may back up with yard waste or other flood debris leading to further localized flooding. Another source of urban flooding is grading associated with development. In some cases, such grading can alter changes in drainage direction of water from one property to another.

History of Floods in Marion County

The Willamette River basin has a long history of flooding. The largest flood on record on the Willamette River occurred in 1861. In 1861, town of Champoeg

disappeared in the flood.¹²⁰ Since then, however, the construction of flood control dams in the 1940s and 1950s has changed the pattern of flooding significantly. Marion County has seen two major floods and five lesser floods during the last 45 years. One of the most memorable floods during this time period, the "Christmas" flood of 1964, was rated "approximately a 100-year flood" by FEMA and was probably the most damaging in Oregon's history.¹²¹ Table 1 provides an overview of flooding history in Marion County. Major floods are discussed in more detail below.

Table 1 Marion County Flood History

Date	Location	Comments
December-January, 1964	The state of Oregon was declared an emergency disaster area	In Salem, the Willamette River crested nearly 10 feet above flood stage
January, 1974	Willamette watershed	Heavy snow and a series of storms caused flooding conditions. Nine counties were declared disaster areas
February, 1986	Salem area	Heavy rain and snowmelt caused high water levels in the Willamette and Pudding rivers
February, 1996	Willamette watershed rivers and creeks	Snow-pack, warm temperatures, and record-breaking rains caused streams to rise to all-time flood record levels
November, 1996	Salem-Keizer	The heavy rains swamped the Salem-Keizer area
January, 1997	Mid-Willamette Valley	The Willamette River crested at 29 feet, one foot above flood level.
December, 2005	Willamette watershed	Heavy rains causing rivers to crest above flood stage
January, 2006	Willamette watershed	Heavy rains caused road closures and damage to agricultural lands

Source: Region 3 Mid/Southern Willamette Valley Regional Profile. January 2009.

December-January 1964

The "Christmas" flood of 1964 was the largest flood to occur since major dam construction occurred on the upper Willamette. This flood occurred as a result of two storms, one on December 19, 1964 and the other on January 31, 1965. These storms brought record-breaking rainfall that exacerbated near record early season snow depths. The flooding caused ten deaths, \$5 million dollars of damage to state bridges and \$10 million dollars of damage in Marion County.¹²² There were hundreds of landslides, bridges and roads washed out, houses were damaged or destroyed, and thousands of people were forced to evacuate their homes. Governor Mark Hatfield declared the entire state an

¹²⁰ Dennis Wylie, Park Manager, Champoeg State Heritage Area. Telephone interview November 5, 2004.

¹²¹ Marion County Emergency Management. Available at <http://publicworks.co.marion.or.us/emergencymanagement/>.

¹²² Oregon Statesman. December 25, 1964

emergency disaster area, and called the flooding, "the worst disaster ever to hit the state."¹²³

Marion County Commissioners also declared the county a disaster area as the Willamette River crested at 29.7 feet in Salem; nearly 10 feet above flood stage, and most other streams in Marion County overflowed their banks.¹²⁴ The floodwaters rendered sewage treatment plants in Salem inoperable causing raw sewage to be channeled directly into the Willamette River.

A significant portion of Keizer was inundated and more than a thousand people were evacuated.¹²⁵ One hundred and twenty one patients were evacuated from the Salem Memorial Hospital and fifteen families in the Turner/Salem area were evacuated from their homes. In Independence, thirty people were temporarily housed in City Hall to escape the floods. Further east, the entire Detroit-Idanha-Marion Forks area was isolated by massive washouts near Detroit Dam and Marion Forks. Seven homes were washed away in Idanha and a landslide destroyed one house.¹²⁶

January 1974

Heavy snow and freezing rain and a series of mild storms caused snowmelt and rapid runoff. The storms resulted in two fatalities and thirteen injuries in Oregon.¹²⁷ Nine counties in Oregon were declared disaster areas, including Marion County.¹²⁸

In Marion County, the Willamette River crested at 32 feet, four feet above flood level and two bridges were washed away on Mill Creek. Many residents experienced power outages and four Turner residents were evacuated from their homes and more than twenty roads were closed due to high water. In Salem and other communities, wastewater treatment plants exceeded capacity resulting in millions of gallons of raw sewage being discharged into the Willamette River. Total damages to Marion County were approximately \$1.75 million.¹²⁹

February 1986

This flood, caused by a combination of heavy rains and snowmelt, caused the Willamette River to crest at just over 29 feet and within ten inches of flooding.

¹²³ Kathleen Carlson. "Christmas Week Flood Brings Major Flooding, December 1964" Salem Online History Project available at <http://www.salemhistory.net/home.htm>

¹²⁴ Oregon Statesman. December 24, 1964. No. 272, page 1.

¹²⁵ Marion County Emergency Management

¹²⁶ Oregon Statesman. December 23, 1964, No. 271, page 1.

¹²⁷ Oregon Statesman. January 16, 1974. Page 1.

