City of Gladstone

Natural Hazards Mitigation Plan Addendum

Prepared for

City of Gladstone
525 Portland Ave.
Gladstone OR 97027

In cooperation with

Clackamas County
2200 Kaen Road
Oregon City, OR 97045

U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

February 23, 2010

Honorable Lynn Peterson,
Chair, Board of County Commissioners
2051 Kaen Road
Oregon City, Oregon 97045

Dear Chair Peterson:

On October 19, 2007, the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) approved the ***Clackamas County Natural Hazards Mitigation Plan Update 2007*** as a multi-jurisdictional local plan as outlined in 44 CFR Part 201. With approval of this plan, the following entities are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through October 19, 2012:

Clackamas County	**City of Canby**	**City of Damascus**
City of Estacada	**City of Johnson City**	**City of Milwaukie**
City of Oregon City	**City of Sandy**	**City of West Linn**
City of Gladstone		

The list of approved jurisdictions has been updated to include the City of Gladstone, which has recently adopted the ***Clackamas County Natural Hazards Mitigation Plan Update 2007***. To continue eligibility the plan must be reviewed, revised as appropriate, and resubmitted within five years of the original approval date.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact our state counterpart, Oregon Emergency Management, which coordinates and administers these efforts for local entities.

Sincerely,

Mark Carey, Director
Mitigation Division

cc: Dennis Sigrist, Oregon Emergency Management

BH:bb

RESOLUTION NO. 988

A RESOLUTION ADOPTING THE CITY OF GLADSTONE'S REPRESENTATION IN THE CLACKAMAS COUNTY MULTI-JURISDICTION HAZARD MITIGATION PLAN

WHEREAS, the City of Gladstone is vulnerable to the human and economic costs of natural, technological and societal disasters, and

WHEREAS, the City Council of the City of Gladstone recognizes the importance of reducing or eliminating those vulnerabilities for the overall good and welfare of the community, and

WHEREAS, the City of Gladstone has participated in the development of the Clackamas County Multi-Jurisdiction Natural Hazard Mitigation Plan, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities, and

WHEREAS, the City of Gladstone's representatives and staff have identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Gladstone to the impacts of future disasters, and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County Multi-Jurisdiction Natural Hazard Mitigation Plan that has been prepared and promulgated for consideration and implementation by the cities of Clackamas County; NOW THEREFORE

THE COMMON COUNCIL OF THE CITY OF GLADSTONE RESOLVES AS FOLLOWS:

Section 1. The Common Council of the City of Gladstone hereby accepts and approves of its section of the Clackamas County Multi-Jurisdiction Hazard Mitigation Plan as a reasonable process to identify and plan for potential hazards in the City of Gladstone and Clackamas County,

Section 2. The agency personnel of the City of Gladstone are requested and instructed to pursue available funding opportunities for implementation of the actions and proposals designated therein,

Section 3. The City of Gladstone will, upon receipt of such funding or other necessary resources, seek to implement the mitigation proposals identified by the jurisdiction's Hazard Mitigation Planning Committee, and

Section 4. The City of Gladstone will continue to participate in the updating and expansion of the Clackamas County Multi-Jurisdiction Hazard Mitigation Plan in the years ahead, and

Section 5. The City of Gladstone will further seek to encourage the businesses, industries and community groups operating within and/or for the benefit of the City of Gladstone to also participate in the updating and expansion of the Clackamas County Multi-Jurisdiction Hazard Mitigation Plan in the years ahead.

ADOPTED BY THE CITY COUNCIL AND APPROVED BY THE MAYOR, this 9 day of February, 2010.

ATTEST:

Wade Byers, Mayor

Jolene Morishita, Assistant City Administrator

F:\New Files\RESOLUTIONS\Res.988MultiJurisidictionHazardMitigationPlan.doc

City of Gladstone
Natural Hazards Mitigation Plan Addendum

Table of Contents

Section 1:
Planning Process

The City of Gladstone Natural Hazards Mitigation Plan includes resources and information to assist city residents, public and private sector organizations, and others interested in participating in planning for natural hazards. The mitigation plan provides a list of activities that may assist City of Gladstone in reducing risk and preventing loss from future natural hazard events. Gladstone has developed this Plan as an addendum to the Multi-Jurisdictional Clackamas County Natural Hazards Mitigation Plan in an effort to take a more regional approach to planning for natural hazard scenarios.

1.1 2003 Plan Development

In 2003 the City of Gladstone developed an addendum to Clackamas County's Natural Hazards Mitigation Plan. The planning process was a collaborative effort between public agencies within the city, non-profit organizations, the private sector, and regional and state organizations. The city's Hazard Mitigation Advisory Committee (HMAC) guided the plan development process, and included the following representatives:

- Grant Cunningham, Clackamas Amateur Radio Emergency Service
- Jim Rogers, Gladstone School District
- Mike Buchanan, Gladstone School District
- Jeff Smith, Gladstone Fire
- Stephanie Stone, Gladstone Citizen
- Brian Early, Gladstone Evangelical Network
- Larry Canfield, Gladstone Public Works
- Carolyn Briggs. Planning Commission
- Ron Partch, City Administrator's Office
- Cindy Kolomechuk, Clackamas County Emergency Management

In order to complete the natural hazards mitigation planning process, Gladstone's HMAC held regular meetings and workshops. Additionally, Gladstone residents participated in county-wide public workshops that were specifically designed to gain citizen input. Please see Appendix B of Clackamas County's Natural Hazards Mitigation Plan for more information regarding the county's multi-jurisdictional planning and public outreach processes.

The City of Gladstone adopted this plan as an addendum to Clackamas County's Natural Hazards Mitigation Plan in August 2005. Since plan adoption, the HMAC met periodically to discuss public response efforts following hazard events.

1.2 2009 Plan Update

In the fall of 2007, the Oregon Partnership for Disaster Resilience (OPDR / the Partnership) at the University of Oregon's Community Service Center partnered with Oregon Emergency Management, Resource Assistance for Rural Environments (RARE), Clackamas County, and cities within Clackamas County to develop a Hazard Mitigation

Grant Program (HMGP) planning grant proposal. The City of Gladstone joined the Partnership by signing a memorandum of understanding for this project. FEMA awarded the Partnership with a grant to support the development and update of city addenda in Clackamas County, and Gladstone's local planning efforts began in July, 2009. RARE provided a staff person ('RARE Participant') to facilitate and document the city's addendum development process.

Who Participated in Developing the Plan?

From July 2009 through August 2009 Gladstone's Hazard Mitigation Advisory Committee reconvened to serve as the steering committee for Gladstone's natural hazards mitigation plan update process. The RARE Participant, in partnership with Clackamas County Emergency Management, facilitated and documented the plan update process. The HMAC was comprised of the following representatives:

- Pete Boyce, Gladstone City Administrator
- Mike Buchanan, Gladstone School District
- Wendy Burns, Gladstone Christian Church
- Mike Funk, Gladstone Fire Marshall
- Tom Hogan, Gladstone Emergency Management Volunteer Coordinator
- Jim Pryde, Gladstone Police Chief
- Laurel Reimer, Clackamas County Emergency Management
- Kim Sieckmann, Planning Commissioner
- Jeff Smith, Gladstone Fire Department
- Scott Tabor, Gladstone Public Works Supervisor

Plan Update Process

The RARE Participant developed and facilitated three plan update meetings with the HMAC on July 13th, July 27th and August 17th, 2009. Minutes from each of Gladstone's 2009 HMAC plan update meetings can be found in Appendix A.

July 13, 2009: the RARE Participant met with members of the HMAC to discuss the reasons and benefits of having a natural hazards mitigation plan. Additionally, the RARE participant provided an overview of the plan update process, as well as plan update requirements, and the types of staff assistance needed throughout the process. The group also discussed potential additions to the HMAC's representation.

July 27, 2009: the RARE Participant facilitated a meeting with the HMAC to discuss the plan's maintenance process and risk assessment. The group revisited the initial plan's mission & goals and discussed whether or not the coordinating body and convener remained applicable. Additionally, the group discussed each of the natural hazards described within the plan, and reviewed and updated the city's list of community assets.

August 17, 2009: the RARE Participant facilitated the final HMAC meeting. The group discussed the final portions of Section 1: Planning Process by creating a plan maintenance and formal review process. The HMAC then reviewed the plan's mitigation actions, and discussed whether actions were completed, deleted, or deferred. The HMAC additionally developed new action items to address new vulnerabilities identified at the July 27th risk assessment meeting.

Plan Update Changes by Section

Section 1: Planning Process

What are the Plan's Mission and Goals?

During the county's 2007 plan update process, the county goals changed slightly to include an action word in each goal statement. The City of Gladstone has chosen to adopt the same mission and goals as the county. As such, the city's mission and goals have been altered to reflect the slight change in the county's goals.

How Will the Plan be Implemented, Monitored, and Evaluated?

The coordinating body changed from the Planning Commission to the Hazard Mitigation Advisory Committee (HMAC). The convener is now the Gladstone Police Chief, and not a 'representative' from the Gladstone Fire Department. The coordinating body and convener's roles and responsibilities are more clearly defined as well.

Economic Analysis of Mitigation Projects

This section was removed from Section 1, and is now covered in Section 5.

Formal Review Process

The section was divided into two sub-sections: semi-annual meetings and five year update. The HMAC will now meet semi-annually instead of quarterly. The plan will now be formally reviewed and updated once every five years in conjunction with the county's plan update schedule, instead of once every two years. The tasks stated in the formal review process remain the same, and more information was added to describe tasks required of the five-year plan update process.

Continued Public Involvement

The HMAC decided that holding annual public meetings would not be the best use of their resources, and instead decided to hold public meetings as needed.

A section titled *"What are the Mitigation Strategies Identified by the City of Gladstone"* was removed and replaced with a listing of the action items in Section 5: Mitigation Planning Priority System

Section 2: Community Profile

The Community Profile was updated to reflect the most recent data available. Figure 2.1, "Understanding Risk" was added at the introduction to the community profile. Two tables were outdated and removed, and the following tables and maps were added:

- Tables 2.1 Population Change from 1970 to 2008 and 2.2 Population by Age, 2000;
- City of Gladstone Zoning Map;
- Tables 2.3 Housing Type, 2000 and 2.4 Age of Housing Structures;
- Table 2.5 City of Gladstone Employment by Major Industry, 2000;
- Table 2.6 Transportation Mode Used to Commute to Work, 2000; and
- City of Gladstone Transportation Map.

Additionally, Section 2 of the plan now includes the following sub-sections: historical and cultural resources; government structure; and existing plans and policies.

Section 3: Hazard Assessment

The subsection entitled "Federal Criteria for Hazard Assessment" was removed. The HMAC felt that this section did not add to the plan in any meaningful way.

The HMAC reviewed the list of community assets and added "Red Cross Shelter" designations to the Gladstone Christian Church and Tri-City Baptist Church. Gladstone High School, Kraxberger Middle School and Wetten Elementary School were moved from critical to essential facilities. Danielson's was removed from essential facilities because it no longer exists. The vulnerable populations were organized into senior living, mobile home parks, schools and daycare centers. Gladstone Senior Center, Clackamas Rehabilitation and Specialty Care and YMCA Gladstone were added to vulnerable populations. Riverview Convalescence Center now reads River View Care Center. Economic Assets/Population Centers now has a subheading for apartment complexes. The bowling alley is no longer in business and was removed from the list. The Gladstone High School bioswale was added under environmental assets. Under hazardous materials Cal Spas Fuel now reads Cal Spas Chemical Storage and Classic Pool and Spa. Gladstone Public Works was also added to the list.

Section 4: Natural Hazards

Updated hazard sections now include documentation of hazard events that occurred between 2005 and 2009, including damages and mitigation efforts that resulted. All hazards have new information on history, causes and characteristics, or location. Mitigation efforts were identified for all hazards except volcano. Each hazard section now includes probability and vulnerability estimates as compared to the Clackamas County Natural Hazards Mitigation Plan.

Many of the city's 2005 mitigation strategies have not yet been implemented and are still included in the plan. For all actions that have been deferred, the HMAC has made minor changes if any (i.e., changes to coordinating organization, timeline, or ideas to implementation). Each action now has a 'status of completion' description as well. The following action items were added to the 2009 addendum: ST-MH #4, LT-MH#4, ST-FL #1, ST-FL #2, LT-FL #1, LT-LS #1, LT-SS #1, LT-WF #1, and LT-WF #2.

Six action items were removed from the plan. One action item sought to address repetitively flooded properties. Because Gladstone does not have any repetitively flooded properties, however, this action was removed. One action item addressing burial of power lines was incorporated into another action item to address multiple negative effects of winter storms. The remaining four actions were removed because they focused on preparedness, response, and/or recovery. Since these actions did not seek to mitigate the effects of natural hazards, the HMAC decided to remove them from this plan.

Funding was not available to update the maps used in the 2005 Gladstone Natural Hazards Mitigation Plan. The critical and essential facilities maps do not include the new community assets identified for the 2009 update. Additionally, the FEMA 100 Year Floodplain map has since been modified by Letters of Map Change.

Section 5: Mitigation Planning Priority System

The mitigation planning priority system was changed to reflect the group's desire to review the feasibility of implementing action items during semi-annual meetings. The previous system required the group to rank action items when updating the addendum using hazard priority, plan goals addressed, and criticality of need, large number of population served, and likelihood of success as ranking criteria. The group determined this system was confusing and unlikely to produce an action item ranking that truly reflects the group's intentions. The new system allows the group to evaluate action items based on current conditions and resources.

1.3 Multi-Jurisdictional Planning Effort

The City of Gladstone is dedicated to taking a regional approach to planning for natural hazards since hazards do not abide by jurisdictional boundaries. The City of Gladstone has representation on the Clackamas County Hazard Mitigation Advisory Committee through the Clackamas Local Emergency Managers (CLEM) to ensure that the city's interests are represented in larger scale planning efforts. The city will partner with the county in implementation of appropriate action items, and will work with other jurisdictions to reduce losses from future natural hazards.

1.4 What is the Plan Mission?

The City of Gladstone concurs with the mission statement developed during the Clackamas County planning process:

The mission of the Clackamas County Natural Hazards Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the county towards building a safer, more sustainable community.

1.5 What are the Plan Goals?

The City of Gladstone concurs with the goals developed during the Clackamas County planning process:

The plan goals describe the overall direction that Clackamas County agencies, organizations, and citizens can take to work towards mitigating risk from natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items.

Protect Life and Property

- Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to losses from natural hazards.
- Reduce losses and repetitive damages for chronic hazard events while promoting insurance coverage for catastrophic hazards.

- Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

Promote Public Awareness

- Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
- Provide information on tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.

Enhance Natural Systems

- Balance watershed planning, natural resource management, and land use planning with natural hazard mitigation to protect life, property, and the environment.
- Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.

Encourage Partnerships and Implementation

- Strengthen communication and coordinate participation among and within public agencies, citizens, non-profit organizations, business, and industry to gain a vested interest in implementation.
- Encourage leadership within public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities.

Augment Emergency Services

- Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.
- Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
- Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

1.6 How Will the Plan be Implemented, Monitored, and Evaluated?

The plan maintenance process includes a schedule for implementing, monitoring, evaluating, and reviewing this plan addendum. It is essential to have this process to ensure plan sustainability.

Plan Adoption

The Gladstone City Council will be responsible for adopting the multi-jurisdictional Clackamas County Natural Hazards Mitigation Plan and the City of Gladstone Addendum. This governing body has the authority to promote sound public policy regarding natural hazards.

Coordinating Body

The Gladstone Hazard Mitigation Advisory Committee (HMAC) will serve as the coordinating body for Gladstone's Natural Hazards Mitigation Plan. Roles and responsibilities of the coordinating body include:

- Serving as the local evaluation committee for funding programs such as the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and Flood Mitigation Assistance program;
- Prioritizing and recommending funding for natural hazard risk reduction projects;
- Encouraging stakeholders and relevant hazard mitigation organizations and agencies to implement and/or report on implementation of the plan's identified action items;
- Evaluating and updating the Natural Hazards Mitigation Plan following a disaster;
- Evaluating and updating the Natural Hazards Mitigation Plan in accordance with the prescribed maintenance schedule; and
- Developing and coordinating ad hoc and/or standing subcommittees. The EMC will engage relevant organizations, agencies, and/or neighboring communities as technical advisers in hazard mitigation as needed.

Convener

The Gladstone Police Chief will serve as the plan's convener. Roles and responsibilities of the convener include:

- Coordinating natural hazards mitigation plan meeting dates, times, locations, agendas, and member notification;
- Facilitating and documenting semi-annual natural hazards mitigation plan meetings;
- Assigning representatives to the coordinating body from appropriate city committees, including but not limited to the current HMAC and community representatives, as needed;
- Serving as a communication conduit between the coordinating body and the public and/or key plan stakeholders;
- Identifying emergency management-related funding sources for natural hazard mitigation projects;
- Facilitating the incorporation, maintenance, and update of the city's natural hazard risk GIS data elements;
- Utilizing the risk assessments as a tool for prioritizing proposed natural hazard risk reduction projects; and
- Facilitating and documenting the plan's five-year update.

Implementation through Existing Programs

The City of Gladstone addresses statewide planning goals and legislative requirements through its Comprehensive Land Use Plan, Capital Improvement Plans, and Building Codes. The Natural Hazard Mitigation Plan provides a series of recommendations that are closely related to the goals and objectives of these existing planning programs. The

City of Gladstone will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

Formal Review Process

Plan maintenance is a critical component of the natural hazards mitigation plan addendum. Proper maintenance of the plan ensures that this plan will maximize the city's efforts to reduce the risks posed by natural hazards. This section includes a process to ensure that regular review and update of the plan occurs. The HMAC and local staff are responsible for implementing this process.

Semi-Annual Meetings

The HMAC will meet on a semi-annual basis to review, implement and update information in the addendum. Additional meetings may be scheduled when necessary. During the first meeting, the HMAC will:

- Discuss funding opportunities for the implementation of mitigation strategies;
- Review existing action items to determine appropriateness for funding;
- Educate and train new members on the plan and mitigation in general; and
- Identify issues that may not have been identified when the plan was developed.

During the second meeting of the year, the HMAC will:

- Review existing and new risk assessment data, and incorporate this information into the plan;
- Document success in implementing mitigation actions and/or applying for funding;
- Discuss the addition and/or subtraction of mitigation actions from the plan;
- Discuss methods for continued public involvement;
- Document successes and lessons learned during the year; and
- Generate a list of members that should be included in future meetings.

The Gladstone Police Chief will be responsible for organizing, facilitating, and documenting the outcomes of semi-annual meetings.

Five-Year Review of Plan

Local mitigation plans must be updated and resubmitted to the Federal Emergency Management Agency (FEMA) for approval every five years in order to maintain eligibility for federal hazard mitigation assistance programs. Plan updates must demonstrate that progress has been made in the past five years for local mitigation plans to fulfill commitments outlined in the previously approved plan.

This plan will be updated every five years in accordance with the Disaster Mitigation Act of 2000. Because this is an addendum to the Clackamas County Natural Hazards Mitigation Plan, the addendum must be updated in conjunction with the county's five-year plan update schedule. As such, Gladstone must update this addendum by September 2012 (and then again five years thereafter). Sufficient time should be allotted for plan update activities and FEMA review, meaning the city should begin the plan update process by September 2011. Additional time will be needed if the city intends to pursue

application for mitigation planning grants, and/or contracting for technical or professional services.

During the five-year plan update process, the city must review and revise its plan to reflect changes in development, progress in mitigation efforts, and changes in priorities. The following questions should help the HMAC in determining how the mitigation plan should be updated (i.e., questions must be addressed in the plan update):

- Have public involvement activities taken place since the plan was adopted?
- Are the plan goals still relevant?
- Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?
- Are there new hazards that should be addressed?
- Have there been hazard events in the community since the plan was adopted?
- Have new studies or previous events identified changes in any hazard's location or extent?
- Has vulnerability to any hazard changed?
- Have development patterns changed? Is there more development in hazard prone areas?
- Do future annexations include hazard prone areas?
- Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?
- Are there new high risk populations?
- Did the plan document and/or address National Flood Insurance Program repetitive loss properties?
- Is there an action dealing with continued compliance with the National Flood Insurance Program?
- Did the plan identify data limitations?
- Did the plan identify potential dollar losses for vulnerable structures?
- What is the status of each mitigation action?
- Are there completed mitigation actions that have decreased overall vulnerability?
- Are there new actions that should be added?
- Are changes to the action item prioritization, implementation, and/or administration processes needed?
- Do changes need to be made within the five year update schedule?

The Gladstone Police Chief will be responsible for organizing the HMAC to address plan update needs. The HMAC will be responsible for updating any deficiencies found in the plan, and for ultimately meeting the Disaster Mitigation Act of 2000's plan update requirements.

