City of West Linn

Natural Hazards Mitigation Plan Addendum

DRAFT

Prepared for

City of West Linn
22500 Salamo Road
West Linn, OR 97068

In cooperation with

Clackamas County
2200 Kaen Road
Oregon City, OR 97045

Table of Contents

Section1:
Planning Process

The West Linn 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 the City of West Linn in reducing risk and preventing loss from future natural hazard events. West Linn has developed this plan as an addendum to the multi-jurisdictional Clackamas County Natural Hazards Mitigation Plan.

Planning Participants

The West Linn Natural Hazards Mitigation Plan is the result of a collaborative effort between the City of West Linn, Tualatin Valley Fire and Rescue, Clackamas County, and others. A project steering committee, termed the Hazard Mitigation Advisory Committee (HMAC), guided the process of developing the plan, and stakeholders were interviewed to ensure that the plan reflected the interests of agencies that have a vested interest in reducing losses from future hazard events. The HMAC and stakeholders consisted of representatives from the following organizations:

- West Linn City Council
- West Linn Community Services Office
- West Linn Building Planning and Building Dept.
- West Linn Neighborhood Associations
- West Linn Police Dept.
- West Linn Paper Co.
- West Linn/Wilsonville School District.
- West Linn Parks Department
- West Linn Public Works Department
- Tualatin Valley Fire and Rescue
- Clackamas County Emergency Management

The HMAC identified other stakeholders that may be asked to serve on the HMAC in the future, including Neighborhood Associations, Chamber of Commerce, Willamette River Keepers, Nature Conservancy, and the Tualatin River Watershed Council. Other relevant stakeholders include FEMA, Oregon Emergency Management, Clackamas County Water Environment Services, Clackamas County Roads Dept., South Fork Water Board, and Oregon Department of Transportation.

Public Process

The City of West Linn is committed to involving the public in the mitigation planning process. A draft was available on the West Linn website for public review on April 1st, 2007. The public was encouraged to review and comment on the draft plan through a variety of media:

Board of Clackamas County Commissioner's Public Hearing 4-19-07

The Multi-Clackamas County Natural Hazards Mitigation Plan: 2007 Update was a discussion item on the agenda. This agenda was published in the Citizen News, which goes to all Clackamas County residents. The presentation focused on soliciting public input on the draft Clackamas County NHMP Update as well as the West Linn Plan Addendum. The plans are located on the County and City's websites and residents were encouraged to comment on the plan and provide edits to the County's Emergency Management Department. The presentation was televised on Clackamas County Cable, and minutes are located on the County website.

City of West Linn Work Session 7-30-07

Members of the West Linn HMAC made a presentation to the City Council to describe the mitigation plan, and FEMA's Pre Disaster Mitigation program, and solicit input from stakeholders and the public. Public notices advertising the Work Session agenda are placed at city hall, the adult community center, the library, on the City's website. Although the Work Session is closed to the public, it is televised on Channel 30 (Public Access), and is on the front page of the City's website (with contact information for feedback). The minutes from the Work Session are available on City's website.

City of West Linn Public Hearing 7-30-07

In an effort to gain more input from stakeholders and residents, members of the West Linn HMAC made a presentation to the City Council to describe the mitigation plan. Public notices advertising the Public Hearing agenda were placed at city hall, the adult community center, the library, and on the City's website.

Many stakeholders such as Planning Commission members and Neighborhood Associations were present at the public hearing. These citizen advisory groups were encouraged to provide comment on the draft plan.

The Public Hearing is the forum for community input on local government policies, and residents were given an opportunity to give comment on the draft mitigation plan. In addition, the public was encouraged to participate in plan development by reviewing and providing information to reflect local needs and priorities. The Public Hearing was televised on Channel 30 (public access), and the minutes are available on the City's website. Residents were given two weeks to comment on the mitigation plan.

Multi-Jurisdictional Planning Effort

The City of West Linn is participating in a regional approach to planning for natural hazards. The City has representation on the Clackamas County Hazard Mitigation Advisory Committee to ensure that the City's interests are represented in the larger scale planning effort. The City will partner with Clackamas County in implementing appropriate action items, and will work with other jurisdictions to reduce losses from future natural hazards.

Plan Mission

The mission of the West Linn Natural Hazards Mitigation Plan is to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, assessing the relative risks of natural hazards and prioritizing the cost-effectiveness of mitigation actions, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the City in building a safer, more sustainable community.

Plan Goals

A. Protect Life and Property

- Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property safe 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 regulating development in areas vulnerable to natural hazards.

B. Enhance 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.

C. Preserve 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.

D. Develop Partnerships and Coordinate 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.

E. Augment Emergency Services Planning

- Establish policies to mitigate risks to 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.

Plan Implementation Monitoring, and Evaluation

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

Coordinating Body

The West Linn Hazard Mitigation Advisory Committee (HMAC) will be responsible for coordinating implementation of plan action items and undertaking the formal review process. The HMAC will discuss the West Linn Natural Hazard Mitigation plan semiannually, or as needed, to identify funding for the implementation of mitigation strategies, evaluate the effectiveness of the plan, and develop new mitigation strategies to reduce losses from natural hazards.

Convener

The Community Services Director or other HMAC designee (likely the Emergency Services Director, when the position is filled) will serve as the HMAC convener. The convener will assign tasks such as updating and presenting the Plan to the members of the committee. Plan implementation and evaluation will be a shared responsibility among all of the HMAC members.

Implementation through Existing Programs

The City of West Linn addresses statewide planning goals and legislative requirements through its Comprehensive Land Use Plan, Capital Improvement Plan, Utility Master 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, and will be adopted by reference into the Community Development Code and City Ordinances. The City of West Linn will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

Economic Analysis of Mitigation Projects

The Federal Emergency Management Agency's approaches to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. 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. 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 can provide 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.

Given federal funding, the HMAC will use a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the HMAC may use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, please see Appendix C of the Clackamas County Natural Hazards Mitigation Plan.

Formal Review Process

The City of West Linn Addendum to the Clackamas County Natural Hazards Mitigation Plan will be evaluated every 3-4 years to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The HMAC will review the goals and action items to determine their relevance to changing situations in the county, as well as changes in State or Federal policy, and to ensure they are addressing current and expected conditions. The committee will also review the hazard assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised. This addendum will be submitted to FEMA every five years for review and approval.

Continued Public Involvement

The City of West Linn is dedicated to involving the public directly in review and updates of the Hazard Mitigation Plan. 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 and City Hall, the Parks Department, the Land Use Planning and Building Departments, the Library, the Tualatin Valley Fire and Rescue, and the West Linn Police Department. In addition, a copy of the plan and any proposed changes will be posted on the city website. This site will also contain an email address and phone number to which people can direct their comments and concerns.

A public meeting will be held when deemed necessary by the HMAC. Input may also be solicited from regular standing committees such as the Planning Commission and neighborhood associations. Public Hearings will also be held during the plan update process.

City of West Linn Mitigation Strategies

The *action items* are a listing of activities in which county agencies and citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation. *Short-term action items (ST)* are activities that county agencies may implement with existing resources and authorities within one to two years. *Long-term action items (LT)* may require new or additional resources or authorities, and may take

between one and five years to implement. The action items are organized within the following matrix, which lists all of the multi-hazard and hazard-specific action items included in the mitigation plan.

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Public Awareness	Preserve Natural Systems	Partner and Implement	Augment Emergency Services
Multi-Hazard Mitigation Action Items								
Short-Term Multi-Hazard #1	Reduce threat to critical and essential public facilities.	Public Works/Engineering	Ongoing	✓		✓	✓	✓
Short-Term Multi-Hazard #2	Enhance recognition of hazards, and appropriate mitigaiton and response activites through public education.	HMAC Members	Ongoing	✓	✓	✓	✓	✓
Short-Term Multi-Hazard #3	Implement Goal 5 Natural Assets Inventory and Analysis including recommendations fore identifying, protecting, and enhancing natural resources.	Planning Department	Ongoing	✓	✓	✓		✓
Short-Term Multi-Hazard #4	Utilize Geographic Information Systems to update the hazard and vulnerability assessment.	GIS/Planning	1-2 years	✓	✓	✓	✓	✓
Long-Term Multi-Hazard #1	Hire an Emergency Service Coordinator to develop an emergency management program for the City with a focus on utilizing citizen volunteers in programs such as Community Emergency Response Teams (CERT).	City Administration	1-3 years	✓	✓	✓	✓	✓
Flood Mitigation Action Items								
Short-Term Flood #1	Recommend revisions to requirements for development within the floodplain, where appropriate	West Linn Planning Department	1-3 years	✓		✓	✓	✓
Short-Term Flood #2	Improve real-time flood advisory/flood warning capability	West Linn Community Services Dept.	Ongoing	✓	✓	✓		
Short-Term Flood #3	Heighten public awareness of flood and storm water hazards and steps they can take to reduce flood threats.	West Linn Community Services Dept.	Ongoing	✓	✓	✓		
Short-Term Flood #4	Implement revised Storm Water Master Plan, and seek revenue sources to fund capital improvement projects that can reduce flood threats.	West Linn Public Works	Ongoing	✓	✓	✓		
Short-Term Flood #5	Address vulnerabilities of sewer pump stations to potetnial flood events.	West Linn Public Works	1-2 years	✓		✓		✓
Long-Term Flood #1	Acquire flood-prone riverfront properties and preserve as open space.	West Linn Parks and Recreation Dept.	1-5years	✓		✓	✓	
Landslide Mitigation Action Items								
Short-Term Landslide #1	Increase public awareness of earthquake/landslide risks, development restrictions and mitigation measures.	Community Services	1-2 years	✓	✓			
Short-Term Landslide #2	Identify, prioritize and mitigate significant landslide threats to critical and essential facilities and infrastructure (e.g. reservoirs, pump stations) and neighborhoods.	Engineering /Parks and Recreation/Planning	Ongoing	✓		✓	✓	✓

Natural Hazard	Action Item	Coordinating Organization	Timeline	Protect Life and Property	Public Awareness	Preserve Natural Systems	Partner and Implement	Augment Emergency Services
Wildfire Mitigation Action Items								
Short-Term Wildfire #1	Increase public awareness of wildfire threat and ways to reduce risk to life and property in the urban/woodland interface.	Community Services, TVF&R	Ongoing	✓	✓	✓	✓	
Short-Term Wildfire #2	Review and assess adequacy of city's water storage capacity for fighting wildfires, and develop strategy to address deficiencies, if any.	Public Works	1 year	✓			✓	✓
Short-Term Wildfire #3	Inventory alternative firefighting water sources.	Engineering Department	1 year	✓			✓	✓
Long-Term Wildfire #1	Support and develop strategies to prohibit shake roofs on homes in the WUI.	Planning/Building	2-3 years	✓	✓	✓	✓	✓
Long-Term Wildfire #2	Reduce fuel loading in WUI, while balancing effects on wildlife and habitat.	Community Services/Parks	Ongoing	✓		✓	✓	
Severe Storm Mitigation Action Items								
Short-Term Severe Storm#1	Reduce risk of erosion and soil destabilization by implementing the strategies outlined in the Storm Water Master Plan	Public Works/Planning	Ongoing	✓		✓	✓	
Short-Term Severe Storm#2	Reduce risk of utility and communications outages.	Public Works	Ongoing	✓			✓	✓
Short-Term Severe Storm # 3	Encourage public preparedness for winter storm events.	Community Services	Ongoing	✓	✓			
Short-Term Severe Storm # 4	Develop a tree hazard program for preventing future hazards, while improving long-term health and care for the urban forest.	Parks/Planning	1-3 years	✓	✓	✓		
Earthquake Mitigation Action Items								
Short-Term Earthquake #1	Reduce threat to critical and essential facilities and infrastructure.	Public Works/Engineering	ongoing	✓				✓
Short-Term Earthquake #2	Increase public awareness of earthquake insurance and availability.	Risk Management	1-2 years		✓		✓	
Short-Term Earthquake #3	Update earthquake risk assessment using HAZUS and new mapping data.	GIS	1-2 years		✓		✓	
Short-Term Earthquake #4	Increase public awareness of earthquake threat and preparedness.	Community Services	Ongoing	✓	✓		✓	
Long-Term Earthquake #1	Develop seismic analyses of key bridges that serve West Linn and develop strategies for retrofitting and replacement.	Public Works	Ongoing	✓	✓		✓	✓

Section 2: Community Profile

Location

The City of West Linn is located in Clackamas County, OR, within the southern bounds of the Portland metropolitan area. It is bordered on the east and divided to the southwest by the Willamette River, bordered on the south by the Tualatin River, and on the north by the City of Lake Oswego. To its southeast, across the Willamette, lies the City of Oregon City, while adjacent to its southerly and westerly borders are rural areas of unincorporated Clackamas County. The City of Portland proper, the largest metropolitan locale within the State of Oregon, is located roughly eight miles to the north (see Map 1: Overview of Study Area).

Many of the natural features of West Linn, such as steep slopes and flood plains, impose limitations on development. If not recognized and addressed in the development process, these natural features can create public health and safety hazards. Improperly engineered hillside construction can endanger downslope development, and erosive soils create stream siltation and compromise surface water quality.

The Goals & Guidelines of Statewide Planning Goal 7 (Areas Subject to Natural Disasters & Hazards) prohibit locating developments subject to damage or loss of life in known areas of natural disasters and hazards without appropriate safeguards. This Natural Hazards Mitigation Plan will provide an inventory of known areas of natural hazards, as well as an inventory of exposure to the built environment. This information will be critical for directing future development away from hazard prone areas, and prioritizing resources for potential mitigation projects.

History

According to information provided by the City, West Linn was originally occupied by pioneer settlers in the early 1840s, when Robert Moore purchased 1,000 acres of land from the "Wallamut" (Willamette) Indians. Moore built a cabin for himself high on a slope overlooking the Willamette Falls and began the process of building a town that he called Robin's Nest, situated on property now occupied by the West Linn Paper Co.
By 1846, Moore's operations had grown into four flour and lumber mills, along with dwellings for his mill workers. He also operated a ferry to Oregon City. In 1845, Moore changed the name of the town from Robin's Nest to Linn City in honor of his friend Dr. Lewis F. Linn — a well-known free-state advocate, U.S. Senator from Missouri, and sponsor of the Donation Land Claim Bill. In 1850, Moore became the first postmaster of Linn City and purchased an Oregon City newspaper, "The Spectator," in 1852. By then, his Linn City enterprises included a gristmill, sawmill, warehouse, wharves and a breakwater that created a basin in the Willamette River where boats could dock to load and unload cargo.
Moore died in 1857, and not long thereafter, a devastating fire destroyed the sawmill, gristmill, wharves and even a steamer ship docked in Moore's basin. Efforts to rebuild

the town were undertaken by local businessmen, but Linn City was entirely destroyed later in that same year by devastating floods. Revival of the town and its industry began in 1868, when the Willamette Transportation Locks Co. started its services of providing passage to shipping over the Willamette Falls, which have remained in continuous operation to this day.

To allow for the several settlements that constituted Linn City to obtain needed services, utilities and improvements, the town was incorporated on August 8, 1913 and encompassed four areas adjacent to the west side of the Willamette River — West Oregon City, Bolton, Sunset and Willamette Heights. After considerable debate on a name, the city founders decided to honor the pioneer town that Moore had established, bestowing upon the City its current name of West Linn.

Government

According to the most recently adopted version of the West Linn City Charter (May 16, 2006), the governmental structure of the City consists of a mayor and four City Councilors who are elected by the residents. To administrate the business of the City, West Linn hires a City Manager who oversees an annual budget of $33,242,994. Most important to this report is an overview of the regulatory structure within which land-use planning and development operates within the City. Land Use in the State of Oregon begins at the state level, where Oregon has developed a statewide program for land-use planning, the foundation of which is a set of 19 statewide planning goals that outline the state's policies on land use and related topics. Most of the goals are accompanied by guidelines that illustrate the ways that each goal should be implemented. The statewide program is achieved through local comprehensive planning that implements the 19 goals.

State law requires each city and county to develop a Comprehensive Plan — as the City of West Linn has — along with the zoning, planning, development and land division ordinances necessary to implement the plan, which in turn must be consistent with the goals. Each local government’s Comprehensive Plan is adopted as the controlling document for land use in the area covered by that Plan. The State Department of Land Conservation and Development (DLCD) reviews each Comprehensive Plan and its associated updates for consistency with the statewide program. Within the Portland Metropolitan Area, a regional planning agency known as Metro provides regulatory guidelines that local jurisdictions must also meet in the implementation of the statewide goals. Much of the information provided in this report is the result of the City’s development of its Comprehensive Plan and its responses to the 19 statewide planning goals.

Geography, Geology & the Environment

With its easterly border of the Willamette River and its southerly border of the Tualatin River, West Linn is comprised of an area of approximately 7.5 square miles. The City’s winters are mild and wet, with an average annual precipitation of about 47 inches, 86 percent of which occurs between October and May, according to the State’s Economic

and Community Development Department. Summers are warm and dry, and the average minimum monthly temperature is 35 degrees Fahrenheit in January, while the average maximum monthly temperature is 82 degrees in August. The driest month is July, while the wettest month is December.

Light Detection and Ranging (LIDAR) information provided by the City, as well as steep slope and topographical information, illustrates that the easterly and southerly areas of the City that border the Willamette and Tualatin rivers are low-lying — 55 to 60 feet above sea level at Willamette Falls — while the central and northwesterly sections of the City contain a ridge that rises to as high as 650 feet above sea level. According to the U.S. Department of Agriculture (USDA) Soil Conservation Service's Soils Survey of Clackamas County, soils of the low-lying areas are generally characterized by Aloha-Woodburn soils that are deep and poorly to moderately drained. Soils of the areas of the ridge are characterized by Cascade-Powell soils that are deep, somewhat poorly drained and underlain by a cemented layer formed in silty material.

According to the Oregon Department of Geology & Mineral Industries (DOGAMI), as inventoried in its Geologic Maps of the Lake Oswego & West Linn and Canby & Oregon City Quadrangles, the geology of the low-lying areas is comprised of Lacustrine Sediments — unconsolidated cross-bedded to graded sedimentary beds that were deposited by late Pleistocene glacial floods that are seismically unstable and prone to liquefaction in an earthquake event. Geology of the central ridge, on the other hand, consists of Columbia River Basalt — gray to black, dense, fine-grained, low-olivine basalt that is seismically very stable. There are no identified mineral and aggregate resource sites within the City of West Linn.

The DOGAMI Geologic Hazards Maps of the same quadrangles illustrates that the outer sloped boundaries of the ridge exhibit areas of landslide topography, mud flow and debris flow, while some areas adjacent to the rivers exhibit thin soils and soils with high water tables. The City has inventoried and mapped the aforementioned geological hazards, pursuant to the Goals & Guidelines of Statewide Planning Goal 7 (Areas Subject to Natural Disasters & Hazards).

Besides the Willamette and Tualatin rivers, the natural environment of the City contains numerous streams, riparian areas, wetlands, steeply wooded slopes and wildlife habitats. These areas have been inventoried and mapped, pursuant to the Goals & Guidelines of Statewide Planning Goal 5 (Open Spaces, Scenic & Historic Areas, and Natural Resources). In July 2006, the City completed its "Sustainable West Linn Strategic Plan," which examines, among other things, the importance of preserving and incorporating its natural environment into its planning and development endeavors of the future.

Major Rivers

As noted above, West Linn is bounded to the east by the Willamette River and to the south by the Tualatin River. The Willamette River originates far to the southeast of the City in the Cascade Range, where it flows north and eventually joins the Columbia River north of Portland at just 10 feet above sea level. According to the U.S. Environmental

Protection Agency (EPA), the Willamette River Basin comprises 11,500 square miles and is bordered by foothills and mountains up to 10,000 feet high to the south, east, and west. The City's eastern boundary along the Willamette River runs from its confluence with the Tualatin River, approximately 1.5 miles upstream (south) from Willamette Falls, to the West Linn/Lake Oswego municipal boundary, approximately 5 miles downstream (north) from Willamette Falls. The City operates two boat ramps with floating docks along the River, and maintains four parks. Mary S. Young State Park is also situated on the Willamette River in West Linn.

The Tualatin River, flowing east from its source in the Oregon Coast Range that lies well west of the City, drains a 712 square-mile basin on the west side of the Portland metropolitan area, according to the U.S. Geological Survey (USGS). It empties into the Willamette River in the southerly corner of West Linn. West Linn's southern boundary follows the Tualatin River upstream (west) from the Willamette for approximately 2 miles. The 20-acre Willamette Park lies at the confluence of the two rivers. In addition to Willamette Park, the City maintains Fields Bridge Park, consisting of approximately 19 acres along the northern shore of the Tualatin River downstream from Fields Bridge at Borland Road.

Both rivers flood during the rainy season; the floodplain of each is regulated and mapped through the National Flood Insurance Program (NFIP), of which the City is a member in good standing, as a component of its implementation of Goal 7.

Population and Demographics

By the time of its incorporation in 1913, the City's population had grown steadily, as it has continued to do since. The 1860 census listed a population for West Linn of 225 residents. By 1920, the number had grown to 1,628. The 1960 census set the population at 2,923, and by 1970, West Linn had grown to more than 7,000 residents. The growth pattern continued through the 1980s and 90s and continues today. The 1980 census listed its population at 11,358. The 1990 census set it at 16,389, while in the year 2000, the census listed West Linn's population at 22,261.

According to information provided by the City, the population of West Linn currently stands at 24,080 residents, 48.1 percent of which are male, 51.9 percent of which are female, and 13,886 of which are registered voters. The median age of the current population is 38.1, and the median family income is listed as $83,252. The number of households is listed as 8,161, with an average size of 2.72.

Planning & Community Development

The City of West Linn's Comprehensive Plan was adopted in 1983 and acknowledged by the State as complying with the 19 statewide planning goals. Using specific criteria and guidelines outlined in the Comprehensive Plan, as illustrated in its Zoning and Comprehensive Plan maps, the City developed zoning categories, and associated ordinances, to delineate low-, medium- and high-density residential areas. The same process was undertaken for the development of commercial, industrial and future urban areas. These guidelines included the evaluation of such criteria as: access to

transportation facilities (roadways and public transit); physical and environmental constraints; availability of services and infrastructure; character of existing housing or businesses; and proximity to existing public and commercial facilities.

As a result, the City's Comprehensive Plan, along with its implementing ordinances and codes, allows for a variety of densities and types of residences in most areas of the community. Other areas are set aside for business uses that are regulated and guided by the City's Design Review standards. Updates to its code include measures to increase zoning densities for certain neighborhoods and properties, and adoption and implementation of the Tanner Basin Master Plan, which provided for a wider variety of housing types and affordability levels.

Pursuant to the Goals & Guidelines of Statewide Planning Goal 8 (Recreational Needs), the City has developed 23 parks that comprise 292 acres, the largest of which is Wilderness Park, situated in the east-central section of the City. The City has designated and preserved additional areas as open space. Pursuant to the Goals & Guidelines of Goal 12 (Transportation), the City has developed 5.1 miles of pedestrian and bike paths, and has master-planned for additional bike paths.

Housing

According to the City's Comprehensive Plan and other information, more than 80 percent of West Linn's dwellings are single-family detached homes. Close to 70 percent of the City's dwellings were constructed after 1970. The total number of housing units is 8,697, with a median property value of $246,500. Existing housing stock varies widely from the pioneer-era dwellings in the historic Willamette District, located in the southwesterly section of the City, to the contemporary architecture exhibited by newer settlements in the wooded highlands of the ridge.

As noted above, residential uses are located throughout the City that offer considerable variety in housing type and density. For example, accessory dwelling units are allowed in all zoning districts, and in those zoning districts that exhibit a density of one unit per 7,000 square feet or greater, up to several different housing types are permitted.
In January of 2000, 670 potential new dwelling units were in various stages of review. In 2006, the City listed a total of 56 building permits for new single family homes and five building permits for multi-family units. Areas that are zoned for and can support infill development and vacant buildable land (land that is not constrained by steep slopes, floodplains, or set aside for roads and other public facilities) can accommodate an additional 2,241 housing units. The City exceeds the allocation for residential capacity required by Metro's Functional Plan (a regulatory planning document that sets, among other things, benchmarks for the year 2020 that local jurisdictions within the Portland Metropolitan Area must meet). Pursuant to the Goals & Guidelines of Statewide Planning Goal 10 (Housing), the City has developed a buildable lands inventory that illustrates vacant lots, potential infill lots and areas already approved for development.

Public Facilities, Services & Infrastructure

According to its Comprehensive Plan, the City provides a wide range of public facilities, services and infrastructure for its residents, property owners, and businesses to directly provide for, or coordinate in the provision of, the basic public infrastructure of the City and the services necessary to live and operate in its urban environment. These items include adequate transportation, storm drainage infrastructure, sanitary sewer service, water service, police protection, schools, solid waste collection, parks & recreation, and library services.

West Linn contains 110 miles of public sewers, ranging in diameter from six to 24 inches. The Water Environment Services (WES) Department of Clackamas County is responsible for providing wastewater treatment services for the cities of West Linn, Oregon City, and West Linn. Eleven pumping stations, eight of which area City-owned and three of which are owned by Clackamas County, carry the City's wastewater to Clackamas County's Tri-City Wastewater Treatment Plant, which cleans more than 8 million gallons of sewage per day and is located in Oregon City. WES operates under a master plan adopted for the Plant. The sanitary sewer system functions separately from the storm sewer system, and untreated storm water drains directly to surface streams. In 1999, the City contracted with Bookman-Edmonston Engineering to update the 1989 Sanitary Sewer System Master Plan. The study determined expansion and rehabilitation needs of the current system, and identified a comprehensive schedule for improvements.

The City of West Linn currently obtains its potable water from the South Fork Water Board (SFWB), which is jointly owned by the cities of West Linn and Oregon City. The SFWB source of water is the Clackamas River that originates, like the Willamette, in the Cascade Range and flows west to its confluence with the Willamette River just east of the City. The SFWB operates a conventional water treatment plant located on the south side of the Clackamas River near its confluence with the Willamette. Its system includes intake facilities, a water treatment plant, and a transmission pipeline to a pump station located on Division Street in Oregon City. The water system includes three pump stations and serves approximately 7,370 water meters, 95 percent of which are for single-family residential meters. In 1999, the City adopted a new Water System Master Plan to provide long-term guidance for the development of the City's water system, which is a supporting document for the Comprehensive Plan.

West Linn is drained by natural intermittent and flowing streams within a major system of natural canyons and drainageways that discharge to the Willamette and Tualatin Rivers. The existing storm drainage system is a composite of natural streams that are conveyed under streets through culverts and a network of underground storm drain conduits in more densely developed areas. Much of the recent and planned new development in West Linn is located in upland areas of the City's watersheds and has increased the need for better erosion control of natural channels; reduction in the level of pollutants that are present in storm water discharge; improved management of flood flows; and reduction in runoff to downhill / downstream areas. To comply with the Federal Clean Water Act and reduce discharges of storm water pollutants, the City has

been issued a National Pollutant Discharge Elimination System (NPDES) permit and has prepared a storm water quality management program. The City uses the City of Portland Stormwater Management Manual to meet water quality requirements. In 1996, the City adopted the Storm Drainage Master Plan, which is a supporting document of the Comprehensive Plan. This document responds to recent and expected growth in West Linn and the City's commitment to natural drainageway preservation and water quality. Tualatin Valley Fire and Rescue (TVF&R) provides emergency response and fire protection services to the City of West Linn and adjacent unincorporated areas of Clackamas County. TVF&R has a large service area, providing hazardous material and other specialty response, as well as fire and EMS response, fire prevention, and related services. AMR Ambulance Transport also provides emergency medical response and transport to West Linn residents, through a contract covering all of Clackamas County. TVF&R responds to calls from the Bolton and Willamette fire stations, which are staffed 24 hours a day. In addition to career personnel, the organization retains residents of West Linn and nearby areas as volunteer firefighter, responding from the Sunset and Rosemont stations. These stations are not regularly staffed, and their response augments that of full-time stations.

The West Linn Police Department, located at 22825 Willamette Drive, operates six divisions: Patrol & Traffic, Detectives, Records, Animal Control & Code Enforcement, Public Education & Awareness, and Management. The Department maintains a working relationship with all neighboring police agencies, other criminal justice agencies, and several human service agencies in Clackamas County.

The remaining City offices are located in City Hall at 22500 Salamo Road. There a full-time staff of 135 employees provide municipal services to operate the police department, municipal court, library, planning department, public works & engineering departments, and a year-round parks & recreation program.

