

**Comprehensive Plan**  
**Goal 7: Areas Subject to Natural Disasters and Hazards**  
**June 2012 Draft**

**EXECUTIVE SUMMARY**

The purpose of this report is to provide the background information needed by the City and the Community to develop a decision-making framework for the Areas Subject to Natural Disasters and Hazards over the next 20 years. The report assesses the existing conditions and changes regarding natural hazards since the Comprehensive Plan's last update in 1994. The report identifies the issues, challenges, and trends that should be considered as we plan for the future, including questions and changes that must be considered in order to sustain the community, economy, and environment for generations to come. The report will analyze the existing goals, policies, and recommended action measures to identify questions and potential changes for consideration during the Comprehensive Plan update process. Finally, the report will suggest how the City might track future progress towards achieving its goals and meeting community, regional, and statewide needs for a sustainable future.

The City of Lake Oswego covers an approximate area of 11 square miles. There are three major drainage basins within the City's Urban Service Boundary: Oswego Lake, the Tualatin River, and the Willamette River. The city is comprised of a complex geography with many steep wooded hillsides and streams that drain into these basins. The 2010 City of Lake Oswego Natural Hazards Mitigation Plan (NHMP) identifies six major hazards that potentially affect the city: floods, landslides, severe storms (wind and winter), wildfires, earthquakes, and volcanoes.<sup>1</sup> Currently, the Comprehensive Plan only addresses three: floods, earthquakes, and landslides. The risks associated with natural hazards increases as more lands affected by natural resources are developed. The inevitability of hazard events creates a need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss of property and life. For example, preserving natural areas along river and stream banks allows those areas to act as flood storage areas, and preserving and managing woodlands on steep slopes may reduce the likelihood of landslides and/or wildfires. The objectives of Goal 7 are therefore related to many other Comprehensive Plan goals.

Since the 1994 Comprehensive Plan Update, the City has experienced a number of changes affecting hazards, including the following:

- Events such as the 1996 floods and significant landslides.
- 2008 floodplain map adjustments which brought more properties and/or more area of specific properties under floodplain regulations.
- The Lake Corporation recently completed dam improvements that modify the floodplain elevation; this mapping update will be considered for adoption in 2012.

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<sup>1</sup> 2010 City of Lake Oswego Natural Hazards Mitigation Plan (NHMP), page 23

- The City completed a Natural Hazards Mitigation Plan in coordination with Clackamas County and other local jurisdictions; this document was last updated in 2010.
- The Lake Oswego Sewer Interceptor project realigned and updated the portion of the City's main sewer line contained within Oswego Lake.
- The City's aging municipal water system is undergoing necessary repairs and updates in partnership with the City of Tigard. Along with other critical facilities and infrastructure, the City's sewer and water systems are vulnerable to flooding, landslides, and seismic events; the projects are addressing known risks.
- New mapping technology is available to help inventory past and potential landslide locations.

### Sustainability

Through protection of community assets from loss, hazard mitigation ensures that economic, social, historical, environmental, and physical resources will be sustained. By using hazard mitigation to preserve permanent open space, manage the existing urban tree canopy, and reduce excess water consumption, the City can be a responsible part of the global effort to minimize conditions contributing to greenhouse gas emissions and to adapt to climate change.<sup>2</sup>

### Recommendations and Policy Questions to Consider:

- Integrate NHMP's six identified hazards and all NHMP action items (infrastructure and facility upgrades).
- To alleviate demand on CIP funds, review NHMP action items for upgrades that could be completed with federal grant money or only require City match.
- Update the Hillside Protection and Weak Foundation Soils standards using the most current and accurate information (LIDAR) and best practices.
- Continue updating Floodplain Management standards and maps at a community-wide and site-by-site basis in conjunction with federal, state, and local efforts.
- Coordinate protection/preservation of the City's natural resources with hazard mitigation principles.
- The City's Emergency Operations Plan includes an Urban Forest section. Policy question to consider if any development standards are necessary to implement this plan beyond what the Fire Marshal already reviews.
- Drainage standards. The Engineering Division in the Public Works Department reviews development proposals against current drainage standards for all building permits and land use applications. The utility code regarding stormwater is out of date; new best practices should be incorporated as a text amendment or the code and design manual for the developing Surface Water program could be used instead.

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<sup>2</sup> Hazard Mitigation: Integrating Best Practices into Planning, page 95.

## BACKGROUND AND EXISTING CONDITIONS

The State of Oregon is one of a few states that integrates planning for natural hazards within Comprehensive Planning. The Statewide Planning Goals 2 and 7 direct local governments to:

- (1) Develop inventories of hazardous areas for inclusion in the Comprehensive Plan;
- (2) Adopt policies which prohibit development in known areas of natural disasters and hazards without appropriate safeguards;
- (3) Enact land use regulations based on those inventories and comprehensive plan policies to protect life and property from losses associated with development in hazard areas; and,
- (4) Update inventories, policies, and land use regulations on periodic basis to reflect new information, new laws and goal requirements, and changing circumstances in the community.<sup>3</sup>

Goal 7 does not provide specific direction on how a jurisdiction should address development in hazardous areas; this is left to the discretion of each individual community. In the best practices advocated by the Federal Emergency Management Agency (FEMA), the American Planning Association (APA), and the Oregon APA, a jurisdiction's natural hazards inventory should contain the following elements:<sup>4</sup>

- A description of each known natural hazard to which the city is vulnerable;
- The history of events for each known hazard;
- Generalized boundaries of all known natural hazards: floods, landslides, fault lines, storm events, volcanoes, and wildfires;
- Inventory of critical facilities, infrastructure, and other key facilities; and,
- A vulnerability assessment for each hazard.

Due to serious natural hazard events in the last 15 years across the country, there has been a concerted push to create mitigation plans to help local jurisdictions prepare for and recover from natural hazard events and to update development regulations to minimize impact. As the measurement and imaging technologies have improved, the public's awareness of the seriousness of various threats and possible mitigation techniques is also increasing. New information, programs, and resources should be integrated into the City's Comprehensive Plan and development codes in order to reduce the risks associated with natural hazards.

### Regional Context

The City of Lake Oswego is located in Clackamas County, which has a total area of 1,879 square miles. More than three-quarters of the County lies within the lower Willamette River basin but

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<sup>3</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 3, page 5.

<sup>4</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 3, page 7.

the area includes numerous other river basins including the Clackamas, the Molalla, the Pudding, and the Tualatin Rivers.<sup>5</sup> The City is on the far western edge of the county and covers an approximate area of 11 square miles. There are three major drainage basins within the City's Urban Service Boundary: Oswego Lake, the Tualatin River, and the Willamette River. The public drinking water is obtained from a water intake and treatment plant on the Clackamas River. The city is comprised of a complex geography with many steep wooded hillsides and streams that drain into these basins.

In coordination with Clackamas County and other jurisdictions, the City began efforts to address the interconnectedness of disaster impacts and to take a more regional approach to natural hazard planning. The City drafted and adopted the Natural Hazards Mitigation Plan (NHMP) in 2004 to serve as a local jurisdictional annex to the larger Clackamas County NHMP. The City's NHMP is a community-wide inventory of assets that are vulnerable to natural hazards and an analysis of an asset's risk exposure to each hazard. If the NHMP is kept up-to-date, the City remains eligible for hazard mitigation project federal grants. The latest NHMP update was adopted by the City Council in the spring of 2010. Staff is currently working with Clackamas County to complete the next update, with an anticipated completion date of late 2013. This update process is primarily to bring the City's NHMP plan timeline into sync with Clackamas County's timeline; only minor revisions to the plan are anticipated.

### **Existing Conditions**

Oswego Lake is the City's largest physical feature and its geographic center. The Willamette River forms the eastern boundary of the City, and the Tualatin River is located to the south.<sup>6</sup> Oswego Lake is augmented by Tualatin River waters through the Tualatin Canal, located in the southwest quarter of the city. The NHMP identifies six major hazards that potentially affect the city: floods, landslides, severe storms (wind and winter), wildfires, earthquakes, and volcanoes.<sup>7</sup> Currently, the Comprehensive Plan only addresses three: floods, earthquakes, and landslides.

The city has undertaken various efforts to minimize risk from hazard events such as implementing development and building codes, completing resource and hazard inventories, and creating emergency response plans. The current hazard land inventories (flood, earthquake, and landslides) encompass residential, commercial, office, industrial, and park/open space lands throughout the jurisdiction.

A number of critical public facilities are vulnerable to potential hazards, as well as important city and regional infrastructure such as bridges, utilities, and transportation routes. A significant amount of private residential development is located in areas of mapped weak foundation soils, along earthquake fault lines, and/or within areas of potential flooding. The

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<sup>5</sup> Clackamas County Natural Hazards Mitigation Plan 2002

<sup>6</sup> 2004 NHMP, page 8

<sup>7</sup> 2010 City of Lake Oswego Natural Hazards Mitigation Plan (NHMP), page 23

challenge of land use planning is to steer development away from hazardous areas, limiting the type and intensity of development, and seeing to it that appropriate hazard mitigation measures are incorporated into new construction. This should be undertaken at both a public infrastructure level and for commercial and residential private development.<sup>8</sup>

## Bridges

There are sixteen bridges located in the City, all of which are vulnerable to flooding, landslides, and seismic events (See attached map). Four of the bridges are not under the City’s purview:

- Oswego Creek/Highway 43 bridge (maintained by Oregon Department of Transportation - ODOT),
- Briarwood Road Railroad Trestle (maintained by Willamette Shore Consortium),
- Stampher Road Railroad Trestle (maintained by Willamette Shore Consortium and Willamette Pacific Railroad), and
- Summit Drive Railroad Bridge (maintained by Clackamas County).