Continued Public Involvement

The City of Gladstone is dedicated to involving the public in the review and ongoing development of the Natural Hazards Mitigation Plan. During the addendum development process, OPDR's website (www.OregonShowcase.org) served as an outreach tool to the community. OPDR's website was used to provide local contact information and updates

on the planning process. Additionally, drafts of Gladstone's addendum were posted on OPDR's website to facilitate HMAC review. Once the HMAC created a final draft of the addendum a press release was posted on the city's website to ask for public comment on the addendum. The public could link to a draft of the plan to review and provide comments to the city for incorporation into the final addendum. No comments were received.

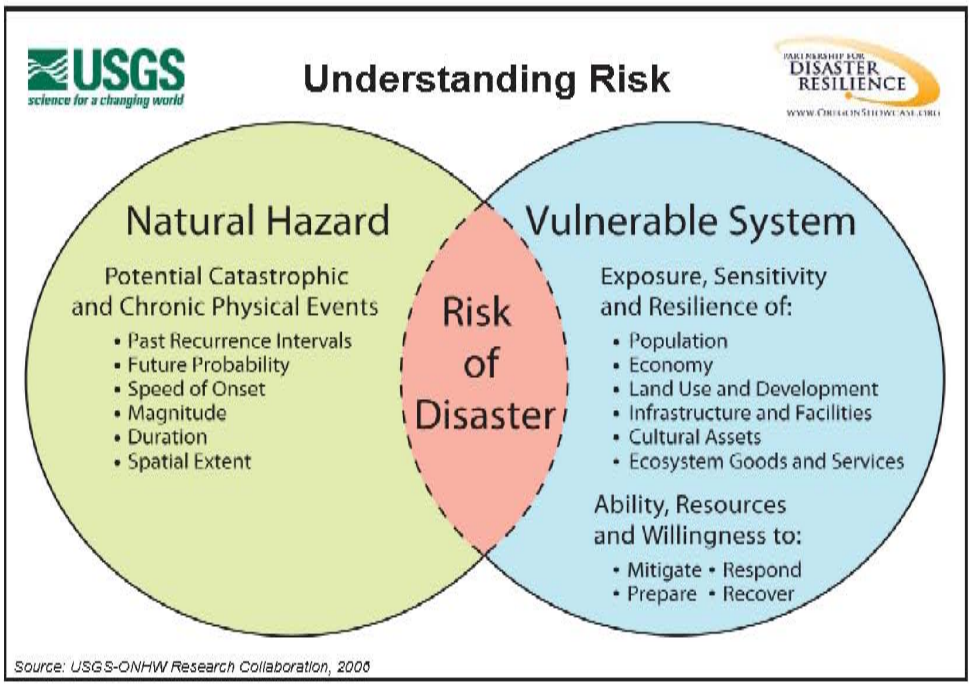
The City of Gladstone will ensure continued public input and involvement over the next five years. The public will have the opportunity to provide feedback about the plan though a variety of forums. Copies of the Plan will be catalogued and kept at all of the appropriate agencies in the city including the Public Works Department, the City Manager's Office, the Planning Commission, the Gladstone Fire Department, and the Gladstone Police Department. In addition, a copy of the plan and any proposed changes will be posted on the city's website. This site will also contain an email address and phone number to which people can direct their comments and concerns. An article in the Gladstone City Newsletter will inform citizens of the plan's adoption and locations for viewing.

Public meetings regarding plan content will be held when deemed necessary by the HMAC. The meetings can provide the public a forum through which Gladstone residents may express concerns, opinions, or ideas about the plan. The HMAC, or designated subcommittee, will be responsible for using city resources to publicize public meetings and maintain public involvement through the public access channel, webpage, newspapers, and local active citizen groups like the Gladstone Vision Group.

Section 2:
Community Profile

The following section describes the City of Gladstone from a number of perspectives in order to help define and understand the city's sensitivity and resilience to natural hazards. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs). The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the city when the plan was developed. The information documented below, along with the hazard assessments located in Section 4: Natural Hazards should be used as the local level rationale for the city's mitigation strategies. The identification of actions that reduce the city's sensitivity and increase its resilience assist in reducing overall risk, or the area of overlap in Figure 2.1 below.

Figure 2.1 Understanding Risk[i]



2.1 Geography and the Environment

Located about 12 miles south of Portland, the City of Gladstone encompasses an area of about 2.5 square miles (1,285.45 acres) and is located at the confluence of the Willamette and Clackamas Rivers in northwestern Clackamas County. Adjacent to Gladstone are the larger suburban communities of Milwaukie, Oregon City, and West Linn. The city is bounded by the Willamette River to the west, and the Clackamas River to the south and east. No additional significant tributaries flow within the city's boundaries.

The topography of Gladstone is mostly flat, although some hilly areas and rises in elevation are located in its northern area. The city's highest elevations are between 300-330 feet, while elevations along the shores of the Clackamas and Willamette Rivers are about 30 feet. Gladstone experiences a moderate climate, with average high temperatures ranging from 82 degrees in the summer to 47 degrees in the winter. Average low temperatures range from 55 degrees in August to 35 degrees in January. The city's winters are mild and wet, with an average annual precipitation of 46.3 inches. [ii] The majority of precipitation occurs between October and May, while summers are warm and dry.

2.2 Population and Demographics

Gladstone has remained a small community since it was settled in 1843 and has grown steadily over the past 170 years. In 2008, Gladstone's population was estimated to be 1,215, an increase of 6.8 % since 2000 (see Table 2.1 below).

Table 2.1 Population Change from 1970 to 2008

Year	Gladstone	Percent Change	Clackamas County	Percent Change	Oregon	Percent Change
1970			166,088		2,091,533	
1980			241,919	45.7%	2,633,105	25.9%
1990			278,850	15.3%	2,842,321	7.9%
2000	11,438		338,391	21.4%	3,421,399	20.4%
2008 Estimate	**12,215**	**6.8%**	**376,660**	**11.3%**	**3,791,075**	**10.8%**

Source: PSU Population Research Center, "Population Estimate for Oregon and Its Counties and Incorporated Cities: April 1, 1990- July 1, 2008, US Census

Disaster impacts (in terms of loss and the ability to recover) vary among population groups following a disaster. Historically, 80% of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon special needs groups, particularly children, the elderly, the disabled, minorities, and low income persons. Portions of Gladstone's residents fall into these special needs groups. In 2000, over 16% of the total population was disabled.[iii] Additionally, 11.5% of the city's population, or 1,313 people, were 65 years or older (see Table 2.2 below). Elderly individuals may require special consideration due to their sensitivities to heat and cold, and their comparative difficulty in making home modifications that reduce risk to hazards.

Table 2.2 Population by Age, 2000

Age Range	Total Persons	% of Total Population
Under 5	764	6.7%
5 to 19	2,615	22.9%
20 to 44	4,074	35.6%
45 to 64	2,672	23.4%
65 and over	1,313	11.5%
Total	**11,438**	**100.0%**

Source: US Census Bureau, "Age Groups and Sex: 2000"

2.3 Land Use and Development

As described in the city's Comprehensive Plan dated April 1979 and updated in July of 1995, the history of the City of Gladstone dates back to the 1840s, when early homesteads in Gladstone were granted by President Lincoln through donation land claims. By the early 1900s, Gladstone had become a quiet, small well-kept community, south of the big city of Portland, with a few local stores that served families who worked in the mills of Oregon City and West Linn. By 1920, the population of Gladstone had grown to 1,069, a figure that more than doubled by 1950, and in 1977, the population of Gladstone stood at 8,985. Residential development in Gladstone and the surrounding areas south of Portland was supported and encouraged in the 1960s by the growth of sewer, water, and fire service districts.

The City of Gladstone today is a mature community that is almost entirely built out, with very few vacant parcels remaining for any type of new development. What little new residential development will occur in the future will be by way of dispersed infill on the scarce and scattered vacant lots, according to the city's Periodic Review Evaluation, prepared for the state in 1997.

As new development has occurred further from the Portland core area, Gladstone has become a close, older suburb where single-family building lots are becoming more scarce and expensive, while the existing housing stock grows older. Most of the area within the original city limits was platted in 1892 and 1893, recognizable today through the grid street system and typical 50-foot by 100-foot lots, according to the Comprehensive Plan.

For purposes of urban development, growth management and other planning and development factors, Gladstone is considered one of 25 cities that comprise the Portland metropolitan area that are governed by a regional planning authority known as Metro. Metro requires cities under its jurisdiction to meet planning criteria through the year 2040 through its Regional Functional Plan. However, unlike many other cities within the Portland metropolitan area, Gladstone is not facing insurmountable pressures from growth and development.

Over the last 30 or so years, the city has not changed dramatically in either its character or its role as a small, stable suburb on the southern outskirts of Portland. In the 1997 report to the state, the city noted that it can accommodate, under its existing Zoning

Ordinance and available land, an adequate number of new dwelling units to meet regional growth projections for the city by the year 2040, as required by Metro. The city concluded that public facilities, utilities and transportation systems were adequate to accommodate anticipated housing development and population growth, and noted that a number of surface water management improvements had been undertaken by the city and private developers to reduce or eliminate damage from surface water flooding. The city concluded that Gladstone is largely a fully developed community with an established street network, in which little new major construction is anticipated.

The new construction that is likely to occur will consist of infill, conversion and small subdivisions. The majority of Gladstone is currently zoned for Single-Family Residential uses. There are four areas of concentrated Commercial zoning in the southern part of the city. A section of Portland Avenue is zoned Local Commercial. General Commercial is concentrated on McLoughlin Boulevard and additional General Commercial is clustered at the intersection of Oatfield and Webster Roads in the southeast part of town. Additionally, a section adjacent to Interstate 205 is primarily zoned for General Commercial uses. For more information regarding the city's land use designations, please see the city's zoning map on page 15 below.

City of Gladstone
ZONING

- Local Commercial - C1
- Community Commercial - C2
- General Commercial - C3
- Light Industrial- LI
- Multi-Family Residential - MR
- Office Park - OP
- Open Space - OS
- Single-Family Residential - R-7.2
- Single-Family Residential - R-5

- City Limits
- Urban Growth Boundary
- Parcels
- Paper Streets
- Railroad
- Rivers

0' 1800' 3600' 7200' 10800'

Tax lot parcels are maintained by the Department of Assessment and Taxation. Zoning, Comprehensive Plan, and streets by County staff. Urban Growth Boundary, city limits, and district boundaries from Metro.

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

2.4 Housing

Housing type and age are important factors in mitigation planning. Certain housing types tend to be less disaster resistant and warrant special attention: mobile homes, for example, are generally more prone to wind and water damage than standard stick-built homes. Generally the older the home is, the greater the risk of damage from natural disasters. This is because stricter building codes have been developed following improved scientific understanding of plate tectonics and earthquake risk. For example, structures built after the late 1960s in the Northwest and California use earthquake resistant designs and construction techniques. In addition, FEMA began assisting communities with floodplain mapping during the 1970s, and communities developed ordinances that required homes in the floodplain to be elevated to one foot above Base Flood Elevation.

In 2000, Gladstone had 4,246 housing units. Of those, 65% (2,741 units) were owner-occupied and 35% (1,505 units) were renter-occupied.[iv] In addition, 84% of the homes in Gladstone are single-family housing units. Mobile homes represent 7% of Gladstone's housing units (see Table 2.3 below).

Table 2.3 Housing by Type, 2000

Housing Type	Total Structures	% of Structures
Single-Family Unit	2927	84.2%
Mobile home	253	7.3%
Duplex	169	4.9%
Multi-Family 3 to 4 units	126	3.6%
Boat, RV, van, etc.	0	0.0%
Total	3,475	100.0%

Source: US Census Bureau, "Units in Structure, Householder 65 Years and Over, and Householder Below Poverty Level: 2000"

Gladstone also has a large number of older housing structures that may be vulnerable to earthquakes. Roughly 85% of all housing units were built before 1980 when more stringent seismic codes were put into place (see Table 2.4 below).

Table 2.4 Age of Housing Structures

Year structure built	Number of Structures	Percent of Structures
1990 to March 2000	214	7.8%
1980 to 1989	199	7.3%
1970 to 1979	1,032	37.8%
1960 to 1969	349	12.8%
1950 to 1959	356	13.0%
1940 to 1949	176	6.4%
1939 and earlier	406	14.9%
Median	**1,971**	**100.0%**

Source: US Census Bureau, "Year Structure Built and Year Householder Moved Into Unit: 2000"

2.5 Employment and Economics

According to the Comprehensive Plan, the great majority of the city's work force is employed outside of the city, in Portland, Oregon City or Milwaukie, and in the employment sectors of manufacturing, retail / wholesale, education, construction and health care services. Gladstone's major employment sectors include office and administrative support occupations; sales and related occupations; and professional and related occupations (see Table 2.5 below). The 2000 census lists the median annual income for the city at $46,368.

Table 2.5 City of Gladstone Employment by Major Industry, 2000

Industry	Total Persons Employed	% of Population
Office and administrative support occupations	1,047	19.1%
Sales and related occupations	779	14.2%
Professional and related occupations	751	13.7%
Management, business, and financial operations and occupations	552	10.0%
Production occupations	536	9.8%
Transportation and material moving occupations	508	9.2%
Construction and extraction occupations	364	6.6%
Installation, maintenance, and repair occupations	257	4.7%
Food preparation and serving related occupations	198	3.6%
Personal care and service occupations	163	3.0%
Building and grounds cleaning and maintenance occupations	146	2.7%
Protective service occupations	105	1.9%
Healthcare support occupations	88	1.6%
Farming, fishing, and forestry occupations	0	0.0%
Civilian employed population 16 years and over	**5,494**	**100.0%**

Source: US Census Bureau, "Occupation by Sex: 2000"

The top five employers in Gladstone include: Gladstone School District, Thomason Ford Company, Thomason Toyota, McCafferty-Whittle Construction, and Stein Oil Inc.[v]

Three distinct areas of commercial development have emerged since the 1960s that are able to thrive without substantial support from the city because of their advantageous locations, according to the Comprehensive Plan. These areas are as follows:

1) The stretch of Highway 99E that bisects the southwestern corner of the city — an approximately 43-acre strip development, which is mostly zoned General Commercial, with a small portion of Light Industrial, that capitalizes on the large volumes of traffic and is dominated by auto-related businesses;
2) The commercially developed Portland Avenue that runs north-south and divides the city roughly in half — the old and well-established downtown core that reflects the charm, character and real personality of the city, most of whose buildings were constructed in the 1920s; and

3) The commercially zoned area that represents the interface between I-205 and SE 82nd Drive, along the eastern fringe of the city — historically developed with residential uses, but recently the area that has witnessed the most expansion of commercial development.

Each of these three commercial / industrial districts serves a different market and has its own distinct character. Consequently, each also exhibits its own opportunities, constraints and problems that the city will need to address as it plans for the future.

2.6 Transportation and Commuting Patterns

The state highway 99E, or McLoughlin Boulevard, runs north-south through the southwestern corner of Gladstone, and connects the city to Portland and Oregon City. Interstate 205 also runs north-south along the eastern edge of the city, and connects Gladstone to communities north and south of Portland. The majority of Gladstone lies west of I-205, although a small portion sits to the east between I-205 and the north bank of the Clackamas River. State Highway 212 / 224, which runs both east and west of I-205, can be accessed just north of Gladstone by driving about one mile north on I-205. The Union Pacific Railroad main line, which travels northwest to southeast, crosses through Gladstone east of I-205 and west of the Clackamas River. The train carries both passengers and freight. Please see Gladstone's transportation map on page 20 below for a greater understanding of transportation routes throughout the city.

Transportation is an important consideration when planning for emergency service provisions. Growth within the city will put pressure on the major and minor roads, especially if the main mode of travel is by single occupancy vehicles. How people travel to work is indicative of the prevalence of single occupancy vehicle travel, and can help predict the amount of traffic congestion and the potential for accidents. The majority of Gladstone's working population, 78.8%, travels in single occupancy vehicles to work (see Table 2.6 below).

Table 2.6 Transportation Mode Used to Commute to Work, 2000

Mode of Commute	Number of Commuters	% of Commuters
Car, truck, or van -- drove alone	4286	78.8%
Car, truck, or van -- carpooled	570	10.5%
Public transportation (including taxicab)	234	4.3%
Worked at home	206	3.8%
Walked	112	2.1%
Bicycle	30	0.6%
Other means	4	0.1%
Motorcycle	0	0.0%
Total	**5442**	**100.0%**

Source: US Census Bureau, "Journey to Work: 2000"

The average commute time for Gladstone residents is 22.9 minutes.[vi] Starting in September 2009, the Tri-County Metropolitan Transportation District of Oregon (TriMet) is opening a new light-rail line in Milwaukie. Milwaukie is six miles northwest of

Gladstone, and the new TriMet line will give Gladstone residents access to Portland via public transportation.[vii]

LEGEND

FUNCTIONAL CLASSIFICATION

STATE HWY	OTHER JURISDICTION	
		INTERSTATE
		PRINCIPAL ARTERIAL
		MINOR ARTERIAL
		URBAN COLLECTOR/ RURAL MAJOR COLLECTOR
		MINOR COLLECTOR
		LOCAL ROAD

FOR FURTHER FUNCTIONAL CLASSIFICATION INFORMATION, CONTACT ODOT REGION OFFICE.

- ORE. ROUTE - US. ROUTE - INTERSTATE ROUTE
- NATIONAL HIGHWAY SYSTEM ROUTE
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- AMTRAK RAIL PASSENGER STATION
- GRAVEL PIT - QUARRY - ODOT STOCKPILE
- PUBLIC BUILDING
- COURTHOUSE
- HOSPITAL
- CITY HALL
- ARMORY
- POST OFFICE
- SCHOOL
- LIBRARY
- SAFETY REST AREA
- WEIGH STATION
- PARK & RIDE LOCATION
- INTERCITY - CITY TRANSIT
- COMMERCIAL - GENERAL AVIATION
- AMTRAK STOP - PORT FACILITY

Published by

ODOT GIS

NORTH

PREPARED DIGITALLY BY THE OREGON DEPARTMENT OF TRANSPORTATION IN COOPERATION WITH THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

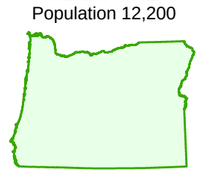
"This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information."

SCALE

0 300 600 1,200 1,800 Feet

0 200 400 800 1,200 Meters

GLADSTONE
Population 12,200



T. 2 S. R. 1-2 E. W.M.

OREGON TRANSPORTATION MAP

Showing Functional Classification of Roads
City of

GLADSTONE

PARK & RIDE · INTERBUS · AMTRAK

CLACKAMAS COUNTY
2008

PORT · AIRPORT · COMM. AIR

AVAILABLE TRANSPORTATION SERVICES SHOWN WITH YELLOW BACKGROUND

AVAILABLE TRANSPORTATION SERVICES SHOWN WITH YELLOW BACKGROUND

Copies Available from the Oregon Department of Transportation, Geographic Information Services Unit, Mill Creek Office Building, 555 13th St. NE, Salem, Oregon 97301, (503) 986-3154, http://www.oregon.gov/ODOT/TD/TDATA/gis/odotmaps.shtml
Population numbers are based on current Oregon Population Report, College of Urban and Public Affairs, Portland State University, http://pdx.edu/prc

2.7 Historic and Cultural Resources

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources of tourism dollars. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Gladstone is the home of the third largest permanent Chautauqua (1895-1927) in the United States.[viii] Each July, there is a large celebration of the venue and its unique history. The Pow Wow Tree, an important landmark in town, marked the entrance to the first Clackamas County Fair in 1860 as well as the Oregon State Fair in 1861 is a local tourist attraction. There are no buildings or sites on the National Registry of Historic Places but the historic Cason-Cross House (built 1850, estimated) is located in town.

There is a strong sense of community in Gladstone. Each summer, Gladstone celebrates its history during the three day Chautauqua Festival. Additionally, there is a series of summer events in Patterson Park. Finally, the local business alliance manages an on-going list of smaller, special interest community groups and meetings.

2.8 Government Structure

The City of Gladstone is a municipal government comprised of an elected Mayor and six City Councilors each serving four year terms. The city administers a number of departments including zoning, police, fire, and public works.

The public works department, in addition to maintaining streets, water, sewer, and parks, offers sand bags to residents during flood events. The city also maintains the water supply and the wastewater treatment system.

Additionally, the City of Gladstone administers a Volunteer Emergency Management Program. The program realizes that Gladstone has limited personnel and equipment resources for a sustained medium to large scale natural or human caused emergency.

2.9 Existing Plans and Policies

Communities in Oregon are required to have plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs. [ix]

The City of Gladstone's Natural Hazards Mitigation Plan Addendum includes a range of recommended action items that, when implemented, will reduce the city's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the city's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the plan, and increases their likelihood of being supported and getting updated, and maximizes the city's resources.

The following is a list of plans and policies currently in place in Gladstone.

Plan: City of Gladstone Comprehensive Plan
Date of Last Revision: August 2008
Author/Owner: Clackamas County, City of Gladstone
Description: Establishes the city's authority to plan for and deal with issues related to the future development of Gladstone.
Relation to Natural Hazard Mitigation:

- Provides policy guidelines for future development and land use in the city.