The West Linn-Wilsonville School District serves 42 square miles of area, including five schools in the City itself and three schools in the nearby City of Wilsonville, located to the southwest of West Linn. Each school also serves as a facility for adult education programs, community groups, and community sports programs. All of the schools are operating at or near educational capacity, or just under maximum capacity. As new housing is built in the area, the school population is expected to increase. All facilities have recently undergone minor or major remodeling, and classroom facilities are adequate for the current enrollment. In 1994, the Oregon Legislature passed Senate Bill 908, requiring rapidly growing school districts to prepare long-range school plans in coordination with local jurisdictions. The West Linn-Wilsonville School District and the three local governments within its boundaries, including West Linn, completed their facilities plan in December of 1994. The School District, the cities of Wilsonville and West Linn, and Clackamas County then developed intergovernmental agreements that include a number of requirements for coordination related to long-range planning, standards for school capacity, site acquisition, enrollment projections, compliance with applicable City and County codes, and alternative measures for providing school

capacity. The City of West Linn also has several private institutions that provide instruction to kindergarten and primary school-age children.

The City works with a variety of utility and telecommunications companies to coordinate the location of infrastructure, including lines and cables in the public right-of-way both above and below ground, as well as transmission, relay, and other communications towers and facilities on private property. The City strives to coordinate utility improvements in the right-of-way with planned public works projects in the same areas to minimize traffic impacts and other disruptions. The siting of transmission towers for communications equipment, whether freestanding or on top of existing or planned buildings, also is regulated to address potential aesthetic and other impacts related to the health, safety, and welfare of the community. Given rapid changes in communications and computer technology during the past two decades, related issues and responsibilities can be expected to intensify in the future, possibly presenting new challenges and opportunities for the community.

For example, Clackamas County has explored the development of "tele-community centers" which would provide residents in relatively rural areas with the opportunity to work remotely, using computers linked to their offices. Centers also could provide learning opportunities and partnerships between businesses, residents, and educational institutions. Although the City's role in working with utility and telecommunications facilities typically has been to regulate or coordinate siting and construction, recent and ongoing deregulation of the energy industry presents new challenges and opportunities. Some cities have begun to explore options to purchase power in bulk directly from utility or power companies to provide lower rates to their citizens. These and similar opportunities may be explored by the City in the future.

There are no state or regional health service facilities within the City limits of West Linn, but there are acute-care hospitals, with full-service emergency departments, in the communities surrounding West Linn: Legacy Meridian Park (eastern Tualatin), Willamette Falls (Oregon City), Providence-Milwaukie, and Kaiser Sunnyside (Clackamas). In addition to EMS advanced life support first-response (TVF&R) and transport (AMR), the Life Flight Network provides emergency aeromedical transport to regional trauma centers in Portland.

Employment & Industry

According to its Comprehensive Plan, the economy of West Linn is based primarily on service and retail-oriented commercial businesses. In addition, West Linn has significantly more residents than employees, in comparison to the Portland metropolitan region as a whole and many other communities within the region. The ratio of residents to employees in West Linn is about 5 to 1, compared to 1.7 to 1 in the region.

Small businesses that are based in individual residences (also known as "home-based businesses" or "home occupations") are growing in number in West Linn. As of 1998, 45 percent of all licensed businesses in the City were home occupations. Though this is a high percentage of existing businesses, it still does not represent a significant percentage

of overall jobs held by West Linn residents, most of which are located outside the City. (West Linn is just eight miles south of Portland — a major source of jobs and employment — via Highway 43 [Willamette Drive] or Interstate 205, and just 20 minutes from the Portland International Airport. Nearly 50 percent of the West Linn workforce is employed in management, executive or professional occupations.)

In July 2002, 626 home-based businesses had obtained City licenses. An additional unknown number of unlicensed home businesses were also in operation at this time. This figure represents an increase of approximately 15 percent since 1999, indicating that the number of home-based businesses has steadily increased because of time, lifestyle, and satisfaction benefits. While some of these businesses generate traffic and other impacts, the overall impact to the City of such businesses when compared to the alternative (business districts, commuters, manufacturing plants) is positive. West Linn can accelerate and expand on this natural trend that, if properly controlled, offers to enhance neighborhoods and reduce traffic congestion.

In October of 2006, the City listed a total of 2,136 licensed businesses that were operating in West Linn. The City's single major industrial employer, the West Linn Paper Company, is located on the Willamette River and provides jobs to more than 300 workers. The company is also West Linn's largest private employer. At the same time, this industrially zoned property features some of the more scenic views of the Willamette River and the Willamette Falls. Because mill operations on both sides of the River have scaled back in recent years, this area has been coveted by some in the community as a prime redevelopment site. In the future, this area may support even more economic and employment activity.

The remaining manufacturers in the City employ a total of less than 50 people. West Linn is also the location for a number of small businesses and industries. In addition to the West Linn Paper Co., the School District and smaller employers (retail, services, offices, and professional) provide for most of the employment in West Linn. The City is one of the largest employers with a total of 136 full-time employees.

The City of West Linn does not contain a major commercial district or downtown, but rather it possesses four distinct commercial districts that collectively fulfill the needs of residents for commercial retail and business activities. The major districts are Willamette in the southern section of the City, including the area north of I-205 at the 10th Street interchange; Bolton in the central and easterly section of the City; Robinwood in the northerly section of the City, adjacent to Highway 43; and Cascade Summit (Tanner Basin), north and east of Willamette.

The Historic Willamette District was one of the first commercial and residential areas in West Linn. The commercial area still retains some of the turn-of-the-century architecture along Willamette Falls Drive and features on-street parking and residential units above retail establishments. Newer commercial and office buildings have been built to the north and east of the Historic District, including north of I-205.

The Robinwood, Bolton, Willamette and Cascade Summit (Tanner Basin) commercial districts focus on neighborhood retail goods and services, and public uses. Some businesses in these districts have developed in small centers, while others have developed along Highway 43.

Since the adoption in 1983 of the Comprehensive Plan, West Linn has averaged a 2.35 percent annual population growth, according to census figures. Such growth is reflected in the City's commercial development that includes the Cascade Summit Shopping Center on Salamo Road; the West Linn Corporate Park Office Center on Blankenship Road; and the River Falls Shopping Center also on Blankenship Road. These three projects resulted in the development of 32 acres that provided approximately 150,000 square feet of new retail commercial space and 130,000 square feet of new office space. In addition, the City has seen new commercial development along historic Willamette Falls Drive, and smaller commercial development projects along Highway 43 in the Robinwood and Bolton districts. These developments have reduced the need for residents to leave the City to obtain goods and services, while increasing employment opportunities within the City.

West Linn has dedicated 144 acres of land for commercial and business development, of which 35 acres are still undeveloped. The remaining sites, while available for commercial use, exhibit topographic and environmental constraints. The City feels that conversion of those vacant commercially zoned lands into developed shopping and employment centers would degrade the quiet, primarily residential character of the City. Since 2001, West Linn has been engaged in neighborhood visioning and planning projects aimed at preserving neighborhood integrity and livability, while seeking to understand and carry out the visions and goals of the City's residents, including the degree to which the City would further develop commercially.

In addition to the West Linn Paper Co., there are 173 acres of land in the city zoned for industrial development, 167 acres of which are zoned for general industrial use and six acres of which are zoned as campus industrial. Industrial uses can include clean, employee-intensive industries, offices, and retail commercial uses, as well as manufacturing, processing, and assembling businesses. Industrial areas typically constitute large areas of economic activity and centers for employment.
Much of the area zoned for industrial development, however, is near the Willamette River and is constrained by severe slopes and areas susceptible to flooding, and West Linn does not contain any additional lands suitable for large-scale industrial development. There are no remaining undeveloped areas in the City of at least 10 acres in size that exhibit relatively level terrain, adequate public services (particularly transportation), and suitable buffering from the residential development that characterizes most of the City. This factor, in conjunction with the slope and floodplain constraints discussed above, results in the City's conclusions that it will be unable to significantly increase its employment base through the construction of new industrial facilities.

Transportation & Commuting Patterns

According to the Comprehensive Plan, the City of West Linn contains 104 miles of streets and is divided by two major regional transportation facilities — Interstate 205, a freeway running east-west through the southerly section of the City and State Highway 43 (Willamette Drive) that connects to I-205 near its southerly terminus and runs north-south through the northerly section of the City all the way to Portland.

Construction of I-205 in the late 1970s considerably altered the physical appearance of West Linn by eliminating much of the historic center near Willamette Falls and the Oregon City bridge area and dividing the Willamette community to the west. The freeway runs for 3.75 miles in its path through the City and reaches its current capacity of 6,000 vehicles per hour during peak commuting times. Traffic in the area is expected to increase further over time, resulting in significant deterioration in service.
West Linn contains two interchanges with I-205, the 10th Street interchange in the Willamette neighborhood and the Highway 43 (Willamette Drive) interchange in the Bolton neighborhood. Both interchanges were reaching capacity by 1999, and significant improvements are necessary to accommodate projected traffic flows at both locations. However, the City of West Linn has little control or influence over the adequacy of I-205, its major transportation link. The responsibility and authority, as well as the financial capability, to maintain an adequate level or service for the freeway I-205 rests with Metro and Oregon Department of Transportation (ODOT) authorities. Congestion on I-205, nonetheless, results in the diversion of traffic onto City streets that are designed to handle only local traffic volumes. A 2006 ODOT project that includes the addition of one lane in each direction on I-205 from Stafford Road to I-5 shall provide some additional capacity to the freeway to help alleviate some of the above-described congestion. ODOT expects to complete the project in late 2007.

State Highway 43, known locally as Willamette Drive, links Portland, Lake Oswego, West Linn and Oregon City. It serves a dual role as a major arterial roadway: First because two of the four identified community centers (Robinwood and Bolton) are located along its route; and, second, because it functions as a regional State highway that brings non-residents to and through West Linn, while bringing residents into and out of West Linn. Its southern terminus is the historic Oregon City-West Linn Bridge that crosses the Willamette River and connects the two cities. The current design of the highway is highly discontinuous, but generally includes two travel lanes, intermittent turn lanes, bicycle lanes, and intermittent sidewalks of varying width and quality.
The third major street in West Linn is Willamette Falls Drive, paralleling I-205 from Highway 43 to the western City limits, and serving as a main street to the Historic Willamette District in the Willamette neighborhood. Willamette Falls Drive becomes Borland Road at the Tualatin River, and provides an alternative route to Interstate 205 between the Stafford Road/I-205 Interchange and Oregon City.

Other significant roadways include routes that connect the hilltop residential areas along Rosemont Road with lower areas, including Hidden Springs Road, Pimlico Drive, Skyline Drive, Sunset Avenue, and Salamo Road. Rosemont Road connects West Linn with Stafford Road and Lake Oswego to the north. West A Street serves as a parallel

route to Willamette Drive in the Bolton neighborhood, and Blankenship Road and Dollar Street serve as parallel routes to Willamette Falls Drive in the Willamette neighborhood. Two transit lines serve West Linn, both operated by the Tri-County Metropolitan Transportation District of Oregon, a regional transit agency known as "Tri-Met" that serves Clackamas, Multnomah and Washington counties that are the three counties within which the Portland metropolitan area is located. Route 35 provides daily, direct service between downtown Portland and the Oregon City transit center via Highway 43. One park-and-ride lot, in the Robinwood neighborhood, is available along this route. Route 154, known as the Willamette Shuttle, connects the Willamette and Bolton neighborhoods with the Oregon City Transit Center on weekdays only. All of the commercially zoned areas of West Linn are currently served by transit. Pursuant to Goal 12 (Transportation), the City has developed a plan for future public transit routes that are intended to enhance its current transit services both within the City and to other locations in the Portland area.

The availability and quality of pedestrian facilities (sidewalks and pathways) in West Linn is inconsistent. Newer neighborhoods, built according to modern subdivision standards, generally have sidewalks on local streets, as well as pathway "shortcuts" connecting parallel streets and cul-de-sacs. The majority of streets in older neighborhoods (Bolton, Robinwood, Sunset, and Willamette) do not exhibit sidewalks, and many of the City's arterial and collector roads also do not feature sidewalks.

There are several existing bicycle lanes in West Linn. Highway 43 (Willamette Drive) features a bike lane along most of its length, although in many places the bike lane is not consistent with current standards for such facilities. There also are area bike lanes on West A Street, and parts of Summit Drive and Imperial Drive.

In 1996, the City began preparing a Transportation System Plan (TSP) designed to provide a blueprint for a balanced transportation system that accommodates the needs of all modes of transportation. The non-motorized portion of the Transportation System Plan was adopted in 1998, and the street element was adopted in 2000.

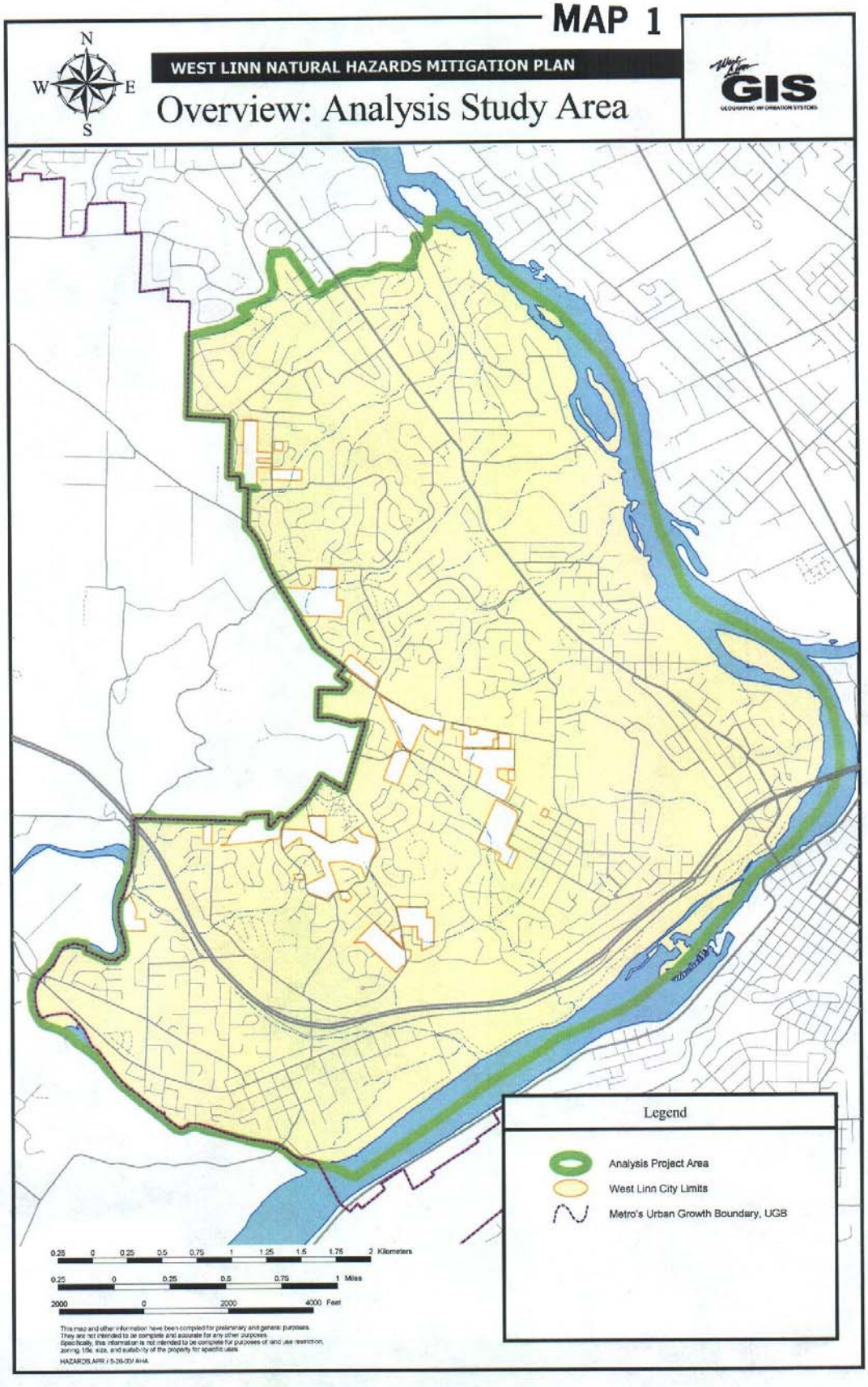
Development Patterns

Like much of the Portland metropolitan area, the City of West Linn is expected to continue to grow. However, unlike some cities of the area, West Linn is likely to remain a primarily residential community from which the majority of residents commute to Portland or other cities for employment. The City will, nonetheless, continue to nurture and enhance its commercial districts, while preserving and revamping its areas of historical significance.

As has been previously discussed, much of the vacant land in the City is constrained by natural hazards (primarily steep slopes, landslides, floodplain and soils prone to liquefaction) or occupied by environmentally significant water quality resources. The City, in general, does not appear to feel that it is important for the City to grow substantially, or to develop significantly more commercial — and, in particular, industrial — centers of employment, services and manufacturing. To the contrary, the City seems

more in favor of preserving the current residential character of the City, along with its aesthetically pleasing commercial centers, while prohibiting development that impacts water quality resources or constrained lands that contain natural hazards. In a 2006 Community Survey prepared by Riley Research Associates, residents most frequently mentioned land-use planning and traffic management as priorities for the next five years, while the management of growth was most frequently mentioned as West Linn's top priority. Land-use planning, traffic management, and affordable housing opportunities were the City services that exhibited the most urgent need for improvement.

Therefore, future planning and development within West Linn will need to balance growth pressures, whatever they may be, against its vision of itself in the future. In 1994, the City adopted "Imagine West Linn," a document that represented a visioning process for the City to engage the community in a collective and creative approach to determining the form and character of West Linn. As noted above, the City has also recently developed the "Sustainable West Linn Strategic Plan" — a substantial document that examines a myriad of factors aimed at planning and directing the City toward a more sustainable future by making decisions that simultaneously enhance its environment, as well as its economy and its community. Of integral importance to confronting all of these issues is the development of a useful and thorough natural hazards mitigation plan, through which the City can analyze, plan and incorporate its natural hazards into its current and future planning and development processes.


MAP 1
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Overview: Analysis Study Area
N
W
E
S
GIS
Legend
Analysis Project Area
West Linn City Limits
Metro's Urban Growth Boundary, UGB
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
This map and other information have been compiled for preliminary and general purposes.
They are not intended to be complete and accurate for any other purposes.
Specifically, this information is not intended to be complete for purposes of land use restriction,
zoning, title, size, and suitability of the property for specific uses.
HAZARDS.APR / 5-26-00/ AHA

Section 3:
Hazard Assessment

Hazard Assessment Process

A hazard assessment is a means of providing 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 West Linn conducted a hazard 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 and intensity of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. The City of West Linn identified seven major hazards that consistently affect this geographic area. These hazards – floods, landslides, wildfires, earthquakes, severe winter storms and windstorms – were identified through an extensive process that utilized input from the Hazard Mitigation Steering Committee.

2) ***Vulnerability Assessment*** combines hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard. An overview of the community assets exposed to the hazards is illustrated by the following maps.

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 the City of West Linn. However, this need is identified in our action plan, and a complete a risk assessment will be conducted when the resources are available.

The City of West Linn Geographic Information Systems Department provided spatial analysis and illustration of all hazards, community assets, and the exposure of the built environment, using the best available data. The maps resulting from this analysis are listed in Table 3-1.

Table 3-1. List of Hazard Mitigation Plan Maps

Map #	Type of Map	Section of the Plan
1	Overview Study Area	Section 2
2	Overview of Community Assets	Section 3
3	Critical Facilities	Section 3
4	Essential Facilities	Section 3
5	Other Infrastructure	Section 3
6	Economic Centers	Section 3
7	Cultural and Historical Assets	Section 3
8	Environmental Assets	Section 3
9	Hazardous Materials:	Section 3
10	Tax Lot Base and Building Values	Section 3
11	Level of Property Vulnerability	Section 3
12	Level of Residential Population Vulnerability	Section 3
13	Level of Asset Vulnerability	Section 3
14	Flood Inundation	Section 4
15	Flood Analysis	Section 4
16	Potential Landslides	Section 4
17	Landslide Analysis	Section 4
18	Earthquake Hazards	Section 4
19	Earthquake Analysis	Section 4
20	Snow and Ice	Section 4
21	Snow and Ice Analysis	Section 4
22	Wildfire	Section 4
23	Wildland Urban Interface	Section 4
24	Wildfire Analysis	Section 4
25	Wildfire Fuels Reduction	Section 4
26	Mt Hood Hazards	Section 4

Federal Requirements for Hazard Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment. This risk assessment requirement is intended to provide information that will help communities to identify and prioritize mitigation activities that will reduce losses from the identified hazards. There are seven hazards profiled in the mitigation plan, including floods, landslides, wildfires, earthquakes, winter storms, windstorms, and volcanic eruptions. The City of West Linn Natural Hazard Mitigation Plan is in compliance with federal requirements, as shown by Table 3-2. Federal Criteria for Hazard Assessment.

Table 3-2. Federal Criteria for Hazard Assessment

Section 322 Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes a map illustrating the geographic extent of the hazards affecting the City of West Linn using the best available data.
Profiling Hazard Events	The hazard sections of the Clackamas County Natural Hazard Mitigation Plan provide documentation for all of the large-scale hazard events affecting the region. Where data is available, City of West Linn has provided local impacts from historical hazard events.
Assessing Vulnerability: Identifying Assets	Table 3-3 documents the community assets that are vulnerable to natural hazards. A more detailed description of the vulnerability of these assets is located in the specific hazard sections.
Assessing Vulnerability: Estimating Potential Losses	Using the best available data, an estimate of potential losses from natural hazards is located in the hazard specific sections.
Assessing Vulnerability: Analyzing Development Trends	The Community Profile Section of this plan provides a description of the development trends in the City of West Linn.

Community Assets

This section outlines the resources, facilities and infrastructure that, if damaged, could significantly impact public safety, economic conditions, and environmental integrity of the City of West Linn. The key community assets identified by the City of West Linn are as defined and illustrated as follows:

Overview of Community Assets (Map 2): includes facilities and infrastructure that support the functional operations of West Linn and its residents, as well as characterizing the community's character.

Critical Facilities (Map 3)**:** are facilities and infrastructure necessary for emergency response efforts such as law enforcement and fire stations, public works, and City Hall.

Essential Facilities (Map 4): are facilities and infrastructure that supplement response efforts, including potential shelter sites such as schools and community centers.

Other Infrastructure (Map 5): is infrastructure that provides services for the City of West Linn, including but not limited to: key arterial and collector streets, water reservoirs and pumping facilities, waste water pump stations and treatment station, electrical, natural gas and water transmission lines. Other infrastructure also includes locations serving populations that have special needs or require special consideration such as primary schools and kindergartens, as well as assisted living care facilities. .

Economic Centers (Map 6): are businesses that employ large numbers of people, and provide an economic resource to the City of West Linn. 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. Economic assets and employment centers consist of West Linn's four commercial areas and the West Linn Paper Co.

Cultural and Historical Assets (Map 7): are facilities that augment or help define community character, and if lost, would represent a significant loss for the community.

Environmental Assets (Map 8): are parks, green spaces, wetlands, and rivers that provide an aesthetic and functional service for the community.

Hazardous Materials (Map 9): are sites that store, manufacture, or use potentially hazardous materials. West Linn hazardous material sites primarily are gasoline stations.

Tax Lot Base and Building Values (Map 10): shows the spatial distribution of residential and commercial development in the City.

Vulnerability Assessment

Vulnerability is a measure of the exposure of the built environment to hazards. The exposure of community assets to hazards critical in assessment the degree of risk a community has to each hazard. Identifying the facilities and infrastructure at risk from various hazards can assist the City of West Linn in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred. The exposure of City assets to each hazard and potential implications are explained Section 4: Natural Hazards.

As shown in Map 11: Level of Property Vulnerability, the majority of property exposed to hazards is either in the floodplain, or on steep slopes. The properties exposed to all five hazards (shown in red) are lots in the floodplain, with the majority of the southern shore of the Willamette being an industrial zone and the northern shore being residential. This means that although less residential population is exposed, businesses that occupy these areas should be engaged in business continuity planning in order to remain operable post disaster.

The same general trend of floodplain and steep slope exposure is noted in Map 12: Level of Residential Population Vulnerability. As noted above residential exposure is higher on the northern shore of the Willamette. This area should be targeted for mitigation and flood fighting efforts.

The City of West Linn GIS department has completed a thorough analysis of exposure of community assets to each hazard. A full listing of asset vulnerability is provided in Appendix 1. An overview of the exposure of West Linn's built environment is provided in Table 3-3, and illustrated in Map 13: Level of Asset Vulnerability.

Table 3-3. Vulnerability Analysis

Hazard	Hazard Acres within City UGB Study Area	Percent of Hazard within City UGB Study Area	No. of Properties within Hazard (all or partial*)	Building Value Exposed*	No. of Res. Units Exposed	Approximate Res. Population Exposed	Percent of Population Exposed
Flood	380	7%	363	$57,650,000	269	710	3%
Landslide	915	17%	4,522	$920,160,000	4,780	12,670	50%
Earthquake	1,216	23%	2,547	$338,230,000	2,468	6,540	26%
Severe Winter Storm	2,247	43%	6,679	$1,304,700,000	6,902	18,290	72%
Wildfire	1,310	25%	2,540	$423,280,000	1,543	4,090	16%

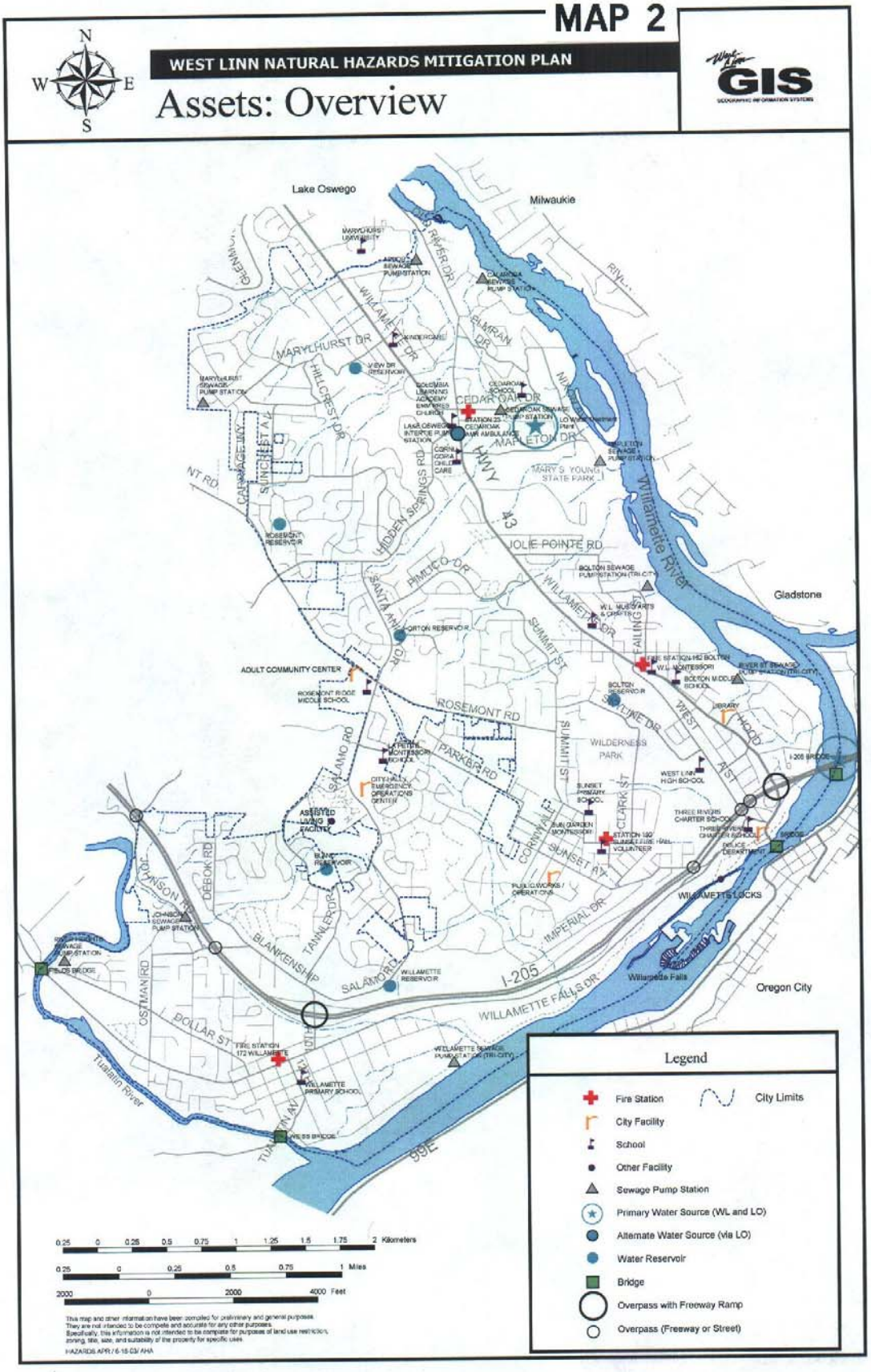
Hazard	Critical Facilities Exposed	Essential Facilities Exposed	Other Infrastructure Exposed	Economic Centers Exposed	Cultural & Historical Assets Exposed	Environmental Assets Exposed	Hazardous Material Sites Exposed
Flood	0	0	11	4	4	16	1
Landslide	4	3	31	14	17	77	5
Earthquake	1	3	20	9	11	32	4
Severe Winter Storm	4	6	26	15	20	80	9
Wildfire	1	4	17	9	12	55	2