¹²⁸ George Taylor and Raymond Hatton. 1999. Oregon Weather Book: A State of Extremes. Corvallis, OR: Oregon State University Press.

¹²⁹ Oregon Statesman. January 16, 1974.

The Pudding River crested at 24½, two-and-one-half feet above flood levels. In Salem, Minto Brown Island was closed because of high water on roads.¹³⁰

February 1996

In February of 1996, a combination of snow-pack, warm temperatures, and record-breaking rains caused streams to rise to all-time flood record levels.¹³¹ Statewide, there were five flood related deaths and 150 people were evacuated from their homes.¹³² During this 25 -year flood event, overflow from the Little Pudding River inundated secondary roads, homes, and farmlands.

Two state parks along the Willamette River in Marion County suffered loss during the flood. Champoeg State Heritage Area lost all its picnic tables, and had to rewire all their electrical systems.¹³³ Willamette Mission State Park is located on what is known as ‘Beaver Island,’ and also suffered severe damage.¹³⁴ All the park’s facilities were flooded, there was no power to the restrooms, all picnic tables were washed away, and some were found in trees down river.¹³⁵ A large chunk of riverbank in the park disappeared with the floods.¹³⁶

Dikes collapsed upstream from Jefferson due to high water on the South Santiam River.¹³⁷ Serious erosion problems occurred within the South Santiam drainage basin.¹³⁸

Claggett Creek also presented flooding problems during the February floods, and was described as a 100-year storm event for the creek.¹³⁹ Three houses with basements flooded in the Keizer area. These homes were later removed from the floodplain with FEMA funding assistance.¹⁴⁰

¹³⁰ The Statesman Journal. February 24, 1986.

¹³¹ George Taylor and Raymond Hatton. 1999. Oregon Weather Book: A State of Extremes. Corvallis, OR: Oregon State University Press.

¹³² Statesman Journal. February 5, 1996. Statesman Journal. February 7, 1996. Page 1.

¹³³ Dennis Wylie, Park Manager, Champoeg State Heritage Area. Telephone interview November 5, 2004.

¹³⁴ Eric Timmons, Park Manager, Willamette Mission State Park Management Unit, Telephone Interview November 9, 2004.

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ Matthew Crall, City of Jefferson, Oregon Development Coordinator. Telephone interview November 4, 2004.

¹³⁸ Ibid.

¹³⁹ Rob Kissler, Public Works Director, Keizer, OR. Telephone interview November 18, 2004.

¹⁴⁰ Ibid.

Marion Soil & Water Conservation District acted as pass through for \$3.5 million from USDA Natural Resources Conservation Service (NRCS) to get financial assistance to farmers, who provided a 25 percent match.¹⁴¹

Flood damages from this flood event were estimated at \$2.6 million for the entire Pudding/Little Pudding River Basin.¹⁴² In Keizer, damages reached \$4.2 million.¹⁴³ Total damages within Marion County were approximately \$24 million.¹⁴⁴

November 1996

Flooding occurred in November 1996 adding to that occurred as a result of the February 1996 flood. Like February's storm, the "pineapple express," a weather system that draws large amounts of moisture from an area near Hawaii and deposits it on the West Coast, caused the heavy rain.¹⁴⁵ Salem received about six inches of rain over a 48-hour period. The heavy rains swamped the Salem-Keizer sewer system, sent raw sewage into the Willamette River and caused smelly backups in some Salem residents' basements.¹⁴⁶ Adding to the troubles of the Salem-Keizer area, eighteen inches of water flooded a Keizer subdivision damaging several homes.

Rural areas of the county were also hit hard by November's deluge. Five rural homes were evacuated and dozens of roads were closed. One such road was Parker Road near Independence. Floodwaters wiped out a 70-foot section of this road and left a fifteen-foot hole filled with rushing waters. Four motorists drove their vehicles into the gap, one was seriously injured, and others' lives were put in jeopardy during rescue operations.¹⁴⁷

January 1997

Heavy rains from the January 1997 storm caused flooding throughout the county. The Willamette River crested at 29 feet, one foot above flood level. Five thousand Mid-Willamette Valley residents lost power as high winds that accompanied the rain blew down power lines. Fallen trees and debris backed

¹⁴¹ Monte Graham, (former) District Manager, Marion SWCD. Telephone interview November 9, 2004.

¹⁴² Marion County Website

http://publicworks.co.marion.or.us/administration/gis/mike11/proj_scope.as

¹⁴³ Statesman Journal. February 10, 1996.

¹⁴⁴ Mid-Willamette Valley Council of Governments. February 1996. Flood Economic Recovery Coordination Project for Marion, Polk, and Yamhill Counties Oregon. FEMA DR-1099-OR.

¹⁴⁵ "Pineapple Express Drenches Oregon Again." Statesman Journal. November 20, 1996.