The City maintains the Lake Oswego Bridge Inspections and Records Manual, a program that was implemented to help responders in the event of a natural disaster. The Public Works Department utilizes staff to visually monitor bridge conditions and establish baseline condition information to compare after a disaster. There is a disaster response plan attached to the manual with bridge closure/detour routes. The City’s Public Works Department also maintains comprehensive inspection records on all bridges dating back 10-15 years. A full bridge condition assessment is planned in order to prioritize work in the upcoming years. Bridges recently upgraded include the following:

Bridge	When updated	Jurisdiction performing work
Oswego Canal Bridge (Kelok Road)	2008	City of LO
Oswego Canal Bridge on Childs Road	late 1990s, prior to annexation into the City).	Clackamas County
Springbrook Creek (to armor footings affected by water flow)	2011	City of LO
West Bay (to armor footings affected by water flow)	2011	City of LO

A full bridge condition assessment is planned in order to prioritize work in the upcoming years.

Federal funding is available to upgrade a bridge if it serves as a trucking/freight route, is the only way in or out of an area, is near a fire station/emergency provider, or serves as an official evacuation route. This funding would only apply to the Oswego Creek/Hwy 43 Bridge which

<sup>8</sup> Planning for Natural Hazards: Oregon Technical Resource Guide.

serves as a regional transportation route. All areas served by the 12 other bridges can be accessed using alternate local street routes and are not essential for evacuation or emergency services. These bridges would be closed in the event of an earthquake until further inspections are completed, as physical upgrades to current seismic standards have not been undertaken.

### **Lake Oswego-Tigard Water Partnership**

Lake Oswego's water supply system is near capacity, and key aging facilities need expansion and upgrades. The water treatment plant on the Willamette River in West Linn, the various water lines and pumping stations, and the water intake station on the Clackamas River are all water assets exposed to flooding, landslides, and seismic events. In August 2008, the cities of Lake Oswego and Tigard formally endorsed an Inter-governmental Agreement (IGA) for a shared drinking water system which also shares the costs associated with updating the water system. The LO/Tigard Water Partnership will provide Tigard with partial ownership of Lake Oswego's water infrastructure rather than continuing its existing status as a customer. The City of LO will manage and build the water system (a line from the West Linn Water Treatment Plant to Tigard's Bonita Pump Station just west of I-5). Tigard will provide 57% of the costs to the upgrade. Hazard risk assessments will be completed for each phase of the project.

### **Lake Oswego Interceptor Sewer (LOIS)**

Constructed in the early 1960s, LOIS lay submerged below the surface of Lake Oswego. The system included almost 3.5 miles of varying diameter pipe traversing Lake Oswego, canals, and bays. The interceptor was originally designed to handle sewer flows from about 3,500 developed acres, but by the end of its lifetime was collecting flows from a 4,500-acre service area, way beyond its capacity. Additionally, the system was vulnerable to flooding, storm events, and seismic events<sup>9</sup>: the pipeline and its pile support system were not likely to survive a moderate earthquake, predicted with a 15% chance of occurring within 25 years.<sup>10</sup> Severe breaks in the pipeline would have dumped raw sewage into the lake and also caused millions of gallons of lake water to drain through the pipe, potentially overwhelming the treatment plant and impacting the Willamette River.<sup>11</sup> In January 2009, heavy storms following a severe winter storm contributed to a sewer interceptor overflow on Cardinal Drive near Oswego Canal. Approximately 226,000 gallons of wastewater were sent out of the sewer system before maintenance crews were able to recapture about 75% of it. This, and other similar events, is an example of why the Lake Oswego Interceptor System (LOIS) was undertaken.

The City completed a massive update to address deficiencies in capacity and structural soundness in 2012.

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<sup>9</sup> The 2010 NHMP.

<sup>10</sup> <http://www.lakeinterceptor.com/overview2.php#problem>

<sup>11</sup> <http://www.lakeinterceptor.com/>

## Flooding

In 1996, a low elevation snowstorm, followed by a major storm event, led to massive flooding along the Willamette Valley's waterways. The Clackamas and Willamette River and their tributaries swelled beyond the 100-year flood level. The heavy precipitation, along with the snowmelt, also caused unstable soil conditions, leading to massive landslides and debris flows throughout the region. The highest recorded flood levels on the Tualatin River were documented, which impacted the Tualatin Canal and levels of Oswego Lake. As the dam at the eastern tip of the lake was unable to sufficiently release water in response, the lake waters overflowed across McVey Avenue and State Street, flowing down into the Foothills area, and into the Willamette River. Many apartments, homes, and businesses experienced severe water and structural damage. Water pumps were installed within the Foothills District to help manage future flood events. In addition, Foothills Park was created to help restore the floodplain in this area. The park project included removing a bark chip plant vulnerable to flooding. All park structures are minimal and open to water flow. The riverine perimeter of the site was left at the natural grade and conditions.

In 2002, the City of Lake Oswego partnered with Clean Water Services, a water resources management utility in the Tualatin River Watershed, to have a new flood study completed for Oswego Lake and the Oswego Canal. Clean Water Services was in the process of conducting a major flood insurance study of the entire Tualatin Basin. The Lake Oswego portion of the study generated new flood insurance rate maps (FIRMs) that depict a rise in the level of the base flood along the Tualatin River, the Oswego Canal, and Oswego Lake. A "base flood" is defined as the area determined to have a 1% chance of flooding in any given year and is more commonly known as the 100-year floodplain. Around the lake, the base flood elevation increased by 2.5 feet over the old elevation (the new base flood level is at 103.5 feet NGVD 29<sup>12</sup>). The new maps identify the area of "Special Flood Hazard" or the 100-year floodplain. The City's Flood Management Area Map also includes the area along the Willamette River that was inundated by flood waters during the flood of February 1996. In 2008, the City Council adopted Ordinance No. 2507, which incorporated the new map and development code amendments to the Flood Management Area standards (LOC Article 50.44).<sup>13</sup> The amendments are in compliance with FEMA, state, and Metro standards.

On April 20, 2010, City Council adopted a map amendment (LU 10-0003) to incorporate a flood insurance study for the Springbrook Creek area.<sup>14</sup> The study was in response to a Letter of Map Revision (LOMR) from FEMA directing the City to reconfigure the floodplain and establish a new

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<sup>12</sup> NGVD-29 is the National Geologic Vertical Datums taken in 1929. This will differ from the NAVD 96 which is derived from modern data gathering techniques. The elevations in the new flood maps are reported as NAVD 96. The 100-year flood elevation of 103.5 (NGVD 29) is equivalent to the base flood elevation of 107 (NAVD 96) reported on the revised Flood Management Area Maps. For consistency, this report will use the NGVD-29 Datums. The adopted maps will have NAVD 96 Datums.

<sup>13</sup> LU 07-0085 and Ordinance No. 2507

<sup>14</sup> LU 10-0003 and Ordinance No. 2549

base flood elevation and boundaries for the 2,030-foot reach of Springbrook Creek. The original Springbrook Creek Flood Insurance Study, completed in 1986, did not account for a stream corridor restoration (completed 3-4 years prior) and determined floodplain boundaries through “best practices” of aerial photo analysis and some field study. The 2009 Upper Springbrook Creek Flood Insurance Study used peak flood flows that reflected current urbanized watershed conditions. The new study resulted in floodplain boundary changes that widened the plain in some locations and narrowed it in others. Approximately eleven properties were removed from the floodplain and two previously unmapped properties were included. The map amendment was in compliance with FEMA, state, and Metro standards.

A resource enhancement project was approved and completed for the Glen Eagles tributary to Springbrook Creek in the vicinity of Glen Eagles Road and Wembley Park Road (LU 09-0030). This project did not necessitate a map amendment as there is no mapped floodplain on the creek tributary. Another resource enhancement project was approved and completed on Springbrook Creek proper (LU 11-0012). The project restored degraded stream banks, replanted native vegetation and trees, and added floodplain capacity. As such, no map amendment was necessary.

A map amendment project that is currently in progress will affect a number of Oswego Lake properties abutting Oswego Lake and associated canals and bays. The Lake Corporation (Lake Corp) approached the City’s Planning and Building Services Department for assistance in a redevelopment project to remodel and increase in height the dam at the lake’s southeastern tip. The Lake Corp scheduled the work to proceed during the lake drawdown associated with the LOIS project (late 2010 through late 2011). The retrofit of the dam reduced the elevation of the 100-year floodplain (NGVD 103.5’) by approximately 2-3 feet, necessitating further amendments to the City’s Flood Management Area Map and the Special Flood Hazards Areas depicted on the FIRM maps of the National Flood Insurance Program. The project will impact 11 commercial properties and 283 residential properties, with a possible 257 residential properties to be removed entirely from the floodplain. The Lake Corp applied for the required map amendments and obtained tentative approval from FEMA in early 2012. Until map amendments are finally approved by City Council in Fall 2012, the current floodplain standards and maps apply to all development projects.

The 2010 NHMP includes an inventory of community assets (critical facilities, essential facilities, and critical infrastructure) and environmental assets vulnerable to a flooding hazard event in Table 3-1, page 26. While no critical facilities (City Hall, West End Building, fire stations, etc) are vulnerable to flooding, much of the City’s infrastructure is vulnerable, including water and wastewater systems, electrical substations, and regional transportation routes. The 2010 NHMP lists all pending flood mitigation projects on page 37 and flood mitigation action items starting on page 39.<sup>15</sup> Please see Goal 11 for further information on these projects.