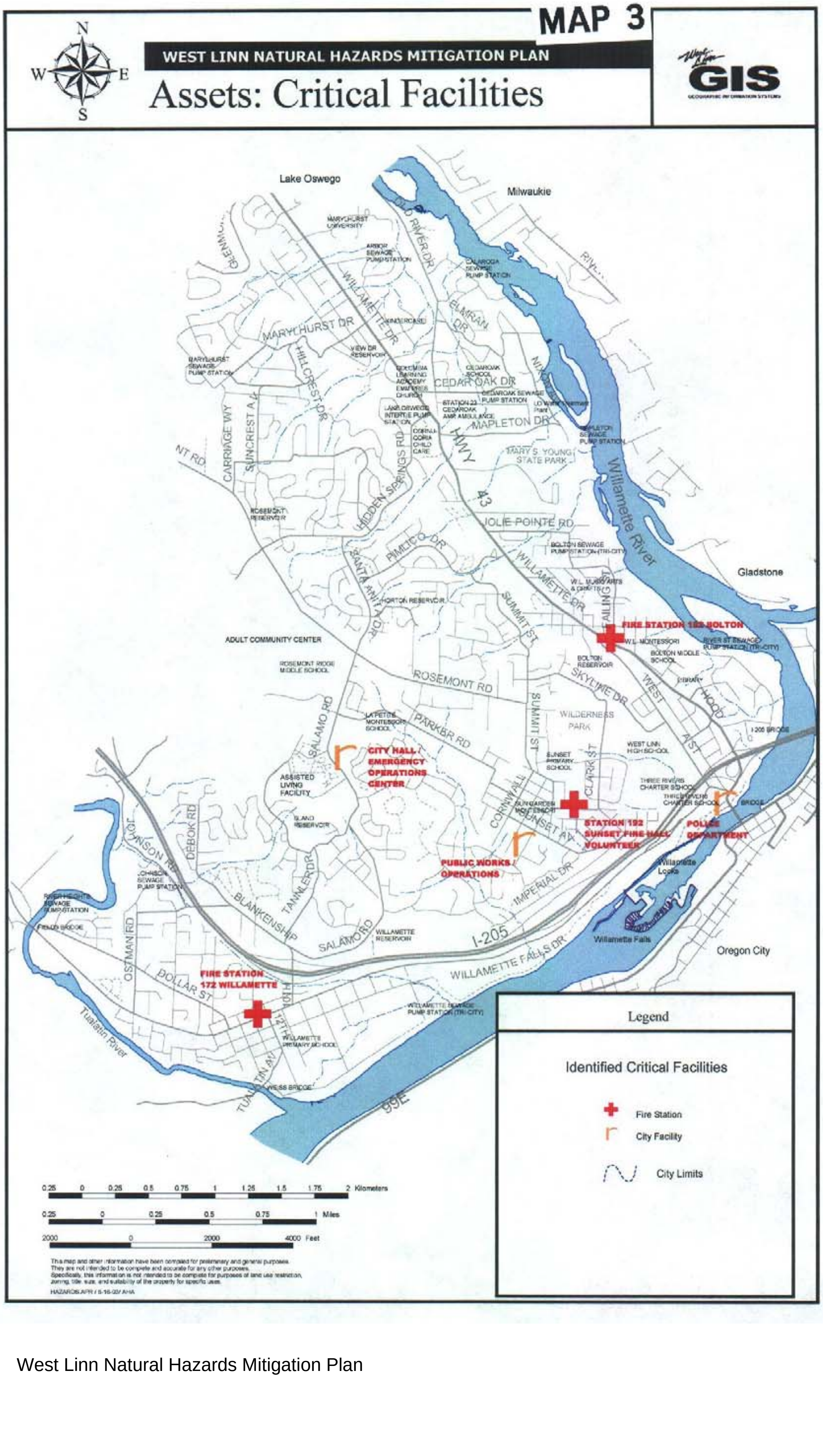
*Analysis of properties that intersect the hazard include property in taxlots that intersect the hazard, but may also include property that does not physically reside in the hazard itself.

MAP 2

WEST LINN NATURAL HAZARDS MITIGATION PLAN

Assets: Overview

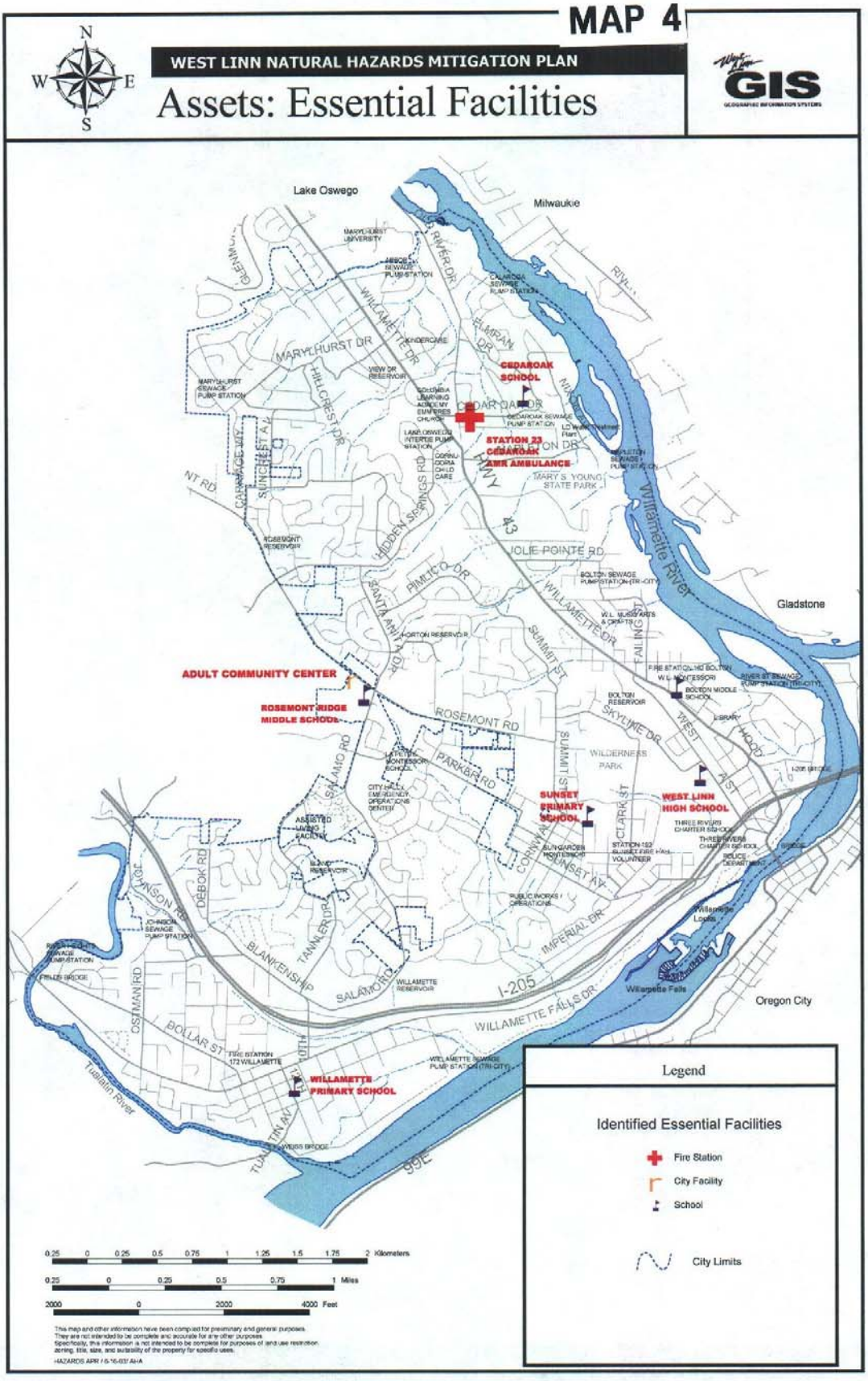



MAP 3
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Assets: Critical Facilities
GIS
N
S
E
W
Lake Oswego
Milwaukie
Gladstone
Oregon City
Willamette River
Tualatin River
MARYLHURST DR
CEDAR OAK DR
MAPLETON DR
JOLIE POINTE RD
ROSEMONT RD
PARKER RD
SKYLINE DR
SUMMIT ST
WILLAMETTE DR
HIDDEN SPRINGS RD
PIMLICO DR
SANTA ANITA DR
SALAMO RD
BLANKENSHIP
IMPERIAL DR
WILLAMETTE FALLS DR
SUNSET AV
CORNWALL
CLARK ST
HWY 43
I-205
99E
FIRE STATION 183 BOLTON
CITY HALL / EMERGENCY OPERATIONS CENTER
STATION 182 SUNSET FIRE HALL VOLUNTEER
POLICE DEPARTMENT
PUBLIC WORKS / OPERATIONS
FIRE STATION 172 WILLAMETTE
ADULT COMMUNITY CENTER
ROSEMONT RIDGE MIDDLE SCHOOL
ASSISTED LIVING FACILITY
WILDERNESS PARK
WEST LINN HIGH SCHOOL
MARY S. YOUNG STATE PARK
Willamette Falls
Legend
Identified Critical Facilities
Fire Station
City Facility
City Limits
2 Kilometers
1 Miles
4000 Feet

MAP 4

WEST LINN NATURAL HAZARDS MITIGATION PLAN

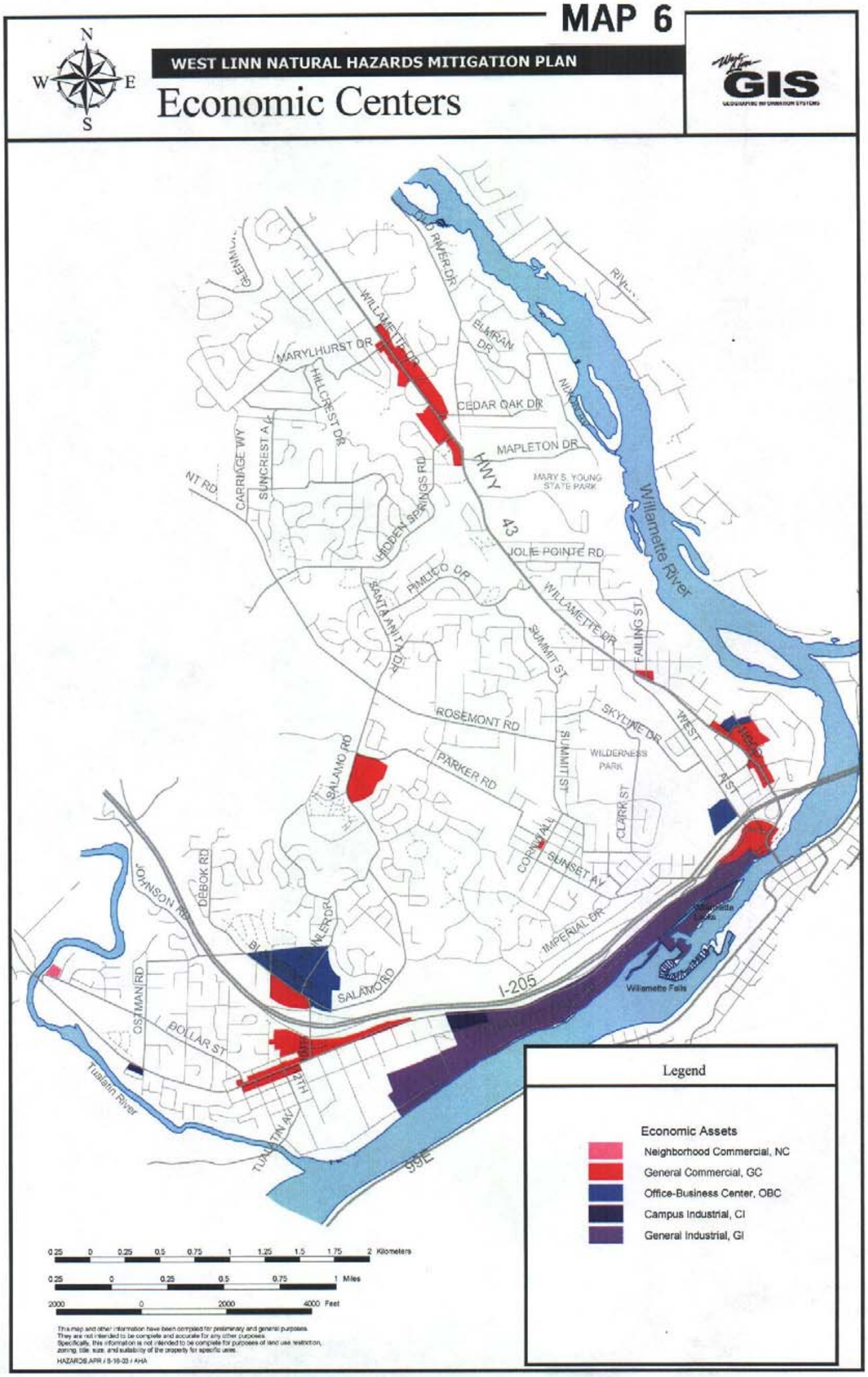
Assets: Essential Facilities

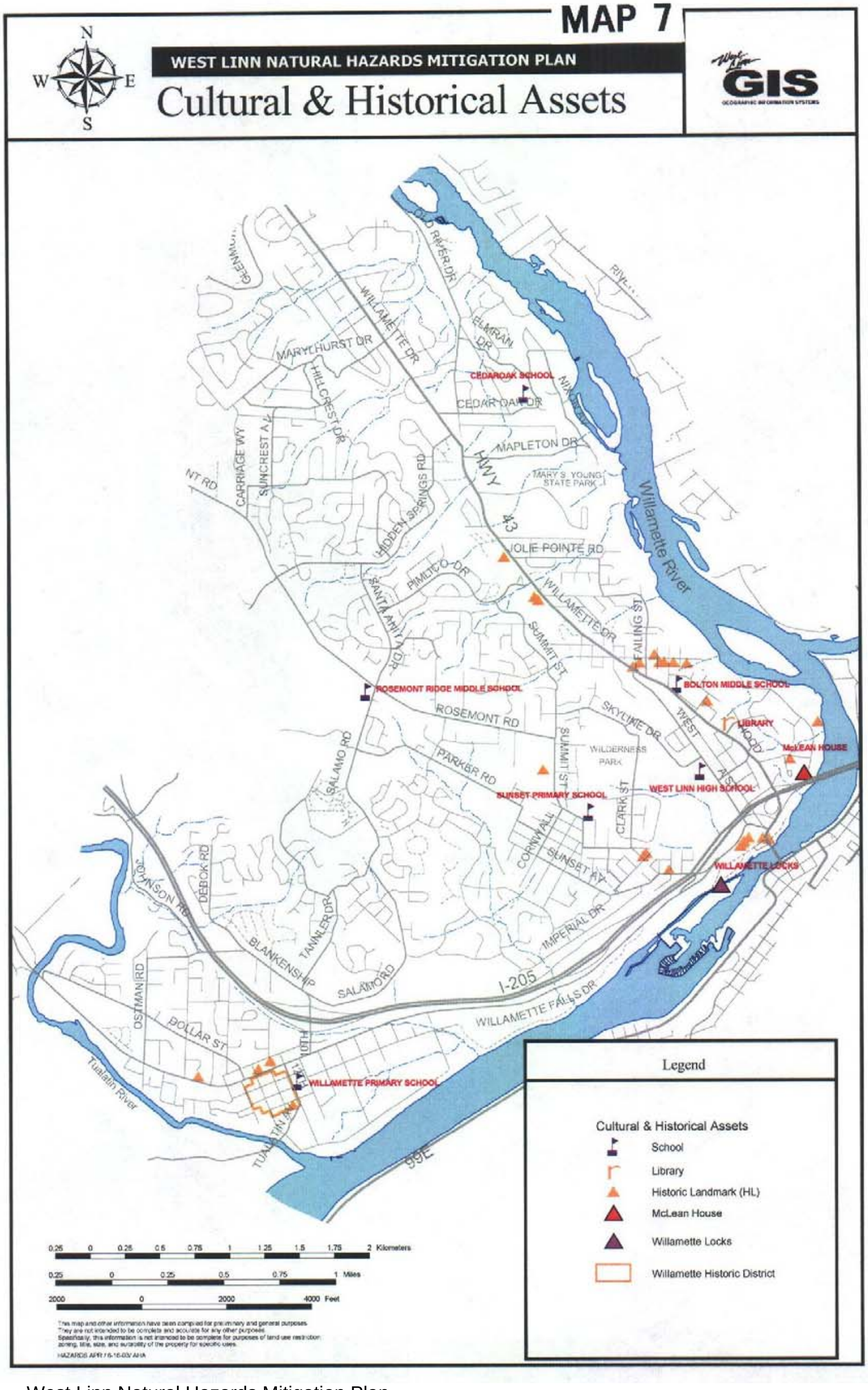


MAP 5

WEST LINN NATURAL HAZARDS MITIGATION PLAN

Assets: Other Infrastructure

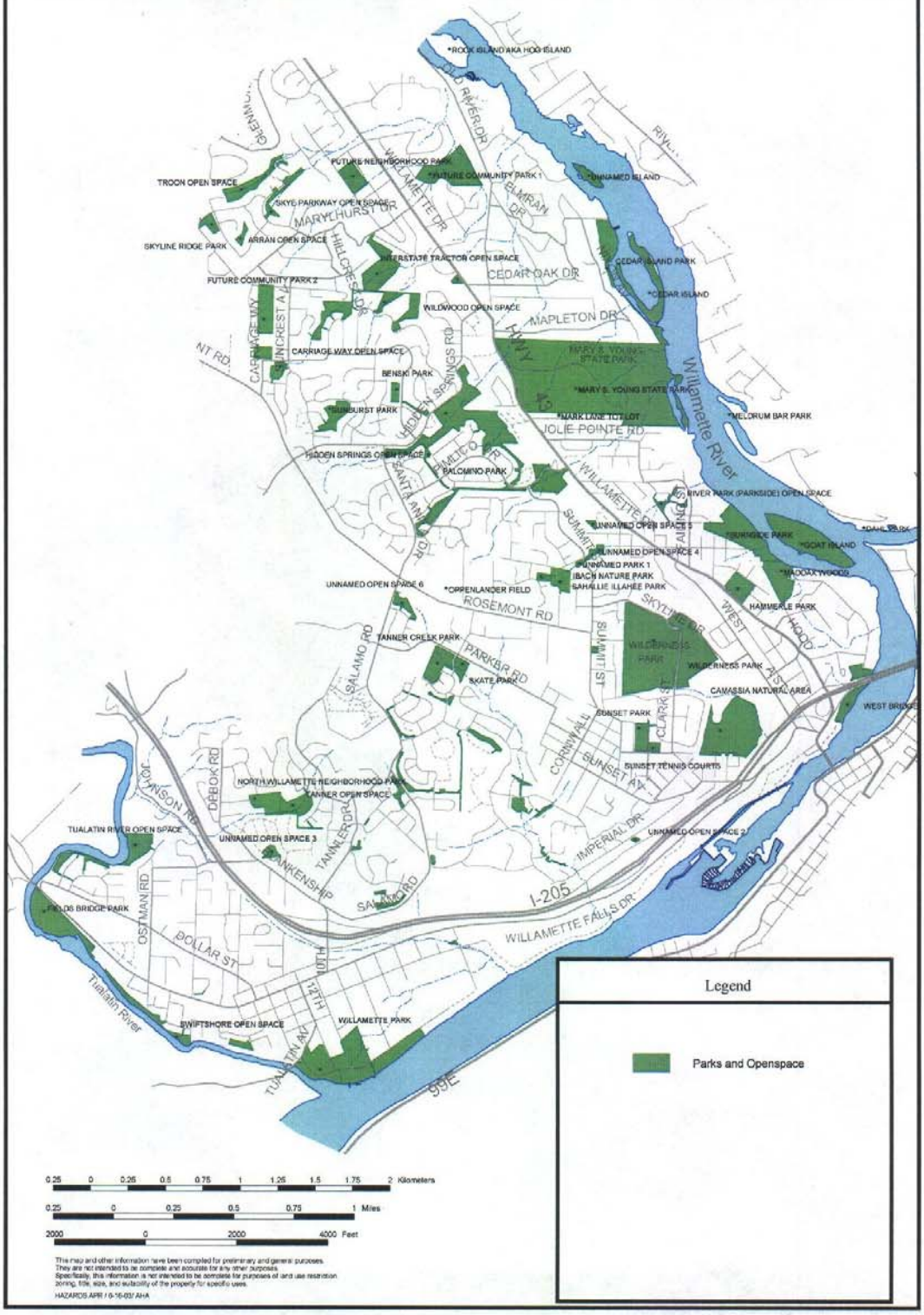

MAP 6
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Economic Centers
GIS
Legend
Economic Assets
Neighborhood Commercial, NC
General Commercial, GC
Office-Business Center, OBC
Campus Industrial, CI
General Industrial, GI
Willamette River
Tualatin River
Willamette Falls
MARY S. YOUNG STATE PARK
WILDERNESS PARK
MARYLHURST DR
CEDAR OAK DR
MAPLETON DR
JOLIE POINTE RD
ROSEMONT RD
PARKER RD
SKYLINE DR
SUNSET AV
IMPERIAL DR
I-205
DOLLAR ST
JOHNSON RD
SALAMO RD
HWY 43
99E
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet

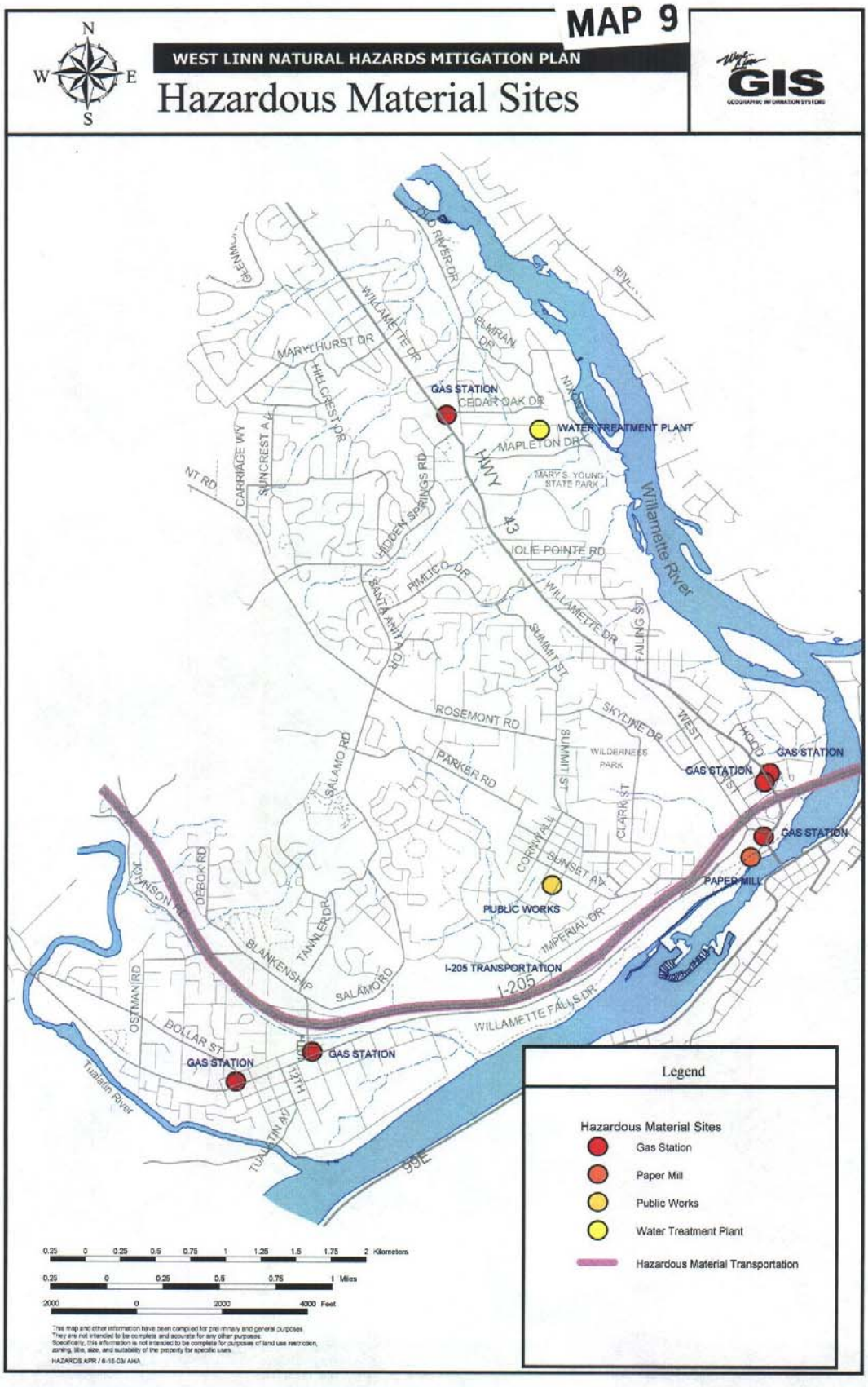

MAP 7
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Cultural & Historical Assets
GIS
N
S
W
E
Willamette River
Tualatin River
CEDAROAK SCHOOL
ROSEMONT RIDGE MIDDLE SCHOOL
BOLTON MIDDLE SCHOOL
LIBRARY
McLEAN HOUSE
WEST LINN HIGH SCHOOL
SUNSET PRIMARY SCHOOL
WILLAMETTE LOCKS
WILLAMETTE PRIMARY SCHOOL
MARY S. YOUNG STATE PARK
WILDERNESS PARK
MARYLHURST DR
WILLAMETTE DR
HILLCREST DR
CEDAR OAK DR
MAPLETON DR
HWY 43
CARRIAGE WY
SUNCREST AV
HIDDEN SPRINGS RD
JOLIE POINTE RD
PIMLICO DR
SANTA ANITA DR
SUMMIT ST
FAILING ST
ROSEMONT RD
SKYLINE DR
PARKER RD
SALAMO RD
CORNWALL
SUNSET AV
CLARK ST
IMPERIAL DR
I-205
WILLAMETTE FALLS DR
BLANKENSHIP
TANNLER DR
DEBOK RD
JOHNSON RD
OSTMAN RD
DOLLAR ST
10TH
TUALATIN AV
99E
Legend
Cultural & Historical Assets
School
Library
Historic Landmark (HL)
McLean House
Willamette Locks
Willamette Historic District
2 Kilometers
1 Miles
4000 Feet