¹⁴⁶ "Sewer System Backs Up Into Willamette." Statesman Journal, November 20, 1996

¹⁴⁷ Statesman Journal, February 20, 1996.

up sewer lines in Salem, and subdivisions in northeast Keizer were flooded, causing damages estimated at hundreds of thousands of dollars.¹⁴⁸

December 2005

Heavy rains caused rivers to crest above flood stage in Polk, Marion, Linn, Lane, and Benton Counties, as well as other counties in the Willamette Valley.¹⁴⁹

January 2006

Heavy rains caused many rivers to crest above flood stage in the Willamette Valley, causing road closures and damage to agricultural lands.¹⁵⁰

Risk Assessment

How are Hazard Areas Identified

Major riverine flood sources in Marion County include the Willamette River, Santiam River, Pudding River, Butte River, Battle Creek, Beaver Creek, Clagget Creek, Croisan Creek, Gibson Creek, Lake Labish Creek, Mill Creek, Senecal Creek, Silver Creek and Shelton Ditch.¹⁵¹ The Marion County 100 year floodplain map shown below shows the location of the flood hazard in Marion County.

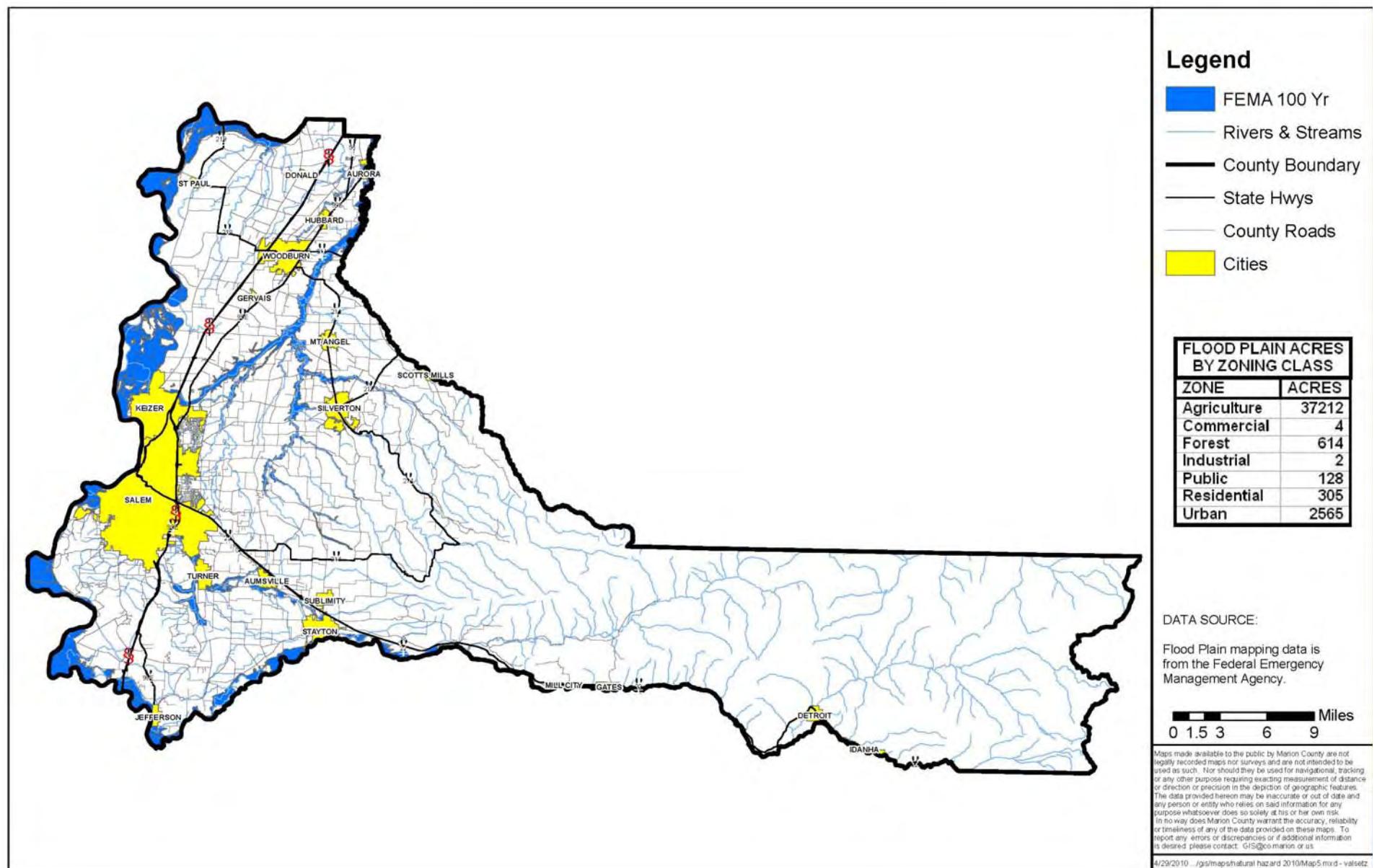
¹⁴⁸ Statesman Journal, January 2, 1997.