Plan: City of Gladstone Municipal Code
Date of Last Revision: August 2008
Author/Owner: Clackamas County, City of Gladstone
Description: The purpose of the Municipal Code is to set minimum regulations on land use, development and construction activities within the city.
Relation to Natural Hazard Mitigation:

- Policies and implementation actions addressing natural hazards and Goal 7 in the Comprehensive Plan can be linked with natural hazard action items.
  The Flood Management Area District (Chapter 17.29) is intended to promote public health, safety, and well being. Additionally, the District seeks to minimize potential losses in the event of a flood. Flood management areas are identified by the Federal Insurance Administration in the scientific and engineering report entitled, "Flood Insurance Study, Clackamas County, Oregon and Incorporated Areas."[x]

Plan: Clackamas County: Tri-City Water Pollution Control Plant Site Master Plan
Date of Last Revision: 2002
Author/Owner: Water Environment Services, CH2MHill, Greenworks, Miller Hull; Tri-City Service District
Description: The purpose of the Water Pollution Control Plant Site Master Plan is to reintroduce past heritage while protecting human health and improving water quality for the Tri-City Area.
Relation to Natural Hazard Mitigation:

- Conforms to Gladstone land use regulations that require a 200 foot buffer from the 2 year high water mark of the Clackamas River and not building in the 100 year floodplain.[xi]

Section 3:
Hazard Assessment

3.1 What is a Hazard Assessment?

Conducting a hazard assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Hazard assessments are subject to the availability of hazard-specific data. The City of Gladstone conducted a risk assessment for all of the hazards for which data was available. The three levels of a risk assessment are as follows:

1) ***Hazard Identification*** identifies the geographic extent, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Gladstone identified six major hazards that consistently affect this geographic area. These hazards – floods, landslides, wildfires, earthquakes, severe storms: wind and winter, and volcanoes – were identified through an extensive process that utilized input from the Hazard Mitigation Advisory Committee. The geographic extent of each of the hazards was first identified by the City of Gladstone HMAC using the best available data and local knowledge, and is discussed within each hazard section. In 2003 Gladstone partnered with Clackamas County Geographic Information Systems to obtain a more scientifically viable hazard assessment, and the maps resulting from this analysis distributed throughout the plan.

2) ***Vulnerability Assessment/Inventorying Assets*** combines hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard. A detailed description of the vulnerability of these assets is located in the specific hazard sections.

3) ***Risk Analysis/Estimating Potential Losses*** involves estimating the damage, injuries, and financial losses likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are magnitude of the harm that may result and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets. Unfortunately, there is insufficient data for conducting a risk analysis for the natural hazards affecting City of Gladstone. However, this need is identified in action item ST-MH #3, and a complete risk assessment will be conducted when resources are available.

3.2 Hazard Assessment Mapping Methodology

The information used to identify the hazards was derived from digital databases on Clackamas County's Geographic Information System (GIS). Data was obtained Metro, the Department of Geology and Mineral Industries (DOGAMI), and the Federal

Emergency Management Agency (FEMA), and some data was produced in-house by Clackamas County GIS.

3.3 Community Assets and Vulnerability Assessment

This section outlines the resources, facilities and infrastructure that, if damaged, could significantly impact public safety, economic conditions, and the environmental integrity of the City of Gladstone. A description of the exposure of community assets to natural hazards is provided within each hazard section. The community assets were defined as follows:

Critical Facilities & Infrastructure: Those critical facilities and infrastructure necessary for emergency response efforts.

- Fire Station
- Police Station
- Drinking Water Distribution System (3 reservoirs that intertie with Clackamas River Water and Oak Lodge Water; all water lines)
- Bridges
- Transportation Networks
- Public Works
- Surface Water Drainage Infrastructure
- 99E, HWY 205, Rail Road, Oregon City Bridge, 82nd Bridge
- Communications Towers
- NW Natural Pipelines off McLoughlin
- Power substation on Jennings
- Gladstone Christian Church – Red Cross shelter
- Tri-City Baptist – Red Cross shelter

Essential Facilities: Those facilities and infrastructure that supplement response efforts.

- Gladstone High School
- John Wetten Elementary
- Kraxberger Middle School
- Sewer Pump Station & Treatment Facility
- Evergreen Lane
- Oxford Suites
- Safeway
- Gladstone Children and Family Services
- River View Care Center
- Somerset
- Churches: First Baptist Church, Seventh-Day Adventist, St. Stephen Lutheran Church, Assembly of God, Church of Jesus Christ of Latter-Day Saints, Faith & Life Center Free Methodist Church, Church of Christ
- Clackamas Rehab Facility
- Dr. King's Office

Vulnerable Populations: Locations serving populations that have special needs or require special consideration.

- Senior Living
  - Somerset Assisted Living
  - Gladstone Senior Center
  - Clackamas Rehabilitation and Specialty Care (Avamere Rehabilitation of Clackamas)
  - River View Care Center
- Mobile Home Parks
  - Tri-City Mobile Home Park
  - Gladstone Mobile Home Park
- Schools
  - Gladstone High School
  - John Wetten Elementary
  - Kraxberger Middle School
- Daycare Centers
  - St. Stephen's Church Daycare
  - Assembly of God Daycare
  - YMCA Gladstone
- Northwest Behavioral Healthcare Services (Adolescent Residential Treatment)

Economic Assets/ Population Centers: Economic Centers are those businesses that employ large numbers of people, and provide an economic resource to Gladstone. If damaged, the loss of these economic centers could significantly affect economic stability and prosperity. ***Population Centers*** usually are aligned with economic centers, and will be of particular concern for evacuation/notification during a hazard event.

- Apartment Complexes
  - Brook Side
  - River Run
  - River Place
  - Fairway Village
  - Autumn Oaks
  - Tall Oaks
  - River Green
- Oxford Suites
- Budget Inn
- Safeway
- McLoughlin Blvd Corridor
- Portland Ave. Corridor
- 82nd / Arlington Corridor

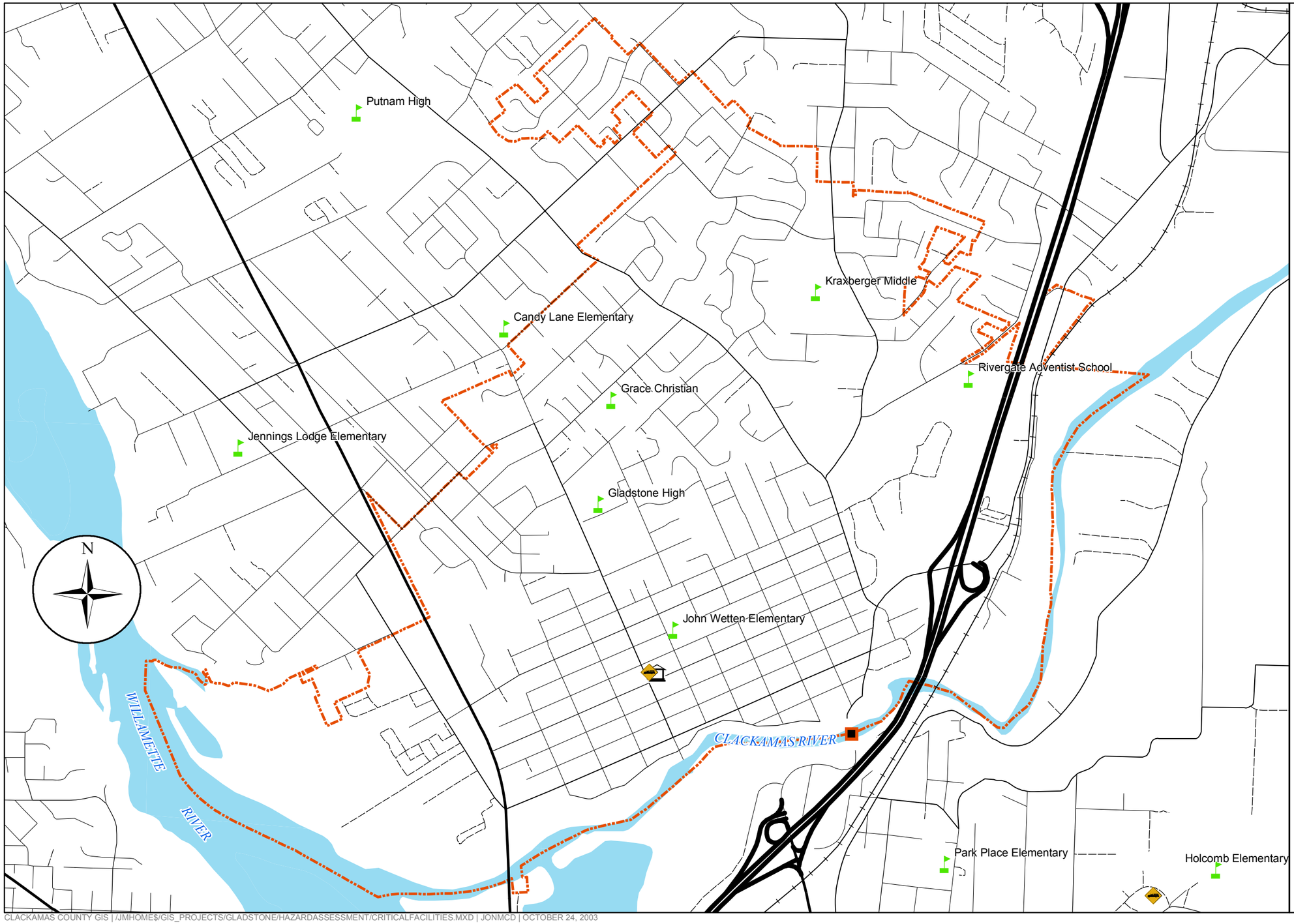
Environmental Assets: Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional service for the community.

- McLoughlin/Risely Wetland
- Glen Echo Wetland
- Detention Ponds
- Willamette and Clackamas Rivers and Riparian Corridors
- Gladstone High School Bioswale

Hazardous Materials: Those sites that store, manufacture, or use potentially hazardous materials.

- Gas Stations
- Cal Spas Chemical Storage
- Classic Pool and Spa
- First Student Bus Barn
- Gladstone Public Works

City of Gladstone Critical Facilities



- Bridges
- City Hall
- Fire Stations
- Schools
- Freeway
- Freeway Ramps
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad
- Major Rivers and Lakes
- Gladstone City Limits

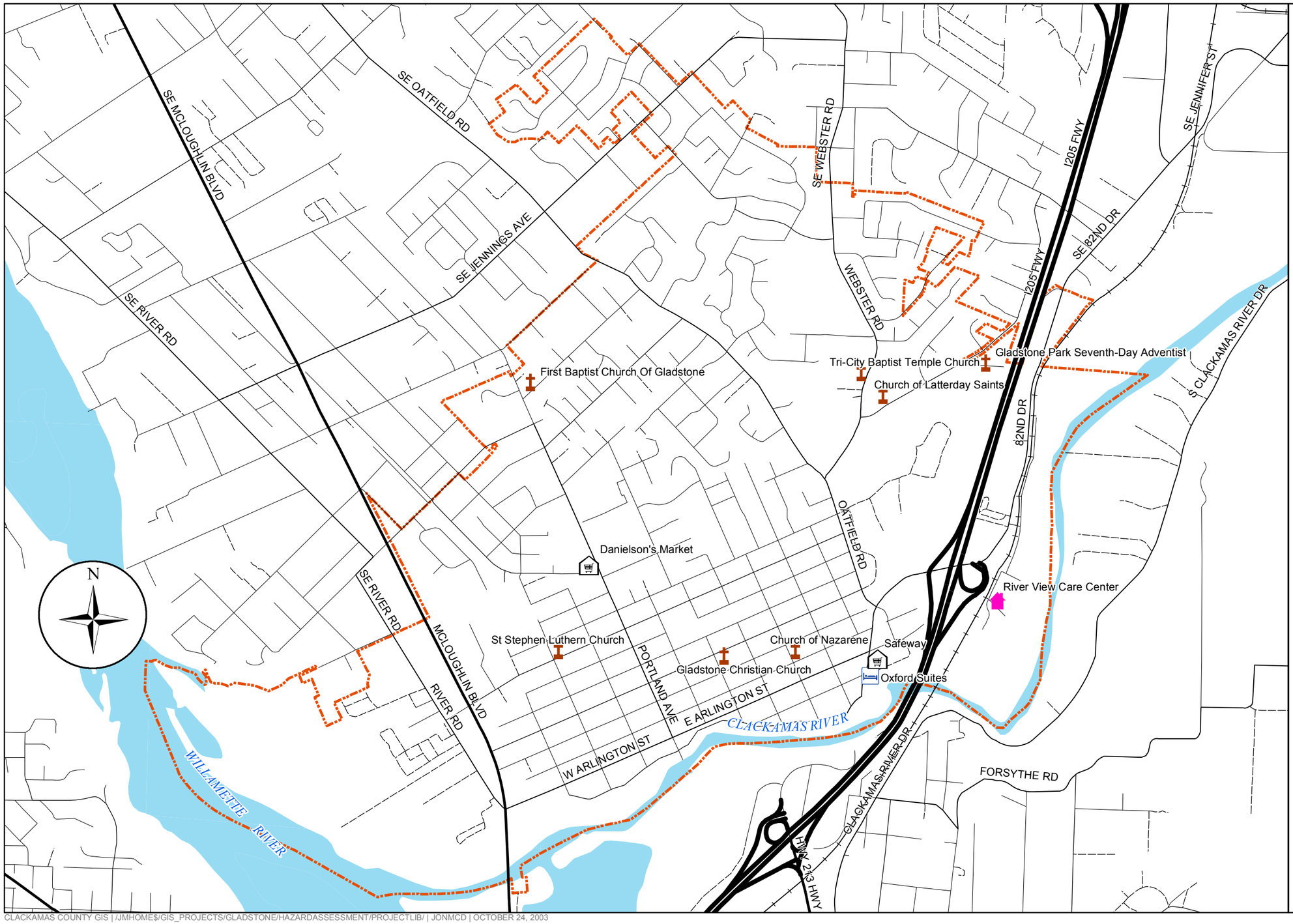
1 inch equals 1,300 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/CRITICALFACILITIES.MXD | JONMCD | OCTOBER 24, 2003



City of Gladstone Essential Facilities

- Hotels and Motels
- Grocery Stores
- Churches
- Health Care Facilities

- Gladstone City Limits
- Major Rivers and Lakes

- Freeway
- Expressway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,300 feet

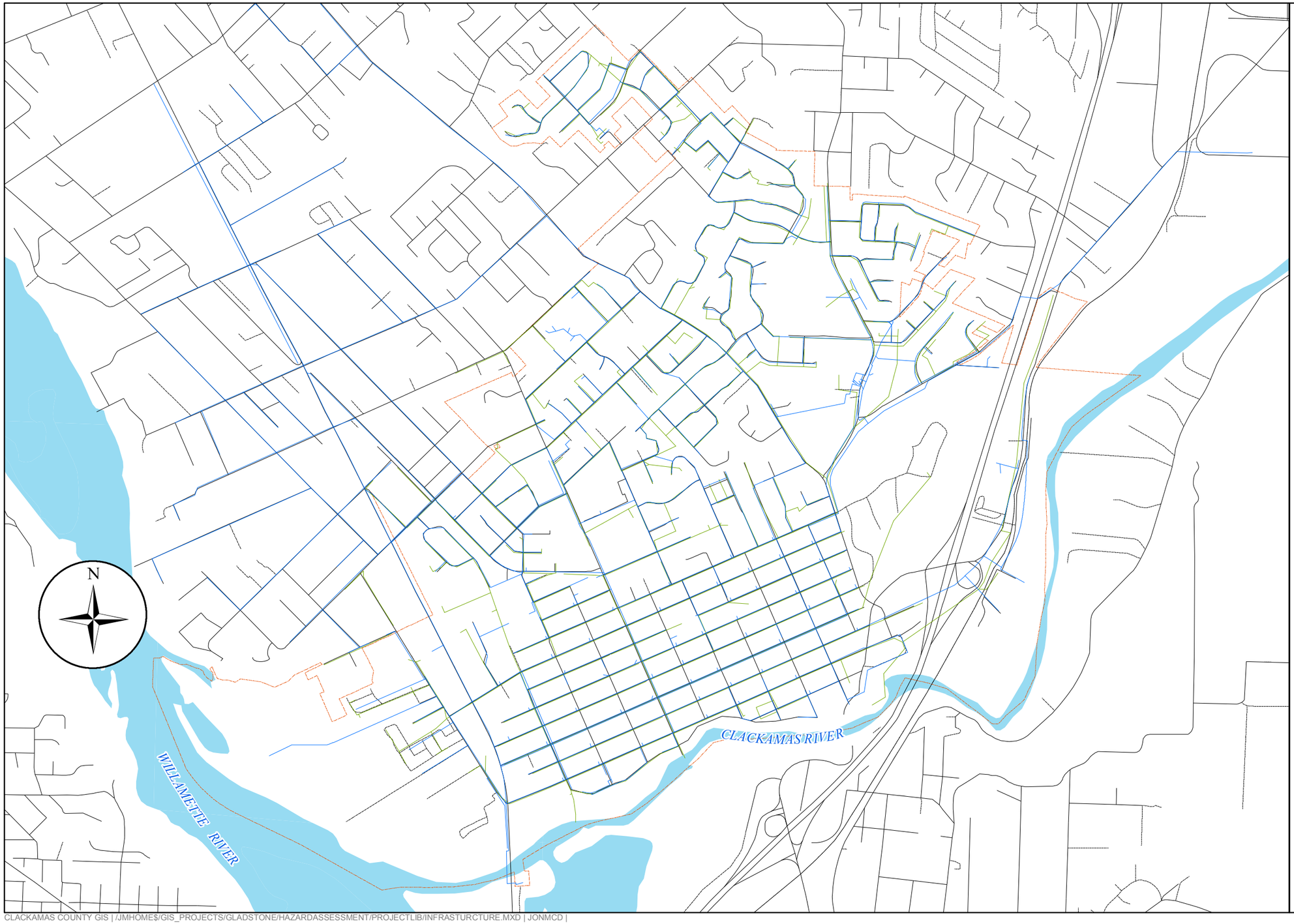
Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/ | JONMCD | OCTOBER 24, 2003

City of Gladstone Infrastructure



Sewer Lines

Water Lines

Gladstone City Limits

Major Rivers and Lakes

Freeway

State Highway

Major Arterial

Local

Private Roads

RailRoad

1 inch equals 1,320 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

Section 4:
Natural Hazards

4.1 Flooding

The Willamette and Clackamas Rivers are both susceptible to annual flooding events in the City of Gladstone. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

Flooding Profile

The causes and characteristics of flooding hazards are adequately described within the Clackamas County Natural Hazards Mitigation Plan. Likewise, historical large-scale flooding events have been described in Section 6 of the Clackamas County Natural Hazards Mitigation Plan, and are applicable to the City of Gladstone as well. The following events require further explanation regarding impacts to the City of Gladstone.

- From December 28, 2005 to January 1, 2006 the Clackamas and Willamette Rivers reached flood stage. The city lost pumping capacity at the sewer pump station, causing back ups in some homes. The city contemplated using portable toilets in these areas but the pump station was fixed quickly enough that this step was not taken. Homes flooded on Edgewater Road and Evergreen Lane. Sandbagging was attempted in these locations but the river overcame the sandbags. Meldrum Bar Park flooded, causing damage to the irrigation pump house, park structures and fields. Floodwaters reached the backside of the bowling alley and flooded the lanes, and reached the North Clackamas County Regional Water Consortium area.
- From December 26, 2008 to January 2, 2009 localized flooding occurred after Clackamas County was hit with the worst winter storm in 40 years. Storm drains were at capacity and caused a sewage backup to occur. Additionally, Portland Avenue flooded. The pump station owned by Oak Lodge Sanitary on Glen Echo also flooded.

Flooding Hazard Assessment

Hazard Identification

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (Map #5) and the 1996 flood inundation map (Map #6) were used to designate the flood prone areas in Gladstone. A 3.5 acre section of the city was removed from the floodplain through a Letter of Map Revision (LOMR) on October 18, 1996. This section is still, however, shown on the Flood Insurance Rate Map as well as within the city's Geographic Information Systems (GIS) data. The area, clearly displayed on Map #5, is an odd-shaped "blob" located on the northwestern edge of the city between Duniway Avenue and Glen Echo Avenue, west of Portland Avenue, and nearly 1 mile north of the Clackamas River. It had been classified as an un-numbered "A" Zone likely as the result of aerial photography taken during the 1964 flood. The area has since been removed by FEMA from the floodplain as a result of the LOMR.

The extent of flooding hazards in Gladstone primarily depends on climate and precipitation levels. Withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow as well. Gladstone is adjacent to the Clackamas and Willamette Rivers, and according to the county's GIS data, roughly 274 acres, or about 21% of the total land within the city, is located within the 100-year floodplain. In addition, the Gladstone HMAC estimates that a larger flooding event (500-year flood) could cause serious damage to the entire City of Gladstone. The city is also quite susceptible to local drainage issues due to surface water management infrastructure that is insufficient for accommodating high flows.