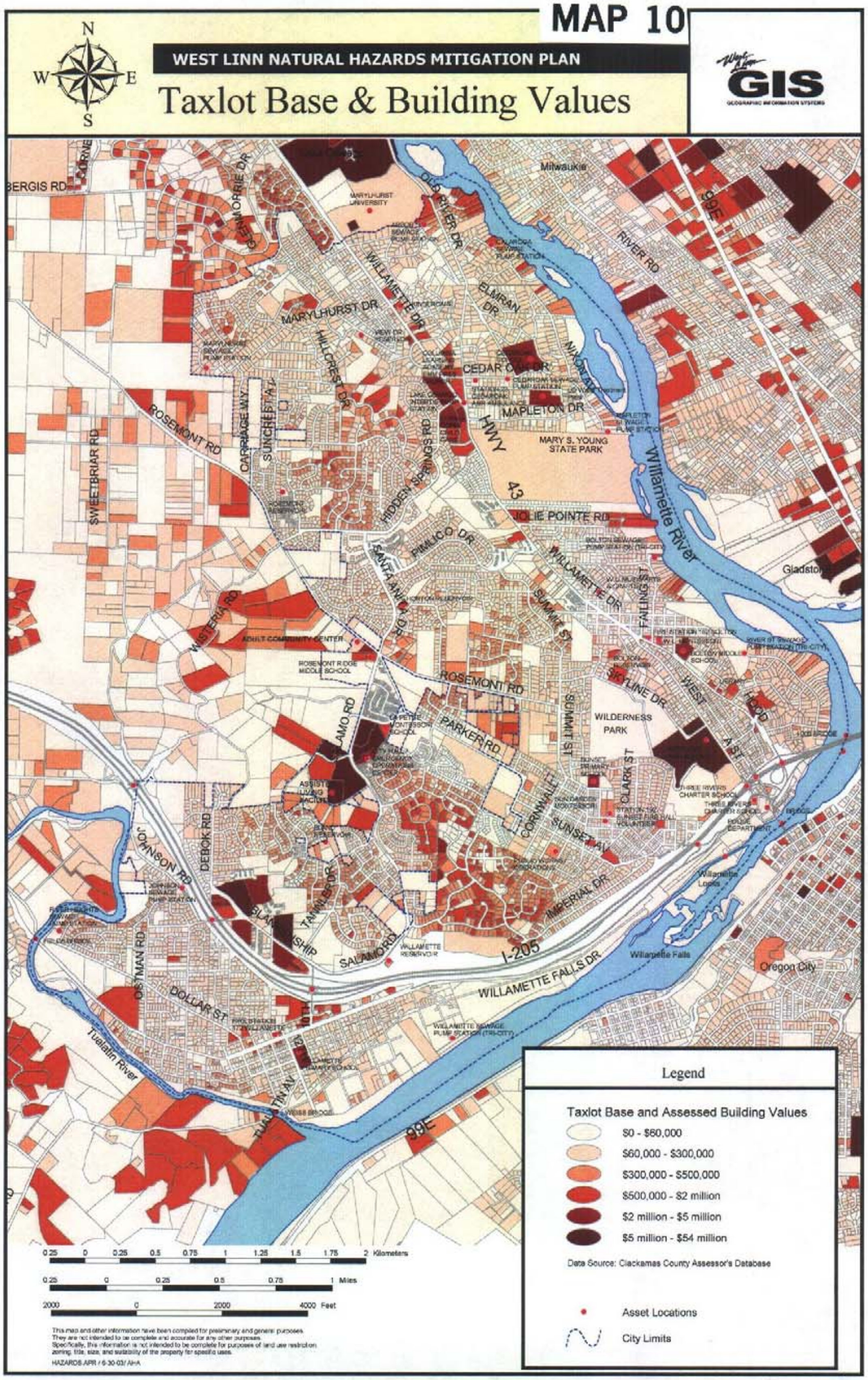
MAP 8

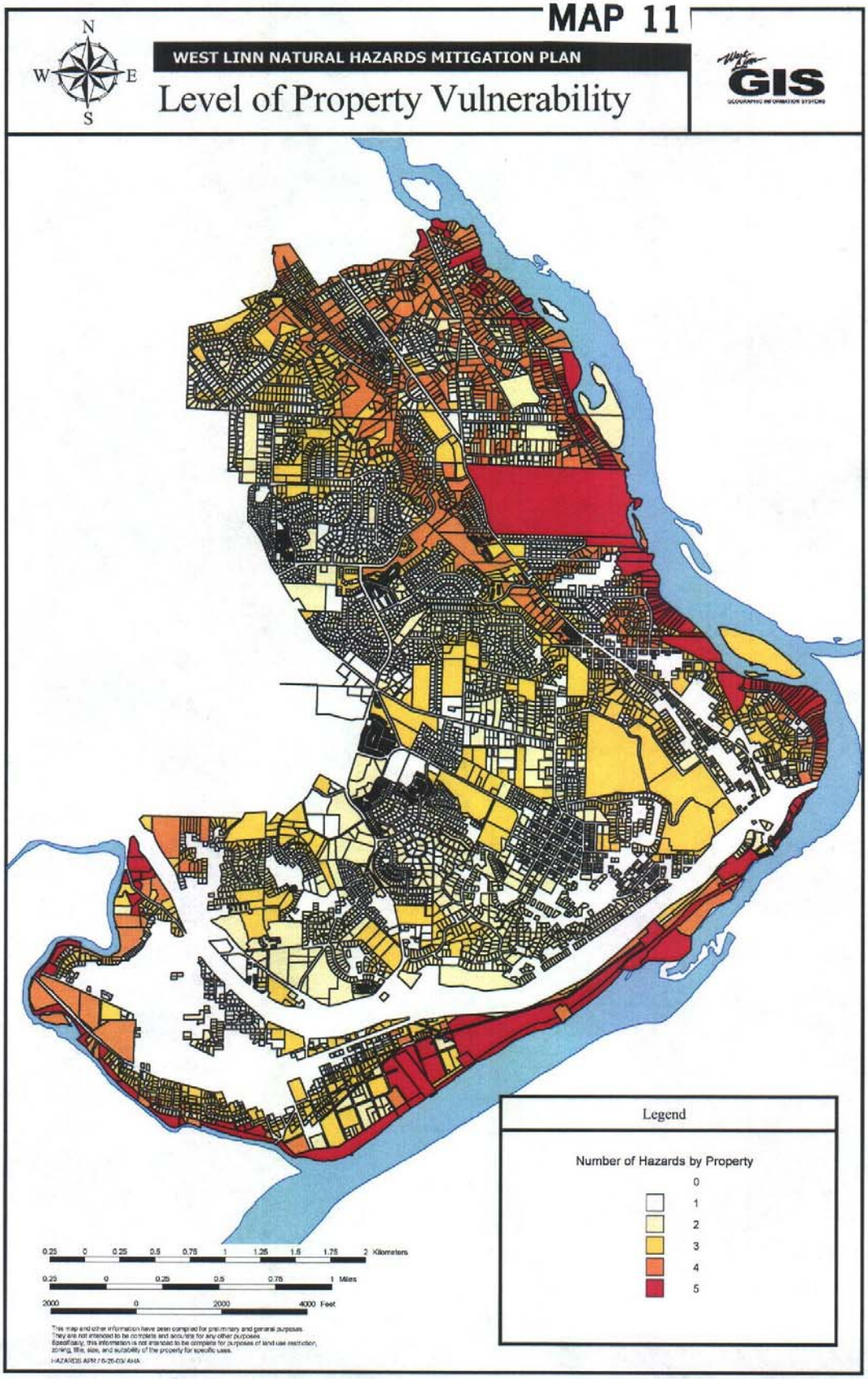
WEST LINN NATURAL HAZARDS MITIGATION PLAN

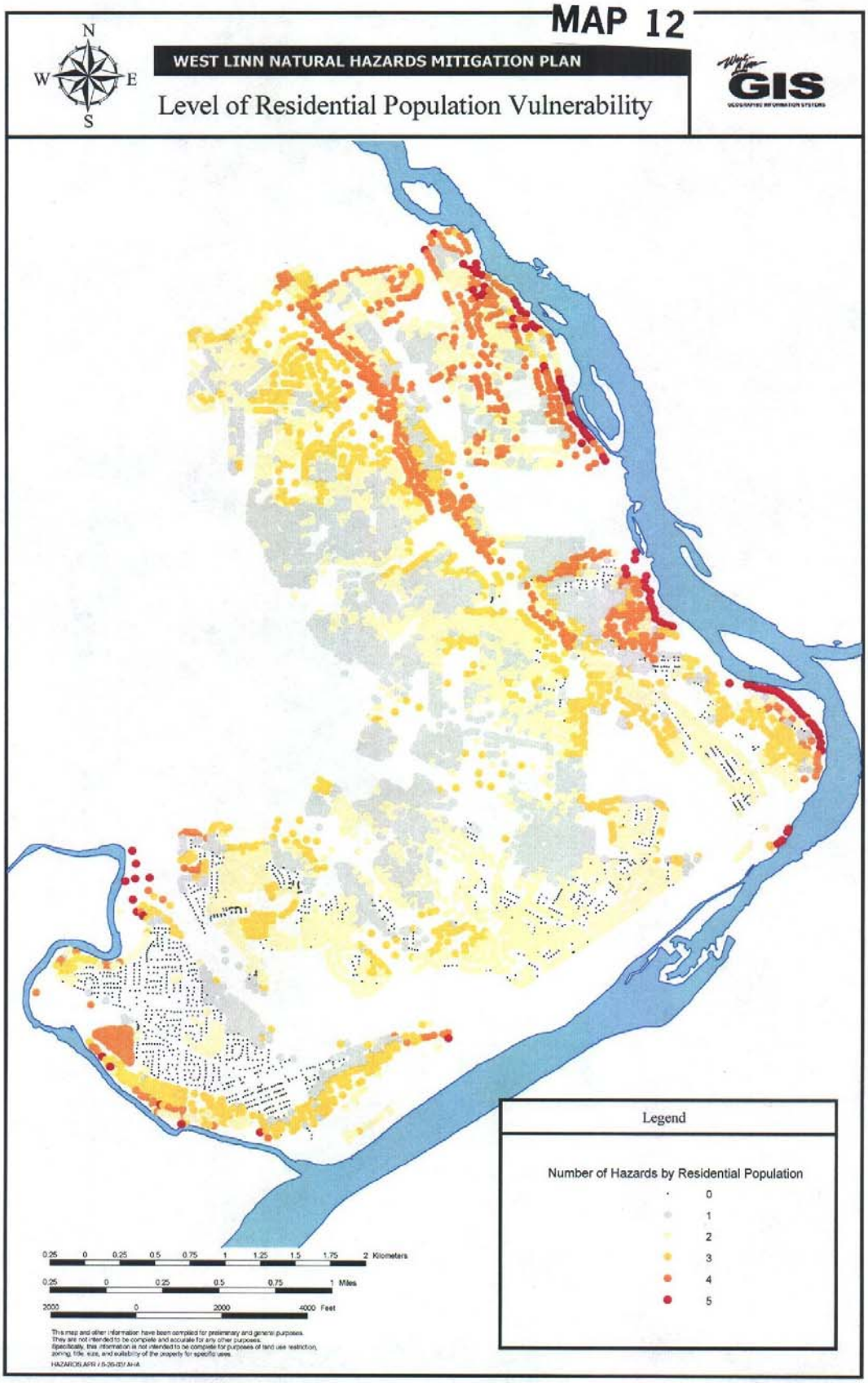
Environmental Assets

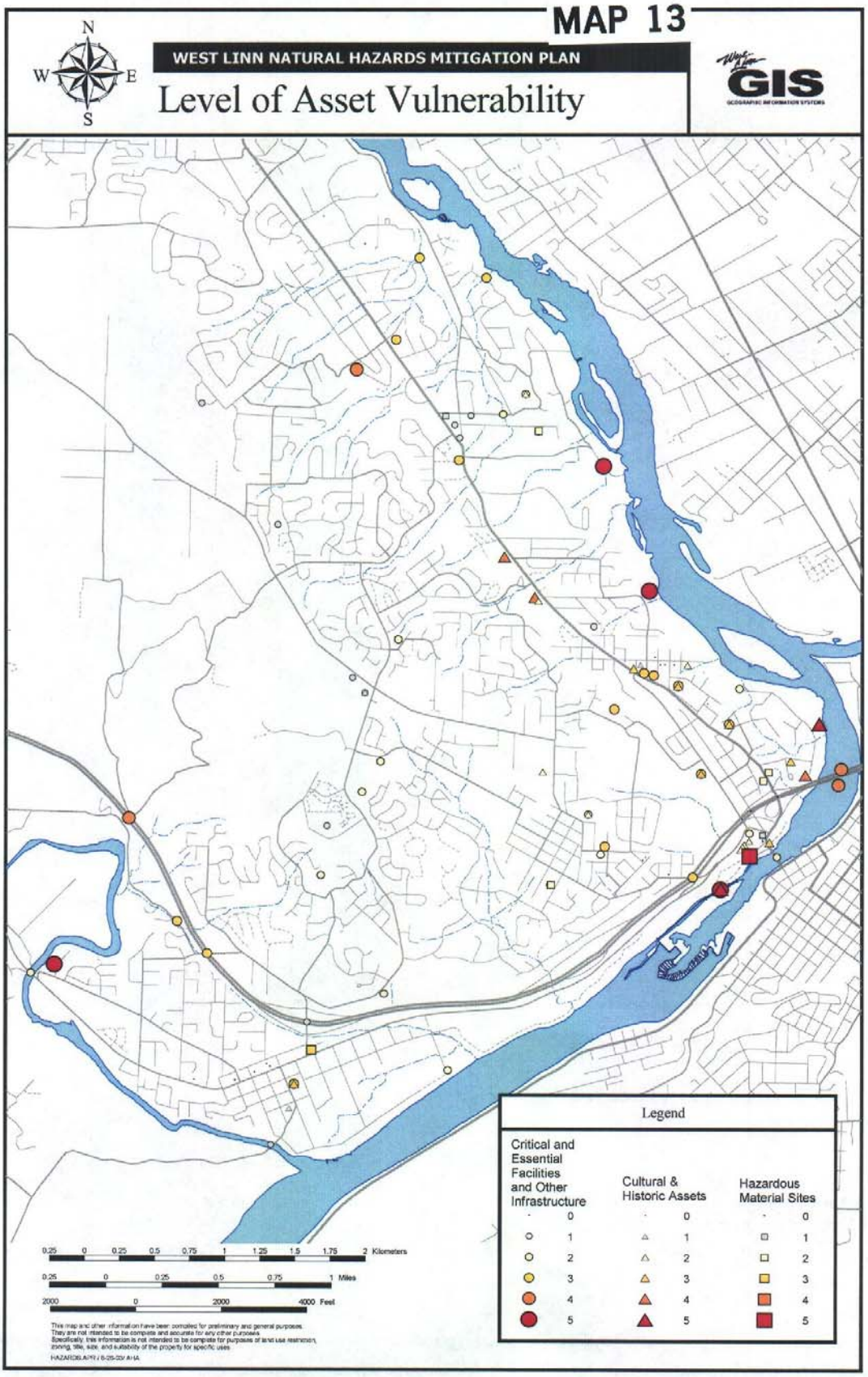



MAP 9
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Hazardous Material Sites
GIS
N
W
E
S
GAS STATION
WATER TREATMENT PLANT
CEDAR OAK DR
MAPLETON DR
MARY S. YOUNG STATE PARK
HWY 43
Willamette River
IOLE POINTE RD
WILLAMETTE DR
SUMMIT ST
ROSEMONT RD
SKYLINE DR
WILDERNESS PARK
PARKER RD
SUNSET AV
PUBLIC WORKS
PAPER MILL
IMPERIAL DR
I-205 TRANSPORTATION
I-205
WILLAMETTE FALLS DR
BOLLAR ST
Tualatin River
99E
Legend
Hazardous Material Sites
Gas Station
Paper Mill
Public Works
Water Treatment Plant
Hazardous Material Transportation
Kilometers
Miles
Feet


MAP 10
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Taxlot Base & Building Values
GIS
N
S
E
W
Willamette River
Tualatin River
Legend
Taxlot Base and Assessed Building Values
$0 - $60,000
$60,000 - $300,000
$300,000 - $500,000
$500,000 - $2 million
$2 million - $5 million
$5 million - $54 million
Data Source: Clackamas County Assessor's Database
Asset Locations
City Limits
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
ROSEMONT RD
SWEETBRIAR RD
HIDDEN SPRINGS RD
MARYLHURST DR
WILLAMETTE DR
JOLIE POINTE RD
MARY S. YOUNG STATE PARK
WILDERNESS PARK
SKYLINE DR
SUMMIT ST
PARKER RD
SUNSET AV
IMPERIAL DR
I-205
WILLAMETTE FALLS DR
DOLLAR ST
JOHNSON RD
DEBOK RD
OSTMAN RD
SALAMO RD
99E
Oregon City
Milwaukie
Willamette Falls


MAP 11
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Level of Property Vulnerability
N
W
E
S
GIS
Legend
Number of Hazards by Property
0
1
2
3
4
5
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
This map and other information have been compiled for preliminary and general purposes.
They are not intended to be complete and accurate for any other purposes.
Specifically, this information is not intended to be complete for purposes of land use restriction,
zoning, title, size, and suitability of the property for specific uses.


MAP 12
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Level of Residential Population Vulnerability
N
W
E
S
GIS
Legend
Number of Hazards by Residential Population
0
1
2
3
4
5
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet


MAP 13
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Level of Asset Vulnerability
N
W
E
S
GIS
Legend
Critical and Essential Facilities and Other Infrastructure
Cultural & Historic Assets
Hazardous Material Sites
0
1
2
3
4
5
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet

Section 4: Natural Hazards

Flood

The City of West Linn has three large rivers with many smaller tributaries that are susceptible to annual flooding events. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

Flood Profile

Riverine Flooding

The three primary sources of riverine flooding affecting West Linn are the Clackamas, Tualatin, and Willamette Rivers. In fact, West Linn is bordered by the Tualatin and the Willamette. The Federal Emergency Management Agency (FEMA) regulatory floodplains for each of these rivers are depicted as relatively narrow areas on each side of the channels. On the Willamette River, the floodway is generally confined within high stream banks. On the Clackamas, and portions of the Tualatin, the floodways cover a somewhat larger area.

Portions of West Linn are within the 100-year flood plain of these rivers (Map #10 Flood Inundation). The tributaries that drain into these two rivers also can impact the flood plain and flood conditions along river banks.

Flash Flooding

The Clackamas, Tualatin and Willamette Rivers are not considered "flashy." "Flash" floods occur on smaller streams during or after a severe local storm, and occur much more quickly than riverine floods.

Surface Water Management

While local drainage flooding may occur with little warning, the depths and velocities are usually not life threatening. However, driving, electrocution, exposure to pollution, and long term disease risks continue. Local drainage problems occur throughout the city. There are three general types of problems:

- High water tables, especially in the south part of the city, result in wet crawlspaces, yards and basements; especially after storms events.
- Topography reduces efficiency of surface water drainage.
- Storm sewers and culverts may be too small to carry peak storm flows.

The West Linn Public Works staff has identified sites where local drainage facilities are taxed during high flows, especially where open ditches enter culverts or go underground into storm sewers.

Property owners who do not realize the repercussions of their actions can aggravate localized flooding. Homeowners who want a flatter, easier-to-mow yard frequently fill

roadside ditches and swales between buildings. Some dump their yard clippings and other waste into the nearest ditch, adding to the debris that dam or plug the channel.

Dam Failure

The speed of onset, lack of advance warning, and depth of flooding make dam failures a potentially deadly, albeit unlikely, occurrence. There are four major dams upstream of West Linn on the Clackamas River: North Fork, Faraday, River Mill and Timothy. These are operated by Portland General Electric and are subject to the dam safety and warning requirements of the Federal Energy Regulatory Commission. According to the Clackamas County Emergency Operations Plan, areas of West Linn bordering on the Willamette in the vicinity of its confluence with the Clackamas would be inundated by a wall of water 60 - 80 feet high in approximately an hour and a half should the North Fork dam fail under a "probable maximum flood" (a worst case scenario where all four dams fail).

There are no major dams on the Tualatin, and the Willamette River dams are far enough upstream and dispersed so that failures on these two rivers would not be much worse than a regular flood.

Historical Flooding Events

The Clackamas, Tualatin and Willamette Rivers have long histories of flooding. The most recent large-scale flooding event occurred in 1996. This and all other major historical flooding events are described in Section 6 of the Clackamas County NHMP.

Probability of Future Flooding Events

The probability of flooding events in West Linn was determined by analyzing historical occurrences, local knowledge, and other data. The probability of flooding in West Linn is described in Section 5 of this plan.

Flooding Hazard Assessment

Hazard Identification

The FEMA Flood Insurance Rate Maps (FIRMs) illustrating the 100-year floodplain is the national and state flood-mapping standard. However, the inundation level during the 100-year flooding event in 1996 is arguably a more accurate estimation of future flood hazard areas. For this reason, the city used the FIRM 100-year floodplain as well as the 1996 inundation line, shown on Map # 14: Flood Inundation to designate the flood prone areas.

The flood hazard analysis (Table 3-3) identifies only 380 acres (or 7% of total City acreage) within the City's Urban Growth Boundary exposed to the flooding hazard. This is a low estimation of the geographic extent of the flooding hazard, as many additional acres are subject to high water resulting from surface water management issues.

Vulnerability Assessment

Exposure to the flooding hazard is illustrated on Map # 15: Flood Analysis. Relatively few people (only 3% of the total population) live in the floodplain and thus are directly at risk from flooding. Dwelling units within or adjacent to the 100 year floodplain of the Tualatin those located on Swiftshore Avenue, Fields Bridge Park, and the Willamette Park.

Residences along the Tualatin that could be exposed to 100-year flooding events include those along River Street, Nixon Ave, Calaroga Ct., and Cedar Oak Park.

However, a larger percentage of residents are indirectly affected by hazards presented by flooding, as four major economic centers in the Campus Industrial zone are located in the 100-year floodplain. The 100-year flood could affect the West Linn Paper Company, creating serious economic and environmental impacts. Studies show that a majority of businesses do not survive extended closure due to disasters, which can thus economically devastate local communities. It will be essential that the economic centers mapped in hazard areas be targeted for business continuity planning.

Additionally, a great deal of infrastructure (bridges, water lines, sewage pump stations, etc.) is located in the floodplain. The Flood Inundation Map (#10) identifies the road closures during the 1996 flooding event, which is a good indicator of future transportation issues. Other infrastructure exposed to flooding includes, but is not limited to Portland General Electric Sullivan Hydroelectric Plant, Weiss Bridge, Fields Bridge, I-205 water line, Tri Cities sewage pump stations, and many more pieces of critical infrastructure that assist in supporting the essential needs of the community. Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

A few historic sites, including the McLean House are also located in the floodplain. Many older buildings will have difficulty sustaining pressure from flooding events, and should be targeted for floodplain retrofitting. The total building value exposed to the 100-year flood is about $57,650,000 (the lowest of all hazards).

Risk Assessment

Risk analysis is the third and most advanced phase of a hazard assessment. It builds upon the hazard identification and vulnerability assessment. A flood risk analysis for West Linn should include two components: (1) the life and value of property that may incur losses from a flood event (defined through the vulnerability assessment); and (2) the number and type of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events.

Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The data used to develop these models is based on hydrological analysis of landscape features. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event. Using GIS technology and flow velocity models such as Multi-Hazard HAZUS, it is possible to map the damage that can be expected from flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties.

At the time of publication of this plan, data was insufficient to conduct a risk analysis for flood events in West Linn. This plan includes recommendations for building partnerships that will support the development of a flood risk analysis in West Linn.

Existing Flood Mitigation Activities

Flood mitigation activities listed here include current mitigation programs and activities that are being implemented by the City of West Linn. In addition to listed items, TVF&R conducts public safety education on the dangers of moving water, has mapped flood-prone areas by address, and coordinates mitigation and preparedness information with local emergency management and other response agencies, as part of the Clackamas County Water Rescue Consortium. TVF&R's Water Rescue Team is housed in the Willamette fire station.

City of West Linn Codes Pertaining to Flooding

West Linn participates in the National Flood Insurance Program (NFIP). The West Linn Comprehensive Land Use Plan ("Goal 7: Areas Subject to Natural Disasters and Hazards") and the West Linn Community Development Code ("Chapter 27, Flood Management Areas") includes adequate controls for development in the flood plain. The following policies have been adopted to reduce losses from future flooding events.

1. Ensure development and associated alterations to the surrounding land are directed away from hazardous areas.
2. Restrict development except where design and construction techniques can mitigate adverse effects.
3. Require soils and geologic studies for development in hazardous areas.
4. Promote slope and soil stability and the use of natural drainageways in areas with landslide potential by retaining existing vegetation in those areas to the greatest extent possible.
5. Follow state and regional designations and construction standards regarding earthquake hazards.
6. Retain storage capacity of floodwaters by protecting flood plains.
7. Prohibit any alteration to the landscape or development that would result in a rise in elevation of the 100-year flood plain.
8. Minimize impacts to natural vegetation within the flood plain by restricting development and related human activity.
9. Manage land within the Willamette and Tualatin River 100-year flood plains to protect its natural functions.
10. Develop and maintain an emergency management program to effectively deal with natural disasters.
11. Implement requirements of Title 3 of the Metro Functional Plan to protect floodplains and other hazard areas.
12. Implement recommendations of the West Linn Park, Recreation and Open Space Plan relating to Willamette and Tualatin River Greenway trails.[1]
13. Enforce restrictions against altering stream courses and natural drainageways on private property.[2]

[1] Section 6: Park and Facility Recommendations, West Linn Park, Recreation and Open Space Master Plan.
[2] Section 4.070, West Linn Municipal Code.

Repetitive Flood Loss

The City of West Linn works to mitigate problems regarding flood issues when they arise. Some areas in the city are more susceptible to flooding issues, and have the potential to incur repetitive losses, meaning that they could have greater than two NFIP claims in the past ten years, in which the cost to repair the flood damage, on average, equals or exceeds 25 percent of the market value of the structure at the time of each flood loss event. According the most current data from Oregon Emergency Management, there is only one property in West Linn that meets the criteria for repetitive loss at this time.

Flood Mitigation Action Items

The flood mitigation action items provide direction on specific activities that organizations and residents in The City of West Linn 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-FL#1: Recommend revisions to requirements for development within the floodplain, where appropriate.

Ideas for Implementation

1. Review and amend development code requirements to ensure consistency with state and federal criteria.
2. Continue to participate in the National Flood Insurance Program.
3. Update the City's flood hazard maps with new information on flood hazard boundaries provided by the Army Corps of Engineers.
4. Adopt recently updated FEMA maps.

Coordinating Organization:	West Linn Planning Department
Timeline:	1-3 years
Plan Goals Addressed:	Protect life and property Develop partnerships Augment emergency preparedness

ST-FL#2: Heighten public awareness of flood and storm water hazards and steps they can take to reduce flood threats.

Ideas for Implementation

1. Use City's website and newsletter to publish appropriate information relating to flood hazards, city ordinances and policies, home mitigation steps and the newly revised Storm Water Master Plan.

Coordinating Organization:	West Linn Community Services Dept./Planning
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Enhance public awareness Preserve natural systems

ST-FL#3: Implement newly revised Storm Water Master Plan and seek revenue sources to fund capital projects that can reduce flood threats.

Ideas for Implementation

1. Revise SDC-eligible capital projects list and adopt new storm SDC as appropriate.
2. Initiate capital projects that can reduce flood threats.

Coordinating Organization:	West Linn Public Works
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Enhance public awareness Preserve natural systems

ST-FL#4: Address vulnerabilities of sewer pump stations to potential flood events.

Ideas for Implementation

1. Explore methods of flood-proofing key components of pump stations, elevating components that can be elevated, and elevating hazardous materials if present.
2. Develop strategies for pump stations to recover and resume operations as quickly as possible from flood event.

Coordinating Organization:	West Linn Public Works
Timeline:	1-2 years
Plan Goals Addressed:	Protect life and property Augment emergency services Preserve natural systems

LT-FL#1: Acquire flood-prone and repetitive loss properties and preserve as open space.