¹⁴⁹ "Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009."

¹⁵⁰ Ibid.

¹⁵¹ State Interagency Hazard Mitigation Team. "State of Oregon Enhanced Natural Hazard Mitigation Plan"

Figure 2 Major Riverine Sources and 100 Year Floodplain Designation



Repetitive Flood Loss in Marion County

Properties in and near the floodplains in Marion County are subject to flooding events almost annually. Since flooding is such a pervasive problem throughout the county, many residents have purchased flood insurance to help recover from losses incurred from flooding events. Flood insurance covers only the improved land, or the actual building structure. Repetitive loss structures are defined as a National Flood Insurance Program (NFIP)-insured structure that has had at least two paid flood losses of more than \$1,000 each in any 10-year period since 1978¹⁵². Repetitive loss structures are troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA recognize this pitfall in floodplain insurance, and attempt to remove the risk from repetitive loss of properties through projects such as acquiring land and relocating homes, or by elevating structures.

Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.¹⁵³

Marion County Flood Insurance Rate Maps are current as of May 2010. As of April 12, 2010, Marion County has 354 flood insurance policies in force with a total value of \$76,343,000.¹⁵⁴ Between 1978 and April 2010, the NFIP paid \$720,623 in claims for 63 total losses. Of these 63 losses, 50 have closed and 13 have closed without payment.¹⁵⁵ As of April 12, 2010, Marion County has four repetitive flood loss properties with payments totaling \$119,331. Marion County's last Community Assistance Visit was March 19th, 2004. Marion County is a member of the Community Rating System (CRS) and has a level 6 community rating.

Probability of Future Occurrence

The historical incidence of riverine flooding events resulting in substantial losses indicates significant flooding events likely within a 10-15 year range, well within the 35 year range used for high likelihood incidents. The Marion County steering committee determined that the probability of flooding is **high**, meaning that one event is likely in a 10-35 year period. This rating is consistent with the 2006 Marion County Hazard Analysis.¹⁵⁶

¹⁵² Federal Emergency Management Agency. Definitions, available online at <http://www.fema.gov/business/nfip/19def2.shtm#R>

¹⁵³ National Flood Insurance Program. Available on the World Wide Web <http://www.fema.gov/nfip>. Accessed April 2002.

¹⁵⁴ Federal Emergency Management Agency Disaster Report - Oregon. Flood Insurance-Detail. Accessed April 12, 2010.

¹⁵⁵ FEMA loss statistics, Oregon. Available online: <http://bsa.nfipstat.com/reports/1040.htm#41> Accessed 5/30/10

¹⁵⁶ Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009

Vulnerability Assessment

Property, infrastructure, and areas that are especially susceptible to flood damage in Marion County include manufactured homes, businesses, public infrastructure, buildings and roads, bridges, stormwater systems, riparian areas, and wetlands.

Based on data through 2003, Marion County's population in its unincorporated area is 83,242 persons, with 16,034 one to four-family structures and 30,013 other structures. In the flood hazard areas only, the county's population is 3,423 persons with 797 one to four-family structures and 2,634 other structures.¹⁵⁷ Vulnerable areas include those critical facilities within or near the 100 year floodplain. Those facilities along low lying portion of the western border of Marion County are at particular risk of flooding due to the close proximity to the Willamette River.

Given the large number of residents in flood hazard areas and facilities in or near the 100-year floodplain, the Marion County steering committee rated the county's vulnerability to flood as **high**, meaning that more than 10% of the county's population or regional assets would be impacted by a flood. This rating is higher than the 2006 Marion County Hazard Analysis which rates the county's vulnerability to flood as moderate.¹⁵⁸

Risk Analysis

A risk analysis estimating the potential loss of life and property for the flood hazard in Marion County has not been completed at this time. However, given the large number of residents in the floodplain, a risk analysis should be completed (see Multi-Hazard Action # 8).

Community Hazard Issues

What is susceptible to damage during a hazard event?

The extent of the damage and risk to people caused by flood events is primarily dependent on the depth and velocity of floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep vehicles downstream. Roads, bridges, other infrastructure and lifelines (pipelines, utility, water, sewer, communications systems, etc.) can be seriously damaged when high water combines with flood debris, mud and ice. Extensive flood damage to residences and other structures also results from basement flooding and landslide damage related to soil saturation. Surface water entering into crawlspaces, basements, and daylight basements is common during flood events not only in or near flooded areas but also on hillsides and other areas far removed from floodplains. Most damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings and appliances). If not properly protected from the entry of flood waters,

¹⁵⁷ Department of Homeland Security NFIP Biennial Report

¹⁵⁸ Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009

mechanical, electrical and similar equipment can also be damaged or destroyed by flooding.

The Marion County steering committee identified the following additional impacts specific to Marion County. These include impacts to the local economy, critical facilities and infrastructure, population, cultural assets, and ecosystem services.