## **Landslides**

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<sup>15</sup> 2010 NHMP, pages 37-40



*The Planning for Natural Hazard Events: Oregon Technical Resource Guide* states that landslides are relatively common, naturally occurring events in some parts of Oregon:<sup>16</sup>

“Landslides include any detached mass of soil, rock, or debris that moves down a slope or a stream channel. Landslides are classified according to the type and rate of movement and the type of materials that are transported. Two types of forces are at work: (1) driving forces combine to cause a slope to move, and (2) friction forces and strength of materials act to stabilize the slope. When driving forces exceed resisting forces, landslides occur.”<sup>17</sup>

As noted in the 2010 NHMP “landslides and soil erosion hazards exist at different locations through the city due to the presence of hilly terrain, steep ridges, and ravines underlain by unstable geology and overlaid by soils which have low carrying capacity for structures. The stability of soils on a hillside is generally dependent on the slope, the amount of precipitation, vegetative cover, and the underlying geology.”<sup>18</sup> Expanded impervious paving can lead to an increase in volume and velocity of stormwater runoff after a rainfall event, impacting the load bearing capacity of soils and exacerbating the potential hazards.<sup>19</sup>

Since the last Comprehensive Plan update in 1994, a number of landslides (both minor and major) have occurred. The small landslides (ones that didn’t result in significant damages to private and public property) are listed in the 2010 NHMP, page 43. The Plan provides details on three recent major landslides that caused significant damage to private and public property:<sup>20</sup>

- In December 2007, a rain event led to three slides on Iron Mountain and Green Bluff. The slides led to road closures and debris removal. A catchment basin was damaged from one slide but no other property was damaged.
- On February 2, 2008, a landslide in George Rogers Park led to the closure of the pathway between George Rogers Park and Old River Road for five months. The landslide, originating on private property, occurred on the slope above the pathway and deposited approximately 50 cubic yards of material onto the pathway. Through the private construction of a steel gabion retaining wall, the slopes have been stabilized and the pathway reopened to public use.
- On January 2, 2009, a large landslide originated from the slopes above Green Bluff Drive in the Marylhurst area and slid into a home on Woodhurst Pace just after 1:00am. Twenty-one homes and 28 people were evacuated, while five people were transported to area hospitals. The Adult Community Center was opened to accommodate families

<sup>16</sup> Planning for Natural Hazards: Oregon Technical Guide, Chapter 5, page 5.

<sup>17</sup> Planning for Natural Hazards: Oregon Technical Guide, Chapter 5, page 5.

<sup>18</sup> 2010 NHMP, page 43

<sup>19</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, page 12

<sup>20</sup> 2010 NHMP, page 43

in need of shelter. A second slide down the hill from Green Bluff damaged another home and the right-of-way. A third slide on Oak Street deposited material onto the road and diverted runoff to the properties downhill. A temporary debris catchment basin was built on Green Bluff Drive and the City worked with the property owners to stabilize the embankment and roadway where the lower slide on Green Bluff Drive occurred. Lawsuits are ongoing; City personnel were called to testify.

In addition to these three landslides, an additional event occurred after the NHMP was finalized. At some point during December 2010, a landslide wiped out a hillside at the rear of the Adult Community Center. Several tens of thousands of cubic yards of wet dirt washed away an entire slope, sending the dirt and other debris into nearby Tryon Creek State Park. No one realized what had occurred until a Parks employee noticed more light coming through that corner of the parking lot than usual. The hill was steep to begin with and after the landslide, a 40-foot cliff with a nearly vertical face sat atop a slope descending another 100 or so yards. Probable causes include a pipe that funneled stormwater runoff over the slope and saturated soils from record rainfalls. The remediation project is now complete with a debris removal, rock buttress, redirected pipes, and native plantings and trees. The total project cost was \$750,000.<sup>21</sup>

The 2010 NHMP includes an inventory of community assets (critical facilities, essential facilities, and critical infrastructure) and environmental assets vulnerable to a landslide hazard event in Table 3-1, page 26. The only critical facility listed as vulnerable to a landslide is the Adult Community Center (please see landslide incident, above). Several essential facilities (Hallinan and Westridge Elementary public schools) are also vulnerable. Much of the City's critical infrastructure is vulnerable as well, including water and wastewater systems, and regional transportation routes (State Highway 43).

The foremost NHMP mitigation project regarding landslides focuses on new research by the State for more precise tracking of potential landslide hazards. The State of **Oregon's Department of Geology and Mineral Industries (DOGAMI)** acts as a valuable information source for mapping data. DOGAMI, in conjunction with the United States Geology Survey, is in the process of providing the public with a new imaging system called the **Light Detection and Ranging System (LIDAR)**. These are high resolution images of the earth's surface to map landslide potentials and historic slides. In their current state, the images are a general assessment (the scale is 1 inch to 8,000 feet) and are used by the City for general surface assessment only. Currently, the City's GIS Department uses the data for accurate topography on base maps. Clackamas County applied for a grant (in cooperation with local jurisdictions including the City of Lake Oswego) to complete a professional interpretation of the LIDAR maps. As interpreted, the higher quality information on potential and historic landslides would likely

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<sup>21</sup> Kara Hansen Murphey. (2011, September 22). The earth moved at the LOACC- now crews are moving again. *Lake Oswego Review*. Retrieved May 5, 2012.  
[http://www.lakeoswegoreview.com/news/story.php?story\\_id=131663881329424100](http://www.lakeoswegoreview.com/news/story.php?story_id=131663881329424100)

require updates to a number of development codes and hazard inventory maps. The anticipated release of the refinement study and data is mid-2013.

The NHMP action items call for incorporating appropriate text and map amendments to the City development standards and hazard inventory maps as necessary with the new data. This may involve a Measure 56 Notice if the code and map amendments limit types or intensity of development on privately owned residential properties where no restriction existed prior.

The City utilizes the Weak Foundations Soils Section (LOC 50.06.006.1) and the Hillside Protection Section (LOC 50.06.006.2) to review development on steep slopes and in potential landslide hazard areas. The Building Official requires a geotechnical report when development (land disturbance) is proposed in an area that may contain weak foundation soils according to the Weak Foundation Soils Atlas. The atlas also inventories known and suspected fault lines, slide areas, and unstable soils. The Drainage Section (LOC 50.06.006.3) includes standards that regulate impervious surfaces so that the burden on watersheds (possibly leading to landslides and flooding) is minimized. These standards were last updated in the late 1960s and do not reflect current development trends and new technologies. In addition, Chapter 38 includes Article 38.24 Surface Water Utility which regulates all aspects of surface water management. The Public Works Department is in the process of revising and updating Article 38.24 to be in compliance with the City's MS4 permit (see applicable State regulatory obligations, below). The update will include revised code language, best management practices, monitoring and maintenance standards, and a design manual. A draft of the proposed code and design manual will be available summer of 2012.

Overall, the 2010 NHMP finds that while the probability of landslide hazard events is high due to soils conditions and steep slopes, less than 1% of the population and assets would be affected. While many major utility lines are located in close proximity to potential landslide areas, the lines are buried, decreasing their vulnerability. Per the 2010 NHMP, a number of park and/or natural areas are vulnerable to landslides. As most parks are located within developed residential neighborhoods, landslides in parks may also impact adjacent residences. The vulnerability risk assessment for residential, office, commercial, and industrial lands is not provided.

## **Earthquakes**

Geological records indicated that Oregon has a long history of seismic activities. The Cascadia Subduction Zone, a 680-mile long zone of active tectonic convergence where the Juan de Fuca Plate is colliding and moving beneath the North American continent, is capable of producing a magnitude 9 earthquake. This zone, located off the Pacific Ocean, is responsible for a series of massive earthquakes in the Pacific Northwest region over the past 6,000 years, on an average of every 500-600 years. The last of these took place in approximately 1700 A.D. but scientists estimate that there is a 10-20% chance of a great subduction zone earthquake in the next 50

years.<sup>22</sup> The 2010 NHMP and the Clackamas County NHMP detail two other fault zones that could cause significant damage: the Portland Hills Fault Zone on the eastern edge of the city and the Gales Creek-Newberg-Mt. Angel Structural Zone located southwest of the city.<sup>23</sup> The City's GIS Department has mapped the geographic extent of seismic hazards with zones ranging from Zone A (highest hazard areas) down to Zone D throughout the city (See [LO Area Earthquake Hazards map, NHMP](#)). Once interpreted and refined, the new LIDAR maps from DOGAMI will provide the City with more specific and detailed earthquake hazard data.

#### Specific Hazards Associated with Earthquakes:

- Ground shaking - seismic waves felt on the earth's surface
- Ground shaking amplification - increased shaking due to soil types that amplify and increase wave strengths
- Liquefaction - ground shaking that causes granular soils to liquefy
- Landslides
- Tsunamis - not a direct hazard to the City
- Surface faulting - ground displacement caused by faults slippage

The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and type of earthquake. As shown on the LO Earthquake Hazards map, many critical and essential facilities and infrastructure would be impacted by any high magnitude earthquakes. These assets include the City Hall [housing the police and emergency dispatch including Lake Oswego's Communications Center's (LOCOM) communication towers], the West End Building, the Main Fire Station, many public and private schools that could act as Red Cross emergency shelter sites, water pumping stations and water treatment plants, wastewater lines, and electrical substations.<sup>24</sup> The 2010 NHMP rates the probability of an earthquake event occurring as "high" with one event likely to occur within a 10-35 year period. The City's vulnerability to an earthquake is also rated as "high", as more than 10% of the population and community assets would be affected in a large scale event.<sup>25</sup>

The other aspect of earthquake vulnerability assessment is evaluation of the structural soundness of the assets in proximity to known hazards. Standards and regulations related to seismic safety in the International Building Code (as modified and adopted by the State of Oregon) are updated every four years. Since many of our critical and essential facilities have been built, the codes have changed significantly.