The probability of flooding events in Gladstone was determined using scientific data, historical occurrences, and local knowledge. Gladstone's HMAC estimates the probability of floods occurring is 'high,' meaning one major flooding event is likely to occur within a 10 year period. This estimate is the same as the county's 'high' probability estimate.

Vulnerability Assessment

Gladstone's HMAC estimates the city's vulnerability to flooding to be 'high,' meaning more than 10% of the population and community assets could be affected by a major flood event. This is higher than the county's 'moderate' estimate because in large events more than 10% of the city can be affected, and over 10% of city land is located within the 500-year floodplain.

Roughly 274 of the city's 1305 acres of land are in the 100 year floodplain, or about 21% of land. Insufficient surface water management infrastructure can make the flooding area bigger.

There are no critical facilities in the 100-year floodplain. The only essential facility exposed to the flooding hazard is the River View Care Center. The River View Care Center is an elderly care facility that serves people with special needs. Less than 1 mile of road, sewer, and waterlines are exposed to the 100-year floodplain. These roads include Clackamas Boulevard, Edgewater Road, River Lane, Evergreen Lane, the south end of Rinearson Road, and the south end of Rivergreens Road. Exposed environmental assets include the Rivergreen Golf Course, Dahl Park, and Meldrum Par Park. The only exposed population center is the Rivergreens Apartments.

According to the Gladstone HMAC, a 500-year flooding event could affect almost all of the critical and essential facilities and infrastructure listed in Section 3. This would seriously impact the ability of the city to exercise efficient response and recovery efforts. Many vulnerable populations would also be affected by a 500-year flooding event, including River View Care Center, Gladstone Mobile Home Park, the Tri-City Mobile Home Park, and the Holly View Mobile Home Park. A 500-year event could have devastating effects at these locations because city services would be strained, limiting assistance to these special needs populations. Finally, all of the fuel storage facilities including the city shops, the 76 fuel station, the Chevron Fuel Station, and the Arco Fuel Station would be inundated with water. These facilities could leak fuel and other hazardous materials into the environment.

The floodplain maps on pages 37 and 38 below do not include the 500 year floodplain but Figures 4.1 and 4.2 below do, as indicated by the “zone x” black dotted areas:

Figure 4.1: Gladstone 500 Year Floodplain FIRMette 1

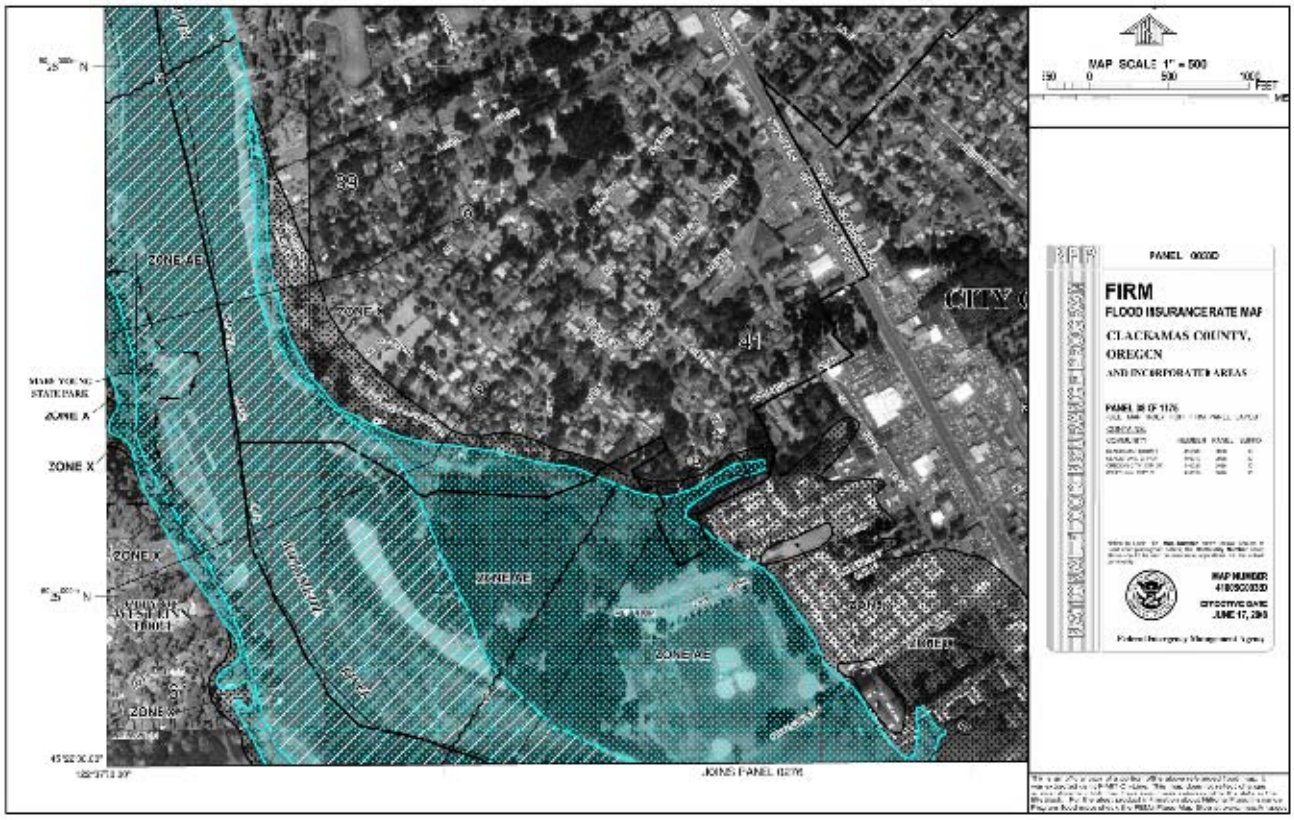
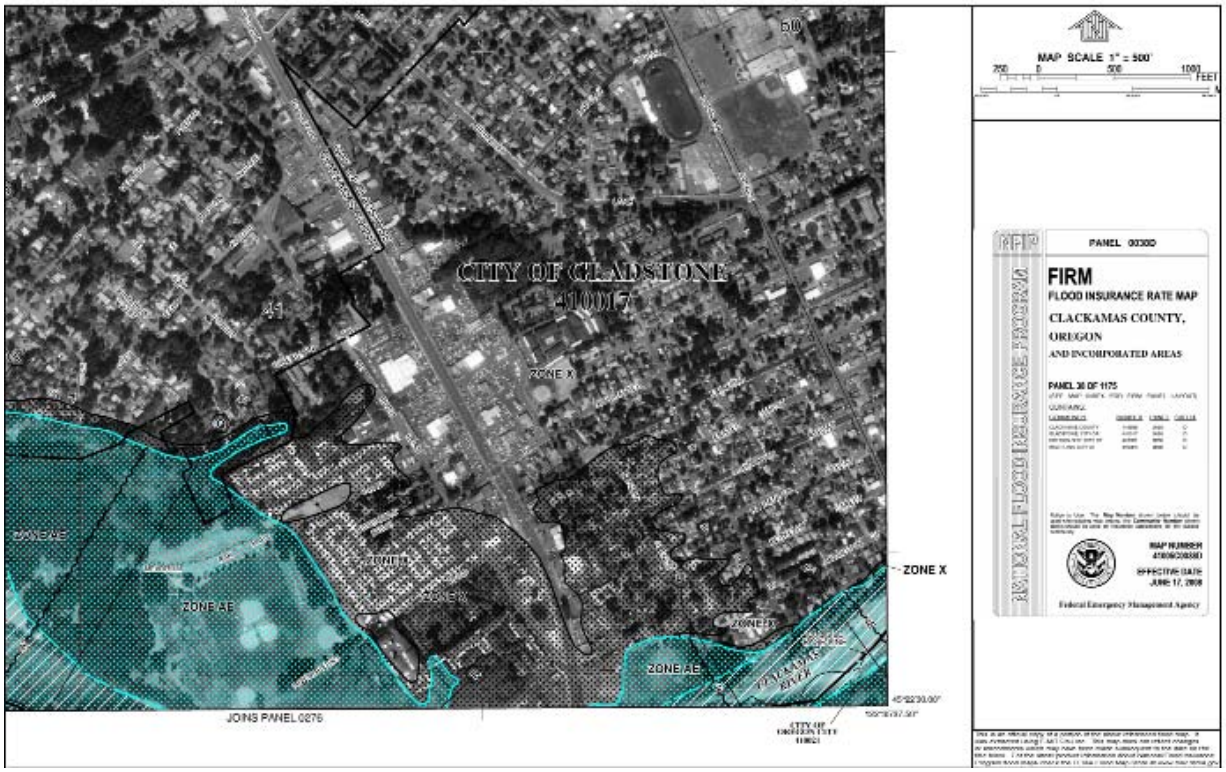


Figure 4.2: Gladstone 500 Year Floodplain FIRMette 2



The city of Gladstone is a regular participant in the National Flood Insurance Program (NFIP) with 51 policies in force at a value of $11,504,900. Gladstone's most recent Community Assistance Visit was March 21, 1994 and the city's most current effective Flood Insurance Rate Map (FIRM) date is June 17th, 2008 (initial FHBM 4/5/1974). At this time 9 losses have been paid at an amount of $137,427.42. Zero substantial damage claims have been made since 1978. No repetitive loss properties are located within Gladstone city limits.

Risk Analysis

Due to insufficient data, Gladstone is unable to perform a quantitative risk analysis at this time. The city has addressed this issue in the action items, and will be completing a risk assessment as data and resources become available.

Existing Flood Mitigation Activities

Flood mitigation activities listed here include current mitigation programs and activities that are being implemented by City of Gladstone agencies or organizations.

City of Gladstone Codes Pertaining to Flooding

Although the City of Gladstone contracts with Clackamas County for planning, zoning, land-use review and building permitting services, the city has adopted local codes pertaining to the flood hazard area to further mitigate losses from flooding, and enhance water quality in natural water sources as well as protect and preserve the riparian areas that serve them.

Gladstone Comprehensive Land Use Plan and Zoning Ordinance:

Chapter 17.27 -- Water Quality Resource Area District

The Water Quality Resource Areas District is comprised of water quality resource areas and is an overlay district. This chapter assists in floodplain restoration by:

a.) Maintaining or reducing stream temperatures
b.) Maintaining stream corridors;
c.) Reducing potential sediment, nutrient and pollutant loading into water;
d.) Providing filtration, infiltration, and natural water purification;
e.) Stabilizing slopes to prevent landslides contributing to sedimentation or damming of water features.

Chapter 17.29—Flood Management Area District

The Flood Management Area (FMA) includes all state and federally identified FMAs, and is an overlay district. The standards that apply to development in the FMA are in addition to state and federal restrictions governing flood management areas, and are designed:

a.) To protect human life and health
b.) To minimize expenditure of public money and costly flood control projects;
c.) To minimize prolonged business interruptions;
d.) To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, and streets and bridges located in areas of special flood hazard;

e.) To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazards so as to minimize future flood blight areas;
f.) To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions; and
g.) To protect Flood Management Areas, which provide the following functions:
   A. Protect life and property from dangers associated with flooding;
   B. Provide flood storage, reduction of flood velocities, reduction of peak flows, and reduction of wind and wave impacts;
   C. Maintain water quality by reducing and sorting sediment loads, processing chemical and organic wastes and reducing nutrients;
   D. Recharge, store and discharge groundwater; and
   E. Provide plant and animal habitat and support riparian ecosystems[xii]

Clackamas County Building Codes

The City of Gladstone contracts with the County Building Code Division to ensure that residential and commercial development are designed using flood-resistant or flood-proofed construction methods, consistent with National Flood Insurance Program (NFIP) standards.

Section R323, *Flood Resistant Construction*, of the Oregon Residential Specialty Code, outlines flood-resistant construction standards and engineering requirements for all phases of residential construction within the floodplain. Chapter 16, *Structural Design*, and Chapter 18, *Soils and Foundations*, of the International Building Code (IBC) outline flood-proofing construction standards and engineering requirements for all phases of commercial construction within the floodplain.

Flood Mitigation Projects

Gladstone Public Works picks up between 2,500 and 3,000 cubic yards of leaves and yard debris between October and January each year to avoid yard debris filling the city's drainage ways. Information is put in the newsletter and online to instruct residents how to properly put out the leaves for pickup. Public Works also teaches a two hour class each year at Gladstone High School to teach students about the functions of city infrastructure and how to maintain its proper functions.

Oak Lodge Sanitary elevated all electronics at their pump station in Glen Echo to avoid them being damaged in flood events. When this pump station fails it leads to flooding at the high school. Elevating electronics above the high water line ensures continued operation of the pump station and reduces the risk of failure.

Flood Mitigation Action Items

The flood mitigation action items provide direction on specific activities that organizations and residents in the City of Gladstone can undertake to reduce risk and prevent loss from flood events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

ST-LF #1: Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.
Ideas for Implementation:

- Community Assistance Visits (CAV) are scheduled visits to communities participating in the NFIP for the purpose of: 1) conducting a comprehensive assessment of the community's floodplain management program; 2) assisting the community and its staff in understanding the NFIP and its requirements; and 3) assisting the community in implementing effective flood loss reduction measures when program deficiencies or violations are discovered. Actively participate with DLCD and FEMA during Community Assistance Visits;
- Conduct an assessment of the floodplain ordinances to ensure they reflect current flood hazards and situations, and meet NFIP requirements;
- Coordinate with the county to ensure that floodplain ordinances and NFIP regulations are maintained and enforced; and
- Mitigate areas that are prone to flooding and/or have the potential to flood. These areas include Clackamas Blvd., Edgewater Road, River Lane, Evergreen Lane, Rivergreen Golf Course, Dahl Park, Meldrum Bar Park, south end of Rivergreens Road (Rivergreens Apartments), complex on River Road south of Rivergreens Apartment, south end of Jensen Road (golf course), bottom of Rinearson Road, and Glen Echo between Addie and Portland Avenue.

Coordinating Organization: City Administrator's Office
Internal Partner: Fire Department, Public Works
External Partner: FEMA, DLCD, Clackamas County Planning Department
Timeline: Short term ongoing
Status: *Added during 2009 update*, yet to be completed

ST-FL #2: Coordinate with Clackamas County to address the flooding issues on Glen Echo that stem from the two-way diversion on Hull Avenue put in by Clackamas County.
Ideas for Implementation

- Hire an engineering firm to conduct a study on areas that have flooded since the two-way diversion was put in, including Glen Echo and Rinearson Road;
- Identify appropriate staff members to present the flooding issues to Clackamas County;
- Develop an Intergovernmental Agreement with Clackamas County; and
- Work with county staff to develop mitigation projects to alleviate the flooding problems.

Coordinating Organization: Public Works
Internal Partner: City Administrator's Office
External Partner: FEMA, DLCD, Clackamas County Planning Department, URS Corporation, Oak Lodge Sanitary
Timeline: Short term
Status: *Added during 2009 update*, yet to be completed

LT-FL #1: Develop a Stormwater Master Plan.
Ideas for Implementation

- Identify appropriate staff members to work on developing a stormwater management plan;

- Research consulting firms that specialize in stormwater management plans;
- Identify funding to create the plan; and
- Identify mitigation action items that reduce the city's vulnerability to flood and landslide related hazards

Coordinating Organization: Public Works
Internal Partner: City Administrator's Office
External Partner: Clackamas County Water Environment Services, Department of Environmental Quality, Metro
Timeline: Long term
Status: *Added during 2009 update*, yet to be completed

City of Gladstone FEMA 100 Year Flood Plain

- Major Rivers and Lakes
- FEMA 100 Year Flood Plain
- 1996 Flood Inundation Line
- Gladstone City Limits

- Freeway
- Freeway Ramps
- Expressway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,300 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/FEMAFIRM | JONMCD | OCTOBER 24, 2002

City of Gladstone 1996 Flood Inundation

- Major Rivers and Lakes
- 1996 Flood
- Gladstone City Limits

- Freeway
- Freeway Ramps
- Expressway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,300 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/FLOOD96 | JONMCD | AUGUST 21, 2002

4.2 Landslide

Landslide Profile

The causes, characteristics, and potential impacts of landslide hazards are adequately described within the Clackamas County Natural Hazards Mitigation Plan. Likewise, historical large-scale landslide events have been described in Section 7 of the Clackamas County Natural Hazards Mitigation Plan, and are applicable to the City of Gladstone as well. Gladstone has no history of landslides, but the city has areas that experience slow ground movement.

Landslide Hazard Assessment

Hazard Identification

The City of Gladstone is primarily flat with few steep slopes located in city limits. Slope data derived from digital elevation models was used to estimate potential landslide hazards, as seen on the map on page 43. Slopes greater than 20% are considered hazardous for the purposes of planning for potential landslides. In order to have a more refined perception of the landslide hazard, slopes greater than 35% are also noted as extremely high hazard. The map below shows that 67 acres, less than 5% of the land area in Gladstone, has slopes greater than 20%.

The location and extent of Gladstone's landslide hazards are also documented within Clackamas County's Natural Hazards Mitigation Plan. The county's plan includes maps for debris flow hazards, slump and earth flows, and percent slope. Landslides may also be generated by the earthquake hazard as soil loses cohesion in a process called liquefaction. This potential landslide hazard is described in more detail and mapped in the earthquake section of this chapter.

The probability of landslide events in Gladstone was determined using scientific data, historical occurrences, and local knowledge. The HMAC estimates that the probability of landslides occurring is 'moderate,' meaning one event is likely within a 35-75 year period. This estimate is lower than the county's 'high' probability rating because Gladstone is more susceptible to slow ground movement rather than landslide events.

Vulnerability Assessment

The Clackamas County GIS department has completed an analysis using the best available data as a component of the vulnerability assessment described in Section 3: Hazard Assessment. Exposure of community assets to natural hazards was determined by manually comparing critical and essential facilities and infrastructure maps with each hazard map, and identifying where assets and hazards intersected. The HMAC estimates the vulnerability of landslides is 'moderate,' meaning between 1% and 10% of the population and assets would be affected by a major landslide event. This is higher than the county's 'low' rating because in a very large landslide event up to 5% of the population could be affected in the Oatfield/Oakridge corridor.

Steep slopes are primarily located along the Willamette and Clackamas Rivers. High Rocks Park, Cross Park, Dahl Park, and Meldrum Park are located along the river banks and are all exposed to steep slopes. The McLoughlin/Risley Wetland, a tributary to the

Willamette River, has small areas of steep slopes. No critical facilities are located in the landslide hazard zone but Oxford Suites and Safeway are located near steep slopes. Tall Oaks Apartment Complex, Arco gas station and Chevron gas station on East Berkeley are also located near steep slopes. The infrastructure identified as vulnerable by the HMAC include water lines, gas lines, and the cable lines (along the city blocks) that could be seriously damaged by sliding slopes. Damage to infrastructure can cause power outages and reduce efficiency of response and recovery efforts throughout the city.

The HMAC believes the biggest landslide threat is located in the residential Oatfield/Oakridge corridor. This area has a number of steep slopes and slow ground movement. A home on Oakridge Drive slowly slid over the years and was eventually removed from the property. Ground movement is also common on Parkway and Caldwell, as a number of homeowners on these streets have put pilings under their homes over the years to protect them from sliding further. Another potential problem area is east of Gladstone High School including the homes on Patricia Drive, E. Kenmore Street, E. Jersey Street, and Cornel Ave. Portions of the above described areas are mapped in a 20%-34.9% slope zone.

Risk Analysis

Due to insufficient data, Gladstone is unable to perform a quantitative risk analysis at this time. The city has addressed this issue in action item ST-MH #3 and will be completing a risk assessment as data and resources become available.

Existing Landslide Mitigation Activities

Landslide mitigation activities listed here include current mitigation programs and activities that are being implemented by City of Gladstone agencies or organizations.

Chapter 17.56—Drainage

Adequate provisions shall be made to ensure proper drainage of surface waters, to preserve natural flow of watercourses and springs and to prevent soil erosion and flooding of neighboring properties or streets. Such provisions include:

a.) Protect and preserve existing natural drainage channels to the maximum practical extent.
b.) Protect development from flood hazards.
c.) Provide a system by which water within the development will be controlled without causing damage or harm to the natural environment, or to property or persons within the drainage basin.
d.) Assure that waters drained from the site are substantially free of pollutants, including sedimentary materials, through such construction and drainage techniques as sedimentation ponds, reseeding, phasing or grading.
e.) Assure that waters are drained from the development in such a manner that will not cause erosion to any greater extent than would occur in the absence of development.
f.) Provide drywells, French drains, or similar methods, as necessary to supplement storm drainage systems.
g.) Avoid placement of surface detention or retention facilities in road rights-of-way.

Chapter 17.58—Grading and Fill

The development standards for grading and fill shall apply to all development permits issued by the city except for substantial improvement or lesser remodel or reconstruction or existing single-family or two-family dwellings.