Economy

Marion County economic activity is vulnerable to flooding through the disruption flood events may have on transportation corridors. Specifically flooding that results in the blockage of the I-5 corridor or Highway 22. Additionally, flooding in downtown Salem would significantly disrupt tourist activity.¹⁵⁹

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close a business for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Critical Facilities and Infrastructure

Publicly owned facilities are a key component of daily life for all citizens of Marion County. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as adopt public policy that reduces risk to private property from flood events.

In the wake of the 1996 flood events, damage to public buildings statewide represented 34 percent of total public losses.¹⁶⁰ Of particular importance during flood events are facilities located in flood hazard areas that are critical to government response and recovery activities.

Infrastructure and facilities that are vulnerable to flooding include bridges on county roads and highways such as I-5 and Highway 22; sewage treatment plants in the cities of Jefferson, Aumsville, Salem, and Aurora; two recycling centers in south Salem, and a major landfill located beside the Willamette River.¹⁶¹ Bridges are a major concern during floods as they provide critical links in road networks by crossing water courses and other significant natural features. However bridges and their supporting

¹⁵⁹ Id.

¹⁶⁰ The Interagency Hazards Mitigation Team. June 2000. State Hazard Mitigation Plan. Oregon State Police – Office of Emergency Management.

¹⁶¹ Id.

structures can also be obstructions in flood-swollen watercourses and can be damaged by debris jams and erosion scour.

There are a variety of drinking water, surface water, and wastewater service providers throughout the county. During flooding events, the infrastructure that supports the water service providers in the county can be damaged and sometimes destroyed.

Power transmission can also be disrupted during a flood because when debris piles up around structures, the power poles sometimes collapse and cause power outages.¹⁶²

Population

Populations along the western border of Marion County are at particular risk due to their close proximity to the Willamette River. Populations along the Santiam River, below Detroit Dam are vulnerable to severe flooding in the event of a dam breach.¹⁶³

Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61 percent were manufactured homes and trailers.¹⁶⁴ Populations that live in older, pre-FIRM manufactured homes are particularly susceptible to flood damage, as many have a lower level of structural stability than wood frame homes. A wood frame home's foundation and building frame are put together on site as opposed to manufactured homes which are pre-fabricated off site. Manufactured homes in floodplain zones must be anchored to provide additional structural stability during flood events. However, because of confusion in the late 1980's resulting from multiple changes in NFIP regulations, there are some manufactured homes that did not enforce anchoring requirements. Current regulations require manufactured homes in floodplain zones to be both elevated and anchored to provide structural stability during flood events comparable to site built homes.

Cultural Assets

The Marion County steering committee identified several cultural assets that may be vulnerable to flooding because of their location next to rivers and streams. These cultural assets include the State Fairgrounds, Silver Falls State Park, Opal Creek Mining Camp, Mission Mills, the St. Paul Rodeo, Woodburn outlet malls, Buena Vista Ferry, Breitenbush Hot Springs, and various historic covered bridges.¹⁶⁵ In addition to defining Marion County's history, these assets also attract tourists that support local businesses.

¹⁶² Ibid.

¹⁶³ Marion County Steering Committee. March 2010

¹⁶⁴ Ernie Eichhorn, Bonneville Power Administration, Chemawa District. Telephone interview November 10, 2004.

¹⁶⁵ Ibid.

Environmental Assets

Environmental assets are vulnerable to flooding events as well as personal livelihoods and property. Environmental assets in Marion County that were identified as vulnerable to flooding includes stormwater management systems, particularly in Salem, the Santiam River, which provides water to surrounding populations, agricultural land along waterway corridors, parks located in floodplains, the Stayton Riverfront Park and associated erosion issues, and the State park north of Salem, which floods regularly.

Maintaining and restoring natural systems help mitigate the impact of flood events on the built environment. High water can be beneficial to the natural processes within a floodplain, and can benefit riparian areas.

Approximately 90 percent of the regulated floodplain areas in Marion County are maintained in open space or undeveloped land due to being public lands or resource lands where development is regulated or limited.

Existing Hazard Mitigation Activities

Participation in the NFIP & CRS

Marion County participates in the National Flood Insurance Program (NFIP) and Community Rating System (CRS). Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.¹⁶⁶ In Marion County, all homes and other buildings legally constructed in the floodplain after January 1974 must be mitigated to NFIP standards with the first floor being elevated at least one foot above base flood level, or in the case of non-residential buildings, flood proofed to at least one foot above the base flood level.

The county's flood outreach efforts and management practices places it in the top 8% of jurisdictions nationwide and brings many benefits to county residents, including a savings of up to 20% on flood insurance premiums. As of February, 2010, there are 18 communities in Marion County participating in the National Flood Insurance Program.¹⁶⁷

Although many communities rely exclusively on FIRM^s to characterize the risk of flooding in their area, there are some flood-prone areas that are not mapped but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and areas susceptible to human made flooding.

¹⁶⁶ FEMA, Region 10. Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program..