As noted previously, in the event of an earthquake most of the local bridges within the city would automatically be closed until further inspection as they have not been updated to meet current seismic standards. The City's main fire station located in the downtown area was built in 1996 and met then-current seismic standards. The South Shore Fire Station was partially

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<sup>22</sup> 2010 NHMP, page 62

<sup>23</sup> 2010 NHMP, page 61; and, Clackamas County Natural Hazards Mitigation Plan (2002), Chapter 11, page 1

<sup>24</sup> 2010 NHMP, page 26

<sup>25</sup> 2010 NHMP, pages 61-62

upgraded to reinforce the apparatus bays and tie the roof into the walls. The two other fire stations were built in the mid-1980s and have not been upgraded beyond strengthening of the apparatus bays. Both the West End Building and City Hall went through seismic studies. While City Hall was found to be not up to current seismic standards, the West End Building was found to be mostly compliant. Only minor updates would be required with a change in occupancy.<sup>26</sup> The Hazard Mitigation Advisory Committee (HMAC) applied for and received a FEMA Pre-Disaster Mitigation grant (around 2003) that funded seismic upgrades to City Hall for \$187,500. The recommended upgrades were not completed as they would have reduced usable space within the building and a funding source for the grant match was unavailable. As noted earlier, the City's wastewater system underwent a partial upgrade (the LOIS project) as have various other facilities such as the water treatment plan in West Linn and the intake facility on Clackamas River.

## Wildfires

The City is characterized by numerous natural areas and open spaces, along with significant tree canopy and wildlife habitat located on private property. Recognizing that these natural features provide an essential part of the overall community character, the 2010 NHMP does not recommend removal of trees or habitat to reduce the risks of wildfires although a number of Lake Oswego's parks and open spaces are considered high wildfire hazards. Instead, the Plan recommends the preparation of an Urban Forest Fire Management Plan with research focused on wildfire and habitat protection in coordination with the City's Tree Code and natural resource protection regulations. One important note is that the understory brush throughout the city primarily consists of non-native invasive plant species; removal would benefit the habitat and reduce wildfire risks.<sup>27</sup>

While no homes have been completely destroyed by a wildfire, this isn't due to lack of wildfires within the City of Lake Oswego. The Fire Department has successfully extinguished every wildfire to date, prior to serious damage. The 2010 NHMP notes that the lack of large-scale wildfires within the city translates to an increasing fuel load combined with steep slopes.

The City's GIS Department has mapped the geographic location and extent of the wildfire hazard using hazard data provided by Clackamas County ([See LO Area Wildfire map, NHMP](#)). The probability of wildfire events was determined to be "moderate" meaning one incident is likely to occur in a 35-75 year period. Using available data, the vulnerability assessment for city was also listed as "moderate" meaning that 1-10% of the population and community/environmental assets would be affected in a large scale event.<sup>28</sup> The Mountain Park neighborhood is especially vulnerable to wildfire risks due to the wooded character and the steep slopes.

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<sup>26</sup> SAFECO Office Building Lake Oswego, Oregon Seismic Study; KPFF Consulting Engineers, submitted May 16, 2008.

<sup>27</sup> 2010 NHMP, page 49

<sup>28</sup> 2010 NMHP, page 50

Due to proximity to heavily wooded steep ravines, both the Adult Community Center and the South Shore Fire Station are critical facilities vulnerable to wildfires. In addition, numerous essential facilities like churches and public schools which could act as Red Cross emergency shelters are also vulnerable due to proximity to natural wooded and sloped areas. It's important to note that all school remodels are now required to include the installation of sprinkler systems upgrades. Most of the City's critical infrastructure (wastewater lines, water lines, natural gas pipelines, and data lines) are buried, limiting their vulnerability to wildfires.

### **Severe Storm Events (winter and wind)**

Severe winter storms can create hazardous conditions such as heavy rain, freezing rain, ice, snow, and high winds. The impacts from these weather conditions can impact public utilities, road conditions, the stability of trees and power lines, and all structures. The extent of this hazard extends to all structures and portions of the City.

While Oregon is reputed to have a temperate climate, destructive winter storms have occurred through the area's recorded history. The Columbus Day storm event in January 1950 caused massive widespread damage through the Portland Metropolitan area. Many older trees in Lake Oswego bear damage from this storm. Since the last Comprehensive Plan update in 1994, a number of storm events (both minor and major) have occurred. In February of 1996, a severe ice storm was created by conflict between cold and warm air fronts. Freezing rain and ice buildup caused massive traffic problems and closed most of the metro area for days. In the past five years alone, the City has experienced winter storm events that caused minimal to severe impacts, listed in the 2010 NHMP, page 55:<sup>29</sup>

- December 1 and 2, 2007, saw a rain storm that brought strong winds requiring a large clean-up effort for City Maintenance staff.
- December 13 through 26, 2008, Oregon was struck by the worst winter storm event since the Columbus Day storm that led to power outages, water main breaks, hazardous road conditions, closed schools, and major clean-up efforts.
- On January 17, 2009, high winds threatened trees and left significant debris in the streets.

The 2010 NHMP lists the probability of a severe storm event as "high," meaning one severe incident is likely to occur in a 10 to 35 year period.<sup>30</sup> The Plan also lists the City's vulnerability to the storms as high due to the dense urban tree canopy, steep slopes and roads, and residential nature of the community. The City has developed an Emergency Operations Plan that describes how the emergency operations system will operate during a storm event. Plans for the evacuation of public buildings, public notification, maintenance of roads and bridges, and preparation for storm events have also been completed.

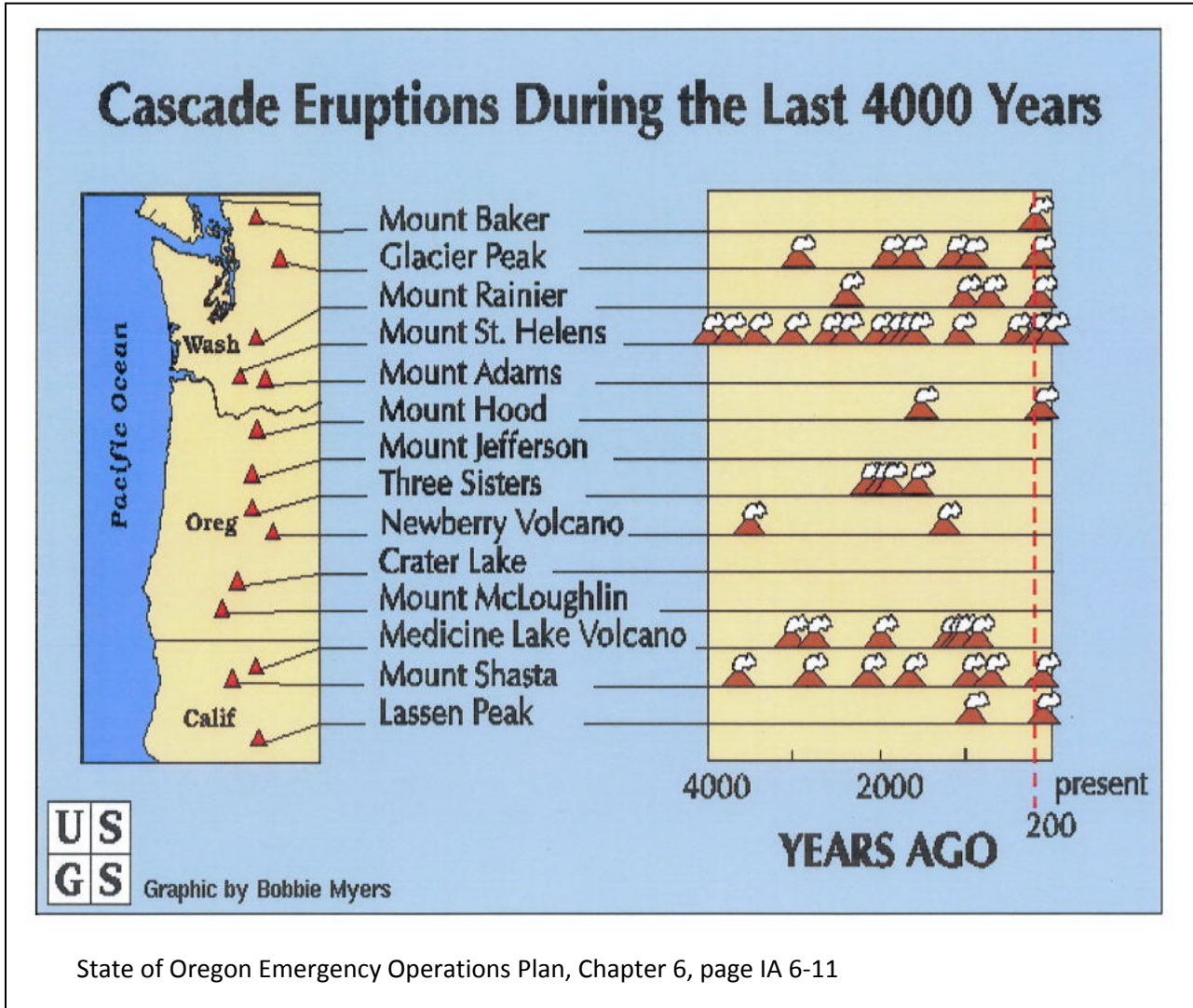
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<sup>29</sup> 2010 NHMP, page 55

<sup>30</sup> 2010 NHMP, page 55

## Volcanoes

While the 2010 NHMP lists the probability of a volcanic event as “low”, meaning one incident is



likely within a 75 to 100-year period, the City is close to four volcanoes (Mt. Hood, Mt. St. Helens, Mt. Adams, and Mt. Jefferson) and is within 300 miles of even more.<sup>31</sup> Although the City is unlikely to be affected by lava flow or ejected volcanic rocks, the subsequent ash clouds could drift and deposit ash over the city. For that reason, and also due to the unpredictable nature of volcanic events and the widespread possible impacts, the City’s vulnerability is listed as “high” as more than 10% of the population may be affected in a large-scale event.<sup>32</sup> The City has determined that it is not cost-effective to implement direct volcanic hazard mitigation strategies at this time.