Ideas for Implementation

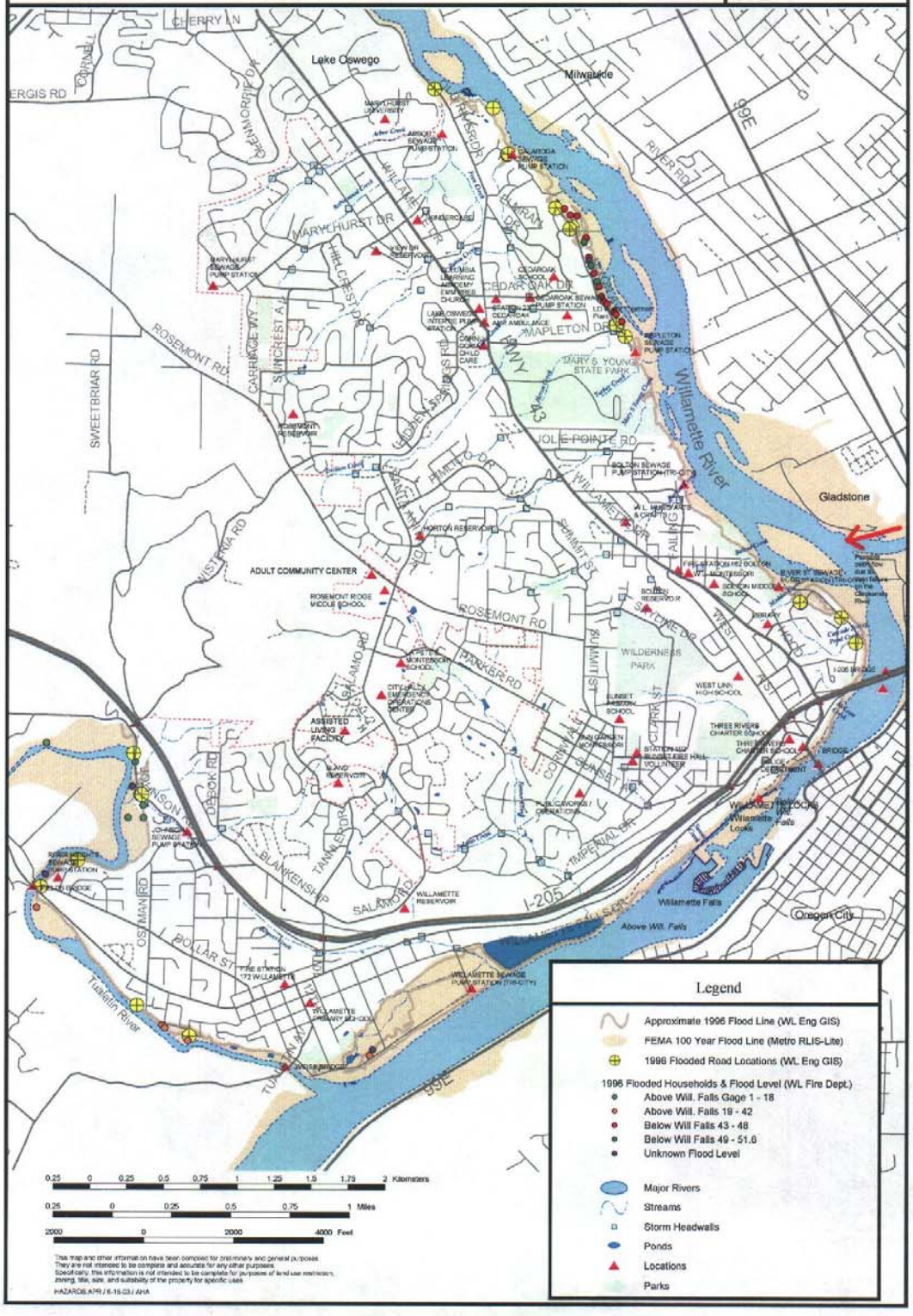
1. Identify funding sources, including bond revenue, grants and cooperative agreements with other agencies and organizations to acquire properties within the flood plain.
2. Implement mitigation strategies identified in the City's update of its Goal 5 analysis — a comprehensive inventory of natural, historic and cultural resources.
3. Explore strategies for acquisition of four identified flood-prone properties along Tualatin River to complete Greenway program, keeping in mind that high-value riverfront properties can be difficult to acquire through FEMA grant programs.

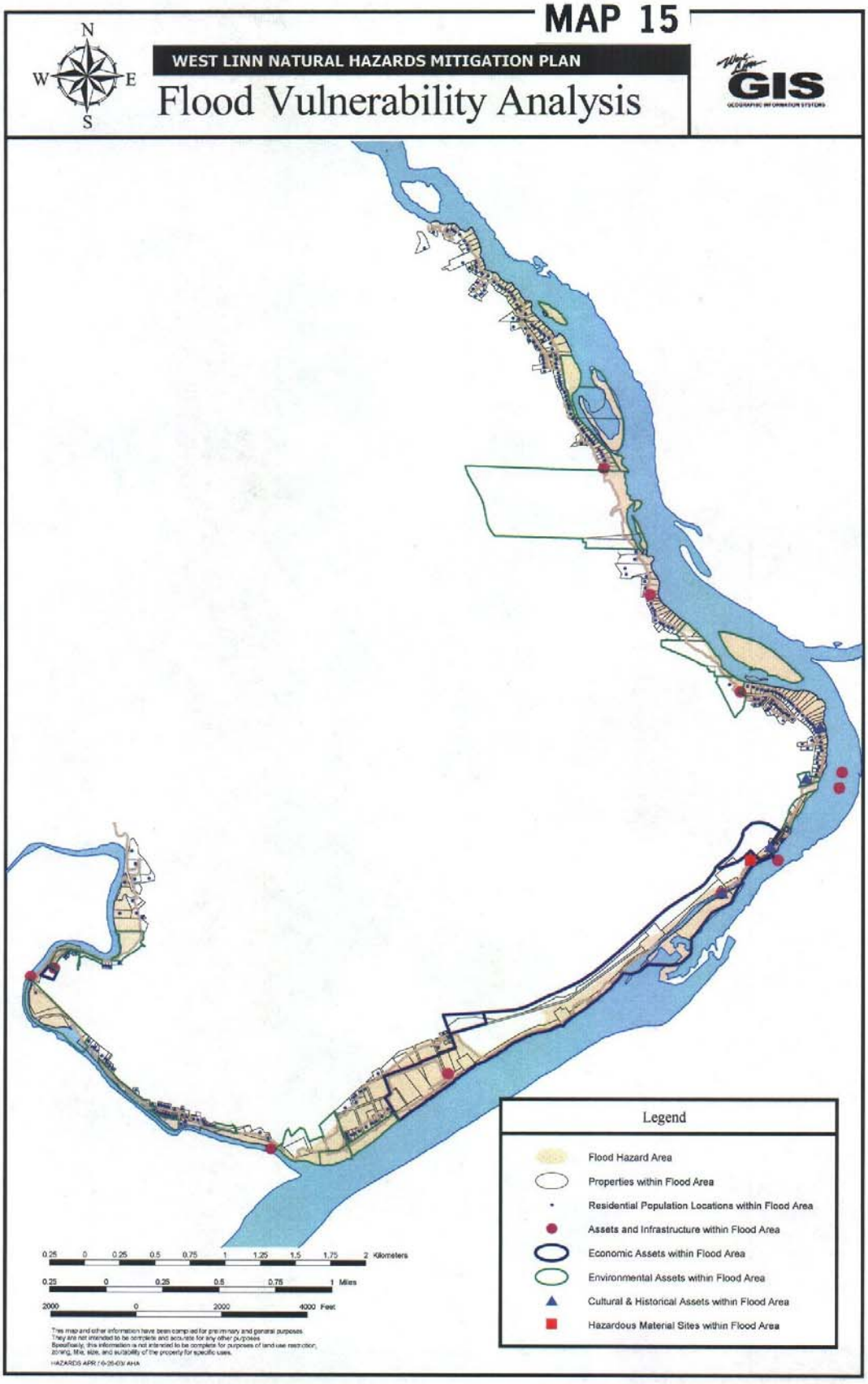
Coordinating Organization:	West Linn Parks and Recreation Dept./ Community Services/Planning
Timeline:	1-5 years
Plan Goals Addressed:	Protect life and property Partnerships and implementation Preserve natural systems

MAP 14

WEST LINN NATURAL HAZARDS MITIGATION PLAN

Flood Inundation




MAP 15
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Flood Vulnerability Analysis
GIS
N
W
E
S
Legend
Flood Hazard Area
Properties within Flood Area
Residential Population Locations within Flood Area
Assets and Infrastructure within Flood Area
Economic Assets within Flood Area
Environmental Assets within Flood Area
Cultural & Historical Assets within Flood Area
Hazardous Material Sites within Flood Area
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet

Landslide

Landslides are downhill movements of rock, debris, or soil mass. The topography of West Linn is conducive for landslides, debris flows (rapidly moving landslides). These hazards are associated with steep and/or poorly drained slopes, shallow subsurface flow of groundwater and springs, and soils that are susceptible to erosion. Landslides are typically slower moving than debris flows, but both can damage buildings and roads, degrade surface water quality and destroy vegetative cover. Debris flows create life-safety issues, as they can travel at high speeds. Though mass movement has not resulted in any loss of life in West Linn, the possibility exists.

The combination of steep slopes, unstable soils, landslide areas, and drainage ways creates significant development constraints. Excessive development in such physically limited areas increases the potential severity of landslides, soil erosion, earthquake damage, and flooding. The City has inventoried geological hazards, and has incorporated them into the Comprehensive Land Use Plan, pursuant to the Goals & Guidelines of Statewide Planning Goal 7 (Areas Subject to Natural Disasters & Hazards).

Landslide Profile

Landslide History

The historical landslide events have been described in the county plan. No catastrophic landslide events have been recorded in West Linn. The City has acted to stabilize some unstable slopes, and has identified areas of past or potential land movement.

Landslide Probability

The probability of landslide events in West Linn was determined by analyzing historical occurrences, local knowledge, and other data. The probability of landslides in West Linn is described in Section 5 of this plan.

Landslide Hazard Assessment

Hazard Identification

The City overlaid DOGAMI data identifying potential rapidly moving landslides (debris flows) with slopes that exceed 25 percent to illustrate landslide hazards in Map 16: Potential Landslides. All of the potential rapidly moving landslide areas correspond to areas that exceed 25 percent slope.

The City has about 915 acres of landslide-prone areas, which represents 17 percent of the total acreage of the City. However, most of the areas that are identified to exhibit dangerous potential rapidly moving landslides are vacant and often preserved in wooded, dedicated open space that is not listed within the City buildable lands inventory.

Vulnerability Assessment

Residents and businesses located in areas that exhibit slopes that exceed 25 percent (Map 17: Landslide Analysis), face some risk of damage from landslides. According to the GIS analysis, a total $920,230,000 worth of existing structures are exposed to the landslide

hazard. In addition, about 50 percent of the City's population or 12,670 individual City residents live in potential landside areas.

Three critical facilities are exposed to the landslide hazard — City Hall, the Public Works Operations Building, and the Bolton fire station. This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, fire stations and key pieces of infrastructure (bridges, sewage pump stations, water reservoirs) that would hinder the ability of the City to respond to emergency situations created by such an event.

Three schools that are considered essential facilities are also exposed to the landslide hazard. In addition 31 pieces of critical infrastructure, 14 economic centers, 17 cultural or historic assets, 77 environmental assets, and five hazardous material sites are exposed to the landslide hazard. Therefore, important transportation routes, business operations and educational facilities could be disrupted, causing transportation problems for both residents and officials, creating economic losses and halting education opportunities.

Hazardous materials sites would also suffer damage, resulting in threats to environmental and human health, while disrupting the availability of gasoline for vehicle transport and furthering economic loss because such sites are also sources of employment.

As a result, it will be important for the City to pursue opportunities for retrofitting and mitigating important structures and infrastructure, such that said facilities can withstand and survive landslides, particularly simultaneous landslides generated by an earthquake. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the landslide hazard.

Risk Assessment

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damages to West Linn due to a specific landslide or debris flow event. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

Existing Landslide Mitigation Activities

Landslide mitigation activities listed here include current mitigation programs and activities that are being implemented by the City of West Linn.

Policies[3]

1. Follow state and regional designations and construction standards regarding earthquake hazards.

[3] West Linn Community Development Code.

2. Promote slope and soil stability and the use of natural drainageways in areas that exhibit landslide potential by retaining existing vegetation in those areas to the greatest extent possible.
3. Refer to current seismic information during development review, including the pre-application meeting, and when enacting new regulations governing the location of structures and land uses.
4. Implement the rules and regulations of the City of West Linn's adopted ordinance that restricts development on slopes greater than 25%.
5. Obtain undeveloped property for open space and wildlife habitat through donations and acquisitions of tax-foreclosed properties.
6. Participate in public recognition of contractors that implement erosion-control practices in their land development projects.

City of West Linn Codes Pertaining to Landslides

- West Linn Comprehensive Land Use Plan (Goal 7: Areas Subject to Natural Disasters and Hazards)
- West Linn Community Development Code (Chapter 30, Wetland & Riparian Area Protection; Chapter 31, Erosion Control; Chapter 32, Natural Drainageway Protection; Chapter 33, Stormwater Quality & Detention; Chapter 41, Structures on Steep Slopes — Exceptions)

Landslide Mitigation Projects

In 2002, the City of West Linn revised its Development Code with respect to the protection of wetlands, drainageways and watercourses and adopted new enforcement mechanisms to prosecute violators and ensure that restoration work is undertaken by violators to mitigate damage caused to wetlands, drainageways and watercourses. In 2006, it developed a Surface Water Management Plan. The City is currently working on another revision to Chapter 32 of its Development Code that addresses its water quality resource areas and wetland codes.

Landslide Mitigation Action Items

The landslide mitigation action items provide direction on specific activities that organizations and residents in West Linn 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.

ST-LS#1: Increase public awareness of earthquake/landslide risks, development restrictions and mitigation measures.

Ideas for Implementation

1. Disseminate educational information using City newsletter, website, readerboard, flyers, etc. Seek coverage of earthquake and landslide risks by local news media.
2. Implement Code 4 telephone alert program to target residents who are directly affected or threatened by an existing or potential landslide.

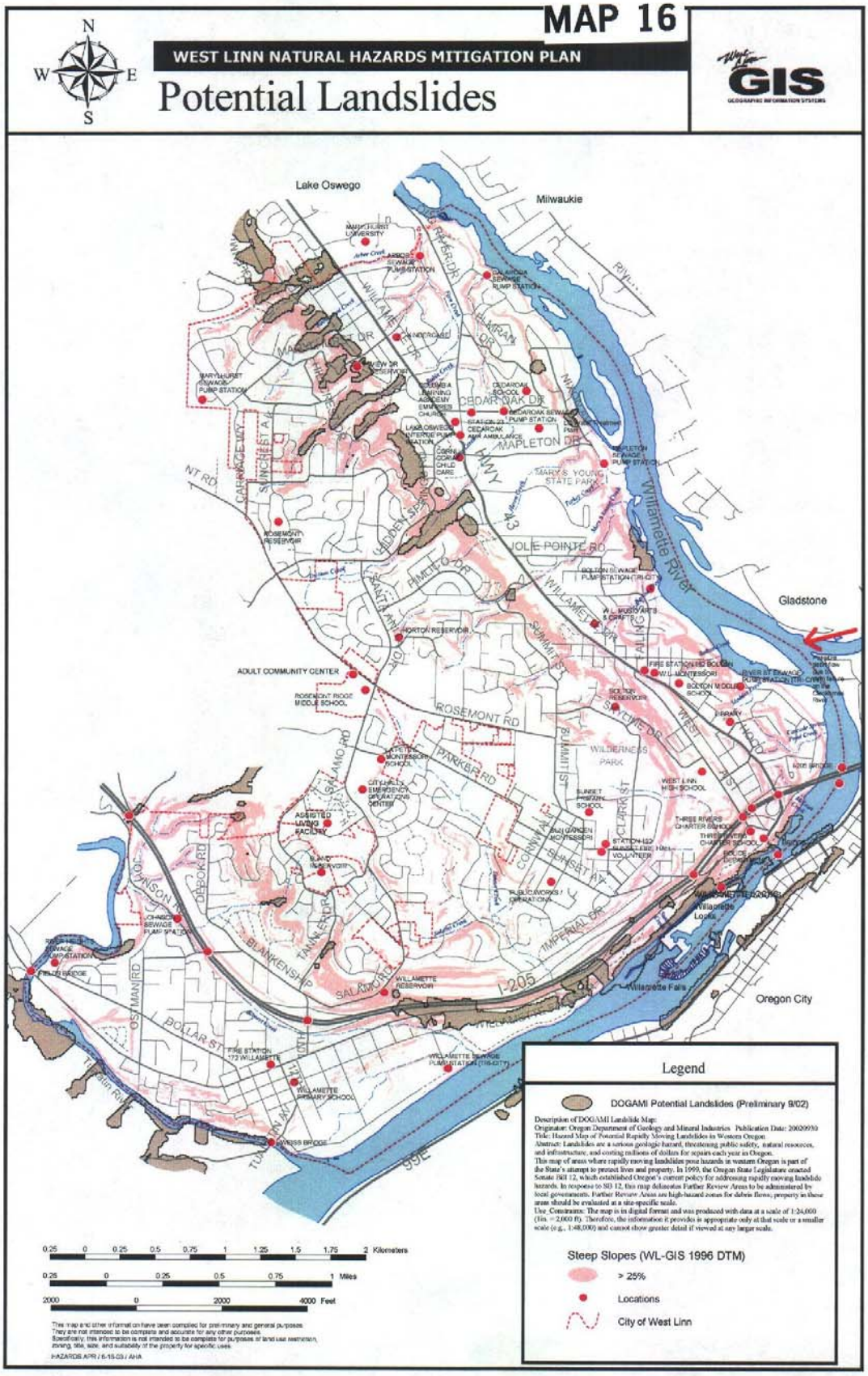
Coordinating Organization:	Community Services
Timeline:	1-2 years
Plan Goals Addressed:	Protect life and property Enhance public awareness

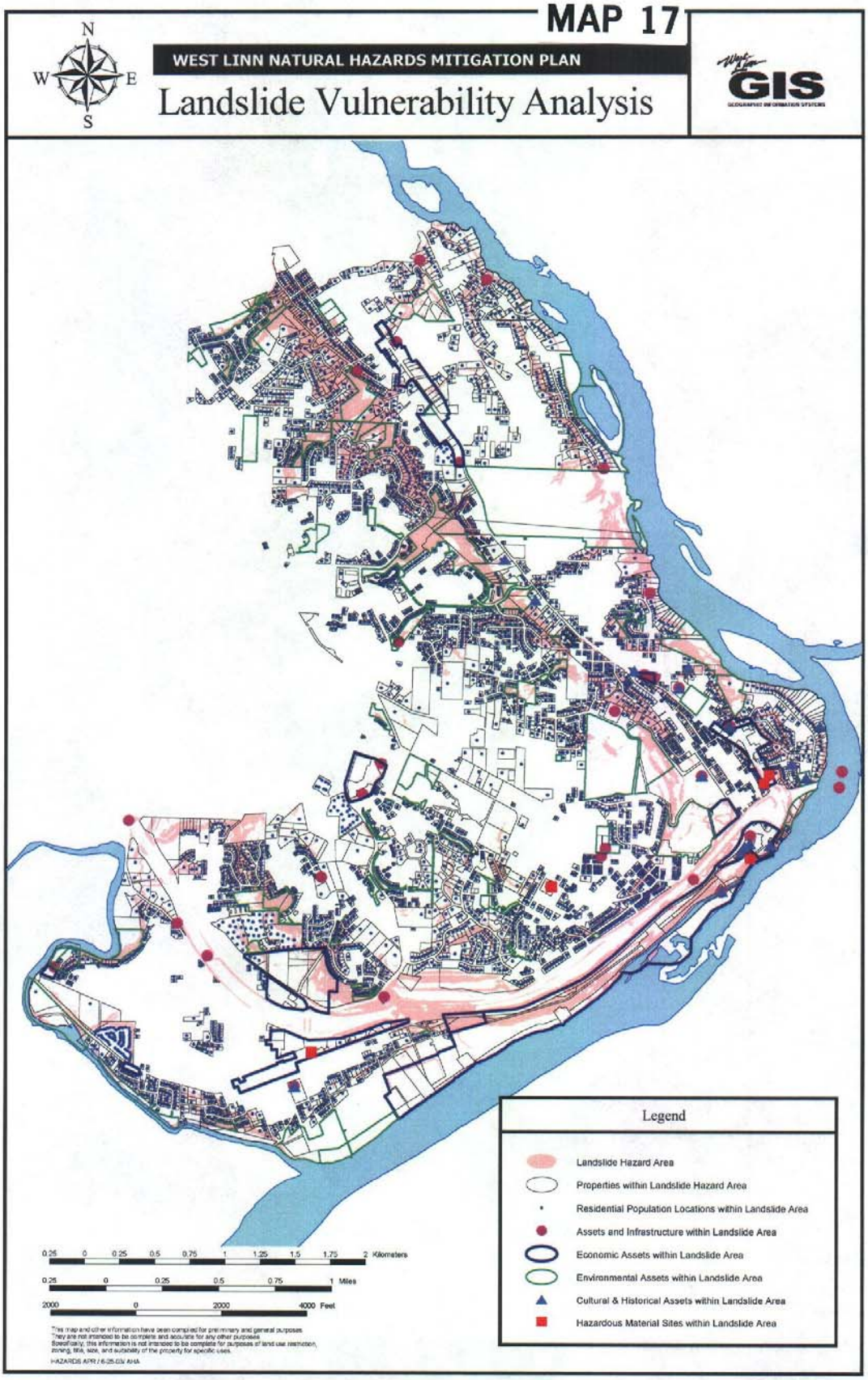
ST-LS#2: Identify, prioritize and mitigate significant landslide threats to critical and essential facilities and infrastructure (e.g. reservoirs, pump stations) and neighborhoods.

Ideas for Implementation

1. Identify and evaluate potential and known landslides that may affect the City's built environment, documenting the possible causes, extents, mitigation proposals and estimated costs of landslide and debris flow mitigation.
2. Utilize update of Goal 5 inventory of wetlands, drainageways and natural assets in the identification and mitigation of potential and known landslides.
3. Pursue opportunities to obtain and preserve such assets in public ownership through grants, bequests and acquisitions, subject to availability of funding.
4. Identify vulnerability of water reservoirs to landslide events through the Water Master Plan.

Coordinating Organization:	Engineering /Parks and Recreation/Planning
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Partnerships and implementation Preserve natural systems Augment emergency services


MAP 16
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Potential Landslides
GIS
Lake Oswego
Milwaukie
Gladstone
Oregon City
Willamette River
ADULT COMMUNITY CENTER
ROSEMONT RD
MAPLETON DR
JOLIE POINTE RD
SUNSET AV
I-205
Legend
DOGAMI Potential Landslides (Preliminary 9/02)
Steep Slopes (WL-GIS 1996 DTM)
> 25%
Locations
City of West Linn
Kilometers
Miles
Feet


MAP 17
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Landslide Vulnerability Analysis
N
W
E
S
GIS
Legend
Landslide Hazard Area
Properties within Landslide Hazard Area
Residential Population Locations within Landslide Area
Assets and Infrastructure within Landslide Area
Economic Assets within Landslide Area
Environmental Assets within Landslide Area
Cultural & Historical Assets within Landslide Area
Hazardous Material Sites within Landslide Area
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet

Earthquake

In recent years, the seriousness of earthquake threat in the Pacific Northwest has become better understood and more widely recognized. In 1991, the Oregon Seismic Safety Policy Advisory Commission researched actions to address earthquake risk in Oregon. This Commission concluded that additional research and assessments of seismic hazards were needed to develop informed policy decisions for land use planning, structural codes, and emergency response to earthquakes. Recently, seismic risk maps for Oregon's Structural Code have been upgraded from seismic zone 2B to zone 3, which requires an increased level of design for structures built in western Oregon.

In 2001, the passage of Senate Bills 14 and 15 requires public schools (kindergarten to universities) and emergency facilities (hospitals, fire, police) to improve life safety standards (focusing on seismic hazards). Measures 15 and 16 on the 2002 ballot were passed by the voters and allow for state general obligations bonds to pay for earthquake mitigation. This was a huge success, but no funding was obligated.

In 2005, a number of Senate Bills were passed to support and implement this previous legislation. The first was Senate Bill 2, which directs the state Department of Geology and Mineral Industries to conduct statewide seismic needs assessment by January 1, 2007, surveying and ranking based on risk factors schools, colleges, police and fire stations, and hospitals. Senate Bill 3 directs the state Office of Emergency Management to create a grant program for local communities to undertake seismic rehabilitation of their schools, colleges, police and fire stations and hospitals. The grant program would be funded by state general obligation bonds authorized by Oregon voters in 2002. Senate Bill 4 authorizes bonding for seismic rehabilitation for education buildings, and Senate Bill 5 authorizes bonding for seismic rehabilitation for public safety buildings.

Earthquake Profile

West Linn is subject to ground shaking from two sources: Crustal earthquakes are by definition relatively shallow, and subduction zone earthquakes occur at greater depths. There are several known and inferred crustal faults in the Portland area, and doubtless many more yet to be discovered. Although the Cascadia Subduction Zone is hundreds of miles away, a large subduction zone earthquake could significantly impact the City of West Linn. Relative seismic risk is illustrated on the Metro/DOGAMI relative earthquake hazards maps for the metropolitan area. The region is organized into hazard zones, which range from A (highest risk) to D (lowest risk), and color coded (Map 12: Earthquake Hazards)

Subduction Zone Earthquakes

The subducting seafloor of the Juan de Fuca plate is being pushed beneath the continental North American plate. The contact between these two plates periodically ruptures in large, subduction zone earthquakes. Depending on location, strong shaking might be felt for several minutes. Subduction zone events can have great magnitudes, with the potential for an M9 in the Pacific Northwest. The Cascadia Subduction Zone is well

offshore and at great depth, but the energy released from a worst-case subduction earthquake could yield several minutes of shaking, generating substantial damage and particularly threatening tall structures.

Crustal Earthquakes

There is ongoing research into local faults to determine their historical and potential seismic activity. There is a direct relationship between a fault's length and its capabilities for generating earthquakes. Local area faults such as the Oatfield and Portland Hills faults, are large, running for up to 30 miles. Earthquakes on local faults can be of high magnitude, and can cause intense shaking. Shaking duration can range from seconds to more than a minute. Smaller nearby faults produce lower magnitude events, but their ground shaking and damage can be intense because of the fault's proximity and local soil conditions. Their proximity also yields the potential for transmission of a greater spectrum of seismic waves than from deeper, more distant faults, including those most damaging to typical residential structures.

Earthquakes can trigger other types of ground failures which could contribute to damage. These include:

- landslides
- dam failures
- liquefaction (Ground shaking can mix groundwater and soil, liquefying and weakening the ground that supports buildings and severing utility lines. This is a significant problem in low-lying areas adjacent to rivers where the water table is shallow and the soils are subject to liquefaction. For example, the alluvial soils near the confluence of the Willamette and the Tualatin and Clackamas Rivers are likely subject to this hazard.)

Earthquake History

Historical records identify over 56 earthquakes in the Portland Metro area (please see the Clackamas County NHMP for details). The more severe ones occurred in 1700, 1877, 1880, 1953 and 1962. The last Cascadia subduction zone earthquake was January 26, 1700. Previous subduction zone quakes were in the years (approximately) 900, 750, and 400 AD. Geological evidence suggests an average of 500 years between events.

The most recent significant event was the March 25, 1993 Scotts Mills earthquake. It was a moderate, shallow, crustal earthquake (5.6 magnitude with aftershocks continuing at least through April 8). It occurred in a previously recognized fault zone. In the three-county area that received a Presidential Disaster Declaration, it was reported that more than 30 public buildings sustained damage, which was concentrated in old masonry buildings. Several buildings required rebuilding. At least 4 fire stations, 1 911 center, 16 schools, 5 city halls, 1 medical center, 1 police station, 1 correctional facility, and 1 library were damaged. No damage was reported in West Linn.

Earthquake Probability

The probability of seismic events in West Linn was determined by analyzing historical occurrences, local knowledge, and other data. The probability of earthquakes affecting West Linn is described in Section Five.

Earthquake Hazard Assessment

Hazard Identification

In 2000, the state of Oregon Department of Geology and Mineral Industries (DOGAMI) updated the 1997 Relative Earthquake Hazard Map, shown on Map 12: Earthquake Hazards. This map is based on the region's geology and specialized geophysical and geotechnical measurements and categorizes areas into one of four relative hazard categories. The four relative hazard zones are based on ground motion, amplification, liquefaction and slope stability. The DOGAMI map is useful in developing hazard mitigation policies such as in emergency response plans, directing efforts for strengthening or replacing older and weaker buildings in areas of greatest hazard effects, or determining the location of future urban expansion or intensified development. However, geotechnical studies are necessary to determine the existence and the extent of the hazard at any specific location.

Although the entire City is vulnerable to earthquakes to some degree, only about 23% of the City's Urban Growth Boundary is in moderate to high earthquake hazard zones. Map 18: Earthquake Hazards depicts the extent of the earthquake hazard zones in West Linn.

Vulnerability Assessment

Although only about 26% of West Linn residents live in high to moderate earthquake hazard zones, vulnerable buildings, roads, bridges and utility lines and the unpredictability and instantaneous nature of earthquakes can result in enormous losses of life (see Map 19: Earthquake Analysis). In addition, a subduction zone earthquake could cause damage to buildings and infrastructure city-wide. Because the greatest potential for loss of life is to people within a collapsing building, the true extent of the risk is dependent on a seismic assessment of each building. In addition to the direct effects of the earthquake, such as collapsed buildings, earthquakes can cause secondary incidents which may also be life-threatening, including hazardous materials incidents, landslides, and dam failures. Both of the major hazardous materials fixed sites in West Linn (West Linn Paper Company & Water Treatment Plant) as well as two gas stations are located in the highest hazard zone for earthquakes. The total building value exposed to the earthquake hazard is $338,230,000.

West Linn's infrastructure is particularly vulnerable to earthquake. Of the city's nine pump stations, eight are in the moderate to high hazard zones for earthquakes. While the I-205 bridge has been seismically retrofitted, its footings lie in the highest hazard zone, as do those for the Oregon City-West Linn Bridge.

During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event. The Bolton fire station, the Police Department's headquarters, and Cedaroak Ambulance are in the moderate to

high hazard zones. TVF&R is remodeling the Bolton and Willamette fire stations, to include seismic upgrades.

Vulnerable populations such as children could be significantly impacted, as many schools lie in the highest two hazard zones. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in West Linn for seismic hazard retrofitting.