¹⁶⁷ Federal Emergency Management Agency Community Status Report Book - Oregon: Communities Participating in the National Flood Program. 2010

In order to address this lack of data, many jurisdictions have taken efforts to develop more localized flood hazard maps. One method that has been employed includes using high-water marks from flood events or aerial photos, in conjunction with the FEMA maps, to better reflect the true flood risk.

Marion County Flood Hazard Mitigation Plan (Resolution 98-38R)

The *Marion County Flood Hazard Mitigation Plan*, adopted by the Marion County Board of Commissioners in 1998, was incorporated into the Marion County Natural Hazard Mitigation Plan in 2006. The purpose of the Flood Hazard Mitigation Plan was to identify strategies to reduce the effects of future floods in Marion County and incorporate those strategies with existing policies and procedures into a long-term approach toward implementing a “disaster resistant” community design. This purpose is consistent with the intent of the Natural Hazards Mitigation Plan, as well as the county’s Emergency Operations Plan, Comprehensive Plan, and the State of Oregon’s Natural Hazard Mitigation Plan.

Public Works, Operations Division

The Public Works Department’s Operations Division monitors water levels of rivers in the county that tend to flood over their banks, and may flood a county road. There are permanent high water gates installed along county roads that seasonally flood. Permanent ‘Road Closed Ahead’ Signs are posted that can be flipped up when not in use along certain county roads that flood.

Marion County Codes, Ordinances and Regulations

Marion County requires the filing of declaratory statements with land use decisions and building permits that involve property within floodplain and identified geological hazard areas. The declaratory statements are recorded with the County Clerk against properties within identified hazard areas. The declaratory statements indicate that the owners acknowledge and covenant that the county has identified the property as being within a floodplain and that the county recommends that measures be taken to mitigate flood damage, flood hazards, and that the property owners maintain flood insurance on all improvements.

Marion County uses building codes, zoning ordinances, and various planning strategies to address the Oregon Land Use Planning Goal 7, which aim at restricting development in areas of known hazards, and applying the appropriate safeguards.

Marion County’s floodplain ordinance, Chapter 178 of the Marion County Rural Zoning Ordinance contains higher regulatory standards than NFIP regulations. For example, new site-built and manufactured dwellings, and replacement dwellings not being placed in the same location as the original dwelling are prohibited in the floodplain if there is an area on the subject

property located outside of the floodplain where the dwelling can be placed.

Other provisions i.e., mitigation requirements in Chapter 178 include:

- Prior to obtaining a building permit, the property owner is required to sign and record in the Marion County Records Office a declaratory statement binding the landowner, and the landowner's successors in interest acknowledging that the property and the approved development are located in a floodplain.
- Prior to any mining, dredging, filling, grading, paving or excavation within the 500-year floodplain of the Mill Creek Basin Flood Hazard Areas as identified on Marion County zoning maps. Developers must complete a Floodplain Development Permit Application as outlined in Chapter 178 of the Rural Zoning Ordinance, and Chapter 19 of the Urban Zoning Ordinance.
- Dwellings shall have the top of the lowest floor, including basement, elevated on a permanent foundation to two (2) feet above base flood elevation and the bottom of the lowest floor constructed a minimum of one (1) foot above the base flood elevation. Developers must complete a Floodplain Development Permit Application as outlined in Chapter 178 of the Rural Zoning Ordinance, and Chapter 19 of the Urban Zoning Ordinance.
- Manufactured homes shall have the finished floor, including basement, elevated on a permanent foundation to two feet above base flood elevation. Where the base flood elevation is not available, the floor, including basement shall be elevated on a permanent foundation to two feet above the highest adjacent natural grade (within five feet) or the building site.
- New construction and substantial improvement of any commercial, industrial or other non-residential structures shall either have the lowest floor, including basement, elevated to two feet above the level of the base flood elevation or together with attendant utility and sanitary facilities shall be flood proofed.
- New construction and substantial improvement of residential and nonresidential structures within AO zones shall have the lowest floor (including basement) elevated above the highest adjacent natural grade (within five feet) of the building site, to two feet above the depth number specified on the FIRM or three feet if no depth number is specified.

Floodplain Area Regulatory Functions

Marion County regulates floodplain areas i.e., 500-year floodplain areas and other areas identified in the floodplain ordinance such as the Mill Creek Basin Flood Hazard Areas and Pudding River Floodplain Areas in addition to the FEMA Special Flood Hazard Areas identified in the FIRMs. The county regulates 10,047 acres of floodplain in addition to the FIRM Flood Hazard Areas that total 64,479 acres. The additional floodplain areas

are mapped on the county zone maps and subject to the county's floodplain ordinance. In addition, the county established a process for making amendments and revisions to the county regulated floodplain areas similar to the federal FIRM processes of "Letter of Map Amendment" and "Letter of Map Revision" that is initiated by owners of property within the regulated floodplain areas.