<sup>31</sup> 2010 NHMP, page 69

<sup>32</sup> 2010 NHMP, page 70

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## REGULATORY OBLIGATIONS

The City is governed by a variety of federal, state, regional, and local regulations concerning natural hazards. Some of the regulations overlap, specifically state and federal regulations governing floods.

### Federal

The **Federal Emergency Management Agency (FEMA)** is under the U.S. Department of Homeland Security. It is a regulatory agency that oversees natural and/or manmade disaster management and readiness plans. The **Disasters Mitigation Act of 2000** requires jurisdictions to have a FEMA-approved natural hazards mitigation plan to qualify for assistance programs. The City has completed a natural hazards mitigation plan in conjunction with Clackamas County that has been reviewed and approved by FEMA. Now that we are eligible, the City can apply for and receive grant funding to help offset the hazard preparation and mitigation costs for various projects.

FEMA also manages the **National Flood Insurance Act (NFIA)** which created the **National Flood Insurance Program (NFIP)** in 1968 to provide federally subsidized flood insurance for specific properties and property owners. The NFIP created two work products: the National Flood Insurance Study (NFIS) and the Flood Insurance Rate Maps (FIRM). Water surface elevations are combined with topographic data to develop FIRMs. The mission of the NFIP was to transfer the costs of private property flood losses from the taxpayers to the floodplain property owners, to provide aid after disasters, to encourage development outside of flood hazard areas, and to require construction that could withstand flooding. To encourage participation in the NFIP, the federal government now requires development in known flood hazard areas to obtain flood insurance and does not give certain types of federal assistance for non-NFIP participating communities.

The NFIP conducted the initial mapping effort to assess the location of flood hazards for the nation, including the State of Oregon. Once the initial maps identified property within Lake Oswego as impacted by floods, the City was required to adopt fine-tuned floodplain development maps and standards to regulate the known hazard (LOC Article 50.44; see below). If the City maintains FEMA approval for these standards, properties with known flood hazards will be provided flood insurance. The City's standards more than meet the federal **NFIP** criteria. Per the 2010 NHMP, there are 376 NFIP policies issued worth \$98,262,500. On these policies, 52 claims have been paid for a total of \$3,579,453.<sup>33</sup>

### **Army Corps of Engineers Permit Program**

The U.S. Army Corps of Engineers is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation. The Corps administers a permit program to ensure that the nation's waters are used in the public interest, and requires

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<sup>33</sup> 2010 NHMP, page 36

any person, firm, or agency planning work in the waters of the United States to first obtain a permit from the Corps. Permits are required even when land next to or under the water is privately owned. It is a violation of federal law to begin work before a permit is obtained and penalties of fines and/or imprisonment may apply. Examples of activities in waters that may require a permit include construction of a pier, placement of intake and outfall pipes, dredging, excavation and depositing of fill. Permits are generally issued only if the activity is found to be in the public interest. In Oregon, permits for development of these activities are issued jointly by the Oregon Division of State Lands (DSL) and the U.S. Army Corps of Engineers. As mentioned in the discussion of DSL permits (below), local planning agencies are required to sign off on any permits issued by DSL and the U.S. Army Corps of Engineers and water quality certification is required by the Department of Environmental Quality.<sup>34</sup>

Another avenue for obtaining federal grant money for natural disaster assistance is the **Urban Area Security Initiative (UASI)**. In 2003, the U.S. Department of Homeland Security (DHS) created UASI Grant Program to help urban areas to respond to and recover from acts of terrorism, but after Hurricane Katrina, the program was expanded to respond to natural hazard events as well. Since 2003, the Portland Urban Area has received UASI grant funds totaling approximately \$48 million for regional hazard preparation and assets. The program is not directly regulatory to Lake Oswego unless the city applies for and is approved as the coordinating organization.<sup>35</sup> The City has applied for grant money and received approval to obtain an emergency water purification system that would provide for the citizens' basic water needs in the event of a natural hazard event. The system, managed by the City of Lake Oswego Water Treatment Plant Division, would be available to serve the larger Portland metro region as well.

### State of Oregon

**Oregon's Statewide Planning Goal 7** calls for jurisdictions to "adopt comprehensive plan inventories, policies and implementing measures to reduce risk to people and property from natural hazards".<sup>36</sup> To implement these measures, Goal 7 requires that a jurisdiction consider and evaluate new information on natural hazards. Natural hazards include floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, volcanic eruptions, coastal erosion, and wildfires. Goal 7 requires localities to adopt and/or amend new hazard inventories, specify uses and the intensity of such uses permitted within hazard areas, adopt technical development guidelines and regulations, protect natural hazard areas, and coordinate emergency preparedness plans with land use plan policies.<sup>37</sup>

### **Department of Land Conservation and Development (DLCD)**

Over the years, DLCD has published significant guidance for local governments addressing planning and mitigation options for each of the hazards outlined in Goal 7. It also notifies local

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<sup>34</sup> Army Corps of Engineers Regulatory Permit Program Brochure. (1989) United States Army Corps of Engineers. As quoted in Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, page 22

<sup>35</sup> <http://www.portlandonline.com/oem/index.cfm?c=48602>

<sup>36</sup> <http://www.oregon.gov/LCD/docs/goals/goal7.pdf>

<sup>37</sup> <http://www.oregon.gov/LCD/docs/goals/goal7.pdf>

governments when relevant new hazard information requires a local planning response, which must occur within three years (Schwab 2004). A local planning response includes evaluating the risk based on the new information and adopting or amending plan policies and measures to avoid both development and siting of essential facilities in hazard areas.<sup>38</sup> DLCD maintains a natural hazard website that provides a series of technical resource guides on planning for specific hazard events ([www.oregon.gov/LCD/HAZ/about\\_us.shtml](http://www.oregon.gov/LCD/HAZ/about_us.shtml)).

Statewide Planning Goal 7 was amended in September 2001. These amendments occurred because Goal 7 had not been amended in over 25 years. Since its initial adoption, federal, state and local agencies have gained a better understanding of the nature and extent of hazards and their impacts. In 1996 and 1997, floods and landslides caused damage in 27 Oregon counties, resulted in six deaths and caused over \$286 million in property damage. After these disasters, the DLCD began a review of the effectiveness of Goal 7 in reducing risks from natural hazards. With a federal hazard mitigation grant, the review of Goal 7 began in 1998. A consultant team from the University of Oregon's Community Planning Workshop conducted a statewide survey of local planning officials and met with hazard experts and state agencies. The survey revealed two priorities for many local planners: 1) the need for updated information about natural hazards affecting their communities, and 2) practical examples and technical assistance to help strengthen the hazard provisions of their comprehensive plans and implementing regulations. In June 1999, based on the survey and the recommendations of a state-local advisory committee, DLCD directed the department to prepare a packet of technical assistance materials for local governments on natural hazards.<sup>39</sup> This is now publicly available as "Planning for Natural Hazards: Oregon Technical Resource Guide 2001".

#### **Division of State Lands (DSL) Fill and Removal Permit Program**

Oregon's Removal-Fill Law (ORS 196.800-990) requires individuals who remove or fill 50 cubic yards or more in "Waters of the State" to obtain a permit from the DSL. "Waters of the State" as they pertain to the City are Oswego Lake, Tualatin River, Willamette River, all streams and their tributaries, and all wetlands.<sup>40</sup> In addition, the Oregon Department of Environmental Quality is responsible for water quality certification under section 401(a) of the Clean Water Act. This certification is required as part of the DSL permitting process.<sup>41</sup>

#### **Oregon State Building Codes**

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by the state and local municipalities throughout Oregon. The One and Two-Family Dwelling Code and the Structural Specialty Code contain requirements to elevate a building at least one foot above the base flood elevation. These codes also contain provisions for flood proofing, subfloor drainage, and directing stormwater away from buildings. The City of

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<sup>38</sup> Goal 7

<sup>39</sup> Planning for Natural Hazards: Oregon Technical Resource Guide 2001, page 2

<sup>40</sup> Oregon Removal-Fill Permit Program Brochure. Division of State Lands. As quoted in Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, page 18

<sup>41</sup> Oregon Removal-Fill Permit Program Brochure. Division of State Lands. As quoted in Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, page 18

Lake Oswego Building Division has jurisdiction and coordinates with other City divisions and departments to ensure that permit applications for new construction meet these requirements. Verification of the floor elevation is obtained as a part of the permitting and inspection process. ORS 455.447 and the State Structural Code establish restrictions on the location of essential facilities within known seismic geologic hazard zones. Essential facilities include hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools. State building codes do not cover facilities constructed in public right-of-ways or waterways used to control flooding.<sup>42</sup>

### **National Pollutant Discharge Elimination System (NPDES) for Phase II Municipalities**

Stormwater runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events often contain pollutants that could adversely affect water quality. NPDES permits are required for storm water discharges to surface waters from construction and industrial activities and municipalities if stormwater from rain or snow melt leaves a site through a "point source" and reaches surface waters either directly or through storm drainage. A point source is a natural or human-made conveyance of water through such things as pipes, culverts, ditches, catch basins, or any other type of channel.<sup>43</sup>

Municipal sources that need to obtain permits are classified as either "Phase I" or "Phase II" municipal separate storm sewer systems (MS4s). With a population of less than 100,000 citizens located within a Census Bureau-defined Urbanized Area, the City of Lake Oswego is regulated a Phase II (or "small") MS4. The City applied for and obtained State approval of an MS4 permit and is now in the process of developing a surface water management program, including code and a design manual, to meet the permit requirements. To remain in compliance with permit approval, the new program must be implemented by 2014.