Risk Assessment

The County 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. West Linn does not have the resources to conduct a local risk assessment for the earthquake analysis, so the data reported in the county plan is the best quantitative assessment for the earthquake hazard in West Linn.

Existing Earthquake Mitigation Activities

Mitigation activities being carried out or completed by the City of West Linn include:

- Seismic strengthening of supports for the West Linn primary water transmission line (24-inch) attached to the underside of the I-205 (Abernety) Bridge over the Willamette River between West Linn and Oregon City, as part of a general seismic upgrade of the bridge by the Oregon Department of Transportation, 2001-02
- Compliance with SB 13, enacted in 2001, requiring local governments to develop seismic preparation procedures, inform their employees about the procedures, and conduct earthquake drills.
- Seismic analysis of West Linn Police Station, 1997.
- Conformance with seismic-related construction requirements in the Oregon Structural Specialty Code and Oregon One- and Two-Family Dwelling Specialty Code.
- Adoption of Capital Improvements Plan calling for future replacement of Bolton Fire Station and seismic upgrade or replacement of West Linn Police Station.
- TVF&R is remodeling the Bolton Fire Station, including seismic upgrades
- Adoption of a policy to require undergrounding of power lines in new subdivisions.
- Development Code restrictions regarding construction on steep slopes.

Earthquake Mitigation Action Items

The earthquake mitigation action items provide direction on specific activities that organizations and residents in City of West Linn 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.

ST-EQ#1: Reduce threat to critical and essential facilities and infrastructure. (Please see data table for exposure information.)

Ideas for Implementation

1. Utilize the DOGAMI inventory of critical and essential facilities to prioritize buildings for seismic upgrades.
2. Identify funding sources (including state funding sources in Senate Bill 4 and Senate Bill 5) for seismic analyses and retrofitting of critical and essential facilities and infrastructure.
3. Build new police station.

Coordinating Organization:	Public Works/Engineering
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property

ST-EQ#2: Increase public awareness of earthquake insurance and availability.

Ideas for Implementation

1. Coordinate with Clackamas County and private insurance providers to disseminate earthquake insurance information.
2. Target property owners in high-hazard areas.

Coordinating Organization:	Risk Management
Timeline:	1-2 years
Plan Goals Addressed:	Increase public awareness Partnerships and implementation

ST-EQ#3: Update earthquake risk assessment using HAZUS and new mapping data.

Coordinating Organization:	GIS
Timeline:	1-2 years
Plan Goals Addressed:	Increase public awareness Partnerships and implementation

ST-EQ#4: Increase public awareness of earthquake threat and preparedness.

Ideas for Implementation

1. Coordinate with Tualatin Valley Fire and Rescue, Clackamas County, West Linn/Wilsonville School District and other organizations (e.g., FEMA) to provide public information on steps to reduce the threat of property damage and injury from earthquakes in the workplace and the home.
2. Provide outreach information that pertains to structural and non-structural mitigation measures and locales of areas of City most vulnerable to earthquakes / liquefaction.

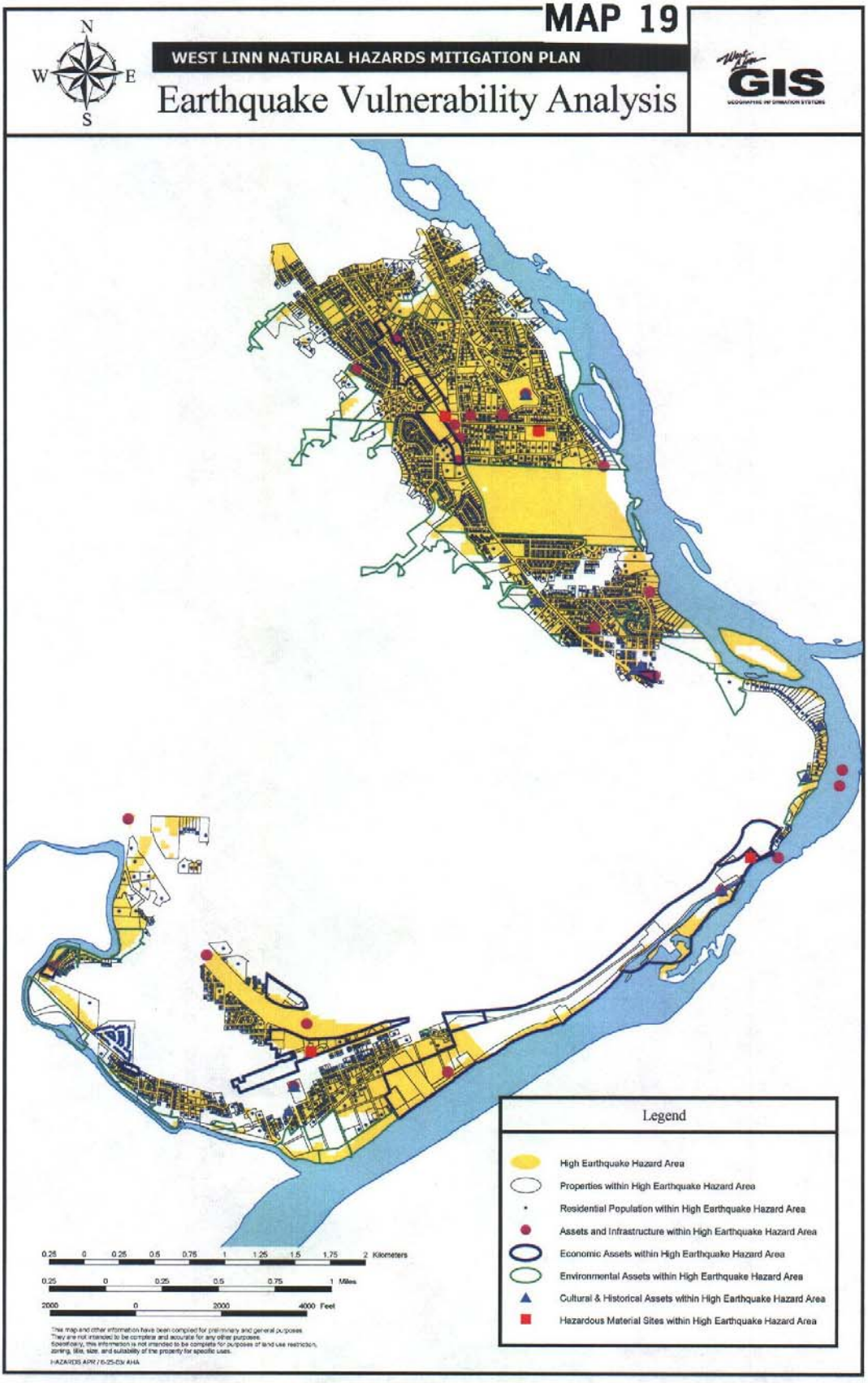
Coordinating Organization:	Community Services
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Increase public awareness Partnerships and implementation

LT-EQ#1: Develop seismic analyses of key bridges that serve West Linn and develop strategies for retrofitting and replacement.

Ideas for Implementation

1. Work with ODOT to undertake seismic analysis of key bridges.
2. Develop strategies with ODOT for retrofitting and replacing key bridges, noting that the Borland Bridge over the Tualatin River will be replaced within one year, and the I-205 bridge is also proposed to be replaced.

Coordinating Organization:	Public Works
Timeline:	1-3 years
Plan Goals Addressed:	Partnerships and implementation Augment emergency services Protect life and property


MAP 19
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Earthquake Vulnerability Analysis
GIS
N
W
E
S
Legend
High Earthquake Hazard Area
Properties within High Earthquake Hazard Area
Residential Population within High Earthquake Hazard Area
Assets and Infrastructure within High Earthquake Hazard Area
Economic Assets within High Earthquake Hazard Area
Environmental Assets within High Earthquake Hazard Area
Cultural & Historical Assets within High Earthquake Hazard Area
Hazardous Material Sites within High Earthquake Hazard Area
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet

Severe Storms

Severe Storm Profile

Wind, snow and ice storms (severe storms) are caused by severe weather conditions. Wind storms can occur at any time of the year, while ice storms are limited to the winter months. These storms produce linear winds rarely exceeding 90 miles per hour. An ice and / or snow storm can be accompanied by high winds. Wind and ice / snow storms are addressed together because they exhibit similar impacts, particularly in the form of damage to trees, power lines and utility lines.

Storm events in the City of West Linn are rarely life-threatening because weather forecasts afford people time to seek shelter and prepare for storm conditions, and existing homes, businesses and other structures offer protection from most storms. Nonetheless, storm events in the City of West Linn can cause major disruptions of service because of the city's steep terrain, exposed utilities and many trees.

The loss of antennas and telephone lines hampers communication between emergency services and disrupts radio and television broadcasts. Icy streets and downed power lines on roads present hazards to drivers, while rendering travel difficult for emergency equipment, which often increases due to traffic accidents and fires during storms and power outages.

Severe Storm History

The City of West Linn was most recently affected by snow and ice in January, 2007. Although there was some accumulation of snow, the city reported no major damages. Just one month prior, a heavy precipitation event followed by a high winds caused many disruptions in power and transportation systems. Again, the City avoided major damages.

In January 2004, Clackamas County received a Presidential Disaster Declaration for a major snow and ice event. The City of West Linn spent over $40,000 to remove debris and repair transportation networks.

The historical severe winter storm events have been described in the county plan, and are applicable to the City of West Linn, which has a history of severe storms, including wind, snow, and ice storms. Wind speeds as high as 119 mph were recorded in Portland during a 1962 winter storm event. The most recent severe storm event in December of 1995 felled trees and blocked roads. Several homes were damaged from falling trees and branches, but no injuries were reported. In areas west and south of West Linn, the storm exhibited hurricane force wind speeds of more than 110 miles per hour. As many as 400,000 people in the Portland metropolitan area lost power. More recently, the area endured an ice storm in January 1998, when a severe winter storm dropped freezing rain and snow that were accompanied by two days of high winds. Much of the City lost power due to downed electrical lines and malfunctioning transformers.

Severe Storm Probability

The probability of severe storm events in West Linn was determined by analyzing historical occurrences, local knowledge, and other data.. The probability of severe storms in West Linn is described in Section 5 of this plan.

Severe Storm Hazard Assessment

Hazard Identification

Severe storm hazards in the City of West Linn were identified at or above 500 feet in elevation with 25 percent or greater slope (Map 20: Snow and Ice). These parameters were used as elevation is an indicator of areas where ice, snow, and harsh winds can persist. The 25 percent slope factor was included to indicate where adverse road conditions could inhibit safe travel or emergency response operations. These hazard factors as well as historic data were analyzed to denote potential road closures as well as sanding and snow-plow routes. Map 13: Snow and Ice indicates that the City exhibits 2,247 acres of areas that are prone to severe winter storms, which represent 43 percent of the total acreage of the City.

Vulnerability Assessment

The areas of the City that are often most at risk to severe storms are residential areas on steeper slopes, where roads may be icy and, thus, difficult to climb and descend (please see Map 21: Snow and Ice Analysis. Road corridors leading to residential areas with fuller tree canopies are susceptible to downed tree limbs, and those areas that are above 500 feet in elevation are particularly vulnerable. However, some weather systems are characterized by a temperature inversion, where the valley floor is colder than the nearby hills. Consequently, severe storms affect the entire city.

The major risk to property results from exposed utilities, especially power lines and water pipes that are damaged by wind, broken tree limbs and cold temperatures. Businesses also suffer economic losses when they must close as the result of the inclement weather and/or the loss of power, which, in turn, disrupts the local supply chain of goods and services. Periods of extended ice coverage hinder emergency response services and limit the mobility of residents, which could result in serious life safety issues.

Residents and businesses that are located in areas that exhibit the severe storm hazard, as illustrated on Map 18: Snow and Ice Analysis face some risk of damage from severe storms. According to information from the City, a total $1,304,700,000 worth of existing structures are exposed to the landslide hazard, along with 18,290 individual City residents that comprise 72 percent of the City's population. Therefore, severe winter storms are a significant factor that impact nearly three-quarters of all City residents.

Four critical facilities are exposed to the severe storm hazard — City Hall, the Public Works Operations Building and two fire stations. The exposure of these four critical facilities means that severe storm events could substantially disrupt the operations of City government buildings and fire stations, impairing key City functions, while hindering the ability of emergency response personnel to respond to emergency situations that are created by a severe storm event.

Five schools and one adult community center that are considered essential facilities are also exposed to the severe storm hazard. In addition, 26 pieces of critical infrastructure, 15 economic centers, 20 cultural or historic assets, 80 environmental assets, and nine hazardous material sites are exposed to the severe storm hazard. All of these facilities depend upon utility lines, roads and bridges to operate and perform their respective important functions within the City. Exposed utility and power lines are particularly vulnerable to damage from severe winter storms by wind, ice and snow. More hardened infrastructure, like bridges and roads, can sustain a severe winter storm, but during the event, they are often hazardous to traverse because of icy, windy and snowy conditions. Consequently, a severe winter storm could substantially disrupt numerous key resources and facilities within the City through impediments to the transportation system and damage to the power grid. Among other things, these transportation problems and power failures disrupt business operations and educational facilities, resulting in economic losses and halting educational opportunities.

Power to Hazardous material sites could also disrupted. The sites themselves could be damaged, or rendered inaccessible. In turn, these conditions could pose threats to the natural environment of the City and the health of its population, while disrupting the availability of gasoline for vehicle transport and furthering economic losses.

As a result, it will be important for the City to pursue opportunities for undergrounding utilities and retrofitting utility lines so that they may withstand cold weather conditions without freezing and bursting. Adhering to current building codes for weatherization of structures, as well as current engineering and fire codes that pertain to the steepness of new roads, are also key factors for the City to consider. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the severe storm hazard.

Risk Assessment

Factors that should be included in severe storm risk analysis include: population and property distribution in the hazard area; the frequency of windstorm events; and information on the types of trees and failure rates most susceptible to severe storm events as well as and information on utilities, and infrastructure that may be impacted by severe winter storms. These inputs can be used in modeling software such as Multi-Hazard HAZUS to predict potential losses from a particular storm event.

Due to insufficient data and modeling capability, West Linn is unable to perform a quantitative severe storm risk assessment 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 Severe Storm Mitigation Activities

Mitigation activities being carried out by the City of West Linn include:

- Ongoing replacement of cast iron and concrete asbestos water pipes with ductile iron pipes, which are more resilient in severe weather and disaster conditions.

- Ongoing replacement of collapsed and broken storm sewer lines to reduce the likelihood of localized flooding.
- Ongoing sealing or replacement of sanitary sewer lines to reduce infiltration of stormwater contributing to overloading of sewer lines and discharges of untreated wastewater into the Willamette River.
- Regular storm drain inspection and debris removal, reducing the risk of localized flooding.
- Sanitary sewer inspections and repair.
- A policy to require undergrounding of power lines in new subdivisions.
- Identification in GIS system of primary and secondary plowing and sanding routes Map 18: Snow and Ice Analysis.

Severe Storm Mitigation Action Items

The severe winter storm mitigation action items provide direction on specific activities that organizations and residents in the City of West Linn 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.

ST-SS#1: Reduce risk of erosion and soil destabilization by implementing the strategies outlined in the newly adopted Storm Water Master Plan.

Ideas for Implementation

1. Review vegetation management policies and identify possible policy revisions to reduce likelihood of erosion and soil destabilization.
2. Utilize updated Goal 5 analysis to identify, control and provide planning strategies for development of areas at risk to erosion and soil destabilization.
3. Implement erosion control and soil destabilization strategies from

Coordinating Organization:	Public Works/Planning Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Preserve Natural Systems Partnerships and implementation

ST-SS#2: Reduce risk of utility and communications outages.

Ideas for Implementation

1. Consult with utility providers to document most vulnerable transportation corridors and pursue possible mitigation steps, including limb pruning.
2. Develop strategies for undergrounding existing utilities, while enforcing programs that require undergrounding of new utilities.

Coordinating Organization:	Public Works
Timeline:	1 year
Plan Goals Addressed:	Protect life and property Preserve Natural Systems

ST-SS#3: Encourage public preparedness for winter storm events.

Ideas for Implementation

1. Collect and disseminate timely information and public education materials for protecting life, property and the environment from severe winter storm events. Utilize City Website, newsletter, video readerboard and news media.
2. Implement Code 4 telephone alert program to warn residents of an impending severe storm event.

Coordinating Organization:	Community Services Dept.
Timeline:	Ongoing
Plan Goals Addressed:	Enhance public awareness Protect life and property

ST-SS#4: Develop tree hazard program for preventing future hazards, while improving long-term health and care of urban forest.

Ideas for Implementation

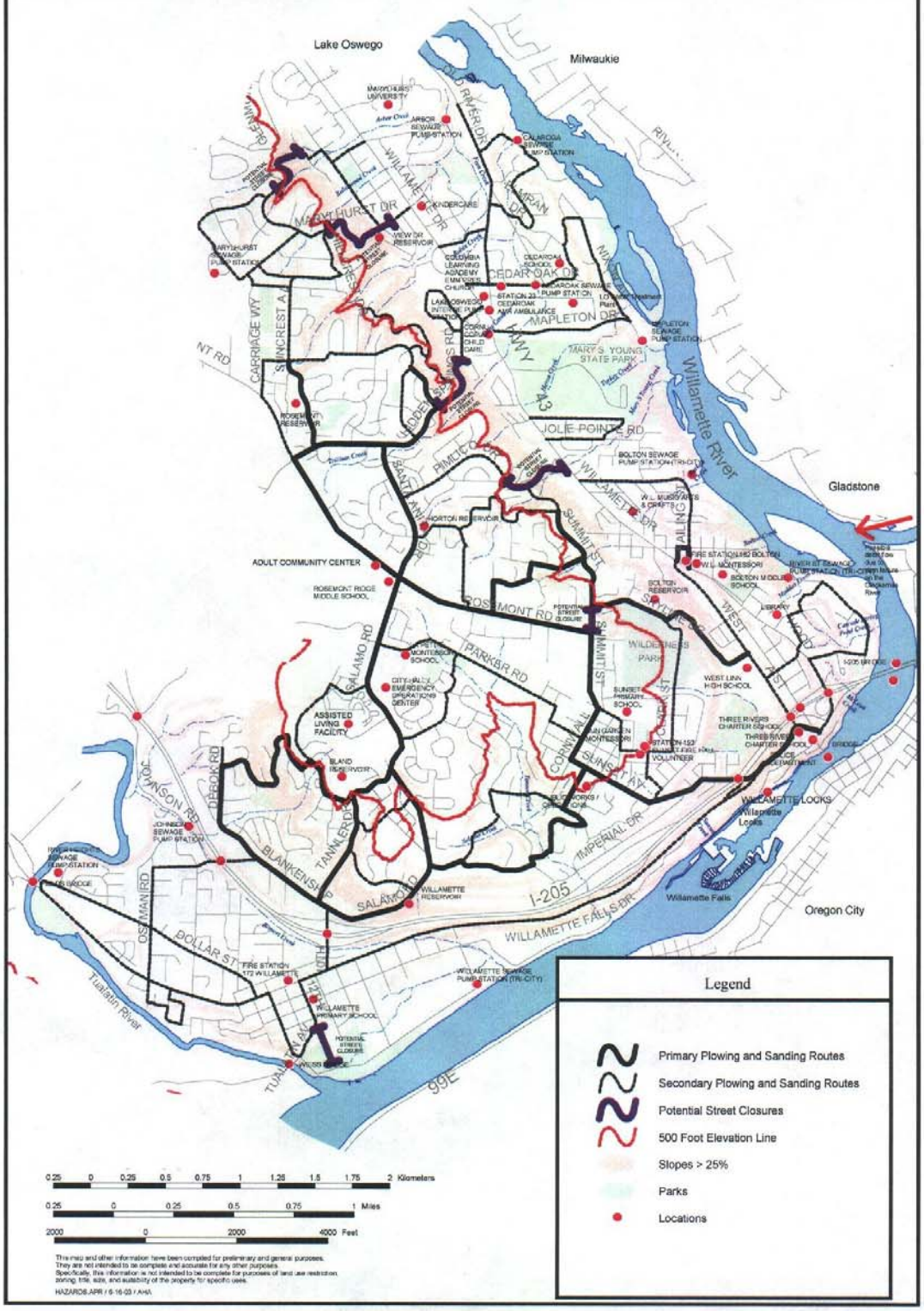
1. Re-evaluate tree preservation and tree-cutting ordinances to ensure consistency and effectiveness of programs.
2. Assess pitfalls of selectively preserving older, taller individual trees that become threats once their surrounding forested environment is removed. Consider preserving younger trees.
3. Consider obtaining services of professional arborist to assist in implementing hazard tree program and associated modifications to ordinances.
4. When implementing tree removal program, exercise sensitivity toward public values of tree preservation and outcry over tree removal.

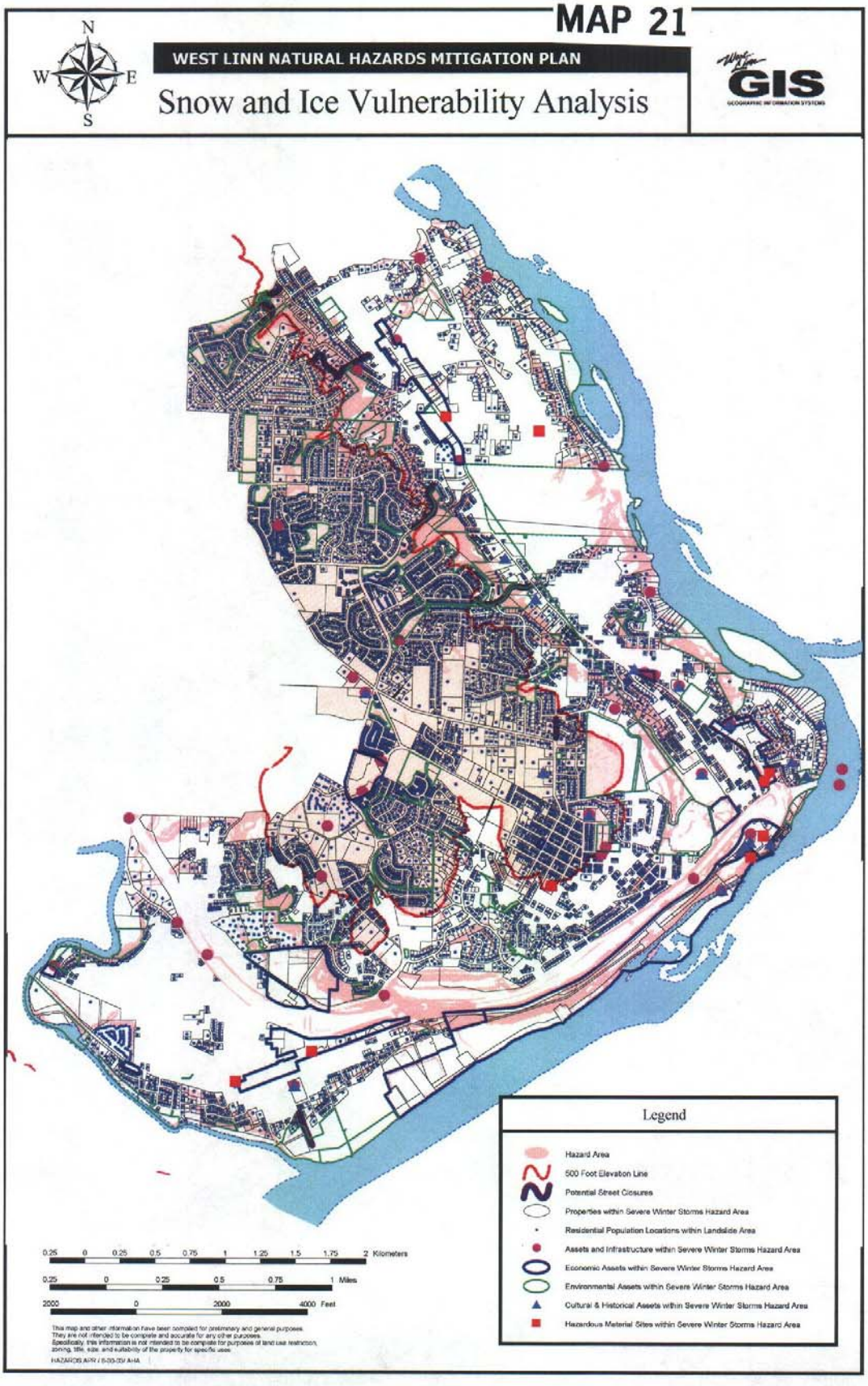
Coordinating Organization:	Parks/Planning
Timeline:	1-3 years
Plan Goals Addressed:	Enhance public awareness Protect life and property Preserve natural systems

MAP 20

WEST LINN NATURAL HAZARDS MITIGATION PLAN

Snow and Ice (Severe Winter Storms)




MAP 21
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Snow and Ice Vulnerability Analysis
N
W
E
S
GIS
Legend
Hazard Area
500 Foot Elevation Line
Potential Street Closures
Properties within Severe Winter Storms Hazard Area
Residential Population Locations within Landslide Area
Assets and Infrastructure within Severe Winter Storms Hazard Area
Economic Assets within Severe Winter Storms Hazard Area
Environmental Assets within Severe Winter Storms Hazard Area
Cultural & Historical Assets within Severe Winter Storms Hazard Area
Hazardous Material Sites within Severe Winter Storms Hazard Area
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
This map and other information have been compiled for preliminary and general purposes.
They are not intended to be complete and accurate for any other purposes.
Specifically, this information is not intended to be complete for purposes of land use restriction,
zoning, title, size, and suitability of the property for specific uses.

Wildfire

Wildfire Profile

The City of West Linn is characterized by lush parks, neighborhoods surrounded by mature trees and under story vegetation and development intermingled with the natural landscape. Much of West Linn's undeveloped topography consists of wooded slopes 25 percent or steeper. These occluded woodlands range in size from 2 to 20 acres, and make up a significant portion of the 373 acres of parks and open space managed by the City. Most of the woodlands are surrounded by urban development. Although this enhances the quality of life, unless adequately maintained, vegetation around homes and development could serve as fuel for wildfires.

Wildfire History

On July 26, 2003, a wildfire along I-205 in West Linn burned approximately 20 acres of dry grass and brush on a hillside below the City's Willamette Reservoir and the Barrington Heights residential neighborhood. The three-alarm blaze was extinguished within two hours without injury or property loss. While there have been no wildfire disasters recorded in West Linn, fires do occur from time to time in occluded woodlands; the possibility of wildfires in steeply sloped, wooded drainageways also exists, putting residences and businesses that border on such areas at risk.

Wildfire Probability

The probability of wildfire events in West Linn was determined by analyzing historical occurrences, local knowledge, and other data. The probability of wildfires in West Linn is described in Section Five.

Wildfire Hazard Assessment

Hazard Identification

Wildfire Hazards in the City of West Linn were identified using topography, vegetation type, and climatic data. Map 22: Wildfire shows that about 25% (1,310 acres) of West Linn is in the high to moderate wildfires hazard zone.

Clackamas County recently completed a Wildland Urban Interface (WUI) map, in accordance with the Clackamas Community Wildfire Protection Plan. This map used urban density and hazardous fuels to denote potential hazard areas. Map 23: Wildland Urban Interface shows that 2,633 acres of West Linn is considered as WUI by Clackamas County.

Vulnerability Assessment

Residences and businesses that border occluded woodlands with slopes greater than 25% are at the greatest risk of loss or damage from wildfires. Homes and businesses and other urban facilities in these areas have been inventoried and are shown on Map 24: Wildfire Vulnerability Analysis.

The only response-related facility exposed to the wildfire hazard is the Sunset Volunteer Fire Station, which is important but not critical. A great deal of infrastructure is exposed to the wildfire hazard, including West Linn's primary water source. This could affect the efficiency of fire protection professionals during a large scale wildfire. Vegetation along roadways is also highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows.

The West Linn Paper Mill and Water Treatment Plant are in high wildfire hazards areas. These industrial facilities use hazardous materials during operation that could be explosive, exacerbating a wildfire, or initiating one.

Because schools are generally located near parks and scenic areas, they can be threatened by wildfires. Sunset Primary School, Cedar oak School, West Linn High School, Bolton Middle School, and the Library are particularly at risk. A variety of historic landmarks are also included in the high wildfire zones. The total building value exposed to wildfire hazards is $423,280,000.

Risk Assessment

Key factors included in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence, and weather, as well as occurrences of drought. At the time of publication of this plan, data was insufficient to conduct a risk analysis. Due to insufficient data, West Linn is unable to perform a quantitative wildfire risk assessment at this time. The City has addressed this issue in the action items, and will be completing a wildfire risk assessment as data and resources become available.