Floodplain Determination Project

Marion County Public Works' 100- and 500-year floodplain determination project identifies floodplain areas in addition to the Flood Insurance Rate Maps' (FIRM's) information. The 100- and 500-year floodplain maps created by Marion County Public Works include three sources of topographical data and two modeling schemes. The base terrain data was derived from elevation points taken from USGS 7.5 minute quadrangle maps with a contour interval of ten feet. This was translated into a triangulated irregular network to form a smooth surface of the terrain. From that point, a lattice was developed that represents a 25-foot grid cell size forming a digital elevation model.

To augment and calibrate this grid model, vertical data was acquired from RadarSAT satellite imagery received from NASA's Goddard Spaceflight Center in Greenbelt, Maryland, and from the Dartmouth Flood Observatory in Hanover, New Hampshire, both of which the county created a partnership for this project.

The telemetry and triangulation from this data proved that in some circumstances, the county improved its elevation value accuracy. The completed elevation model was used to determine continuity of FEMA's FIRM maps through areas that were not included in FEMA's previous reports. The county incorporated Marion County Public Works' detailed hydrologic layer to correct errors and remedy the absence of date in the FIRM's.

A 'broad stroke pass' was made to determine floodway limits of the rivers and channels in the county. The floodway limits were used to calculate the 100- and 500-year floodplains. The county based this on interpolating historical inundation limits (floods of 1865 and 1964), and extending them through the terrain model. The county calibrated the results by recent Global Positioning System (GPS) surveys conducted during the floods of February 1995 and January 1997.

Subsequent to this initial modeling endeavor, Public Works updated the current 100- and 500-year floodplain data, and added a 50-year event to the information. The county completed this by using the Danish Hydraulic Institute's MIKE 11 floodplain determination/river channel modeling/flood water protection software package. Using this modeling program and the accurate elevation model, the county will develop a tool for determining an accurate floodway, add a 50-year floodplain inundation extent limit to the county flood management inventory, revise present 100-

and 500-year floodplain maps (and by request from FEMA, update the FIRMs), and gain the ability to forecast flood behavior and high water limits during flooding events.

Elevation Certificate Maintenance

The county maintains its elevation certificates in computer format using the FEMA Elevation Certification software. Certificates are maintained in this computer format on all buildings built since county participation in the CRS program (October 1999). The county also maintains paper files of some pre-FIRM and post-FIRM buildings, listed by address. The certificates are available to the public for review.

Flood Data Maintenance

Marion County uses an ESRI Map Objects, desktop application to view data in the system. County staff uses its GIS and Map Objects on a daily basis when assisting the public, other county departments, and for individual staff projects. The system allows staff to display information and mapping contained in the data layers on computer monitors at county public service counters for viewing by the public regarding individual properties. The information can then be printed out for the public and maps can be generated and created utilizing the various data layers for use and distribution to the public for areas within the county. The system can also be used to conduct research on properties as the database contains building permit data, assessor records, deed information, survey records, land use case history, public works permits, and enforcement actions along with the geographic data. The county routinely updates its GIS. New system applications and programs that improve staff access to and use of data are made periodically. The county enters geographic and/or digital data as it becomes available, such as studies or inventories creating a new data layer.

Mill Creek Culvert Project

Marion County received funding from the National Marine Fisheries Service to improve fish passage through county road culverts in the Mill Creek Watershed. The retrofitting of these culverts allows passage of Chinook salmon and steelhead, as well as cutthroat trout, opening up over 25 kilometers of habitat. Current barriers include inlets blocked by debris, excessive slope and outlet jumps, and shallow outlet pools. Unblocking the culverts also acts as flood mitigation. Marion County worked with ODFW to design "fish-friendly" culverts. The County completed the retrofits in 2005.

Little Pudding River Floodplain Modeling Project

Marion County developed a hydrological model capable of predicting and illustrating river flow, flooding characteristics, and water pollution levels on the Little Pudding River and its associated watershed basin. The model serves as a useful tool in flood mitigation and management efforts within the Little Pudding River Watershed by providing information on flood

water extent and road closure status for emergency officials and the public, and allow for wetland restoration planning.

FEMA Flood Map Modernization Program

Marion County and the cities within the county were selected in July 2000 as one of the first communities in FEMA Region X to receive Digital Flood Insurance Rate Maps (DFIRMs) in addition to the traditional paper format. The county converted its micro station maps, to the new GIS-based DFIRM standard in the latter part of 2003. Such conversion included a digital database that allows the county to incorporate FIRM information into a format compatible with standard GIS software.

Outreach

The county conducts an annual outreach (public service announcement) project to realtors, builders, mortgage brokers, insurance agents, and appraisers regarding available flood information and current flood management activities.

The county utilizes its Website, the community's official telephone directory, brochures and Capital Community Television (CCTV) as outreach tools to disseminate information pertaining to flooding and other hazards, flood protection tips, and links to other emergency preparedness activities. CCTV televises non-commercial television made by local residents about subjects important to the community.