### Regional

The Portland metropolitan region is managed by **the Metro Urban Growth Management Function Plan (Metro 2040 Plan)**. There are various "titles" that discuss different aspects of growth within the metro region. Metro also managed a federally funded program called the Metro Natural Hazard Program from 1995 to 1999. The program provided local jurisdictions with data and maps for natural hazards; the City used this resource to help prepare the initial Lake Oswego Natural Hazard Mitigation Plan.

The goal of Title 3 of Metro's 2040 Plan is to protect the region's health and public safety by reducing flood and landslide hazards, controlling soil erosion and reducing pollution of the region's waterways. Title 3 specifically implements the Oregon Statewide Land Use Goals 6 and 7 by protecting streams, rivers, wetlands and floodplains by avoiding, limiting or mitigating the impact on these areas from development. The areas subject to these requirements have been mapped and adopted by the Metro Council, specifically, the FEMA 100-year floodplain and the

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<sup>42</sup> Collins, Peggy, Personal Interview. 10 May 2000. As quoted in the Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, page 19

<sup>43</sup> <http://www.deq.state.or.us/wq/stormwater/stormwater.htm>

area of inundation for the February 1996 flood. The City is mandated to update and amend applicable development codes and inventories to comply with Metro Title 3 requirements. Several updates have been completed in the last seven years and more are in process.

Title 3 contains performance standards to protect against flooding. The standards limit development in a manner that requires balanced cut and fill and requires floor elevations at least one foot above the flood hazard standard. Title 3 also contains performance standards related to streams, rivers and wetlands. The purpose of these standards is to protect and allow enhancement of water quality. The water quality areas are rivers and streams with a protected vegetated corridor width depending on the slope of the stream and the number of acres drained by the stream. Typically, the vegetated corridor is 50 feet wide. The performance standards require erosion and sediment control, planting of native vegetation on the stream banks when new development occurs and prohibition of the storage of new uses of uncontained hazardous material in water quality areas.

#### Local: City of Lake Oswego

##### **LO Comprehensive Plan**

The goals and policies of the LO Comprehensive Plan are intended to guide the community in making informed short and long-term decisions for the future of the city. The Plan is required by the state to be in conformance with all applicable statewide Oregon Planning Goals. State law also requires jurisdictions to periodically review their Comprehensive Plans and adjust them to accommodate changed circumstances and address changing community values and needs. Other planning documents, such as the Capital Improvement Plan, are also considered when making land use decisions but should be coordinated with the applicable policies outlined in the Comprehensive Plan.

**Goal 7 of the current LO Comprehensive Plan** implements the city's goal of protecting life and property from natural hazards and disasters but the goal is intertwined with all other goals. Goal 7, as adopted in 1994, contains a number of recommended action measures, some of which have been completed, other of which are no longer applicable. New action measures should be adopted in this update to reflect recent hazard events, new technologies for mapping and mitigating hazards, changes in existing infrastructure, and development trends.

## **APPLICABLE CITY PLANS/PROGRAMS/PROCEDURES/CODE**

As natural hazards do not follow political boundaries, the City is involved with numerous cooperative efforts at a regional level such as inter-governmental agreements, regional plans, and emergency management programs to provide coordinated disaster response, to map and update regional assets, and to organize partnerships to apply for federal grant monies. These efforts help institutionalize a jurisdiction's responsibility to mitigate impact from development both up- and downstream.

### **Regional Emergency Management Group (REMG)**

This is a non-regulatory intra-governmental agreement (IGA) that acts as an oversight committee. The mission is to review mutual aid agreements with state, regional, and local agencies to coordinate disaster response, resource allocation, and vertical and horizontal hazard mitigation. The City has had representatives from the City Manager's Office and the Fire Department on the technical advisory committee, and a City Councilor member on the policy committee.

### **Lake Oswego Natural Hazard Mitigation Plan (NHMP)**

The NHMP is a community-wide vulnerability assessment and risk analysis that combines the information from hazard identification with an inventory of the community and environmental assets exposed to a particular hazard, and it attempts to forecast how those assets will be affected by each hazard. The NHMP was approved by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security, rendering Lake Oswego eligible for hazard mitigation project federal grants. To maintain eligibility, a jurisdiction must perform an annual review of the plan and complete updates every five years to reflect changes in data, information, events, technology, development patterns including annexation, funding, etc. The latest update was submitted to FEMA and approved in 2009, then adopted by the City Council in the spring of 2010. A useful list of guiding questions for future NHMP updates are listed in the 2010 NHMP on pages 9 through 10.

The plan is non-regulatory in nature and includes goals and action items. . It provides a foundation for coordination and collaboration among agencies and the public, identifies and prioritizes future mitigation activities, and aids the City in meeting federal planning requirements and qualifying for assistance programs.<sup>44</sup> The NHMP works in conjunction with the City's Comprehensive Plan, the Capital Improvement Plan, Building Codes, Development Codes, as well as other county and state plans.

Due to the limited resources available for improvements, the City has prioritized potential hazard mitigation projects as a part of the NHMP. These action items are listed on page 75 of the 2010 NHMP and those not already underway should be incorporated into the Comprehensive Plan update. The Planning Department would be responsible for integrating many of these action items into regulatory documents.

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<sup>44</sup> 2010 NHMP, page 8

As noted earlier, the City is in the process of completing another NHMP update that will bring the City's update timeline into sync with that of Clackamas County. Only minor revisions are anticipated.

#### **Clackamas County's Community Wildfire Protection Plan**

This is a non-regulatory plan that representatives from the City's Fire Department participated in creating with Clackamas County and other local jurisdictions. The LO Fire Department is also tied into Clackamas County Fire Prevention Co-op with U.S. Forest Service and Oregon Department of Forestry.

#### **LO City Building Evacuation Plan**

Based on the adopted state program, this plan establishes evacuation procedures, including the designation and training of evacuation coordinators. An up-to-date plan is essential to maintain emergency services for the City.

#### **Lake Oswego Clean Streams Plan**

The Clean Streams Plan is the 2009 update of the Stormwater Master Plan and focuses on City-wide policies, standards, and projects that seek to protect streams, lakes, and rivers. It also implements mitigation activities related to emergency situations including a list of potential capital improvement projects meant to improve the City's surface water system. One of the action items in the 2010 NHMP is to obtain funding, possibly from FEMA, to implement the Plan's infrastructure improvement recommendations.

#### **Emergency Management Program**

This is an umbrella program for City-wide emergency plans, policies, IGAs, etc. It is managed out of the City Manager's office.

#### **Emergency Operations and Management Plans for State, Clackamas County, and City of Lake Oswego**

##### **Lake Oswego Emergency Operations Plan (EOP)**

This plan incorporates procedures supporting all facilities, operations, and personnel to be relied upon during a hazard emergency. The plan outlines the roles and responsibilities of all local responders within the City and:

- Identifies who will be in charge of responding in the event of an incident;
- How the response will be handled;
- Guidelines for coordinating emergency services; and,
- Coordinates actions with other jurisdictions, State and Federal agencies

Tied in with the City's EOP and Emergency Management Program is the **Community Emergency Response Teams (CERT)**. This non-regulatory program has been training members since 1995 for disaster readiness and response as well as hazard mitigation.

The Lake Oswego EOP is supplemental to the Clackamas County EOP and the State of Oregon Emergency Management Plan (EMP).<sup>45</sup>

**Clackamas County EOP** is an all-hazard plan describing how Clackamas County will organize and respond to events that occur in individual cities, across the county and in the surrounding region. The plan describes how various agencies and organizations in the County will coordinate resources and activities with other federal, state, local, and private-sector partners. The Clackamas County EOP Basic Plan describes roles, responsibilities, and concepts of operations, command, and control, while clearly defining escalation pathways and legal authorities involved with critical decision-making and resource allocation by local and county governments.<sup>46</sup>

**Emergency Management Plan** for the State of Oregon is developed, revised, and published by the Director of Oregon Emergency Management (OEM) under the provisions of Oregon Revised Statutes (ORS) 401.270, which are designed to coordinate the activities of all public and private organizations that provide emergency services within the state and provide for and staff a State Emergency Coordination Center (ECC) to aid the Governor. ORS 401.035 makes the Governor responsible for the emergency services system within the State of Oregon. The Director of OEM advises the Governor and coordinates the state's response to an emergency or disaster.<sup>47</sup>

### **Continuity of Operations Plan and Continuity of Government Plan**

Lake Oswego is in the process of developing COOP and COG plans. The Lake Oswego Police and Fire Departments have current COOP plans. Once these plans are developed, they may be used in conjunction with the City EOP during extraordinary emergency situations. The COOP and COG plans detail the processes for accomplishing administrative and operational functions during emergencies that may disrupt normal business activities. Parts of these plans identify essential functions of local government, private sector businesses, and community services and delineate procedures developed to support their continuation.<sup>48</sup>

### **LO Capital Improvement Plan (CIP)**

The CIP forecasts the City's capital needs for a 5-year period. The plan is drafted by the City Manager's Office in coordination with the various department heads and then adopted by City Council. To be eligible for inclusion in the CIP, a project must have cost at least \$10,000, have a useful life of more than three years, and result in the creation or revitalization of a capital asset. The City Council considers and plans for all such projects at a single time for a more comprehensive view of the community's capital needs. Hazard mitigation activities such as infrastructure and facility evaluations and updates, hazard inventory updates, bridge repair, etc, may meet the criteria for a CIP project.

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<sup>45</sup> LO EOP draft page 1-2 of Basic Plan

<sup>46</sup> Ibid, draft page 1-6 of Basic Plan

<sup>47</sup> Ibid, draft page 1-6

<sup>48</sup> Ibid, draft page 1-7



### **Lake Oswego Public Facilities Plan (PFP)**

This document was adopted in 1997 and identifies the major facilities and capacity improvements to city infrastructure and services that are necessary to support land uses allowed by the Comprehensive Plan for the period of 1997-2017. These facilities include water, sewer, surface water management, and substantial transportation system improvements. Because the PFP also describes potential funding mechanisms, the plan is essential to the long-range financial planning of capital facilities, and provides general guidance for the cost of future facilities and their location.