Clackamas County Building Codes

The City's Comprehensive Plan requires development within areas of steep slope, soil hazards, landslide hazards, and other geological hazards to be reviewed during the building permit review process. Building permits in the City of Gladstone are reviewed by County Planning and Building staff, pursuant to a contract between the city and the county. The county has adopted an inventory of geological hazards prepared by the State Department of Geology and Mineral Industries (DOGAMI). If new development is identified as within an area of geological hazards, county planning staff recommends to the city that a geotechnical evaluation be prepared by a qualified engineer that provides conditions for construction to mitigate for the identified geological hazard. These conditions are incorporated into the engineering requirements of the design and into the plan-checking and field inspection process of the development.

The County Building Codes Division also reviews residential and commercial development on areas of steep slope to ensure that such construction meets the most current development codes within areas of slope that could potentially exhibit landslides.

Various subsections of Section R403 of the Oregon Residential Specialty Code, outline construction standards and slope-setback requirements for residential construction of footings and foundations in areas of steep slope and soil hazards. Chapter 16, *Structural Design*, and Chapter 18, *Soils and Foundations*, of the International Building Code (IBC) outline engineered construction requirements for commercial development in areas of steep slope and soil hazards.

Landslide Mitigation Action Items

The landslide mitigation action item provides direction on specific activities that organizations and residents in the City of Gladstone can undertake to reduce risk and prevent loss from landslide events. The action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

LT-LS #1: Reduce the vulnerability of property owners in landslide-prone areas.

Ideas for Implementation

- Focus efforts on Oatfield Road, Oakridge, Parkway, Caldwell and the area from Jennings to Glen Echo;
- Develop public information to emphasize economic risk when building on potential or historical landslide areas;
- Update the landslide hazard map when LIDAR data becomes available; and
- Review the planning and building codes and make updates or changes, if necessary.

Coordinating Organization: City Administrator's Office
Internal Partner: Public Works
External Partner: DOGAMI, Clackamas County, Metro
Timeline: Long term ongoing

Status: *Added during 2009 update*, yet to be completed

City of Gladstone Slope Greater than 20 percent

Percent of Slope

- 20 - 34.9
- >= 35
- Major Rivers and Lakes
- Gladstone City Limits

- Freeway
- Freeway Ramps
- Expressway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,301 feet

WILLAMETTE RIVER

CLACKAMAS RIVER

N

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/SLOPE.MXD | JONMCD | OCTOBER 23, 2003

4.3 Wildfire

Wildfire Profile

The causes and characteristics of wildfire hazards are adequately described within the Clackamas County Natural Hazards Mitigation Plan. Likewise, historical large-scale wildfire events have been described in Section 8 of the county's plan, and are applicable to the City of Gladstone as well. As such, the events will not be repeated here. The Clackamas County Community Wildfire Protection Plan details a limited history of wildfire in the county. In 1951 approximately 2,000 acres burned in Clackamas and Multnomah Counties. In 2001 lightning strikes started eight fires in eastern Clackamas County on US Forestry Service lands, burning about 80 acres. In 2002 the Bowl Fire burned over 300 acres just east of Estacada.[xiii] In Gladstone a fire started on the Oberson property a few years back. A transient campfire is the suspected source of the fire and while it was quickly suppressed by fire fighters it could have been much larger and more destructive. On July 4, 2009 a large debris pile near Meldrum Bar Park caught fire for unknown reasons. A city resident had been putting debris there for quite some time and if conditions were right it could have spread and affected homes.

Wildfire Hazard Assessment

Hazard Identification

Clackamas County GIS has used topographic, climate, and vegetation data to model the location and extent of potential wildfire hazards in the county and incorporated cities. According to the county's GIS data, approximately 34% of the land area in Gladstone is at least moderately susceptible to wildfires (see map on page 47 below). The Gladstone HMAC mapped the wildfire hazard as areas that have good vegetative coverage. Although only parts of the city are wooded, the entire city could be vulnerable to the wildfire hazard if climatic conditions were conducive to fire spreading.

The probability of wildfire events in Gladstone was determined using scientific data, historical occurrences, and local knowledge. The HMAC estimates that the probability of wildfire events is 'moderate,' meaning one incident is likely to occur in a 35 to 75 year period. This is in agreement with the county's 'moderate' probability rating.

Vulnerability Assessment

Exposure of community assets to natural hazards was determined by manually comparing critical and essential facilities and infrastructure maps with each hazard map, and identifying where assets and hazards intersected. The HMAC estimates that the city's vulnerability to wildfires is 'moderate,' meaning between 1% and 10% of the population and assets would be affected by a major wildfire event. This is in agreement with the county's rating.

The wildfire map below shows that no critical facilities lie in the moderate or high hazard areas. Essential facilities located in wildfire hazard zones include Gladstone High School, Kraxberger Middle School, John Wetten Elementary, Grace Christian Church, and River View Care Center. The infrastructure also seems to be fairly safe from the wildfire hazard because only 7.5 miles of road, 4 miles of sewer and 4 miles of waterlines are located in moderate to high hazard zones. Water lines would be an essential piece of

infrastructure during a wildfire event. Environmental facilities in the wildfire hazard zone include Dahl Park, Meldrum Bar Park, Cross Park, and the McLoughlin/Risley Wetland.

According to the HMAC, the buildings and facilities that are adjacent to heavily wooded or grassland areas include many residential homes, essential facilities, and vulnerable population centers. This is largely because people like to live in areas that have high quality environmental assets. The number of people choosing to live in the wildland-urban interface is escalating, and without sufficient landscaping and maintenance, these residential properties can be highly vulnerable to wildland fires.

The areas that have a large supply of fuel for wildland fires include the open field along Webster Road, Billy Goat Island, Meldrum Bar, and Nick Shannon Park. Additionally, the following areas are located adjacent to potential wildfire hazard zones: the business corridor located along 99E, the area between Ridgegate Drive and Parkway Drive, the area between Salty Acres and Barberry Cove, the area near Bird Song Way, Rinearson Creek wetlands, areas along the Clackamas River, and the Oatfield/Oakridge corridor.

Risk Analysis

Due to insufficient data, Gladstone is unable to perform a quantitative risk analysis at this time. The city has addressed this issue in action item ST-MH #3 and will be completing a risk assessment as data and resources become available.

Existing Wildfire Mitigation Activities

Clackamas County Zoning and Building Codes

The City of Gladstone contracts with Clackamas County for enforcement of building codes regarding wildfire hazards in commercial structures. The Gladstone Fire Department works with the County Building Division to ensure safety in commercial structures.

If residential development is identified to be within a wildfire hazard zone, such development is reviewed by the County Building Codes Division pursuant to the construction standards outlined in Section R324, *Wildfire Hazard Mitigation*, of the Oregon Residential Specialty Code.

Gladstone Fire

The City of Gladstone provides fire prevention and education programs as well as structural fire response. Some of their most useful programs include the following:

- Counseling juvenile fire-setters
- Teaching fire prevention in schools
- Conducting CPR classes
- Teaching proper use of fire extinguishers
- Coordinating educational programs with other agencies, hospitals, and schools
- Answering citizens' wildfire prevention questions

Wildfire Mitigation Action Items

The wildfire mitigation action items provide direction on specific activities that organizations and residents in the City of Gladstone can undertake to reduce risk and prevent loss from wildfire events. The action items are followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

LF-WF #1: Conduct community based fuel reduction demonstration projects in the wildland-urban interface.

Ideas for Implementation:

- Focus on the developments near heavily vegetated areas including Billy Goat Island, Meldrum Bar Park, Nick Shannon Park, the Oberson Property, Rinearson Creek, along the Clackamas River, and the open field along Webster Road.

Coordinating Organization: Fire Department
Internal Partner: City Administrator's office, Public Works, Code Enforcement
External Partner: Fire Defense Board, Fire Co-op
Timeline: Long term ongoing
Status: *Added during 2009 update*, yet to be completed

LT-WF #2: Promote fire-resistant strategies for new and existing developments.

Ideas for Implementation:

- Require fuel breaks in site plans;
- Describe the procedures for ongoing maintenance, and place information on the city website for public viewing;
- Require street design that facilitates the movement of firefighting equipment;
- Review roofing standards and develop recommendations for promoting non-combustible roofing; and
- Promote use of sprinkler systems in residential construction.

Coordinating Organization: Fire Department
Internal Partner: City Administrator's Office
External Partner: Fire Defense Board, Fire Co-op
Timeline: Long term ongoing
Status: *Added during 2009 update*, yet to be completed

City of Gladstone Relative Wildfire Hazards

Relative Wildfire Hazard Risk Areas determined from state-wide model resulting from Oregon Senate Bill 360 (1997). State-wide hazard areas rated low, moderate, high, and extreme. Only moderate and high values present in Clackamas County. Three elements (fuels, slope & weather) comprised the model. Fuels data derived from 2001 Landsat Enhanced Thematic Mapper (ETM) satellite imagery (30-meter pixels). Image classification for fuels completed by Spatial Solutions, Inc. in 2002. Slope data from 10-meter digital elevation model (DEM). Weather hazard factor determined by state as a constant for Clackamas County. Determination of these Relative Wildfire Hazard Risk Areas did not account for wildland-urban interface areas or other risk factors like property accessibility, water sources or defensible space.

SE MCLOUGHLIN BLVD
SE OATFIELD RD
SE JENNINGS AVE
SE WEBSTER RD
WEBSTER RD
SE JENNIFER ST
SE 82ND DR
I205 FWY
82ND DR
S CLACKAMAS RIVER DR
SE RIVER RD
OATFIELD RD
PORTLAND AVE
SE RIVER RD
MCLOUGHLIN BLVD
RIVER RD
E ARLINGTON ST
W ARLINGTON ST
CLACKAMAS RIVER
FORSYTHE RD
S FORSYTHE RD
HWY 213 HWY
WILLAMETTE RIVER
N

Relative Hazard

- HIGH
- MODERATE

- Major Rivers and Lakes
- Gladstone City Limits

- Freeway
- Freeway Ramps
- Expressway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,300 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/WILDFIRE.MXD | JONMCD | OCTOBER 23, 2003

4.4 Severe Storms: Wind and Winter

The Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan adequately describes the causes and characteristics, location, extent and impacts of the severe storm hazard in the City of Gladstone. Severe storm information can be found on pages 9-1 to 10-7 of the 2002 Clackamas County Natural Hazards Mitigation Plan, and pages 46 to 50 in the 2007 plan update.

Severe Storm Profile

The historical severe windstorm and winter storm events have been described in the county plan, and are applicable to Gladstone. As such, the events will not be repeated here.

Severe Storm Hazard Assessment

Hazard Identification

Severe storms present a significant threat to Gladstone residents, property, and infrastructure. Although there is very little data to spatially represent this hazard, severe storms can occur throughout the city. Likewise, the effects of severe storms can occur city-wide.

The probability of severe wind and winter storm events in Gladstone was determined using scientific data, historical occurrences, and local knowledge. The probability of winter storm events is high, meaning one event is likely in a 10 to 35 year period. The probability of wind storms is moderate, meaning one event is likely in a 35 to 75 year period. Both ratings are in agreement with the county's probability estimates for wind and winter storms.

Vulnerability Assessment

Severe storms can be life threatening, cause major infrastructure damage, and can be difficult to manage in terms of response and recovery. Winter storms can cover the road networks with snow and ice, impeding transportation to schools and medical facilities. Winter storms and windstorms can topple trees, down power lines, and cause widespread power outages.

The HMAC believes that areas most vulnerable to severe wind and/or winter storms are places where trees and vegetation align with utility and power lines. The majority of severe storm events in Gladstone result in power outages due to damaged utility lines and power outages. This usually results from vegetation failure (i.e., trees and/or brush breaking utility lines), or from failure caused by the heavy weight of ice and snow. The high tension power lines and water lines along city blocks are particularly vulnerable to these severe storm hazards. Gladstone's public works department works to clear roads, replace utility transmission lines, and maintain telephone lines during severe storm events.

The HMAC estimates that the City of Gladstone has a 'moderate' vulnerability to winter storms, meaning 1-10% of the community's population and/or assets could be affected in a major winter storm event. Additionally, the HMAC estimates a 'low' vulnerability to wind storms, meaning less than 1% of the population and/or assets could be affected by a

major wind storm event. Both vulnerability ratings are in agreement with the county's winter and wind storm vulnerability ratings.

Risk Analysis

Due to insufficient data, Gladstone is unable to perform a quantitative risk analysis at this time. The city has addressed this issue in action item ST-MH #3, and will be completing a risk assessment as data and resources become available.

Existing Severe Storm Mitigation Activities

The City of Gladstone is currently not engaged in any severe storm mitigation activities that vary from the programs listed in the Clackamas County Natural Hazard Mitigation Plan. Fore more information regarding county, state, and federal programs, please refer to the county's plan.

Severe Storm Mitigation Action Items

The severe winter storm mitigation action items provide direction on specific activities that organizations and residents in Gladstone undertake to reduce risk and prevent loss from landslide events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

LT-SS #1: Reduce negative effects from severe windstorm and severe winter storm events.

Ideas for Implementation:

- Reduce power outages by partnering with PGE to obtain funding to bury power lines subject to frequent failures;
- Continue regular tree trimming practices;
- Partner with PGE to continue hazardous tree inventory and mitigation programs; and
- Continue to require that new developments place utilities underground.

Coordinating Organization: Public Works
Internal Partner: City Administrator's Office, Fire Department, Police Department
External Partner: PGE
Timeline: Long term
Status: *Added during 2009 update*, yet to be completed

4.5 Earthquake

Earthquake Profile

Clackamas County's Natural Hazards Mitigation Plan adequately describes the causes and characteristics of earthquake hazards for the region. Likewise, the county's plan adequately documents past earthquake occurrences. Historical records count over 56 earthquakes in the Portland area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Three potential source zones capable of generating damaging earthquakes are thought to exist in the region. These include the Portland Hills Fault Zone, Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone.

- Portland Hills Fault Zone: a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment.[xiv] The fault zone extends along the eastern margin of the Portland Hills for a distance of 25 miles, and lies just east of Gladstone.
- Gales Creek-Newberg-Mt. Angel Structural Zone: a 50-mile-long zone of discontinuous, NW trending faults that lies about 19 miles southwest of Gladstone. These faults are recognized in the subsurface by vertical separation of the Columbia River Basalt and offset seismic reflectors in the overlying basin sediment.[xv]
- Cascadia Subduction Zone: a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year.[xvi] Scientists have recently found evidence that11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D. [xvii]

Earthquake Hazard Assessment

Hazard Identification

For the purposes of identifying the potential extent of earthquake hazards in Gladstone, the HMAC reviewed historic earthquake and geology maps developed by DOGAMI. According to the DOGAMI IMS-4 map, which shows faults, bedrock geology, and sediment thickness within Clackamas, Multnomah, Marion, and Washington Counties, the soil type in Gladstone is primarily composed of unconsolidated sediments. This type of soil composition increases the likelihood of ground shaking amplification and liquefaction.[xviii]

The HMAC estimates that the probability of an earthquake occurring in Gladstone is 'high,' meaning one event is likely to occur within a 10 to 35 year period. This is in agreement with the county's 'high' rating as well. Paleoseismic studies along the Oregon

coast indicate that the state has experienced seven Cascadia Subduction Zone (CSZ) events possibly as large as M9 in the last 3,500 years. These events are estimated to have an average recurrence interval between 500 and 600 years, although the time interval between individual events ranges from 150 to 1000 years. Since Clackamas County's Natural Hazards Mitigation Plan was updated in 2007, better earthquake probability estimates have surfaced. Scientists now estimate that the chance in the next 50 years of a great subduction zone earthquake is between 10 and 20 percent assuming that the recurrence is on the order of 400±200 years.[xix] Crustal and deep intraplate earthquakes remain difficult to predict.

Vulnerability Assessment

The Department of Geologic and Mineral Industries (DOGAMI) recently completed an earthquake hazard and secondary earthquake hazards GIS mapping project for the entire county in 2003. This data was used by the Clackamas County GIS department to assess the relative earthquake hazards, by combining the ground shaking, liquefaction, and amplification hazards in Gladstone. The following are further descriptions of DOGAMI's findings:

- *Relative Earthquake Hazards (see map below on page 54)*
  The Relative Earthquake Hazard Map incorporates ground shaking, amplification, liquefaction, instability of slopes, and potential landslides. The map predicts the tendency of a site to have greater or lesser damage than other sites in the area. According to the 2003 DOGAMI GIS data, over 40% of the land area in Gladstone is identified as being in the moderate to higher earthquake hazard zones

  Additionally, 13 miles of road, 10 miles of sewer lines and 12 miles of water lines are located in moderate to high hazard areas within the relative earthquake hazard map.

- *Amplification (see map below on page 55)*
  Gladstone is highly vulnerable to amplification due to the unconsolidated sediments that comprise the majority of the soils in the city. The vast majority of the city is in the moderate to high amplification hazard area

- *Liquefaction (see map below on page 56)*
  The 2003 DOGAMI data shows that about 20% of land is located within either the high or low soil liquefaction zones. No moderate zones exist within the city, and the majority of the city has a non/very low risk to liquefaction.

When overlayed with city-level data, the city has found that 13 miles of road, 10 miles of sewer lines, and 12 miles of water lines are located in moderate to high hazard areas (see Relative Earthquake Hazards Map below on page 54). Due to the city's likelihood of experiencing high levels of amplification in a high magnitude earthquake, a great portion of city property, including all critical and essential facilities and infrastructure, have the potential for significant damage and loss. Furthermore, the area that's enclosed by Portland Ave, Abernethy Lane, and SE Hull Ave is highly vulnerable to liquefaction, amplification and relative earthquake hazards. Meldrum Bar Park and Dahl Park are also

vulnerable to all earthquake hazards. The public works building, a critical facility, is located in the high liquefaction, amplification, and relative earthquake hazards zones.

The city is less vulnerable to the liquefaction hazard, since only 11% of parcels are in the moderate and/or high hazard zones. Only 3 miles of road and 2 miles of sewer lines are located in high liquefaction areas. While the maps do not show the Oatfield/Oakridge corridor in a high liquefaction zone, the HMAC believes it could be vulnerable to earthquake-induced landslides because this area has experienced slow ground movement over the years.

The Gladstone HMAC estimates a 'high' vulnerability to earthquakes, meaning more than 10% of the city's population and/or community assets would be affected in a major earthquake event. Potential earthquake-related impacts are adequately documented in the county's plan.

Risk Analysis

The county's plan provides a quantitative analysis of nine potential earthquake scenarios for the county. This analysis includes an estimation of fatalities, direct damage losses, number of buildings in complete damage state, and number of people requiring shelter. Gladstone does not have the resources to conduct a local risk assessment for the earthquake analysis. Currently, the county's analysis is the best available risk analysis data.

Existing Earthquake Mitigation Activities

After the Scotts Mills Quake in 1993, the city's reservoir was seismically upgraded. The Gladstone High School has a new building and seismic work has been done on the other buildings. The Gladstone Center for Children and Families (previously Danielson's market) had seismic work done to make it suitable for its current use. Finally, the Gladstone Fire Department received a grant for seismic retrofits.

Clackamas County Building Codes

The State of Oregon has three seismic design categories that are enforced within three regions of the state. The design categories reflect construction standards that account for and are engineered to the region's level of earthquake risk and force. Clackamas County is within Seismic Design Category D2. As previously noted, building permits in the City of Gladstone are reviewed by county planning and building staff, pursuant to a contract between the city and the county. Construction methods for city building permits therefore must meet the seismic design and engineering standards for Seismic Design Category D2.

Various portions of Section R403 of the Oregon Residential Specialty Code outline residential construction standards for development within Seismic Design Category D2. Chapter 16, *Structural Design*, Chapter 17, *Structural Tests and Special* Inspections, and Chapter 18, *Soils and Foundations*, of the International Building Code (IBC) outline engineered construction requirements for commercial development within Seismic Design Category D2.

Earthquake Mitigation Action Items

The earthquake mitigation action items provide direction on specific activities that organizations and residents in the City of Gladstone can undertake to reduce risk and prevent loss from landslide events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

LT-EQ#1: Conduct seismic evaluations on identified critical/essential facilities & infrastructure for implementing appropriate structural and non-structural mitigation strategies.

Ideas for Implementation:

- Obtain funding to perform evaluations;
- Obtain funding to retrofit/replace the Police and Fire Station (City Hall) as a model project for other critical facilities in Gladstone.
- Prioritize seismic upgrades based on criticality of need and population served; and
- Partner with agencies responsible for maintaining the 205 Bridge, Oregon City Bridge, and the sewerage treatment walking bridge to upgrade these bridges.

Coordinating Organization: City Administrator's Office
Internal Partners: Fire Department, Police Department, Gladstone Emergency Management Support (GEMS), Public Works
External Partners: ODOT, Clackamas County, WES, Oak Lodge Sanitary
Timeline: Long term
Status: *Partially Complete/Deferred:* The Gladstone Fire Station received a grant for seismic upgrades. An engineering firm has been hired but the project will not be fully completed for a couple more years. In 1996 the upper reservoir had seismic upgrades done, and all new reservoirs are seismically upgraded. GEMS educates citizens on non-structural mitigation projects and distributes red cross information pamphlets at community events.