Existing Wildfire Mitigation Activities

Tualatin Valley Fire and Rescue provides emergency fire suppression, medical response and rescue services to the City of West Linn under an intergovernmental agreement related to voter-approved annexation to the district. TVF&R staffs a four-person engine company at the Bolton fire station, and a three-person engine company at the Willamette station, 24 hours a day, seven days a week. Mutual aid agreements with neighboring jurisdictions are also in place. Water supply and storage capacity in West Linn conforms with recommended fire flow requirements.

Cooperatively with the City of West Linn Community Services Department, TVF&R provides outreach and education to the community on wildfire mitigation via news releases, posters, signage, website messages, safety exhibits at community events such as the West Linn Old Time Fair, and visits to schools, civic organizations and neighborhood associations. TVF&R also:

- Provides fire and life safety plan review for new development and construction consistent with applicable codes and ordinances,
- Investigates fires within the City,
- Performs fire inspections,
- Provides public safety education to citizens, civic groups, and other entities,

- Plans and trains internally and with other agencies on disaster response.

In addition to City and TVF&R efforts, Clackamas County recently developed a county-wide Community Wildfire Protection Plan in accordance with the Healthy Forest Restoration Act. This coordinated planning effort will assist the City in implementing identified wildfire mitigation strategies by laying the foundation for partnerships and increasing the City's eligibility for grant funding.

City woodlands have been inventoried and mapped in the course of a natural assets inventory required by Oregon State Land Use Planning Goal 4: Forested Lands. A combination of local building restrictions, previous open space dedications and development constraints effectively limit further development in West Linn's wooded areas. However, because vegetation is difficult to regulate and maintain, there are many areas in West Linn that have been identified in the Clackamas Community Wildfire Plan as potential fuels reduction projects. These areas are illustrated in Map 25: West Linn's Occluded Woodlands, and are included in Long Term Action Item #1, below.

The City provides detailed plan review, development review, and building (construction) review services in conformance with the Community Development Code, Uniform Building Code and Fire Code.

Wildfire Mitigation Action Items

The wildfire mitigation action items provide direction on specific activities that organizations and residents in the City of West Linn can undertake to reduce risk and prevent loss from wildfires. 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-WF#1: Increase public awareness of wildfire threat and ways to reduce risk to life and property in the urban/woodland interface.

Ideas for Implementation

1. Continue to conduct education and outreach activities through use of city newsletters, public access TV, fire marshal's office (home/business "audits"), and demonstration projects and displays, including education on:
   --building and roofing materials
   --setbacks
   --home fire plans and evacuation routes
   --voluntary fire inspections
   --creation of defensible space
   --clearly marked addresses
   --providing adequate access for emergency services.
2. Avoid causing concern/panic to residents when implementing outreach programs.

Coordinating Organization:	Community Services, TVF&R
Timeline:	Ongoing
Plan Goals Addressed:	Enhance public awareness

Protect life and property
Preserve natural systems
Partnerships and implementation

ST-WF#2: Review and assess adequacy of city's water storage capacity for fighting wildfires, and develop strategy to address deficiencies, if any.

Ideas for Implementation

1. Assign responsibility for water storage analysis and recommendations to West Linn Engineering Department, with support from professional consultants.
2. Utilize water master planning process in the review and assessment of city's adequacy of water storage capacity for fighting wildfires.

Coordinating Organization:	Public Works
Timeline:	1 year
Plan Goals Addressed:	Protect life and property Augment emergency services Partnerships and implementation

ST-WF#3: Inventory alternative firefighting water sources and incorporate into Water Master Plan.

Ideas for Implementation

1. Identify and map stormwater detention basins, holding ponds and other water sources and access points.
2. Utilize newly adopted Storm Water Master Plan and water master planning process in the identification and mapping of stormwater detention basins, holding ponds and other water sources and access points.

Coordinating Organization:	Engineering Department
Timeline:	1 year
Plan Goals Addressed:	Protect life and property Augment emergency services planning Partnerships and implementation

ST-WF#4: Support and develop strategies to prohibit shake roofs on homes in WUI.

Ideas for Implementation

1. Support TVF&R's pending adoption of the Wildland Urban Interface map and corresponding code enforcement.
2. Support legislation, while developing ordinances and / or overlays, that prohibit shake roofs on homes in WUI and override Covenants, Codes & Restrictions of Homeowners Associations that stipulate shake roofs.

Coordinating Organization:	Planning/Building

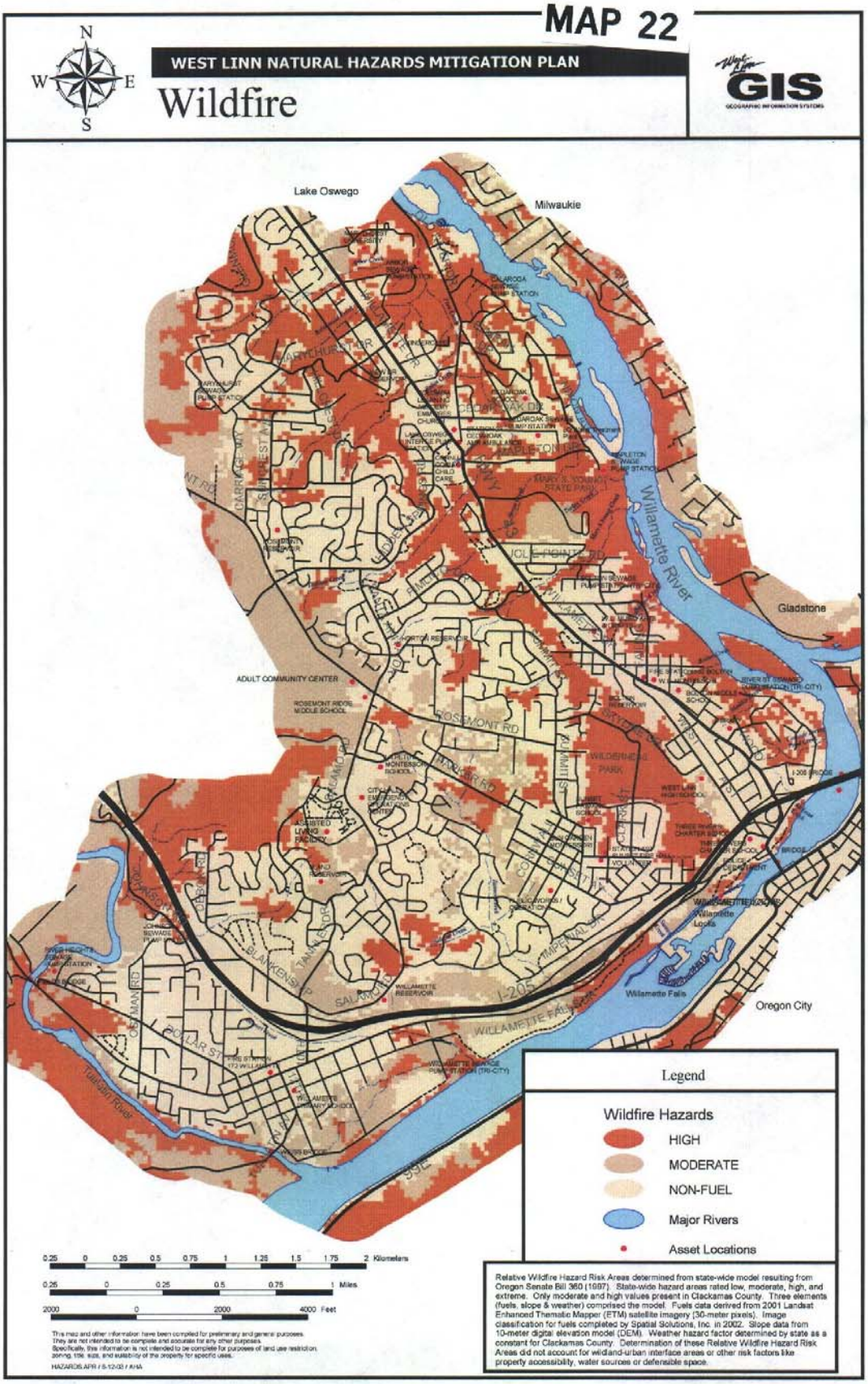
Timeline:	2-3 years
Plan Goals Addressed:	Protect life and property Augment emergency services Partnerships and implementation Enhance public awareness

LT-WF#1: Reduce fuel loading in woodland/urban interfaces, while balancing effects on wildlife and habitat.

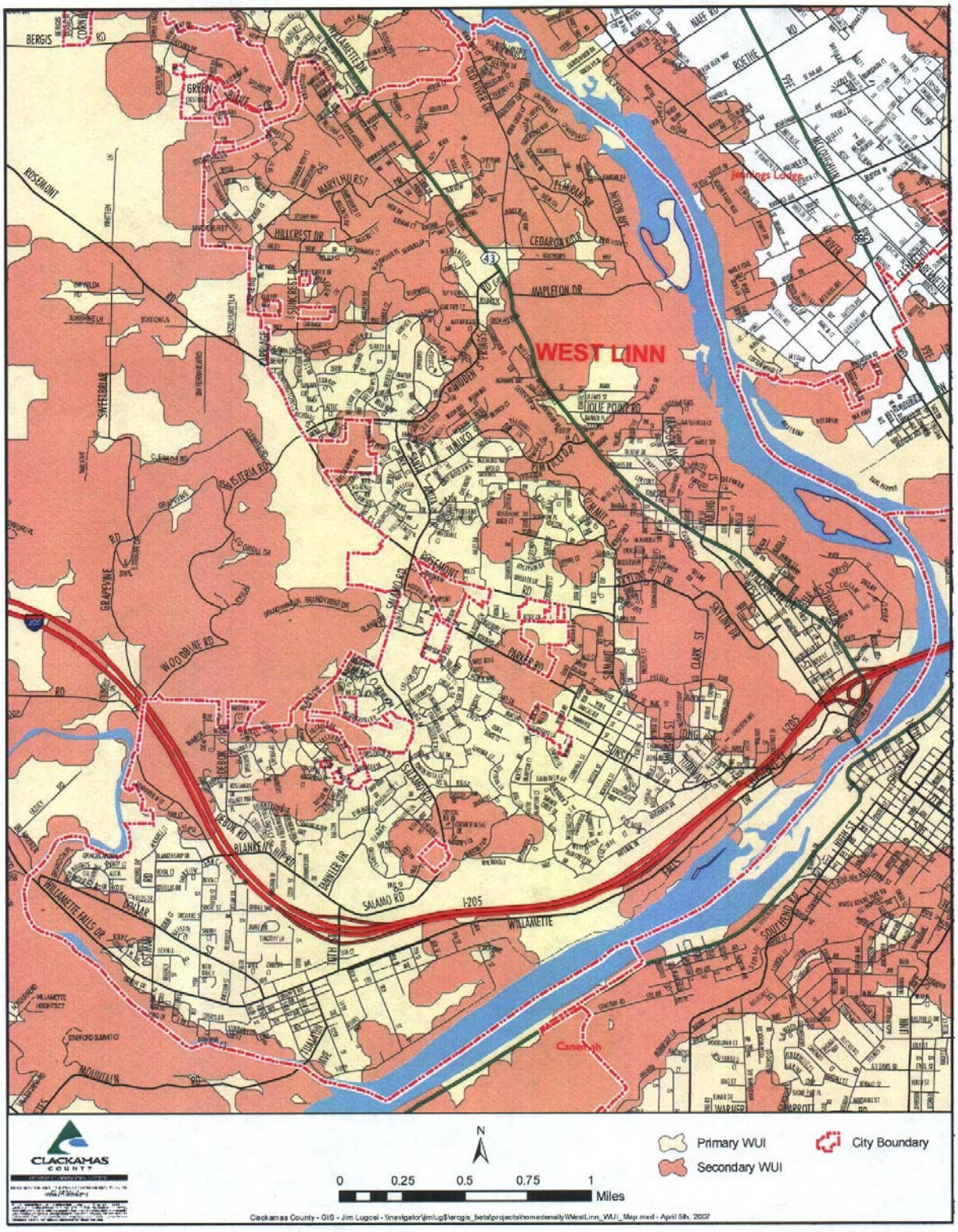
Ideas for Implementation

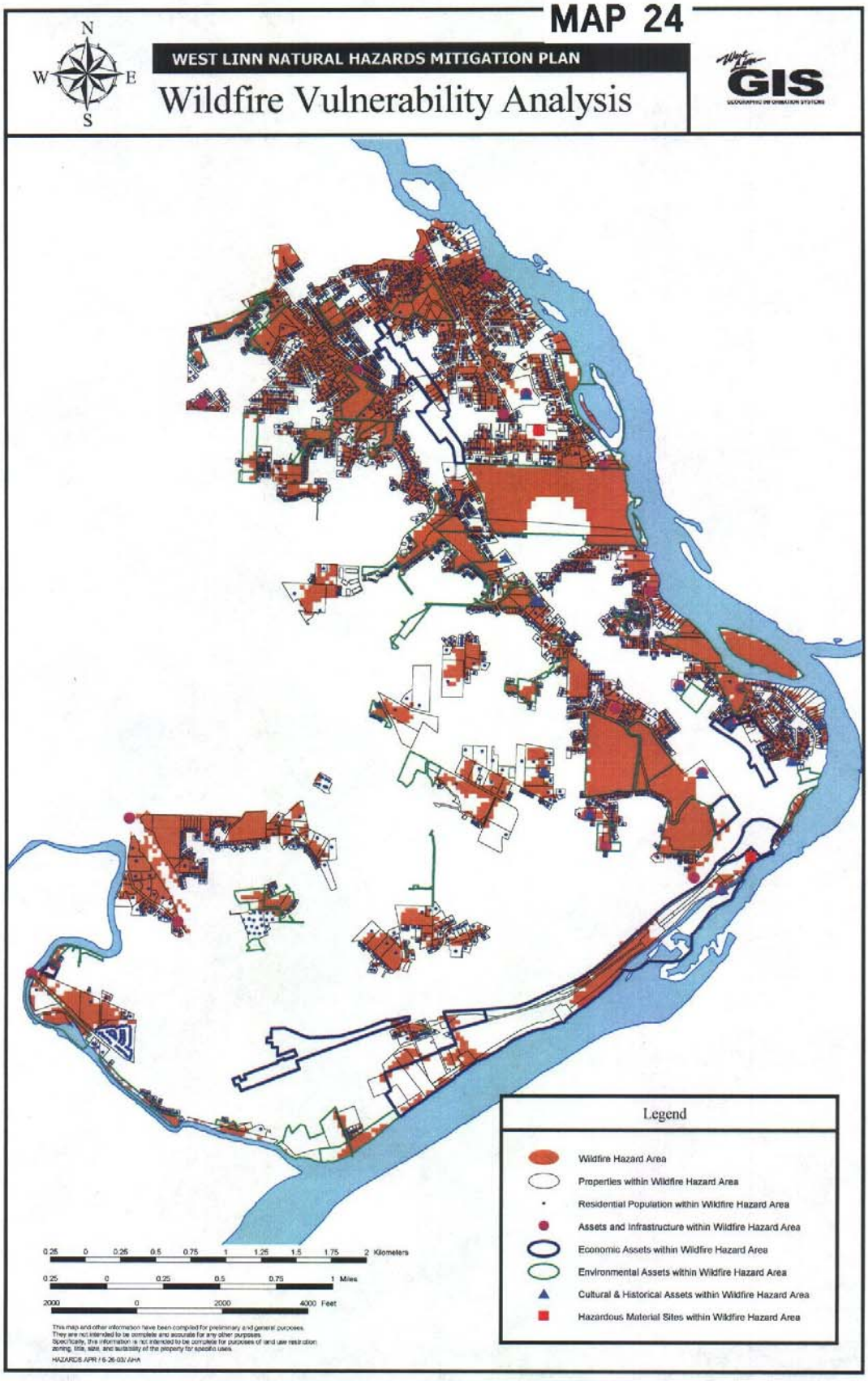
1. Utilize volunteers, civic organizations, park and recreation staff, and work crews to clear brush and debris from interfaces, and identify opportunities for mitigation grants to reduce fuel loading in all wildfire hazard areas, particularly those shown on Map 25: West Linn's Occluded Woodlands.
2. Balance the effects on wildlife and habitat in the process of reducing fuel loading.
3. Build public outreach strategies into all programs for fuel loading reduction that address sensitive and potentially controversial issues of residents' values toward trees and the removal thereof.
4. Avoid causing alarm or panic to residents in the course of fuel removal programs.

Coordinating Organization:	Community Services/Parks
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Preserve natural systems Partnerships and implementation


MAP 22
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Wildfire
GIS
N
W
E
S
Lake Oswego
Milwaukie
Willamette River
Gladstone
Oregon City
Willamette Falls
ADULT COMMUNITY CENTER
ROSEMONT RD
I-205
Legend
Wildfire Hazards
HIGH
MODERATE
NON-FUEL
Major Rivers
Asset Locations
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.
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
This map and other information have been compiled for preliminary and general purposes. They are not intended to be complete and accurate for any other purposes. Specifically, this information is not intended to be complete for purposes of land use restriction, zoning, title, size, and suitability of the property for specific uses.
HAZARDS.APR / 5-12-03 / AHA

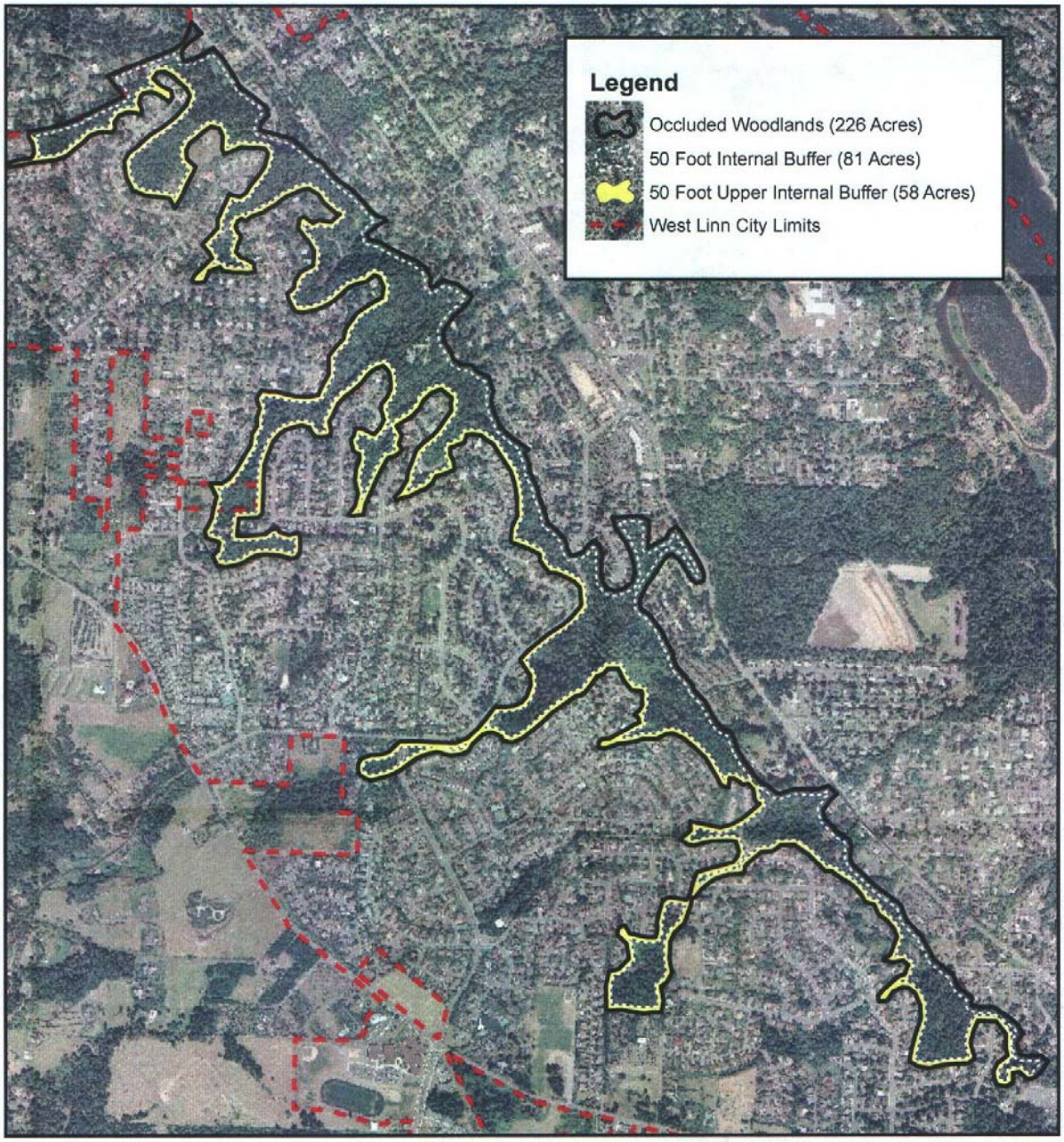
MAP 23


WEST LINN
Jennings Lodge
Canemah
CLACKAMAS COUNTY
N
0 0.25 0.5 0.75 1
Miles
Primary WUI
Secondary WUI
City Boundary
Clackamas County - GIS - Jim Lugosi - \\navigator\jmlug$\arcgis_beta\projects\homedensityWestLinn_WUI_Map.mxd - April 5th, 2007


MAP 24
WEST LINN NATURAL HAZARDS MITIGATION PLAN
Wildfire Vulnerability Analysis
N
W
E
S
GIS
Legend
Wildfire Hazard Area
Properties within Wildfire Hazard Area
Residential Population within Wildfire Hazard Area
Assets and Infrastructure within Wildfire Hazard Area
Economic Assets within Wildfire Hazard Area
Environmental Assets within Wildfire Hazard Area
Cultural & Historical Assets within Wildfire Hazard Area
Hazardous Material Sites within Wildfire Hazard Area
0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 Kilometers
0.25 0 0.25 0.5 0.75 1 Miles
2000 0 2000 4000 Feet
This map and other information have been compiled for preliminary and general purposes.
They are not intended to be complete and accurate for any other purposes.
Specifically, the information is not intended to be complete for purposes of land use restriction
zoning, title, size, and suitability of the property for specific uses.
HAZARDS.APR / 6-26-03/ AHA

MAP 25

West Linn's Northern Occluded Woodlands



hazards\fuelreductionarees\photointerp.mxd AHA 6-13-05

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.

Volcanic Eruption

Volcanic Eruption Profile

The Pacific Northwest lies on the "Ring of Fire," an area of active volcanic activity surrounding the Pacific Basin. The primary volcanic threat to lives and property in West Linn is from eruptions of Mount Hood, potentially generating mud and debris flows that could sweep down river valleys for tens of miles. Although Mount Hood does not have a history of explosive eruptions, even small amounts of volcanic ash can crate a nuisance. In addition, the proximity of Mount Saint Helens carries with it a risk of more substantial ash clouds that could drift over the area.

History of Volcanic Eruption

The last major volcanic eruption on Mount Hood occurred in the 1790s, not long before Lewis and Clark's expedition to the Pacific Northwest, according to the USGS. In the mid-1800s, local residents reported minor explosive activity, but since that time, the USGS reports, the volcano has not actually erupted. However it continues to exhibit seismic activity. In the period between July 6-9, 1980, four earthquakes measuring 3.2 and 3.3 were recorded as having their epicenter at, or near Mount Hood. Numerous smaller aftershocks also occurred following these earthquakes. Subsequently, a number of seismic activities ranging up to 3.2 have been recorded at the mountain, almost annually, the most recently substantial one having occurred in 2002. There are earthquake swarms routinely, gas emissions from summit fumaroles, and, most importantly, numerous small debris flows generated by storms, landslides, and glacier outburst floods that affect areas around the volcano and sometimes affect highways. The latter events are real issues for the Forest Service and ODOT, primarily in Hood River County but also in Clackamas.

In contrast to Mount Hood, Mount St. Helens underwent several substantial eruptive events in 1980 that carried and deposited substantial amounts of ash into the Portland metropolitan area. More recently, the mountain has again erupted several times beginning in 2004. None of these recent eruptions has approached the magnitude of the 1980 eruptions.

Volcanic Eruption Probability

The probability of volcanic eruptions in West Linn was determined by analyzing historical occurrences, local knowledge, and other data. The probability of volcanic eruptions in West Linn is described in Section Five.

Volcanic Eruption Hazard Assessment

Hazard Identification

The hazard zones illustrated on Map 26: Mount Hood Hazards for Clackamas County were determined based on the distance from the volcano, vent location, and type of hazardous events. West Linn is outside of both proximal and distal hazard zones, although the entire region could feel the effects of disrupted transportation routes (I-84

and US 26) and some evacuations. As Mount Hood contains a range of popular recreational sites, West Linn residents should be aware of the hazard zones and how they are defined. Proximal Hazard Zones 1 and 2 are subject to rapidly moving debris avalanches, pyroclastic flows, and lahars that can reach the hazard boundary in less than 30 minutes, as well as slow-moving lava flows. Areas within proximal hazard zones should be evacuated before an eruption begins because there is little time to get people out of harm's way once an eruption starts. Most pyroclastic flows, lava flows, and debris avalanches will stop within the proximal hazard zone, but lahars can travel much farther.

Distal Hazards Zones 3 includes areas adjacent to rivers that are pathways for lahars. Estimated travel time for lahars to reach these zones is more than 30 minutes, which may allow individuals time to move to higher ground and greater safety if given notice. Lahars could affect transportation corridors by damaging or destroying roads, and can damage Bull Run pipelines that cross the Sandy River.

While Mount Hood has shown no recent signs of volcanic activity, scientists predict the next eruption will consist of lava dome growth accompanied by small explosions, and lava-dome collapse generating pyroclastic flows, ash clouds, and lahars. Future eruptions from Mount Hood could seriously disrupt transportation, water supplies, and hydroelectric power generation and transmission in northwest Oregon and southwest Washington.

Vulnerability Assessment

Ash fall generated by Mount Hood and other nearby volcanoes is the primary volcanic hazard that could affect West Linn. The impacts of a significant ash fall are substantial. Persons with respiratory problems are endangered, transportation, communications, and other lifeline services are interrupted, drainage systems become clogged, and the economy can be adversely impacted. Any future eruption of a nearby volcano (e.g., Hood, St. Helens, or Adams) occurring during a period of easterly or southern winds would likely have adverse consequences for the county.

Risk Assessment

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments. Key factors included in assessing risk from volcanic eruptions and ash fall include population and property distribution in the hazard area, the frequency of events, and potential wind direction. At the time of publication of this plan, data were insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

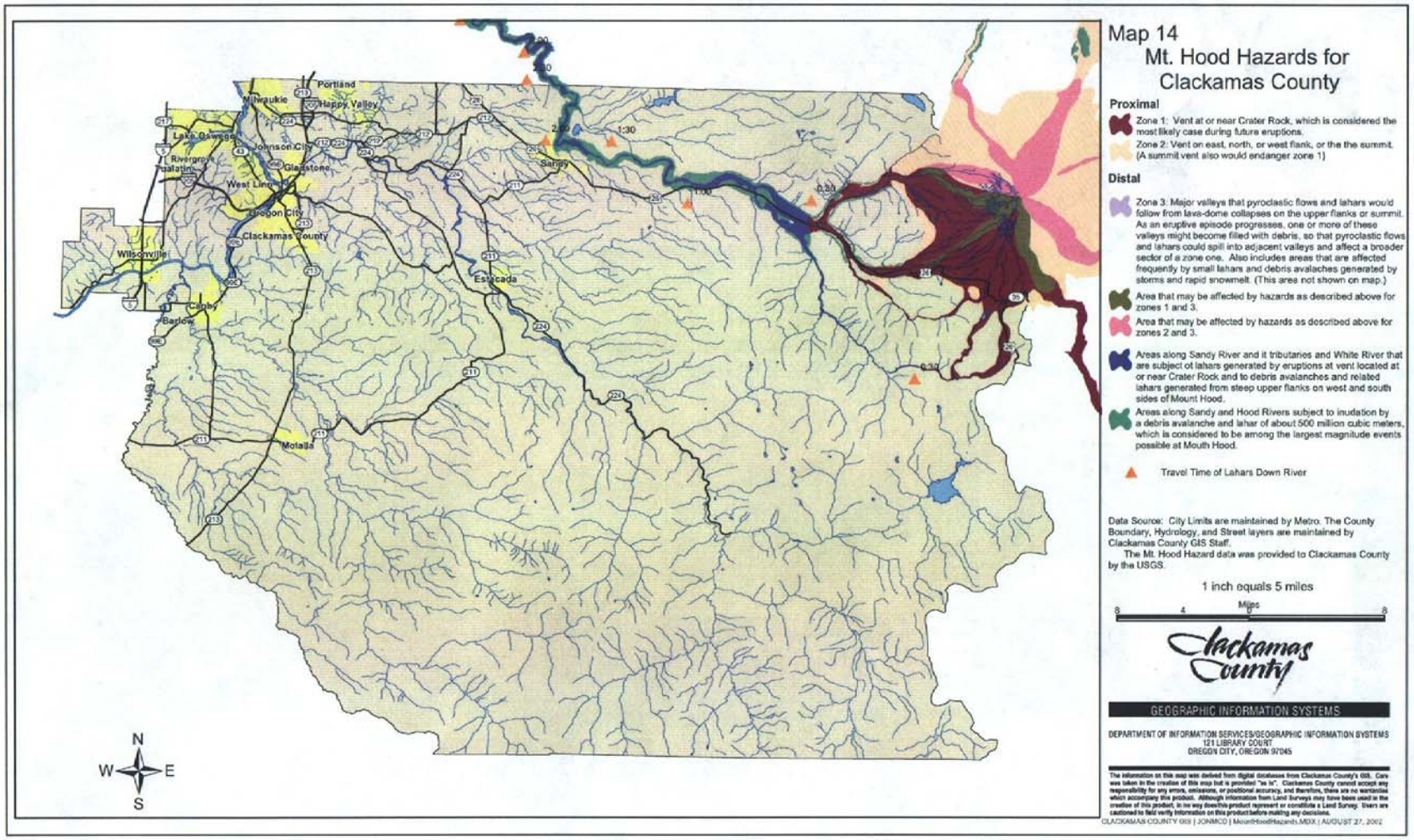
Existing Volcanic Eruption Mitigation Activities

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

West Linn will not be undertaking any local volcanic eruption mitigation activities, but will partner with the county in the implementation of identified mitigation strategies.