### **Wastewater Master Plan (WWMP)**

This plan was last revised in 1989. An update to the 1989 WWMP is currently under way (with a complete draft due mid-2012) and will include a review of wastewater policies and development criteria, flow projections, existing system conditions, and modeling of capacity evaluations for future flows. The study will include recommendations for CIP projects. The City of Portland's Tryon Creek Wastewater Treatment Plant (which treats wastewater generated in Lake Oswego) experiences a wintertime demand increase of approximately eight times more than summer, due to inflow and infiltration of stormwater in deteriorated sewer pipes and leaking manholes. The treatment plant ends up treating millions of gallons of rain water before discharging it into the Willamette River. In the worst-case scenario, a major storm event could (and has in the past) lead to sewer overflow into the lake or onto city streets. A possible CIP project would be to fund replacement or re-lining of the City's sewer pipes and manholes to reduce stormwater inflow and infiltration.

### **City of Lake Oswego Community Development Code**

The purpose of the **CDC** is to provide the principal means for implementing the Comprehensive Plan. The various code chapters give developers and property owners criteria to guide development, provide a public process for transparent and prompt review of development proposals, ensure that negative impacts from development on the natural and built environment are minimized and regulated, and help citizens maintain the aesthetically charming character of the city. These goals also help the city meet its housing requirements, provide economic opportunities, and align the vision of the city's future with its present needs. The following articles from Chapter 50 are directly applicable to all development associated with natural hazards:

Greenway Management Overlay (LOC Section 50.05.009)

Sensitive Lands (LOC Section 50.05.010)

Flood Management Area (LOC Section 50.05.011)

Weak Foundation Soils (LOC Section 50.06.006.1)

Hillside Protection (LOC Section 50.06.006.2)

Drainage (LOC Section 50.06.006.3)

### **Lake Oswego Building Codes**

The City of Lake Oswego adopts and regulates the Oregon State Building Codes as Chapter 45 (Building Code) and Chapter 46 (Plumbing Code). The State Building Code goes through regular updates on a four-year cycle, alternating every two years between commercial and residential standards. The Plumbing Code is updated every four years. The City's Building Code and Plumbing Code chapters are automatically updated afterwards. As noted, above, through building permit review, the Building Division coordinates with other City divisions and departments to ensure that permit applications for construction meet the Building Code requirements, as well as Utilities (Chapter 38) on private property. In addition, Chapter 55 (Tree Code) and Chapter 15 (Erosion Control) help manage and mitigate for hazards.

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## **SUMMARY OF EMERGING ISSUES, CHALLENGES AND TRENDS**

“Hazard Mitigation” is defined by the Code of Federal Regulations as: any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards.

### **The Role of Local Government**

As more has been learned about the environment and the risks inherent in the forces of nature, government (at all levels) has acquired the responsibility to address those risks, including not allowing or restricting (re)development that would likely increase threats to public health and safety.<sup>49</sup> This responsibility is the backbone of our existing federal environmental and disaster regulations but is a responsibility more and more being taken up by state and local jurisdictions. The balance a government must maintain is between property rights and protection of the commons with the understanding that some activities performed on private property may negatively impact the environment and community.

In a real sense, governments should decide whether or not to take a more proactive response towards natural hazards, focusing on preparedness and reduction of vulnerability rather than focusing on response and clean-up after an event. If the community’s decision is to focus on the preparedness and reduction of vulnerability the City should obtain and allocate the necessary funding and staff resources to continue the inventories of natural hazards impacting the community using all available technology, develop and update the appropriate responses (regulations, emergency response plans, IGAs, hazard mitigation programs, etc), and finally, update critical and essential infrastructure and facilities. Allocation of scarce resources is a difficult issue to deal with during these harder economic times. If there are not policies and a funding framework focused on a resilient and prepared community, these steps will not be taken.

### **Hazard Preparedness**

The 2010 NHMP (along with the 2004 NHMP and the Clackamas County NHMP) details the history of hazard events in this area; this report summarizes some of the major or most recent events that have directly impacted the city. That history clearly demonstrates that due to geography, topography, development patterns, proximity to water resources, and dense urban tree canopy, this city is vulnerable to multiple hazards. Theoretically, we understand that climate change has had a direct influence on the frequency and intensity of natural hazard events. Increased temperatures and heat waves create drought conditions, leading to increased potential for wildfires. Extreme precipitation events saturate soils and overburden failing stormwater systems, leading to flooding, landslides, and community wide damage. The foundation of the community’s hazard planning effort should be the understanding that the only way to reduce vulnerability to hazards (regardless of probability or how climate change may increase the number or scale of events) is to prepare for all likely events and ensure that future growth is appropriate to its context.

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<sup>49</sup> Hazard Mitigation: Integrating Best Practices into Planning, page 2

For example, all of the bridges are noted in the 2010 NHMP as being vulnerable to earthquakes as are many of our public utility systems. When the “big one” hits, a prepared and resilient community would have already updated aging infrastructure to current seismic codes. It would also have many options in place for alternate evacuation routes, for people to get drinking water, and means of wastewater disposal. There would also be emergency response systems in place to provide shelter and other essentials for citizens who are not already prepared on their own. This community would have reduced its vulnerability to the hazard and then been prepared for what happens afterwards.

### **Conservation and Development**

Unlike some jurisdictions in the metro area, the City does not have a sizable inventory of large tracts of vacant land. The Buildable Lands Inventory (2009) removes the following environmental constraints from the vacant land inventory: steep slopes, streams and wetlands and a portion of tree groves. However, it does not remove areas subject to natural hazards and disasters. This raises the question: Should hazards be included as one of the constraints? If so, how would this be implemented?

The most important aspect of combining the various hazard overlays with the BLI would be to identify any tracts of land large enough to partition or subdivide which are zoned with a higher density zoning but contain known natural hazards. The City has the opportunity to look at existing regulations to see if the standards clearly and objectively mitigate for potential hazards from development.

## RECOMMENDED PLAN UPDATES & POLICY QUESTIONS TO CONSIDER

### Plan Updates to Consider

Include an introduction to Natural Disasters and Hazards at the beginning of the Goal chapter.

- The hazards are interrelated to each other
- Goal 7 is interrelated to other goals.
- The city's hazard planning, emergency responses and programs, and development codes are interrelated to other jurisdictions both horizontally and vertically.

Expand scope of Goal 7 to reflect the full list of hazards listed in 2010 NHMP

- Comprehensive list of potential hazards
- Hazards (and subsequent hazard abatement/mitigation) are interrelated, as are the intra-jurisdictional programs and plans that address them.

Integrate NHMP and other hazard planning programs into Comp Plan.

- The two large plans should be closely linked when dealing with natural hazards and any action items, especially high priorities.
- Have NHMP as an appendix to Comp Plan?
- NHMP is updated more frequently than Comp Plan but that can be used to show progress.

Update the 2008 Vacant Lands inventory including additional hazards layers

- Break down the 77 acres into parcel size and zone
- Overlay all available hazard inventory maps
- Determine if sites are appropriately zoned, if regulations are in place to minimize negative impacts, and determine if any of these areas would create increased hazard risks if developed
- Consider public purchase and conservation of undeveloped areas subject to high hazard ratings as public parks/natural areas

Adopt DOGAMI LIDAR maps

- Continue work with Clackamas County to refine maps
- Complete map amendments to incorporate new and improved data into the Weak Foundations Soils Atlas
- Text amendments to adjust regulations as appropriate
- Use the LIDAR maps to update 2008 Vacant Lands inventory
- Adoption of DOGAMI LIDAR maps as a part of the Weak Foundation Soils regulations would require Measure 56 Notice to all property owners not currently identified as having slides/fault lines/weak foundation soils or if the amended maps/text further limits use of the site.

**[Note on Measure 56 Notices:** In adopting natural hazards regulations, local governments should be aware that 1998’s Ballot Measure 56 amended ORS Chapters 215 and 227 to require “written individual notice of land use change to be mailed to each owner whose property would have to be rezoned in order to comply with [an] amended or new comprehensive plan ... ” Property is considered “rezoned when the governing body ... : (a)changes the base zoning classification of the property; or (b) adopts or amends an ordinance in a manner that limits or prohibits land uses previously allowed in the affected zone.”<sup>50</sup>

The City Attorney’s Office found that a Measure 56 Notice may be required for a property without a designation that was later identified with a hazard (due to more accurate mapping) if development would be further restricted than it was before.

This is not a “regulatory taking” as it doesn’t deny the property owner all economically viable use of the property. This is a Supreme Court decision. Most times, the site or development can be “engineered” to mitigate for all hazards. A regulation that denies all economically viable use may not result in a taking if the use was already prohibited at the time the owner acquired the property.