City of Gladstone Relative Earthquake Hazards

Relative Earthquake Hazard Areas determined by Clackamas County GIS staff based on data developed by the Oregon Department of Geology and Mineral Industries (DOGAMI). The relative earthquake hazard map integrates four separate earthquake hazard components: amplification (of ground shaking by a "soft" soil column), liquefaction (of water-saturated sand, creating areas of "quicksand"), instability of slopes (triggered by the shaking of the earthquake), and historic landslides. It delineates areas that likely will experience the greatest effects from any earthquake. The map predicts the tendency of a site to have greater or lesser damage than other sites in the area. It does not depict the absolute degree of earthquake hazard at any site, which means that in any given earthquake it is possible that damage in even the highest relative hazard category will be light. Conversely, in a severe earthquake even the lowest relative hazard category could experience severe damage. The areas depicted should not be used as the sole basis for any type of restrictive or exclusionary policy.

SE WEBSTER RD
SE JENNINGS AVE
WEBSTER RD
I205 FWY
I205 FWY
SE 82ND DR
SE JENNIFER ST
82ND DR
S CLACKAMAS RIVER DR
SE RIVER RD
SE RIVER RD
OATFIELD RD
PORTLAND AVE
MCLOUGHLIN BLVD
RIVER RD
E ARLINGTON ST
W ARLINGTON ST
CLACKAMAS CLACKAMAS
S FORSYTHE RD
FORSYTHE RD
WILLAMETTE RIVER
HWY 213 HWY
N

Relative Hazard

- Slight
- Lower
- Moderate
- Higher

- Faults
- Rivers, Creeks, and Streams
- Gladstone City Limits

- Freeway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,320 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/RELATIVEHAZARD.MXD | JONMCD | OCTOBER 23, 2003

City of Gladstone
Soil Amplification

Soil Amplification
- LOW
- MODERATE
- HIGH

- Gladstone City Limits
- Major Rivers and Lakes

- Freeway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,320 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

SE MCLOUGHLIN BLVD
SE OATFIELD RD
SE JENNINGS AVE
SE WEBSTER RD
WEBSTER RD
I205 FWY
SE 82ND DR
SE JENNIFER ST
82ND DR
S CLACKAMAS RIVER DR
SE RIVER RD
RIVER RD
MCLOUGHLIN BLVD
PORTLAND AVE
OATFIELD RD
E ARLINGTON ST
W ARLINGTON ST
CLACKAMAS RIVER
WILLAMETTE RIVER
S FORSYTHE RD
FORSYTHE RD
HWY 213 HWY
N

City of Gladstone
Soil Liquefaction

Soil Liquefaction

- NONE/VERY_LOW
- LOW
- MODERATE
- HIGH

- Gladstone City Limits
- Major Rivers and Lakes

- Freeway
- State Highway
- Major Arterial
- Local
- Private Roads
- RailRoad

1 inch equals 1,320 feet

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

DEPARTMENT OF INFORMATION SERVICES/GEOGRAPHIC INFORMATION SYSTEMS
121 LIBRARY COURT
OREGON CITY, OREGON 97045

CLACKAMAS COUNTY GIS | /JMHOME$/GIS_PROJECTS/GLADSTONE/HAZARDASSESSMENT/PROJECTLIB/LIQUEFACTION.MXD | JONMCD | OCTOBER 23, 2003

4.6 Volcanic Eruption

Volcano Profile

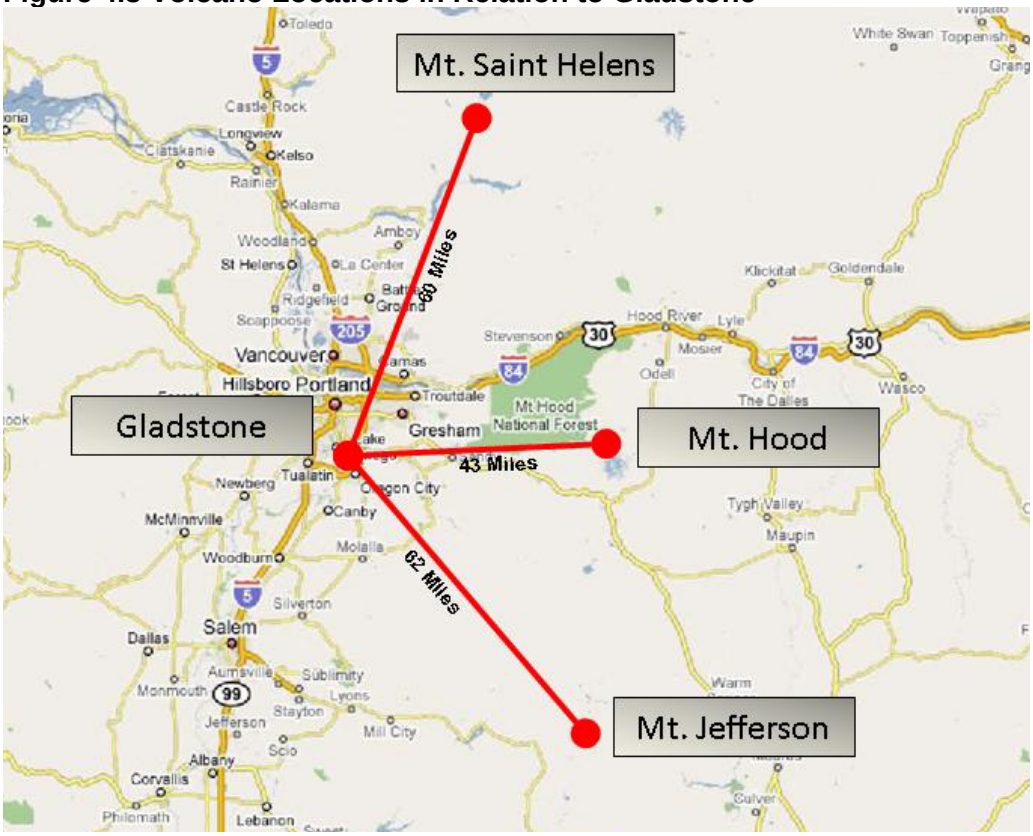
The Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan adequately describes the causes and characteristics, history, location, extent and impacts of volcanic eruptions affecting the City of Gladstone. Descriptions of the volcano hazard can be found on pages 12-1 to 12-13 of the 2002 Clackamas County Natural Hazards Mitigation Plan and pages 61 to 64 of the 2007 plan update

The probability of volcanic eruptions in Gladstone was determined using scientific data, historical occurrences, and local knowledge. The HMAC estimates the probability of a volcanic eruption to be 'low', meaning one incident is likely within a 75 to 100 year period. This is in agreement with the county's 'low' rating.

Volcanic Eruption Hazard Assessment

Immediate danger areas for volcanic eruptions lie within a 20-mile radius of the blast site, and ashfall is likely to affect communities downwind of the eruption. Mount Hood, Mount Jefferson, and Mount Saint Helens are the closest of the cascade volcanoes to Gladstone (see Figure 4.3 below). Additionally, Mount Adams is located north of Mount Hood, and the Three Sisters lie to the south of Mount Jefferson.

Figure 4.3 Volcano Locations in Relation to Gladstone



Due to Gladstone's distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or

lahars). Depending on wind patterns, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash.

Mount Jefferson's last eruptive episode culminated about 15,000 years ago. The volcano is capable of large explosive eruptions, meaning areas downwind are at risk of experiencing ashfall. The largest eruption of Mount Jefferson occurred between 35,000 and 100,000 years ago, and caused ash to fall as far away as the present-day town of Arco in southeast Idaho. Although an event has not occurred in a long time, experience at explosive volcanoes elsewhere suggests that Mount Jefferson cannot be regarded as extinct.[xx]

Mount Hood's last eruption ended shortly before the arrival of Lewis and Clark in 1805. When Mount Hood erupts again, it will severely affect areas on its flanks and far downstream in the major river valleys that head on the volcano. Likewise, volcanic ash may fall on areas up to several hundred kilometers downwind.[xxi] Please see Clackamas County's Natural Hazards Mitigation Plan for more details regarding Mt. Hood and Mt. Jefferson, as well as additional Cascade volcanoes.

The HMAC estimates that Gladstone has a 'high' vulnerability to volcanic eruptions, meaning more than 10% of the population could be affected in a large-scale event. This is in agreement with the county's 'high' vulnerability rating as well.

Hazards related to volcanic eruptions (i.e., potential community impacts) are adequately described in the Clackamas County Natural Hazards Mitigation Plan. Although the City of Gladstone is unlikely to experience lahars or lava flows, tephra (sand-sized or finer particles of volcanic rock that is ejected rapidly into the air from volcanic vents) drifts downwind from the explosions and can form a blanket-like deposit of ash. Tephra is a public health threat, and can damage agriculture and transportation systems (i.e., aircraft and on-the-ground vehicles). Tephra can also clog drainage systems and create major debris management problems. Within Gladstone, public health would be a primary concern, and keeping transportation routes open/accessible would be important as well.

Existing Volcanic Eruption Mitigation Activities

The existing volcanic hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County natural Hazards Mitigation Plan. As such, the information will not be repeated here.

Volcanic Eruption Mitigation Action Items

The City of Gladstone does not believe that implementing volcano-related mitigation activities will be cost-effective at this time. As such, the city has not identified volcanic-eruption mitigation action items. Gladstone will partner with Clackamas County, however, on the implementation of mitigation strategies that benefit both jurisdictions.

4.7 Multi-Hazard

Multi-Hazard Action Items (MH)

Multi-hazard action items are those activities that pertain to all six hazards in the mitigation plan: flood, landslide, wildfire, severe storms, earthquake, and volcanic eruption. The multi-hazard mitigation action items provide direction on specific activities that organizations and residents in Gladstone can undertake to reduce risk and prevent loss from multi-hazard events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation. Plan goals and county action items addressed are also noted for each action item.

ST-MH #1: Integrate the goals and action items from the Gladstone Natural Hazard Mitigation Plan into existing regulatory documents and programs, where appropriate.

Ideas for Implementation:

- Use the mitigation plan to help the update the Goal 7 section within Gladstone's Comprehensive Land Use Plan;
- Integrate mitigation actions into current plans and policies where appropriate in order to ensure that mitigation becomes a integral component of the city's long-term priorities; and
- Use the natural hazard mitigation planning resources provided by the Oregon Partnership for Disaster Resilience to learn how to better integrate the NHMP into existing documents and programs (to be released Spring, 2010).

Coordinating Organization: County Planning
Internal Partner: Planning Commission
External Partner: Metro, Oregon Partnership for Disaster Resilience
Timeline: Short term ongoing
Status: *Partially Complete/Deferred*. The city adopted the 2008 FEMA maps and studies, and the updated areas of the development code that require stormwater detention on lots before releasing it to waterways (approved by the Planning Commission and City Council in September, 2009). Metro is now an external partner instead of a coordinating organization. The 2009 update expanded the action item to include ideas for implementation.

ST-MH #2: Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.

Ideas for Implementation:

- Gather hazard related information and public information materials, and disseminate to the public through the Gladstone City Newsletter and city website;
- Identify property owners in the flood, landslide, and wildfire hazard zones, and conduct a targeted mailing to disseminate hazard information;
- Encourage local businesses to develop business continuity plans;
- Partner with Clackamas County and other jurisdictions to develop education outreach for all hazards;

- Conduct public education as hazard seasons approach. Provide information for earthquake awareness month in April, wildfire prevention in summer, and flood and severe storm information in winter;
- Post hazard information on the Gladstone Fire Department website;
- Prepare and distribute an informational brochure on unstable slopes, historical landslide areas, and mitigation strategies; and
- Encourage individual homeowners to implement mitigation practices.

Coordinating Organization: Gladstone Emergency Management and Support (GEMS)
Internal Partner: Gladstone Police Department, Gladstone Fire Department
External Partner: Clackamas County Emergency Management, Oregon Partnership for Disaster Resilience
Timeline: Short term ongoing
Status: *Partially Complete/Deferred*. The Gladstone City Newsletter regularly writes about emergency preparedness and hazard mitigation, especially as hazard seasons approach. Gladstone Emergency Management Support (GEMS) canvasses the city and passes out emergency preparedness/mitigation information at community events such as Chautuaqua and National Night Out. A GEMS subcommittee focuses on one type of hazard at a time and targets educational pieces about that hazard. The 2009 update expanded this action item to include additional ideas for implementation.

ST-MH #3: Continue to update and improve hazard assessments in the Natural Hazards Mitigation Plan as new information becomes available.
Ideas for Implementation:

- Obtain funding to contract with the county to provide digital GIS hazard layers and a vulnerability assessment;
- Continue to update the hazard assessment as the county and/or Gladstone acquires better data and as new development occurs;
- Contract with the county or other service provider to conduct a risk assessment for Gladstone;
- Cooperate with participating agencies to obtain data for improved risk analyses;
- Use new data to guide public outreach programs and update educational outreach pieces as new data becomes available;
- Update hazards maps when the city has in-house GIS capabilities; and
- Update codes and city policies as required by state planning goal 7 when new data and information becomes available.

Coordinating Organization: City Administrator's Office
Internal Partners: Gladstone Fire Department, HMAC, Police Department
External Partners: Clackamas County Emergency Management, Clackamas County Water Environment Services, Clackamas County GIS, Portland General Electric (PGE), DOGAMI, FEMA
Timeline: Short term ongoing
Status: *Partially Complete/Deferred*. The city adopted new FEMA maps in 2008 and city leaders have met with PGE to learn more about upstream dam failure and its implications on Gladstone. The 2009 update expanded the action item to include additional ideas for implementation.

ST-MH #4: Improve vegetation management throughout the city.
Ideas for Implementation:

- Partner with Clackamas County, Oregon Department of Forestry, US Forestry Service, ODOT, and citizens to control vegetation along transportation corridors;
- Identify appropriate practices for eliminating invasive species such as blackberry and English Ivy;
- Maintain vegetation coverage for slope stability;
- Provide education to the public about justifications for, and benefits of vegetation mitigation practices; and
- Encourage fuels reduction on private property by providing education for pruning and remove trees and using native vegetation

Coordinating Organization: Public Works
Internal Partners: Fire Department
External Partners: Clackamas Soil and Water Conservation District, Fire Co-op, Oregon Department of Forestry, US Forestry Service, Clackamas County, Clackamas River Basin Council, ODOT
Timeline: Short term ongoing
Status: *Added during 2009 update*, yet to be completed

LT-MH #1: Enhance strategies for debris management for all hazards.
Ideas for Implementation:

- Research debris management strategies used by other jurisdictions;
- Develop a debris management plan;
- Obtain funding for better equipment to handle debris; and
- Partner with neighboring jurisdictions and organizations to manage debris during disasters.

Coordinating Organization: Public Works
Internal Partners: City Administrator's Office
External Partners: Gladstone Disposal, Clackamas County, Metro
Timeline: 3-5 years
Status: *Deferred from 2005 addendum*. Action was not implemented due to limited staff time and resources. The 2009 update added ideas for implementation.

LT- MH #2: Update and revise the Gladstone Emergency Operations Plan.
Ideas for Implementation:

- Consult and integrate appropriate information from neighboring jurisdictions' emergency operations plans such as the Clackamas County Emergency Operations Plan and the PGE Emergency Operations Plan

Coordinating Organization: Gladstone Police
Internal Partners: Public Works, Fire Department, City Administrator's Office
External Partners: Clackamas County, Oregon City, Milwaukie, West Linn
Timeline: 3-5 years
Status: *Deferred from 2005 addendum*. Action was not implemented due to limited staff time and resources. The EOP was last updated in 2005 and GEMS works with it the plan on a regular basis. Public Works receives updates from PGE when their EOP has changes.

LT-MH #3: Evaluate & upgrade surface water management infrastructure and identify appropriate mitigation strategies.

Ideas for Implementation:

- Identify culverts that are insufficient for handling high flows& obtain funding for upgrades;
- Obtain funding to replace antiquated clay sewer lines in the downtown area with ductile iron; and
- Obtain funding to replace 16 miles of asbestos concrete water lines in Oak Ridge area (landslide prone) with ductile iron.

Coordinating Organization: Gladstone Public Works
Internal Partners: City Administrator's Office
External Partners: Oak Lodge Sanitary District, URS Corporation (engineering firm)
Timeline: 3-5 years
Status: *Partially Complete/Deferred.* Gladstone has mapped the water system using GPS units and continues to map surface water management areas. The city has tentative plans for updating the stormwater system in Municipal Separate Storm Sewer (MS4) plans. Funding to replace the asbestos concrete water lines in ongoing. The 2009 update now lists Oak Lodge Sanitary District as an external partner instead of a coordinating organization.

LT-MH #4: Identify and pursue funding opportunities to develop and implement hazard mitigation activities.

Ideas for Implementation:

- Meetings will be held semi-annually to discuss, update, and implement actions in the NHMP. Funding opportunities should also be discussed at the semi-annual meetings.
- Allocate city resources and assistance to mitigation projects when possible;
- Develop incentives for special service districts, citizens, and businesses to pursue hazard mitigation projects;
- Review mitigation projects during each city budget review cycle;
- Partner with other organizations and agencies to identify grant programs and foundations that may support mitigation activities; and
- Pursue funding opportunities for the five-year update (2012)

Coordinating Organization: City Administrator's Office, Public Works, Hazard Mitigation Advisory Committee, County Planning
Internal Partners: City Council
External Partners: CCEM, OEM, FEMA Region X
Timeline: Long term ongoing
Status: *Added during 2009 update*, yet to be completed

Section 5:
Mitigation Planning Priority System

The Disaster Mitigation Act of 2000 (via the Pre-Disaster Mitigation Program) requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore the project prioritization process needs to be flexible. Projects may be identified by HMAC members, local government staff, other planning documents, or the risk assessment.

5.1 Action Items

Short and long-term action items identified through the planning process are an important part of the mitigation plan. Action items are detailed recommendations for activities that local departments, citizens and others can engage in to reduce risk. Full action item descriptions are located in the corresponding hazard section of this addendum. Descriptions include ideas for implementation, and coordinating / partner organizations.

- ST-MH #1: Integrate the goals and action items from the Gladstone Natural Hazard Mitigation Plan into existing regulatory documents and programs, where appropriate.
- ST-MH #2: Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.
- ST-MH #3: Continue to update and improve hazard assessments in the Natural Hazards Mitigation Plan as new information becomes available.
- ST-MH #4: Improve vegetation management throughout the city.
- LT-MH #1: Enhance strategies for debris management for all hazards.
- LT- MH #2: Update and revise the Gladstone Emergency Operations Plan.
- LT-MH #3: Evaluate & upgrade surface water management infrastructure and identify appropriate mitigation strategies.
- LT-MH #4: Identify and pursue funding opportunities to develop and implement hazard mitigation activities.
- LT-FL #1: Develop a Stormwater Master Plan.
- ST-FL #2: Coordinate with Clackamas County to address the flooding issues on Glen Echo that stem from the two-way diversion on Hull Avenue put in by Clackamas County.
- ST-LF #1: Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.
- LT-LS #1: Reduce the vulnerability of property owners in landslide-prone areas.
- LF-WF #1: Conduct community based fuel reduction demonstration projects in the wildland-urban interface.
- LT-WF #2: Promote fire-resistant strategies for new and existing developments.

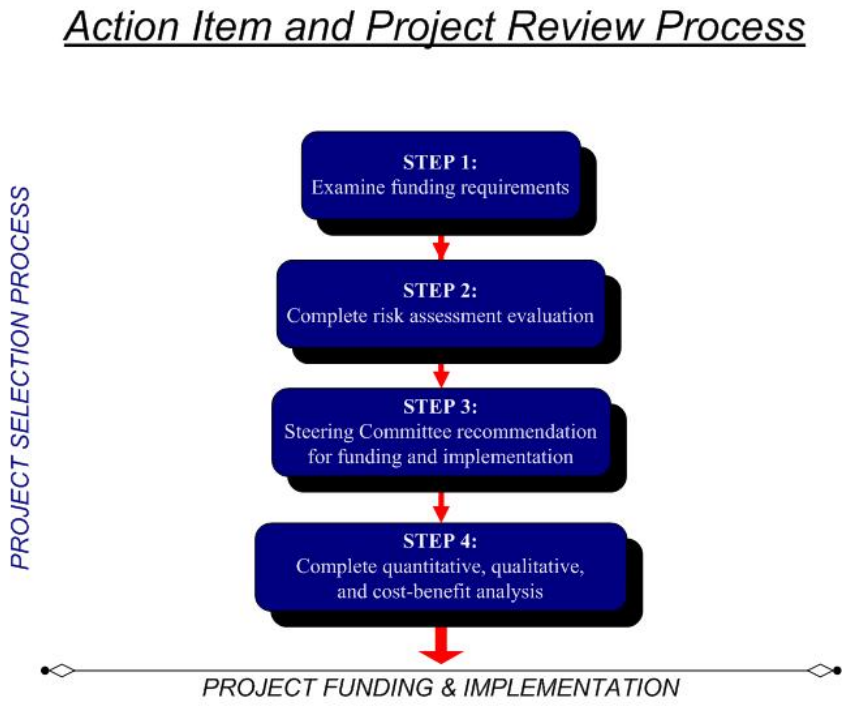
- LT-SS #1: Reduce negative effects from severe windstorm and severe winter storm events.
- LT-EQ#1: Conduct seismic evaluations on identified critical/essential facilities & infrastructure for implementing appropriate structural and non-structural mitigation strategies.