MAP 26



Map 14
Mt. Hood Hazards for Clackamas County

Proximal

Zone 1: Vent at or near Crater Rock, which is considered the most likely case during future eruptions.

Zone 2: Vent on east, north, or west flank, or the the summit. (A summit vent also would endanger zone 1)

Distal

Zone 3: Major valleys that pyroclastic flows and lahars would follow from lava-dome collapses on the upper flanks or summit. As an eruptive episode progresses, one or more of these valleys might become filled with debris, so that pyroclastic flows and lahars could spill into adjacent valleys and affect a broader sector of a zone one. Also includes areas that are affected frequently by small lahars and debris avalaches generated by storms and rapid snowmelt. (This area not shown on map.)

Area that may be affected by hazards as described above for zones 1 and 3.

Area that may be affected by hazards as described above for zones 2 and 3.

Areas along Sandy River and it tributaries and White River that are subject ot lahars generated by eruptions at vent located at or near Crater Rock and to debris avalanches and related lahars generated from steep upper flanks on west and south sides of Mount Hood.

Areas along Sandy and Hood Rivers subject to inudation by a debris avalanche and lahar of about 500 million cubic meters, which is considered to be among the largest magnitude events possible at Mouth Hood.

▲ Travel Time of Lahars Down River

Data Source: City Limits are maintained by Metro. The County Boundary, Hydrology, and Street layers are maintained by Clackamas County GIS Staff.

The Mt. Hood Hazard data was provided to Clackamas County by the USGS.

1 inch equals 5 miles

8 4 0 8 Miles

Clackamas County

GEOGRAPHIC INFORMATION SYSTEMS

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

The information on this map was derived from digital databases from Clackamas County's GIS. Care was taken in the creation of this map but is provided "as is". Clackamas County cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from Land Surveys may have been used in the creation of this product, in no way does this product represent or constitute a Land Survey. Users are cautioned to field verify information on this product before making any decisions.

CLACKAMAS COUNTY GIS | JOHNCD | MountHoodHazards.MXX | AUGUST 27, 2002

Multi-Hazard

Multi-Hazard Action Items (MH)

Multi-hazard action items are those activities that pertain to all seven hazards in the mitigation plan: flood, landslide, wildfire, severe winter storm, windstorm, earthquake, and volcanic eruption.

ST-MH#1: Reduce threat to critical and essential public facilities.

Ideas for Implementation

1. Utilize revised Storm Water Master Plan to reduce risk of erosion and destabilization of soils in areas where critical and essential public facilities are built.
2. Update list of SDC-eligible projects to fund project to reduce threats from natural hazards to critical and essential public facilities.

Coordinating Organization:	Public Works/Engineering
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Preserve natural systems Augment emergency services Partnerships and Implementation

ST-MH#2: Enhance recognition of hazards, and appropriate mitigation and response activities through public education.

Ideas for Implementation

1. Work with Community Planning Organizations to create a steering committee for developing and distributing informational materials relating to natural hazards.
2. Enhance public understanding of natural hazards and appropriate mitigation/response activities through public education, including evacuation planning, provision of disaster supply kites, and dissemination of information via public service announcements on cable TV, the Internet and implementation of Code 4/telephone alert system.

Coordinating Organization:	Steering committee, Planning Dept., all other available city staff
Timeline:	Ongoing
Plan Goals Addressed:	Enhance public awareness Partnerships and implementation Protect life and property Preserve natural systems Augment emergency services

ST-MH#3: Implement Goal 5 Analysis including recommendations for identifying, protecting and enhancing natural resources.

Ideas for Implementation

1. Review inventory and recommendations to identify areas vulnerable to natural hazards that present opportunities for natural hazard mitigation activities, such as refining Comprehensive Plan maps, amending vegetation management policies, reducing fuel loading in occluded woodlands, etc.
2. Utilize inventory and recommendations to identify natural hazards in new development that can affect both existing and proposed development.

Coordinating Organization:	Planning Department
Timeline:	Ongoing
Plan Goals Addressed:	Preserve natural systems Augment emergency services Protect life and property Enhance public awareness

ST-MH#4: Utilize Geographic Information Systems to update the hazard and vulnerability assessment.

Ideas for Implementation

1. Develop strategies for acquiring the necessary staff, resources, software, etc. for undertaking the project of importing all GIS data into new GIS software.
2. Strengthen the historical assets analysis to include all of the buildings located in the historic districts.

Coordinating Organization:	GIS/Planning
Timeline:	1-2 years
Plan Goals Addressed:	Augment emergency services Enhance public awareness Partnerships and implementation Preserve natural systems Protect life and property

ST-MH#5: Improve real-time hazard warning capability.

Ideas for Implementation

1. Implement Code 4 telephone alert program to target residents who are directly threatened by an impending hazard event.

Coordinating Organization:	West Linn Community Services Dept.
Timeline:	Ongoing
Plan Goals Addressed:	Protect life and property Enhance public awareness

LT-MH#1: Hire an Emergency Service Coordinator to develop an emergency management program for the City with a focus on utilizing citizen volunteers in programs such as Community Emergency Response Teams (CERT).

Ideas for Implementation

1. Develop budget and personnel strategies for hiring an emergency services coordinator.
2. Work with TVF&R and active citizen groups to develop and train Community Emergency Response Teams (CERTs).

Coordinating Organization:	City of West Linn
Timeline:	1-3 years
Plan Goals Addressed:	Augment emergency services Enhance public awareness Partnerships and implementation Protect life and property

Section 5:
Mitigation Planning Priority System

Action Item Prioritization Methodology

As City of West Linn works toward action item implementation, the Hazard Mitigation Advisory Committee (HMAC) has prioritized the identified mitigation strategies in order to better allocate resources for implementation. The criteria used for prioritizing the action items are the plan goals, hazards addressed, criticality of need, population served, and likelihood of success.

Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new situations arise, such as capitalizing on funding sources that could pertain to an action item that is not the highest priority.

Step 1: Prioritize Plan Goals

The City of West Linn mitigation goals including Protect Life and Property, Public Awareness, Emergency Services, Natural Systems, and Partnerships and Implementation were considered during each phase of the mitigation planning process. As the mitigation action items were developed, the HMAC identified which plan goals were addressed by each action item. The HMAC ranked the plan goals to determine the priorities for City of West Linn, and each goal was given a score of one point to five points, in ascending order. The points for the plan goals were then totaled for each action item. The prioritized plan goals are as follows:

5 Points: Protect Life and Property
4 Points: Emergency Services
3 Points: Public Awareness
2 Points: Partnerships and Implementation
1 Point: Natural Systems

Step 2: Prioritize Hazards

The natural hazards addressed by the City of West Linn Natural Hazard Mitigation Plan were prioritized using the FEMA-accepted hazard analysis methodology for Emergency Operations Plans. This methodology considers the history of the hazard, the vulnerability to the hazard, the maximum threat of the hazard (worst case scenario), and the probability of the hazard. Each of these criteria are weighted, and the final score was used for prioritizing the hazards. The following is a full description of the methodology used:

Categories Considered:

HISTORY: The record of occurrences of previous major emergencies or disasters (weight factor = 2).

LOW	0 - 1 event per 100 years
MEDIUM	2 - 3 events per 100 years
HIGH	4 + events per 100 years

VULNERABILITY: The percentage of population and property likely to be affected (weight factor = 5).

LOW	< 1% affected
MEDIUM	1 - 10% affected
HIGH	> 10% affected

MAXIMUM THREAT: The maximum percentage of population and property that could be impacted under a worst case scenario (weight factor = 10).

LOW	< 5% affected
MEDIUM	5 - 25% affected
HIGH	> 25% affected

PROBABILITY: The likelihood of occurrence within a specified period of time (weight factor = 7).

LOW	> 1 chance per 100 years
MEDIUM	> 1 chance per 50 years
HIGH	> 1 chance per 10 years

SEVERITY RATING:

LOW	= 1 - 3 points
MEDIUM	= 4 - 6 points
HIGH	= 7 - 10 points

Although the methodology used allows the City of West Linn to quantify and compare natural hazards, it is flawed in that it compares hazards with high probabilities and relatively low consequences with hazards that have low probabilities and high consequences. The HMAC took this into consideration during the prioritization process, and the results are shown in table 5-1. The hazards were given a score of one point to seven points, in ascending order. The Multi-Hazard action items were given the highest score, as they address more than one hazard. The points for the hazard scores were then totaled for each action item.

Table 5-1 Natural Hazard Prioritization Score

Hazard	History	Vulnerability	Max. Threat	Probability	Total	Hazard Score
Multi-Hazard	-	-	-	-	-	7
Severe Storm	18	50	100	49	217	6
Earthquake	14	35	90	35	174	5
Landslide	2	40	40	21	103	4
Flood	12	20	20	49	101	3
Wildfire	2	35	50	7	94	2
Volcano	4	25	30	35	94	1

Step 3: Incorporate Criticality of Need, Large Number of Population Served, Likelihood of Success

The final score for each action items was computed by summing the plan goal score and the hazard score. The committee then considered the criticality of need, the number of population served, and the likelihood of success. The HMAC was given an opportunity to add five points to action items that fit these criteria. The prioritized action items are as follows:

Table 5-2. Action Item Prioritization Score

Existing Resources		***Funding Required***	
Short-Term Multi-Hazard #2	22	Long-Term Multi-Hazard #1	37
Short-Term Multi-Hazard #4	22	Short-Term Multi-Hazard #5	26
Short-Term Multi-Hazard #1	19	Short-Term Severe Storm # 4	25
Long-Term Wildfire #1	17	Short-Term Multi-Hazard #3	20
Short-Term Flood #1	15	Long-Term Wildfire #2	20
Short-Term Earthquake #4	15	Short-Term Earthquake #1	19
Short-Term Severe Storm # 3	14	Long-Term Earthquake #1	19
Short-Term Wildfire #1	13	Short-Term Severe Storm#2	17
Short-Term Wildfire #2	13	Long-Term Flood #1	16
Short-Term Wildfire #3	13	Short-Term Landslide #2	15
Short-Term Flood #2	12	Short-Term Severe Storm#1	14
Short-Term Landslide #1	11	Short-Term Flood #4	13
Short-Term Earthquake #2	10	Short-Term Flood #3	12
		Short-Term Earthquake #3	10

Section 6:
Resource Directory

The City of West Linn Resource Directory supplements the Clackamas County Master Resource Directory. It provides contact information for local agencies, departments and organizations that are currently or potentially engaged in, hazard mitigation activities that are relevant to West Linn. Additional entries to this list will be added as new resources and organizations are identified.

Resource	Contact Information	Type of Assistance
West Linn City Hall	22500 Salamo Rd West Linn, OR 97068 **Phone:** 503-657-0331 **Web:** http://www.ci.west-linn.or.us	• General City Information
West Linn Community Services Dept.	22500 Salamo Rd West Linn, OR 97068 **Phone:** 503-657-0331 **Fax:** 503-650-9041 **Web:** http://www.ci.west-linn.or.us	• Community Outreach, Education & Public Information. • Public & Government Access Television. • West Linn Web Site • City Newsletter • Neighborhood Associations Liaison
West Linn Parks & Recreation Dept.	22500 Salamo Rd West Linn, OR 97068 **Phone:** 503-557-4700 **Fax:** 503-656-4106 **Web:** http://www.ci.west-linn.or.us	• Parks & Open Space Acquisition & Development Operations & Maintenance • Community Outreach
West Linn Planning & Building Dept.	22500 Salamo Rd West Linn, OR 97068 **Phone:** 503-656-4211 **Fax:** 503-656-4106 **Web:** http://www.ci.west-linn.or.us	• Land Use Planning • Development Review • Resource Management • Building Permits & Inspections
West Linn Police Dept.	22825 Willamette Drive West Linn, OR 97068 **Phone:** 503-655-6214 **Fax:** 503-656-0319 **Web:** http://www.westlinnpolice.com/	• Law Enforcement • Community Policing

Resource	Contact Information	Type of Assistance
West Linn Public Works Dept.	22500 Salamo Rd West Linn, OR 97068 **Phone:** 503-722-5500 **After Hours Emergency Phone:** 503-635-0238 **Fax:** 503-656-4106 **Web:** http://www.ci.west-linn.or.us	• Public Works Operations (Sewer, Water, Storm, Street) • Infrastructure Maintenance & Repair • Land Development Plan Review & Inspection • Geographic Information Systems Mapping
Tualatin Valley Fire & Rescue	20665 SW Blanton Aloha, OR 97007 **Phone:** 503-649-8577 **Web:** http://www.tvfr.com	• Fire Suppression and investigation • Land & Water Rescue • Emergency Medical Response • Plan review and code Enforcement • Hazmat Response • Emergency Operations
Clackamas County	2051 Kaen Rd. Oregon City, OR 97045 **Phone:** 655-8581 **Web:** http://www.co.clackamas.or.us	General County Information
NW Natural	220 NE 2nd Portland, OR 97204 **Phone:** 503-226-4211 **Gas Odor Emergencies 24-Hour Phone:** 800-882-3377 **Web:** https://www.nwnatural.com	Natural Gas Utility
Portland General Electric	121 SW Salmon St. Portland, OR 97204 **Phone:** 503-228-6322 **24-Hour Emergencies Phone:** 503-464-7777 or 800-544-1795 **Web:** http://www.portlandgeneral.com	Electric Utility
Comcast	10831 SW Cascade Ave. Tigard, OR 97223 **Phone:** 800-266-2278 **Web:** http://www.comcast.com	Cable, Internet & Phone Utility
Qwest	8021 SW Capitol Hill Rd., Rm. 110 Portland, OR 97219 **Phone:** 800-491-0118 **Web:** http://www.qwest.com/	Cable, Internet & Phone Utility
Verizon	**Phone:** 866-232-4282 **Web:** http://www.verizon.com	Cable, Internet & Phone Utility

Resource	Contact Information	Type of Assistance
West Linn Chamber of Commerce	6148 Elliott Street West Linn, OR 97068 **Phone:** (503) 655-6744 **Fax:** (503) 655-4245 **Web:** http://www.westlinnchamber.com/	Business Community Liaison
West Linn-Wilsonville School District	22210 SW Stafford Rd. West Linn, OR 97068 **Phone:** 503-673-7000 **Fax:** 503-673-7001 **Web:** http://www.wlwv.k12.or.us/	Public School System
Willamette Falls Hospital	1500 Division Street Oregon City, OR 97045 **Phone:** (503) 656-1631 **E-mail:** wfh@wfhonline.org **Web:** http://www.willamettefallshospital.org/	Medical Facility
Legacy Meridian Park Hospital	19300 SW 65th Avenue Tualatin, Oregon 97062 **Phone:** 503-692-1212 **Web:** http://www.legacyhealth.org/	Medical Facility
Kaiser Sunnyside Hospital	10180 SE Sunnyside Rd, Clackamas, Oregon 97015 **Phone:** 503-652-2880	Medical Facility
Providence Milwaukie Hospital	10150 SE 32nd Ave. Milwaukie, Oregon 97222 **Phone:** 503-513-8300	Medical Facility
KEX Radio 1190 AM	5002 SW Macadam St. Portland, OR 97201 **Phone:** 503-242-1190 **Fax:** 503-323-6666 **E-mail:** news@1190kex.com **Web:** http://www.1190kex.com/	Radio Station Media Outlet
KPAM Radio 860 AM	6605 SE Lake Rd Portland, OR 97222 **Phone:** 503.417.8783 **Fax:** 503.226.3994 **E-mail:** news@kpam.com **Web:** http://www.kpam.com/	Radio Station Media Outlet
KATU TV Channel 2	2153 N.E. Sandy Blvd, Portland, OR 97232 **Phone:** 503-231-4222 **E-mail:** thedesk@katu.com **Web:** http://www.katu.com/	Television Station Media Outlet
KGW TV Channel 8	1501 SW Jefferson St. Portland, OR 97201 **Phone:** (503) 226-5000 **E-mail:** newsdesk@kgw.com **Web:** http://www.kgw.com	Television Station Media Outlet

Resource	Contact Information	Type of Assistance
KOIN TV Channel 6	222 SW Columbia St. Portland, OR 97201 **Phone:** 503-464-0600 **E-mail:** koindesk@koin.com **Web:** http://www.koin.com/	Television Station Media Outlet
KPDX TV Channel 49	14975 NW Greenbriar Pkwy. Beaverton, OR 97006 **E-mail:** foxdesk@kpdx.com **Web:** http://www.kpdx.com/	Television Station Media Outlet
KPDX TV Channel 12	14975 NW Greenbrier Parkway Beaverton, OR 97006-5731 **Phone:** 503-906-1249 **Fax:** 503-548-6920 E-mail: kptvnews@kptv.com **Web:** http://www.kptv.com/	Television Station Media Outlet
The Oregonian	1320 SW Broadway Portland, OR 97201. **Phone:** 503-221-8100 **Web:** http://www.oregonlive.com/oregonian/	Newspaper Media Outlet: daily
Community Newspapers	6605 S.E. Lake Road Portland, OR 97222 **Phone:** 503-226-6397 **Fax:** 503-620-3433 **Web:** http://www.commnewspapers.com	Newspaper Media Outlets: weekly
Portland Tribune — A Publication of Community Newspapers	6605 S.E. Lake Road Portland, OR 97222 **Phone:** 503-226-6397 **Fax:** 503-620-3433 **Web:** http://www.portlandtribune.com/	Newspaper Media Outlet: weekly
West Linn Tidings — A Publication of Community Newspapers	400 Second St. Lake Oswego, OR 97034 **Phone:** 503-635-8811 **Fax:** 503-635-8817 **Web:** http://www.westlinntidings.com/	Newspaper Media Outlet: weekly
Clackamas Review — A Publication of Community Newspapers	6605 S.E. Lake Road Portland, OR 97222 **Phone:** 503-684-0360 **Fax:** 503-620-3433 **Web:** http://www.clackamasreview.com/	Newspaper Media Outlet: weekly
Oregon City News — A Publication of Community Newspapers	6605 S.E. Lake Road Portland, OR 97222 **Phone:** 503-684-0360 **Fax:** 503-620-3433 **Web:** http://www.oregoncitynewsonline.com/	Newspaper Media Outlet: weekly

Appendix 1:
Vulnerability Analysis Data Tables

West Linn Natural Hazards Mitigation Plan
Vulnerability Analysis Data Table 2 - Asset Listing

CODE	DESCRIPTION	CITY OWNED	TYPE	ASSET	FLOOD	SLIDE	QUAKE	FIRE	STORM	NO. OF HAZ
1	POLICE DEPARTMENT	YES	City Facility	Critical Facility						0
1	PUBLIC WORKS / OPERATIONS	YES	City Facility	Critical Facility		YES			YES	2
1	CITY HALL	YES	City Facility	Critical Facility		YES			YES	2
2	FIRE STATION 172 WILLAMETTE	YES	Fire Station	Critical Facility						0
2	STATION 192 SUNSET FIRE HALL VOLUNTEER	YES	Fire Station	Critical Facility		YES		YES	YES	3
2	FIRE STATION 182 BOLTON	YES	Fire Station	Critical Facility		YES	YES		YES	3
2	STATION 23 CEDAROAK AMR AMBULANCE	YES	Fire Station	Essential Facility			YES			1
3	WEST LINN HIGH SCHOOL	NO	School	Essential Facility		YES		YES	YES	3
4	BOLTON MIDDLE SCHOOL	NO	School	Essential Facility		YES		YES	YES	3
4	ROGEMONT RIDGE MIDDLE SCHOOL	NO	School	Essential Facility					YES	1
5	WILLAMETTE PRIMARY SCHOOL	NO	School	Essential Facility		YES	YES		YES	3
5	SUNSET PRIMARY SCHOOL	NO	School	Essential Facility				YES	YES	2
5	CEDAROAK SCHOOL	NO	School	Essential Facility			YES	YES		2
13	ADULT COMMUNITY CENTER	YES	City Facility	Essential Facility					YES	1
0	LAKE OSWEGO WATER SOURCE	NO	Primary Water Source	Infrastructure			YES	YES		2
0	I-205 WATER LINE	YES	Primary Water Source	Infrastructure	YES	YES	YES		YES	4
0	I-205 BRIDGE	NO	Bridge	Infrastructure	YES	YES	YES		YES	4
0	OREGON CITY / WEST LINN BRIDGE	NO	Bridge	Infrastructure	YES		YES			2
0	FREEWAY OVERPASS	NO	Overpass Freeway	Infrastructure		YES	YES	YES	YES	4
0	FREEWAY OVERPASS	NO	Overpass Freeway	Infrastructure		YES	YES		YES	3
0	FREEWAY OVERPASS	NO	Overpass Freeway Ramps	Infrastructure			YES			1
0	STREET OVERPASS	NO	Overpass Street	Infrastructure		YES		YES	YES	3
0	STREET OVERPASS	NO	Overpass Street	Infrastructure						0
0	FREEWAY OVERPASS	NO	Overpass Freeway Ramps	Infrastructure						0
0	STREET OVERPASS	NO	Overpass Street	Infrastructure						0
0	ASSISTED LIVING FACILITY	NO	Other Facility	Infrastructure					YES	1
0	WILLAMETTE LOCKS	NO	Other Facility	Infrastructure	YES	YES	YES	YES	YES	5
6	MARYLHURST UNIVERSITY	NO	School	Infrastructure						0

WEST LINN GIS

G:\GIS\HAZARDS\ASSETS_POINTS.XLS 6-30-03

West Linn Natural Hazards Mitigation Plan
Vulnerability Analysis Data Table 2 - Asset Listing

CODE	DESCRIPTION	CITY OWNED	TYPE	ASSET	FLOOD	SLIDE	QUAKE	FIRE	STORM	NO. OF HAZ
6	SUN GARDEN MONTESSORI	NO	School	Infrastructure		YES			YES	2
6	W.L. MUSIC ARTS & CRAFTS	NO	School	Infrastructure			YES			1
6	CORNUCOPIA CHILD CARE	NO	School	Infrastructure		YES	YES		YES	3
6	W.L. KINDERCARE	NO	School	Infrastructure		YES	YES		YES	3
6	W.L. MONTESSORI	NO	School	Infrastructure		YES	YES		YES	3
6	LA PETITE MONTESSORI SCHOOL	NO	School	Infrastructure		YES			YES	2
6	THREE RIVERS CHARTER SCHOOL	NO	School	Infrastructure		YES			YES	2
6	COLUMBIA LEARNING ACADEMY EMM PRES CHURCH	NO	School	Infrastructure			YES			1
9	LIBRARY	YES	City Facility	Infrastructure		YES		YES	YES	3
20	MAPLETON SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure	YES	YES	YES	YES	YES	5
20	ARBOR SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure		YES		YES	YES	3
20	CALAROGA SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure		YES		YES	YES	3
20	CEDAROAK SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure			YES	YES		2
20	JOHNSON SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure		YES		YES	YES	3
20	RIVER HEIGHTS SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure	YES	YES	YES	YES	YES	5
20	MARYLHURST SEWAGE PUMP STATION	YES	Sewage Pump Station	Infrastructure				YES		1
20	WILLAMETTE SEWAGE PUMP STATION (TRI-CITY)	NO	Sewage Pump Station	Infrastructure	YES		YES			2
20	RIVER ST SEWAGE PUMP STATION (TRI-CITY)	YES	Sewage Pump Station	Infrastructure	YES			YES		2
20	BOLTON SEWAGE PUMP STATION (TRI-CITY)	NO	Sewage Pump Station	Infrastructure	YES	YES	YES	YES	YES	5
22	BOLTON RESERVOIR	YES	Reservoir	Infrastructure		YES		YES	YES	3
22	HORTON RESERVOIR	YES	Reservoir	Infrastructure		YES			YES	2
22	BLAND RESERVOIR	YES	Reservoir	Infrastructure		YES			YES	2
22	ROSEMONT RESERVOIR	YES	Reservoir	Infrastructure					YES	1
22	VIEW DR (ROBINWOOD) RESERVOIR	YES	Reservoir	Infrastructure		YES	YES	YES	YES	4
22	WILLAMETTE (SALAMO) RESERVOIR	YES	Reservoir	Infrastructure		YES			YES	2
22	LAKE OSWEGO INTERTIE PUMP STATION	YES	Alternate Water Source	Infrastructure			YES			1
27	WEISS BRIDGE	NO	Bridge	Infrastructure	YES					1
27	FIELDS BRIDGE	NO	Bridge	Infrastructure	YES			YES		2

WEST LINN GIS

GIS\HAZARDS\ASSETS_POINTS.XLS 6-30-03

West Linn Natural Hazards Mitigation Plan

Vulnerability Analysis Data Table 3 - Cultural and Historical Asset Listing

CODE	DESCRIPTION	GENERAL DESCRIPTION	FLOOD	SLIDE	QUAKE	FIRE	STORM	NOHAZ
5	WILLAMETTE PRIMARY SCHOOL	School		YES	YES		YES	3
3	WEST LINN HIGH SCHOOL	School		YES		YES	YES	3
5	SUNSET PRIMARY SCHOOL	School				YES	YES	2
4	BOLTON MIDDLE SCHOOL	School		YES		YES	YES	3
9	LIBRARY	City Facility		YES		YES	YES	3
13	McLEAN HOUSE & PARK	McLean House	YES	YES	YES		YES	4
5	CEDAROAK SCHOOL	School			YES	YES		2
4	ROSEMONT RIDGE MIDDLE SCHOOL	School					YES	1
0	HISTORIC LANDMARK	HL		YES	YES	YES	YES	4
0	HISTORIC LANDMARK	HL		YES	YES		YES	3
0	HISTORIC LANDMARK	HL				YES	YES	2
0	HISTORIC LANDMARK	HL		YES			YES	2
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL	YES	YES	YES	YES	YES	5
0	HISTORIC LANDMARK	HL		YES		YES	YES	3
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL		YES	YES	YES	YES	4
0	HISTORIC LANDMARK	HL			YES	YES		2
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL			YES			1
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL		YES			YES	2
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL	YES	YES			YES	3
0	HISTORIC LANDMARK	HL		YES			YES	2
0	HISTORIC LANDMARK	HL		YES			YES	2
0	HISTORIC LANDMARK	HL		YES			YES	2
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL			YES			1
0	HISTORIC LANDMARK	HL						0
0	HISTORIC LANDMARK	HL						0
0	WILLAMETTE LOCKS	Willamette Locks	YES	YES	YES	YES	YES	5

Vulnerability Analysis Data Table 4 - Hazardous Material Listing

ADDRESS	DESCRIPTION	FLOOD	SLIDE	QUAKE	FIRE	STORM	NOHAZ
22250 WILLAMETTE DR	GAS STATION		YES			YES	2
22355 WILLAMETTE DR	GAS STATION		YES			YES	2
1590 WILLAMETTE FALLS DR	GAS STATION						0
19120 WILLAMETTE DR	GAS STATION			YES			1
22805 WILLAMETTE DR	GAS STATION					YES	1
2115 8TH CT	GAS STATION		YES	YES		YES	3
4800 MILL ST	PAPER MILL	YES	YES	YES	YES	YES	5
3951 CALAROGA DR	PUBLIC WORKS		YES			YES	2
4260 KENTHORPE WY	WATER TREATMENT PLANT			YES	YES		2