Stormwater

Marion County is one of several jurisdictions in Oregon that fall under the National Pollutant Discharge Elimination System (NPDES). The county developed a five-year stormwater plan that mostly addresses water quality in the U.S. Census-designated Urbanized Area around Keizer and Salem, Oregon. Components of that plan include better maintenance of the drainage system, low impact development ordinances and education, pollutant discharge detection, and erosion control.

In October 2000, the City of Salem, City of Keizer and Marion County entered into a Stormwater Management Agreement to address regional stormwater management issues of mutual concern within the Claggett Creek, Labish Ditch and Little Pudding River watersheds. The agreement provides a framework for communication and coordination with respect to stormwater management within the three watersheds.

Wetlands

County transportation projects can impact wetlands and streams. When this is the case, the county replaces lost wetland functions via a mitigation process. This is primarily regulated through Section 404 of the Federal Clean Water Act. The county monitors these projects closely to ensure compliance with the relevant regulations. There are typically several projects each year.

Aumsville Wetlands Restoration

Many floodplain and stream-associated wetlands absorb and store stormwater flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices. Many wetland restoration projects have been initiated and completed by various organizations throughout the county.

The Aumsville Wetlands site is located 1.5 miles southeast of Aumsville at the intersection of Bates and Bishop Roads. The 77-acre site is composed of wetlands and upland buffer areas flows into Porter Creek, within the Mill Creek Watershed. Working with many community volunteers, the County intends to restore and preserve this site as part of the Natural Heritage Parks Program. In addition to enhancing hydrologic functions, the Aumsville Wetlands Restoration will also expand educational and recreational opportunities for the community. Large-scale removal of blackberry and scotch broom has begun and the site is prepped for future restoration efforts.

Floodplain Parcel Acquisition

Acquisition of floodplain parcels to serve as parks and to reduce development in riparian areas e.g., Stayton Riverfront, Keizer Rapids, is one of Marion County's goals. Floodplain parcel acquisition, similar to the county's wetlands restoration projects, is aimed at ecological restoration in rural parks to enhance environmental benefits of parks and increase their capacity to absorb floodwater. Additional information about these projects is available on the World Wide Web at

<http://publicworks.co.marion.or.us/parks/nhp/index.asp>.

Regional Programs

Marion SWCD is adding stream gauges and weather stations, and will have them accessible on a website, with a weather station at the headwaters of the Pudding River.

Wetland Restoration

Flood mitigation projects include wetland restoration. The Marion Soil & Water Conservation District (SWCD) has been working with the Claggett Creek Watershed Council to restore wetlands along Claggett Creek for flood mitigation.

Along the North Santiam River, the Marion SWCD has been working with the Natural Resources Conservation Service (NRCS) and the North Santiam Watershed Council on returning areas along the North Santiam River to a riparian state. The Marion SWCD also is involved with a Conservation Reserve Enhance Program (CREP) activity along Abiqua Creek.

An offspring of the Conservation Reserve Program (CRP), CREP is a voluntary program for agricultural landowners. Unique state and federal

partnerships allow participants to receive incentive payments for installing specific conservation practices. Through the CREP, farmers can receive annual rental payments and cost share assistance to establish long-term, resource-conserving covers on eligible land.

Flood Management Projects

Flood management structures can assist in regulating flood levels by adjusting water flows upstream of flood-prone areas. There are a total of 58 dams in Marion County registered with the Oregon Water Resources Department holding billions of gallons of water in reservoirs. The largest reservoirs in the County, Detroit and Big Cliff Dam, are not included in that total because they are managed by the US Army Corps of Engineers. Releases of water from Detroit and Big Cliff Dams are designed to protect Marion County from high floodwaters. The largest reservoirs in Marion County include:

- Detroit (Lake) Dam - 321,000 acre feet usable storage (North Santiam River)
- Big Cliff Dam - 134,000 acre feet storage (North Santiam River)
- Silver Creek Reservoir - 1,300 acre feet storage (Silver Creek)
- Mission Creek Dam - 1,140 acre feet storage (Mission Creek)

Hazard Mitigation Action Items

The following actions have been identified by the Marion County steering committee, and are recommended for mitigating the potential effects of floods in Marion County. Please see full action item worksheets in Appendix A.

F1: Develop and implement a formal and regular drainage system maintenance program.

F2: Create partnerships and facilitate riparian habitat restoration projects in flooding or erosion prone areas (e.g. Spongs Landing County Park)

F3: Develop strategies with property owners to minimize future losses from repetitive flood loss areas.

F4: Take steps to reduce Marion County's Community Rating System (CRS) rating to lower National Flood Insurance Premiums in the county.

F5: Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.

F6: Install gauges in Mill Creek to collect flood data and obtain data from the City of Salem's flood gauges to improve flood warning.

F7: Identify bridges in Marion County with flow blockage problems.

F8: Identify the location of existing levees in Marion County and implement a maintenance program with their owners and operators to ensure levees remain operable during flood events.