Note: the City of Gladstone does not believe that implementing volcano-related mitigation activities will be cost-effective at this time. As such, the city has not identified volcanic-eruption mitigation action items. Gladstone will partner with Clackamas County, however, on the implementation of mitigation strategies that benefit both jurisdictions.

5.2 Project Prioritization Process

The Disaster Mitigation Act of 2000 (via the Pre-Disaster Mitigation Program) requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore the project prioritization process needs to be flexible. Projects may be identified by committee members, local government staff, other planning documents, or the risk assessment. Figure 5.1 illustrates the project prioritization process.

Figure 5.1 Project Prioritization Process



Source: Community Service Center's Partnership for Disaster Resilience at the University of Oregon, 2008.

Step 1: Examine funding requirements

The HMAC will identify how best to implement individual actions within the appropriate existing plans, policies, or programs. The HMAC will examine the selected funding stream's requirements to ensure that the mitigation activity would be eligible through the funding source. The HMAC may consult with the funding entity, Oregon Emergency

Management, or other appropriate state or regional organizations about the project's eligibility.

Depending on the potential project's intent and implementation methods, several funding sources may be appropriate. Examples of mitigation funding sources include, but are not limited to: FEMA's Pre-Disaster Mitigation competitive grant program (PDM), Flood Mitigation Assistance program (FMA), National Fire Plan (NFP), Community Development Block Grants (CDBG), local general funds, and private foundations.

Step 2: Complete risk assessment evaluation

The second step in prioritizing the plan's action items is to examine which hazards they are associated with and where these hazards rank in terms of community risk. The HMAC will determine whether or not the plan's risk assessment supports the implementation of the mitigation activity. This determination will be based on the location of the potential activity and the proximity to known hazard areas, historic hazard occurrence, vulnerable community assets at risk, and the probability of future occurrence documented in the plan.

Step 3: Committee Recommendation

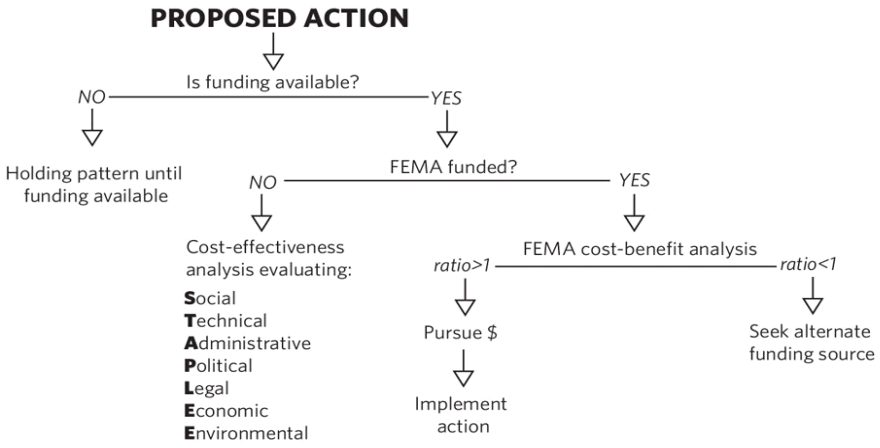
Based on the steps above, the HMAC will recommend whether or not the mitigation activity should be moved forward. If the HMAC decides to move forward with the action, the coordinating organization designated on the action item form will be responsible for taking further action and, if applicable, documenting success upon project completion. The HMAC will convene a meeting to review the issues surrounding grant applications and to share knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

The HMAC and the community's leadership have the option to implement any of the action items at any time, (regardless of the prioritized order). This allows the HMAC to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of the highest priority. This methodology is used by the HMAC to prioritize the plan's action items during the annual review and update process.

Step 4: Complete quantitative and qualitative assessment, and economic analysis

The fourth step is to identify the costs and benefits associated with natural hazard mitigation strategies, measures or projects. Two categories of analysis that are used in this step are: (1) benefit/cost analysis, and (2) cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Figure 5.2 shows decision criteria for selecting the appropriate method of analysis.

Figure 5.2 Benefit Cost Decision Criteria



Source: Community Service Center's Partnership for Disaster Resilience at the University of Oregon, 2006.

If the activity requires federal funding for a structural project, the HMAC will use a Federal Emergency Management Agency-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA grant funding.

For non-federally funded or nonstructural projects, a qualitative assessment will be completed to determine the project's cost effectiveness. The HMAC will use a multivariable assessment technique called STAPLE/E to prioritize these actions. STAPLE/E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Assessing projects based upon these seven variables can help define a project's qualitative cost effectiveness. The STAPLE/E technique has been tailored for use in natural hazard action item prioritization by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center. See Appendix B for a description of the STAPLE/E evaluation methodology.

References

[i] USGS - Partnership for Disaster Resilience Research Collaborative, 2006. Black = Canby; Blue = Oregon City; Aurora = Red;

[ii] Western Regional Climate Center, www.wrcc.dri.edu, Oregon City, Oregon (356334), accessed July 13, 2009. Note: Oregon City was the closest Western Oregon COOP Station to Glastone.

[iii] US Census Bureau, "Disability Status by Sex: 2000

[iv] US Census Bureau, 2000 Census "Tenure, Household Size, and Age of Householder: 2000"

[v] Oregon Economic & Community Development Department, Gladstone Community Profile, accessed July 10, 2009. http://info.econ.state.or.us:591/FMPro?-db=Community.fp4&-Format=forms.htm&-lay=webpage&-op=eq&sort%20name=Molalla&-script=hit%20count&-Find#employers

[vi] US Census Bureau, 2000 Census "Journey to Work: 2000"

[vii] TRIMET. Accessed July 13, 2009. http://trimet.org/

[viii] Gladstone Historical Society. Accessed July 13, 2009. http://www.gladstonehistoricalsociety.org/

[ix] Burby, Raymond J., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.*

[x] Gladstone Municipal Code, Accessed July 20, 2009. http://www.ci.gladstone.or.us/Files/Chapter%2017_29.pdf

[xi] Tri-City Water Pollution Site Master Plan. Accessed July 20, 2009 https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/8757/Clackamas_Water_Treatment_Site_Plan_2002.pdf?sequence=1

[xii] Gladstone Comprehensive Land Use Plan

[xiii] Clackamas County Community Wildfire Protection Plan, 2005. Page 16-18.

[xiv] Madin, Ian, 1990. Earthquake-hazard geology maps of the Portland metropolitan area, Oregon; text and map explanation: Portland, OR. Oregon Department of Geology and Mineral Industries.

[xv] Yeats, R.S., Graven, E.P., Werner, K.S., Goldfinger, C., and Popowski, T., 1996. *Tectonics of the Willamette Valley, Oregon.* U.S. Geological Survey Professional Paper 1560

[xvi] Goldfinger, C., L. D. Kulm, R. S. Yeats, C. Hummon, G. J. Huftile, A. R. Niem, C. G. Fox, and L. C. McNeill, 1996. *Oblique strike-slip faulting of the Cascadia submarine forearc: the Daisy Bank fault zone off central Oregon*, in Subduction Top to Bottom, G. E. Bebout, D. Scholl, S. Kirby and J. P. Platt (Editors), American Geophysical Monograph 96, 65–74.

[xvii] The Cascadia Region Earthquake Workgroup, 2005. *Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario.* http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf

[xviii] Scott Burns et. all. *Faults, bedrock geology, and sediment thickness of the western half of the Oregon City 1:100,000 quadrangle.* **DOGAMI IMS-4.**

[xix] NOAA, 1993. Tsunamis affecting the West Coast of the United States: 1806-1992.

[xx] United States Geological Survey, Cascades Volcano Observatory. Vancouver, Washington. http://vulcan.wr.usgs.gov/

[xxi] United States Geological Survey, Cascades Volcano Observatory. Vancouver, Washington. http://vulcan.wr.usgs.gov/

Appendix A:
Planning and Public Process

The following appendix documents Gladstone's natural hazards mitigation planning and public involvement processes.

Work Sessions

AGENDA

Meeting: Gladstone Natural Hazards Mitigation Plan Intro Meeting
Date: July 13, 2009
Time: 3:00 to 4:00pm
Location: Gladstone City Hall

1. Meeting Attendees
    a. Mike Funk, Gladstone Fire Marshal
    b. Jim Pryde, Gladstone Chief of Police
    c. Scott Tabor, Gladstone Public Works Supervisor

2. Natural Hazards Mitigation Plan Overview
    a. The group reviewed the handouts that explain natural hazards mitigation plans, the disaster cycle, and the "understanding risk" Venn diagram
        (See handouts below)

3. Planning Process

First Planning Meeting:

During this meeting we will:

- Adopt Plan Mission Statement, Goals, and Objectives
    - We will re-adopt the Clackamas County Goals and Mission Statement unless the group wants to add to it.
- Determine who will be the Coordinating Body
    - This is the group who will implement the action items in the plan.
- Determine who will be the Convener
    - This is the person who will call the coordinating body together, facilitate meetings, create agendas, etc or designate someone to do these tasks
- Review hazard data and history and get feedback
    - Laurel will research hazard history and email to the group before the next meeting. Between now and the next meeting everyone should be thinking about past natural hazards events between 2005 and now.
- Discuss community issues related to each hazard
    - What happened when the hazard hit? Where did the hazard hit? Who was affected? By answering these questions the group will identify vulnerabilities in the community.
- Review next steps – action item updates
    - The action items will be created based on the vulnerabilities identified. The goal of creating a mitigation plan is to reduce the vulnerabilities within a community, and action items are specific projects/programs/etc that a community can do to build resiliency. Laurel will create a list of potential action items but the group should also be thinking of specific projects to put in the plan.

Second Planning Meeting:

During this meeting we will discuss the following:

- Create mitigation action items
    - We will review the existing action items and write about any work that has been accomplished
    - The reason we make natural hazards mitigation plans is to create action items that address each of the vulnerabilities. Laurel will create a list of suggested action items and the group will review and add action items as needed.

- Discuss the formal review process and plan maintenance
    - We will come up with a schedule of meetings and tasks so the action items can be implemented.
- Discuss public involvement
    - The public needs to be made aware of the plan's existence both during and after the planning process. Once we have a final draft of the plan we will need to advertise it to the public and allow time for comments.
- Review timeline for city review, OPDR review, FEMA review
    - Once Laurel finishes her draft she will email it to the committee for editing. The Oregon Partnership for Disaster Resilience will also review the plan and then send it off to FEMA for preliminary review.
    - There's a good chance Laurel will not be here when the draft will go through edits but the Oregon Partnership for Disaster Resilience will take over.
- Review process for adoption
    - The City Council will need to adopt the plan after FEMA gives preliminary approval.

4. Needs from you
    - Maps – GIS department participation
        - Any new data should be reflected in the maps, but the 2005 plan maps should still be applicable for the new plan.
    - Access to existing plans/policies
        - Laurel can find plans linked on the city website but plans not listed on the website should
    - List of critical facilities, infrastructures, populations
        - These are your community assets, and the destruction or damage of one or more of these facilities would have an impact on the community. We'll work off the existing list.
    - Hazard history facts/statistics
        - The group should be thinking of the impacts of past natural disasters on the city to prepare for the next meeting. Any numbers you have (# of damaged homes, costs to repair, etc) would be very beneficial.
    - Most recent employment and economics data
        - Laurel will use the 2000 Census data unless the city has more up-to-date information
    - Land use and development information
        - Future development should be discussed in the NHMP
    - Existing mitigation projects, education, etc

5. Next meeting: Tentatively Monday, July 27th from 3:00 to 5:00

HANDOUT

What is 'natural hazards mitigation'?

Natural hazards mitigation is defined as permanently reducing or alleviating the losses of life, property and injuries resulting from natural hazards through long and short-term strategies.

Engaging in mitigation activities provides jurisdictions with a number of benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship; reduced short-term and long-term recovery and reconstruction costs; increased cooperation and communication within the community through the planning process; and increased potential for state and federal funding for recovery and reconstruction projects.

Why develop a natural hazards mitigation plan?

A natural hazards mitigation plan provides a community with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. The process of developing a mitigation plan can also forge new partnerships among community organizations, businesses, and local citizens. These partnerships can lead to the development and implementation of risk reduction strategies that assist the community in reducing losses from any future natural disaster events.

In 2000, Congress approved the Disaster Mitigation Act of 2000 (DMA2K). DMA2K set forth requirements for communities to develop and adopt local natural hazard mitigation plans to become eligible for mitigation grant funding, including FEMA's Hazard Mitigation Grant Program (HMGP), and Pre-Disaster Mitigation (PDM) Grant Program.

What does a mitigation plan do?

Natural hazards mitigation plans document knowledge about the problems associated with natural hazards in a community. A mitigation plan articulates goals that will guide the community in implementing short- and long-term risk reduction activities, recommending appropriate mitigation action items, and identifying resources to implement activities. Preparing a mitigation plan for your community can reduce public and private costs resulting from natural disaster events. Successes in risk reduction and loss prevention are achieved by implementing programs that address and mitigate the potential impacts natural disasters may have on society, the economy, and the environment.

How will the county help with this process?

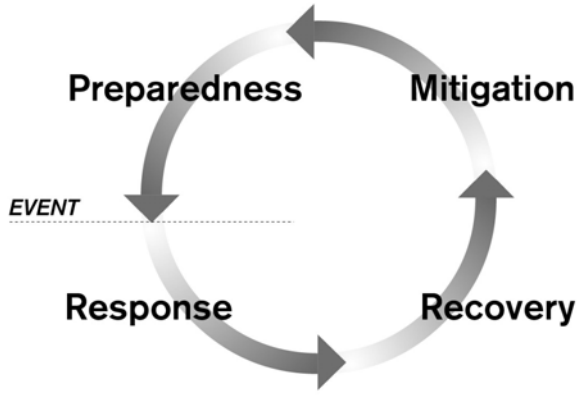
In an effort to assist each city in their addendum development process, Clackamas County partnered with the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon to hire a Resource Assistance for Rural Environments Participant (RARE Participant). The RARE Participant was hired using funds made available through the Hazard Mitigation Grant Program, and she will work with each participating city in developing an addendum to Clackamas County's Natural Hazards Mitigation Plan. The planning processes will occur between February and August 2009.

The RARE Participant will be responsible for developing and facilitating all natural hazards mitigation plan meetings within each city. Likewise, the RARE Participant will be responsible for documenting the results of each meeting, and preparing a draft addendum for all cities involved.

The Disaster Cycle

The emergency management profession and FEMA have used the concept of the disaster cycle (Figure 1-1) to describe the phases of a disaster. Although described as separate phases, each phase is tied to the others. It is helpful to think of the disaster cycle as a simple equation. Every risk or vulnerability we mitigate today reduces our overall exposure whereby decreasing the pressure on the response side of the disaster cycle and lowering our recovery costs from future events. This section defines the four phases and describes plans and activities associated with them. The four phases, Response, Recovery, Preparedness, and Mitigation can be described as follows:

Figure 1-1: The Disaster Cycle



Response

Response begins as soon as a disaster event occurs. Response is the provision of search and rescue, medical services, and access control as well as repairing and restoring communication and data systems during a crisis. A coordinated response plan can help reduce casualties, damage, and decrease recovery time. Examples include emergency operations plans and business continuity plans and established networks of first responders.

Recovery

Recovery operations provide for basic needs and restore the community. There are two components in the recovery phase. During the first phase, infrastructure is examined, and repairs are conducted to restore water, power, communication and other utilities. The second phase includes returning to normal functions and addressing future disasters. The process of recovery can take months or possibility years to accomplish depending upon the event. An example would be the development of a post-disaster recovery plan.

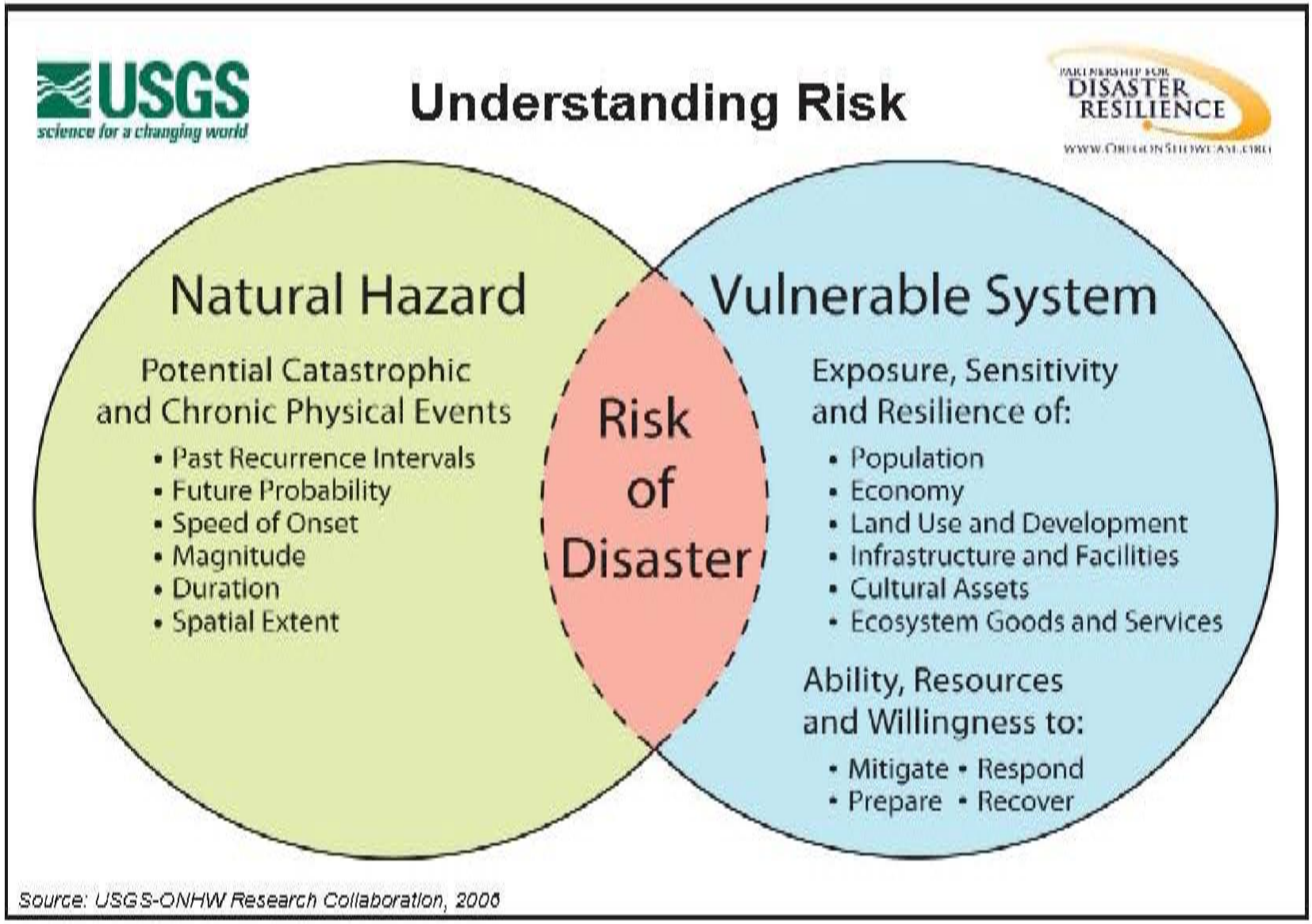
Preparedness

Preparedness refers to activities, programs, and systems developed in advance of a disaster designed to build and enhance capabilities at an individual, business, community, state and federal level to support the response to and recovery from disasters. Example strategies might include developing awareness and outreach campaigns and training targeted to individuals and businesses on personal and professional responsibility to be self sufficient for at least 72 hours post-disaster.

Mitigation or Risk Reduction

Mitigation is the act of reducing or eliminating future loss of life and/or property, and/or injuries resulting from hazards through short and long-term activities. Mitigation strategies may range in scope and size; however, no matter the size, effective mitigation activities have the potential to reduce the vulnerability and/or exposure to risk and impact of disasters. Example mitigation activities for flooding include acquiring, elevating, or relocating structures; for seismic include building code, retrofitting buildings or infrastructure and non-structurally retrofitting labs and offices; and for wind or winter storms include under grounding power lines and tree replacement programs.

CLACKAMAS COUNTY



Natural Hazard Mitigation Plan Introductory Meeting

City of Gladstone
July 13, 2009
3:00 to 4:00pm

First	Last	Agency	Job Title	Email	Roundtrip Mileage
Scott	Tebor	City of Gladstone	Public Works Supervisor	tebor@ci.gladstone.or.us	
Jim	Pryde	" "	Chief of Police	pryde@ci.gladstone.or.us	
Mike	Funk	" "	Fire Marshal	funk@ci.gladstone.or.us	

Meeting: Gladstone Natural Hazard Mitigation Plan Meeting 1
Date: July 27, 2009
Time: 3:00 to 5:00pm
Location: Gladstone City Hall

Minutes

1. Meeting Attendees
    a. Pete Boyce, Gladstone City Administrator
    b. Scott Tabor, Gladstone Public Works Supervisor
    c. Jim Pryde, Gladstone Police Chief
    d. Wendy Burns, Gladstone Christian Church
    e. Tom Hogan, Gladstone Emergency Management Volunteer Coordinator
    f. Kim Sieckmann, Planning Commissioner
    g. Jay Wilson, Clackamas County Emergency Management

2. Planning Process Discussion
    a. Laurel provided the group with a handout of the planning process information currently in the Gladstone NHMP. The group reviewed the existing information and made changes as needed.
    b. The assembled group is called the hazard mitigation advisory committee.
    c. Mission and Goals – The group will keep the county's mission and goals
    d. Plan Adoption – The Gladstone City Council is still the authoritative body which will adopt the plan
    e. Coordinating Body – The current plan lists the Planning Commission as the coordinating body, however there was discussion to change the group to the Hazard Mitigation Advisory Committee. Pete and Kim will talk to the Planning Commission about this and make a formal decision at the next meeting.
    f. Convener – The 2005 plan lists the Gladstone Fire Department as convener but the group decided to make the Gladstone Police Chief the convener for the 2009 plan.
    g. Public Involvement
        i. Copies will be catalogued and kept at the Public Works Department, the City Manger's Office, The Planning Commission, the Gladstone Fire Department, and the Gladstone Police Department.
        ii. A copy of the plan and any proposed changes will be posted on the city website.
        iii. An article in the Gladstone City Newsletter will refer citizens to the website to view the entire plan.
        iv. The 2005 plan says they will have a public meeting annually but the group changed it to only have a public meeting will when deemed necessary. The public has been involved after every hazard event but not in a formal meeting setting.

3. Community Assets
    a. The group reviewed the list of community assets listed in the 2005 plan and made changes as necessary.
    b. ***Critical Facilities & Infrastructure:*** Those critical facilities and infrastructure necessary for emergency response efforts.

i. Fire Station
ii. Police Station
iii. Drinking Water Distribution System (3 reservoirs that intertie with Clackamas River Water and Oak Lodge Water; all water lines)
iv. Bridges
v. Transportation Networks
vi. Public Works
vii. Surface Water Drainage Infrastructure
viii. 99E, HWY 205, Rail Road, Oregon City Bridge, 82nd Bridge
ix. Communications Towers
x. NW Natural Pipelines off McLoughlin
xi. Power substation on Jennings
xii. Gladstone Christian Church – Red Cross shelter
xiii. Tri-City Baptist – Red Cross shelter

c. ***Essential Facilities:*** Those facilities and infrastructure that supplement response efforts.
i. Gladstone High School
ii. John Wetten Elementary
iii. Kraxberger Middle School
iv. Sewer Pump Station & Treatment Facility
v. Evergreen Lane
vi. Oxford Suites
vii. Safeway
viii. Gladstone Children and Family Services
ix. Riverview Convalescence Center
x. Somerset
xi. Churches: First Baptist Church, Seventh-Day Adventist, St. Stephen Lutheran Church, Assembly of God, Church of Jesus Christ of Latter-Day Saints, Faith & Life Center Free Methodist Church, Church of Christ
xii. Clackamas Rehab Facility
xiii. Dr. King's Office

d. ***Vulnerable Populations:*** Locations serving populations that have special needs or require special consideration.
i. Senior Living
1. Somerset Assisted Living
2. Gladstone Senior Center
3. Clackamas Rehabilitation and Specialty Care (Avamere Rehabilitation of Clackamas)
4. River View Care Center
ii. Mobile Home Parks
1. Tri-City Mobile Home Park
2. Gladstone Mobile Home Park
iii. Schools
1. Gladstone High School
2. John Whenton Elementary
3. Kraxberger Middle School
iv. Daycare Centers
1. St. Stephen's Church Daycare
2. Assembly of God Daycare

3. YMCA Gladstone

v. Northwest Behavioral Healthcare Services (Adolescent Residential Treatment)

e. ***Economic Assets/ Population Centers: Economic Centers*** are those businesses that employ large numbers of people, and provide an economic resource to Gladstone. If damaged, the loss of these economic centers could significantly affect economic stability and prosperity. ***Population Centers*** usually are aligned with economic centers, and will be if particular concern for evacuation/notification during a hazard event.

i. Apartment Complexes
   1. Brook Side
   2. River Run
   3. River Place
   4. Fairway Village
   5. Autumn Oaks
   6. Tall Oaks
   7. River Green

ii. Oxford Suites
iii. Budget In
iv. Safeway
v. McLoughlin Blvd Corridor
vi. Portland Ave. Corridor
vii. 82nd / Arlington Corridor

f. ***Environmental Assets:*** Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional service for the community.

i. McLoughlin/Risely Wetland
ii. Glen Echo Wetland
iii. Detention Ponds
iv. Willamette and Clackamas Rivers and Riparian Corridors
v. Gladstone High School Bioswale

g. ***Hazardous Materials***: Those sites that store, manufacture, or use potentially hazardous materials.

i. Gas Stations
ii. Cal Spas Chemical Storage
iii. Classic Pool and Spa
iv. First Student Bus Barn
v. Gladstone Public Works

4. Mitigation Planning Priority System Discussion
   a. Laurel will email the new priority system out to the committee to see if they would like to go with it or stay with the current ranking system, which gives points to each action item.

5. Hazard Identification
   a. Laurel provided a handout with information about each hazard including the causes and characteristics, history, impacts & vulnerabilities, probability and vulnerability ratings, and information from the county and 2005 plans. The group reviewed the information and provided more details.
   b. Flood

i. December 28, 2005 to January 1, 2006 - Clackamas, Willamette, Tualatin, and Pudding Rivers reached flood stage. The majority of costs were damages to roads, wastewater treatment facilities, and repairs to stabilization of landslides, debris removal, and overtime of public works employees.
    1. Gladstone lost pumping capacity at the sewer pump station, causing back ups in some homes. The city contemplated using portable toilets in these areas, but the pump station was fixed quickly enough that this step was not taken.
    2. Meldrum Bar Park flooded causing damage to the irrigation pump house, park structures and fields.
    3. Floodwaters reached the backside of the bowling alley and flooded the lanes.
    4. Water reached North Clackamas County Regional water consortium area.
    5. Homes were flooded on Edgewater Road and Evergreen Lane. Sandbagging was attempted but the river overcame the sandbags.

ii. December 26, 2008 to January 2, 2009 - Clackamas County was hit with the worst winter storm event in over 40 years. The storm saturated soils and led to a landslides, sewer overflows, downed trees, and car accidents.
    1. Stormdrains were at capacity and led to localized flooding. Portland Avenue flooded and a sewage backup occurred.
    2. The pump station owned by Oak Lodge Sanitary on Glen Echo flooded. When this pump station goes down it can lead to flooding near the high school.
    3. This flooding was primarily a capacity issue. Flooding occurred in places where flooding had never occurred before.

iii. Impacts/Vulnerabilities
    1. Places that have experience flooding in the past include Clackamas Blvd., Edgewater Road, River Lane, Evergreen Lane, Rivergreen Golf Course, Dahl Park, Meldrum Bar Park, south end of Rivergreens Road (Rivergreens Apartments), complex on River Road south of Rivergreens Apartment, south end of Jensen road (golf course), bottom of Rinearson Road
    2. Vulnerable populations affected are Riverview Convalescence Center, Gladstone Mobile Home Park, Tri-City Mobile Home Park, and Holly View Mobile Home Park
    3. Vulnerable fuel stations include 76, Chevron, Arco, and the Gladstone city shops
    4. Glen Echo between Addie and Portland Avenue systematically backs up. A diversion was put in by the county that allows for two way flows, but it only seems to flow towards Gladstone

iv. Probability of Future Occurrence: High
v. Vulnerability: High – in major events more than 10% of the population can be affected because Gladstone had both the Clackamas and Willamette Rivers on its borders
vi. Mitigation Steps Taken
    1. All electronics at the pump station in Glen Echo (owned by Oak Lodge Sanitary) have been elevated above flood level.
    2. Public works picks up between 2500 and 3000 cubic yards of leaves between October and January each year. Information is put in the newsletter and online to instruct residents on how to properly put out the leaves for pickup.
    3. Public Works teaches a 2 hour class each year at Gladstone High School to teach students about the functions of city infrastructure. It also teaches them how to keep the system working (ie don't plug it up, etc)

c. Landslide
    i. A home on Oak Ridge Drive was removed because of ground movement. The home slid slowly over years.
    ii. Residential properties on the east side of Gladstone High School to Oatfield Road are on steep slopes
    iii. Exposed essential facilities include Gladstone High School and First Baptist Church
    iv. Economic/Population Centers exposed include Safeway, Tall Oaks Apartments and Shady Oaks Apartments
    v. Park Way and Caldwell could be susceptible to sliding. Homes in these areas have put pilings under the homes to stop the slow ground movement.
    vi. Probability: High
    vii. Vulnerability: Moderate – in a very large landslide event up to 5% of the population could be affected. The Oatfield/Oakridge corridor has a number of homes.

d. Wildfire
    i. July 4, 2009 – a large debris pile near Meldrum Bar Park caught fire for unknown reasons late at night. Someone has been putting yard debris there for quite some time and if conditions were right it could have been a large fire.
    ii. Oberson property fire – it is suspected a transient campfire started the fire, the fire was quickly suppressed by fire fighters but could have been worse
    iii. Gladstone has a number of heavily vegetated areas around the city. Places that have a large fuel supply include the open field along Webster Road, Billy Goat Island, Meldrum Bar, and Nick Shannon Park. Places adjacent to fuel include the business corridor along 99E, area between Ridgegate Drive and Parkway Drive, between Salty Acres and Barberry Cove, Rinearson creek wetlands, and areas along the Clackamas river too
    iv. Probability: Moderate
    v. Vulnerability: Moderate
    vi. Mitigation Steps Taken:

1. Volunteer groups remove invasive species
2. Public Works removes dead fuels such as rotten trees
3. The city is working on an intergovernmental agreement with Metro for the Regional Illegal Dumping Patrol (RID) to help clean up transient camps

e. Severe Storm: Wind and Winter
   i. Noting out of the ordinary has occurred – the county plan is sufficient
   ii. The majority of power lines are above ground in Gladstone, making the risk of power outages higher than other cities
   iii. Probability of winter storms: High
   iv. Probability of wind storms: Moderate
   v. Vulnerability to winter storms: Moderate
   vi. Vulnerability to wind storms: Low
   vii. Mitigation steps
      1. The city has a regular sanding route
      2. The city encourages citizens to shovel their sidewalks and take action on their own property

f. Earthquake
   i. The county plan is sufficient
   ii. Impacts/Vulnerabilities
      1. The Oatfield corridor is susceptible to earthquake induced landslides
      2. The Fire Department received a grant for retrofits. So far the new façade is seismic, other projects are planned
      3. After the Scotts Mills Quake in 1993 the reservoir had seismic upgrade work
      4. The Gladstone High School has a new building and seismic work has been done on the other building
      5. Gladstone Center for Children and Families – used to be the Danielson's so seismic work was done to make it suitable for it's current use
   iii. Probability: High
   iv. Vulnerability - High

g. Volcano
   i. The county plan is sufficient
   ii. Probability: Low
   iii. Vulnerability: High

6. Next Time: Action Items
   a. Think of action items like a wish list, if someone gave Gladstone a big pot of money what mitigation projects would you do?
   b. The next meeting is scheduled for August 17th at 3:00

Natural Hazard Mitigation Plan Meeting 1

City of Gladstone
July 27, 2009
3:00 to 5:00pm

First	Last	Agency	Job Title	Email	Roundtrip Mileage
Pete	Boyce	City of Gladstone	City Administrator	boyce@ci.gladstone.or.us	0
Scott	Tabor	City of Gladstone	Public Works Supervisor	tabor@ci.gladstone.or.us	
Jim	Pryde	" " "	Police Chief	pryde@ci.gladstone.or.us	—
Wendy	Burns	Gladstone Christian Church	Volunteer	gladstone100@gmail.com	2
Tom	Hogan	City of Gladstone	EM Vol. VOLUNTEER COORDINATOR	thogan@ci.gladstone.or.us	8
Kim	Sieckmann	Gladstone Planning	Planning Commissioner	KLSieckmann@Comcast.net	1
Jay	Wilson	CCEM	Haz Mit Coord.	jaywilson@co.clackamas.or.us	

Meeting: Gladstone Natural Hazards Mitigation Plan Meeting 2
Date: August 17, 2009
Time: 3:00pm
Location: Gladstone City Hall

MINUTES

1. Attendees
    a. Pete Boyce, Gladstone City Administration
    b. Mike Buchanan, Gladstone School District
    c. Wendy Burns, Gladstone Faith Based Community
    d. Jim Pryde, Gladstone Police Chief
    e. Kim Sieckmann, Gladstone
    f. Jeff Smith, Gladstone Fire Department Planning Commission
    g. Scott Tabor, Gladstone Public Works

2. Meeting Minutes Clarifications
    a. Laurel ask clarifying questions from the first meeting minutes
    b. Flood – the electronics were elevated at the Glen Echo pump station, not Glen Echoes
    c. The other edits were correct in the original meeting minutes

3. Formal Review Process and Plan Maintenance
    a. The committee will meet at least two times a year. Additional meetings will be held when deemed necessary.
    b. No meetings were held between adoption of the plan in 2005 and now.
    c. The group agreed to put the bullet points in detailing what should be talked about at each meeting. During the first meeting, the committee will:
        - Discuss funding opportunities for the implementation of mitigation strategies.
        - Review existing action items to determine appropriateness for funding;
        - Educate and train new members on the plan and mitigation in general; and
        - Identify issues that may not have been identified when the plan was developed.

        During the second meeting of the year, the committee will:
        - Review existing and new risk assessment data, and incorporate this information into the plan;
        - Document success in implementing mitigation actions and/or applying for funding;
        - Discuss the addition and/or subtraction of mitigation actions from the plan;
        - Discuss methods for continued public involvement;

- Document successes and lessons learned during the year; and
- Generate a list of members that should be included in future meetings.

d. Instead of evaluating the plan every other year, the plan will not be evaluated starting one year prior to FEMA review, meaning the next update will begin in September 2011.
e. The convener will be responsible for initiating the evaluations process and updating the plan.
f. Timeline for plan updates
    i. The plan will be updated every five years follow the follow county's update cycle. This means the first update will be due in September 2012.
    ii. The update process will begin in September 2011 to allow sufficient time for update activities and FEMA review.
g. The group agreed to include in the plan a list of questions that should be asked for the next plan update in 2011. During the plan evaluation the committee will ask:
    - Have public involvement activities taken place since the plan was adopted?
    - Are there new hazards that should be addressed?
    - Have there been hazard events in the community since the plan was adopted?
    - Have new studies or previous events identified changes in any hazard's location or extend?
    - Has vulnerability to any hazard changed?
    - Have development patterns changed? Is there more development in hazard prone areas?
    - Do future annexations include hazard prone areas?
    - Are there new high risk populations?
    - Are there completed mitigation actions that have decreased overall vulnerability?
    - Did the plan document and/or address National Flood Insurance Program repetitive loss properties?
    - Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?
    - Did the plan identify data limitations?
    - Did the plan identify potential dollar losses for vulnerable structures?
    - Are the plan goals still relevant?
    - What is the status of each mitigation action?
    - Are there new actions that should be added?
    - Is there an action dealing with continued compliance with the National Flood Insurance Program?

- Are changes to the action item prioritization, implementation, and/or administration processes needed?
- Do changes need to be made within the five year update schedule?
- Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?

4. Mitigation Planning Priority System Decision
    a. The group agreed to use the new priority system rather than ranking action items based on point values.

5. Update and Brainstorm Action Items
    a. Laurel provided the group with a handout of the 2005 action items and proposed action items.
    b. The group reviewed and revised the action items from the 2005 plan to discuss what had or hadn't been completed. The group updated the "ideas for implementation", coordinating organization, and timeline if needed.
    c. Laurel included proposed action items on the handout. The group discussed each action item to determine if they wanted to keep, alter, or delete it.
    d. See the attached handout for the final list of action items.

6. Next Steps
    a. Laurel will compile the plan and email it out to the committee for review. Laurel's job with the county ends August 31st so Megan Findley at the Oregon Partnership for Disaster Resilience will take over after Laurel completes a draft.
    b. Once a final draft is completed it will need to be presented to the public for their comments. This can mean posting the plan online, writing a press release, presenting it at a community meeting/event, etc.
    c. Once public comment is completed the plan will be sent into FEMA for preliminary review. Preliminary review takes between 40 and 60 days.
    d. FEMA will either pre-approve the plan or return the plan with edits. The Partnership will make any necessary edits and then resubmit the plan.
    e. After we've gained pre-approval the plan will need to be adopted by City Council and then resent to FEMA for official approval.

Appendix B
Economic Analysis of Natural Hazard Mitigation Projects

This appendix was developed by the Community Service Center's Oregon Natural Hazards Workgroup at the University of Oregon. It has been reviewed and accepted by the Federal Emergency Management Agency as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: The Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan,* (Oregon State Police – Office of Emergency Management, 2000), and Federal Emergency Management Agency Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigatio*n. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to provide the details of economic analysis methods that can be used to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout the

community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are Some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the there methods is outlined below:

Benefit/cost Analysis

Benefit/cost analysis is a key mechanism used by the state Office of Emergency Management (OEM), the Federal Emergency Management Agency, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoided future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in public sector mitigation activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still

affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in private sector mitigation activities

Private sector mitigation projects may occur on the basis of one of two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchasers. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Conducting detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practicable. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of these methods is the STAPLE/E Approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a systematic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E Approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process".

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff, and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or county planning commission, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?

- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)?
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

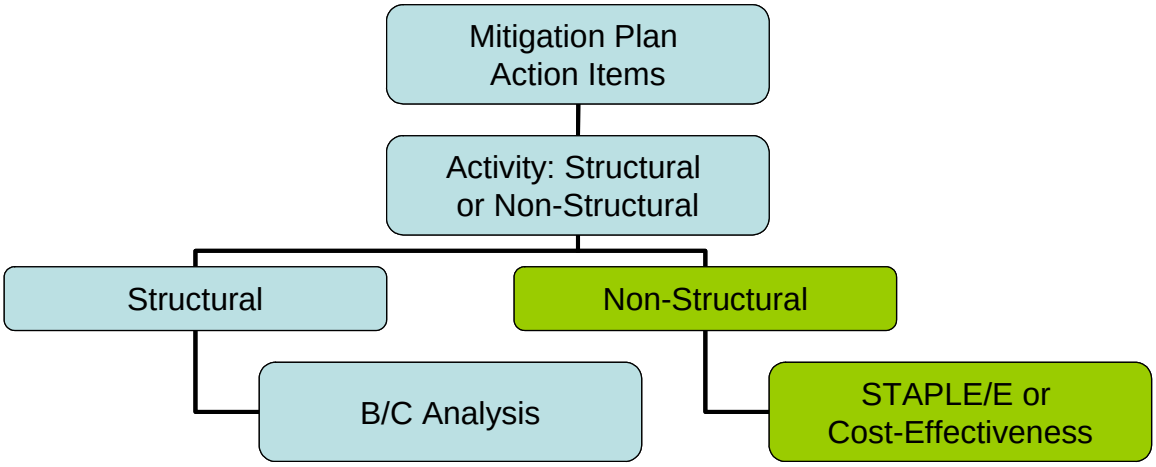
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed Benefit/Cost Analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure is to serve as a guideline for when to use the various approaches.

Figure A.1: Economic Analysis Flowchart



Source: Community Service Center's Oregon Natural Hazards Workgroup at the University of Oregon, 2005

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. Identify the Activities

Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation project can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost.*** This may include initial project development costs, and repair and operating costs of maintaining projects over time.
- ***Estimate the benefits.*** Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult

to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- ***Consider costs and benefits to society and the environment.*** These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- ***Determine the correct discount rate.*** Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Activities

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of expected future cost expressed in today's dollars. If the net present value is greater than the project costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.
- ***Internal Rate of Return***. Using the *internal rate of return* method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to

understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Many communities are looking towards developing multi-objective projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies For Evaluating The Socio-Economic Consequences Of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997.

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation Projects*, Riverine Flood, Version 1.05, Hazard Mitigation Economics Inc., 1996.

Federal Emergency Management Agency *Report on Costs and Benefits of Natural Hazard Mitigation.* Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in The City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olson Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000).

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency Management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.