Where some economic use of the property remains after application of the regulation, a court will apply a balancing test to determine whether a taking has occurred. The factors of this test are:

- (a) The economic impact of the regulation on the claimant,
- (b) The character of the governmental action, and
- (c) The reasonable expectations of the property owner.<sup>51]</sup>

#### Floodplain Maps and Regulations

- Assist Lake Corporation with map and text amendments to adjust floodplain boundaries and elevations once dam retrofit is complete
- This includes FEMA approval

#### Incorporate the natural hazard inventories in Sensitive Lands Overlay update processes

- Overlay landslide and earthquake inventories with natural resource maps
- Determine if land should be wholly protected from development due to steep slopes, weak foundation soils, landslides, earthquake fault lines, riparian or upland natural resources encumbrances, etc

#### Obtain and allocate funding for seismic upgrades to critical facilities and infrastructure

- All bridges

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<sup>50</sup> ORS 215.503(3) and 227.185 (1999)

<sup>51</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 3, page 10

- City Hall
- Consider location of future North Anchor development with regards to seismic hazards
- Foothills Redevelopment

#### Review NHMP for non-CIP projects

- Identify the NHMP for projects that only require staff time or rely on outside funding sources and complete them as possible

#### Review existing high capacity gas lines

- Review NW Natural gas line maps to determine location of all gas lines over a certain diameter
- Review installation and maintenance records to determine condition of pipe lines
- Overlay landslide and earthquake hazard maps with gas utility maps to determine vulnerability

### **Policy Questions Regarding Best Practices**

The Oregon Technical Resource Guide recommends jurisdictions regularly review their hazard mitigation plans, policies, and regulations. The recommended actions to strengthen policies or regulations are listed for each hazard. Staff has noted in *italics* where the City of Lake Oswego has already taken steps to comply with the recommendation.

#### Flooding:

The Planning for Natural Hazards: Oregon Technical Resource Guide has tips to strengthen floodplain standards including:<sup>52</sup>

- Adopting stricter flood elevation requirements  
*The City regularly updates its floodplain maps and regulations under LOC Section 50.06.006.1*
- Prohibiting development within the floodways  
*The City regulates and restricts development within floodways*
- Adopting hazardous waste provisions  
*Metro regulations*
- Adopting water quality provisions  
*The City adopted drainage standards in the 1960s, now LOC Section 50.06.006.3. These standards need to be updated to reflect current best practices and offer incentives for sustainable stormwater and surface water management*
- Improving maps of flood hazard areas  
*The City regularly updates its flood hazard areas maps to reflect new flooding events, floodplain enhancement projects, etc*
- Strengthening setback requirements

<sup>52</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 4, pages 27-32

*The City's Community Development Code requires a 25-foot Oswego Lake Setback (including the canals) with restrictions on the types of structures allowed in this yard. The CDC also includes Section 50.05.009, the Greenway Management Overlay District, along the Willamette River with required setbacks.*

- Considering the effect of proposed development on existing development  
*The Flood Management Area standards do this indirectly. Each project is basically reviewed on its own. Could review possible standards that deal with cumulative impacts upstream and downstream.*
- Regulating fill within the floodplain  
*The Flood Management Area standards along with state (DSL) and federal regulations do this.*
- Improving stormwater management  
*The City has and will continue to improve stormwater management plans and systems. Staff recommends updating Drainage standards.*
- Protecting natural and beneficial floodplain functions  
*LOC Section 50.05.011 Flood Management Area standards, Sensitive Lands Overlay (LOC Section 50.05.010), Greenway District Overlay (LOC Section 50.05.009)*
- Discouraging location of critical facilities within floodplains  
*This is being considered with the redevelopment of the Foothills neighborhood*

#### Landslides:

The Planning for Natural Hazards: Oregon Technical Resource Guide has tips to strengthen development standards affecting potential landslide hazards, including:<sup>53</sup>

- Overlay and Combining Zones (special development requirements for landslide prone areas)  
*Weak Foundation Soils, Hillside Protection LOC Section 50.06.006*
- Incentive Zoning (to encourage development outside of landslide prone areas)
- Performance Zoning (related to minimizing impacts to landslide prone areas)
- Incorporating Landslide Mitigation Requirements into Subdivision Regulation  
*The City does not have a "Subdivision Regulation"; instead, all partitions and subdivisions are subject to certain development standards, including the Weak Foundations Soils and Hillside Protection, if applicable.*

#### Earthquakes:

The Planning for Natural Hazards: Oregon Technical Resource Guide has tips to strengthen development standards affecting potential earthquake hazards, including:<sup>54</sup>

- Identifying and mapping seismic prone areas  
*The Weak Foundation Soils Atlas identifies possible fault lines but these are approximations only; the Building Official does not rely on this data. The only time a*

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<sup>53</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 5, pages 23-24

<sup>54</sup> Planning for Natural Hazards: Oregon Technical Resource Guide, Chapter 8, pages 18-20



*geotechnical report would be required if a property contains a possible fault line is if the property also contains a potential slide area, weak foundations soils, or both.*

- Adopting zoning ordinances that prohibit/restrict development in seismically active areas

*Weak Foundations Soils Section. The Building Official will require a geotechnical report confirming the soils type for any property identified as being in a slide area or having weak foundation soils in the Atlas. If just fault lines, no geotechnical report is required. Development must incorporate all structural/design recommendations in the report. Development is not prohibited.*

- Adoption of a Seismic Hazard Area ordinance with required engineering analysis for projects
- Adoption of an ordinance to retrofit dangerous buildings (hazard abatement)
- Creation of a local rehabilitation program for dangerous buildings with incentives and funding

#### Wildfires:

The Planning for Natural Hazards: Oregon Technical Resource Guide has tips to strengthen development standards affecting potential wildfire hazards, include:

- Wildfire Hazard Overlay District  
*The 2010 NHMP has an action item to develop and implement an Urban Forest Fire Management Plan. This would be non-regulatory. The status is partially completed/deferred. The City's Emergency Operations Plan includes an Urban Forest section. Policy question to consider if any development standard necessary to implement this plan beyond what the Fire Marshal already reviews. City has a completed fire hydrant system. School remodels must incorporate fire suppression systems. Educational and informational activities are undertaken by the City's Fire Department and CERT teams. Wildfire early warning detection system was an action item in 2004 NHMP but was removed in update with CODEred (modified 911 system) in place instead.*

#### Storm Events (Winter and Wind):

The Planning for Natural Hazards: Oregon Technical Resource Guide does not address severe storm events.

#### Volcanoes:

The Planning for Natural Hazards: Oregon Technical Guide does not address volcanic events.

#### **RAMs (Recommended Action Items):**

Staff reviewed the RAMs for the 1994 Comprehensive Plan and has noted which ones have been completed and which are ongoing.

#### **Flooding Hazards [Comprehensive Plan 7.1-4]**

- i. Maintain current floodplain information for the Lake Oswego Urban Services Boundary and make it easily available to the public.

*Ongoing. Updates completed.*

- ii. Coordinate with the Army Corps of Engineers, Federal Emergency Management Agency and other responsible state, regional and local agencies regarding:

- a. Periodic review and update of floodplain information;

*Ongoing. Updates completed.*

- b. Review of major development which could have flood impacts across jurisdictional boundaries; and,

*Ongoing. Projects are reviewed as submitted.*

- c. Emergency operations planning necessary to protect life and property during a major flood.

*Ongoing. City coordinates EOP with county, state and federal agencies.*

- iii. Encourage acquisition within the floodplain, of property and easements, as designated by the Lake Oswego Surface Water Management Plan, for conveyance and storage of floodwaters and for natural open space and passive recreation uses.

*Ongoing. Two properties acquired as a part of LOIS. Foothills Industrial Area partially redeveloped as a public park.*

- iv. Encourage Clackamas County not to approve on-site sewage treatment systems within the unincorporated Urban Services Boundary which would be impaired during flooding and which could contaminate floodwaters.

*There are only two areas where unincorporated properties overlay mapped floodplains: properties south of 35<sup>th</sup> Court abutting the Tualatin River and properties along Fielding and Stampher Roads abutting the Willamette River. Property owners wishing to divide properties are required to annex to the City. Properties on Fielding and Stampher Roads are within 300 feet of a main wastewater line; failing septic tanks cannot be replaced.*

- v. Utilize other federal, state and local sources to estimate the floodplain's location if an area suspected to be subject to flooding has not been mapped by FEMA. If these sources are not available, the required information shall be provided by the developer.

*Ongoing. Coordinated efforts to keep Floodplain regulations and maps updated with new flood events and resource enhancement projects. FEMA approval is required for all map amendments.*

- vi. Encourage uses within the floodplain which do not require protection by dams, dikes or levees such as parks, open space areas, wetlands, and storm water detention facilities.

*Ongoing. Foothills Industrial area redeveloped as a park. The City should research other opportunities.*

- vii. Establish development regulations and standards to protect and restore watercourses within the floodplain which require:
  - a. Buffers between development and water courses;
  - b. Maintenance and restoration of natural vegetation;
  - c. Erosion control and protection of water quality, and;
  - d. Implementation of other measures necessary to maintain the water carrying capacity of watercourses and preserve their natural functions.

*Completed. Ongoing updates.*

#### **Earthquake Hazards [Comprehensive Plans 7.2-3]**

- i. Review and modify the City's Emergency Operations Plan as necessary to achieve a reduction in loss of life, personal injury and property damage in the event of an earthquake.

*Completed. Ongoing updates.*

- ii. Integrate earthquake safety planning into all City operations.

*Completed. Ongoing updates.*

- iii. Maintain and provide current earthquake information and Oregon Structural Specialty Code seismic requirements to developers and other interested citizens.

*Completed. Ongoing updates to Building Codes automatic by State of Oregon every two years (alternately between residential and commercial). The Weak Foundations Soils Atlas includes the possible location of earthquake fault lines.*

- iv. Assess potential seismic influences, damage potential and possible corrective actions to City sewer and water systems, bridges and other City facilities

*Ongoing. All upgrades must meet current seismic standards.*

- v. Use DOGAMI's inventory of relative earthquake hazards in the Lake Oswego area to determine areas that will likely experience the greatest effects from any earthquake. This

information can be used in refining the Emergency Operations Plan and determining relative damage potential of various locations.

*Completed with old data. Ongoing action item due to new technology. New DOGAMI LIDAR maps are in the process of being refined.*

- vi. Supply information brochures on earthquake preparedness, to residents, schools and civic groups and make brochures available at the Library.

*Completed. Ongoing with new information.*

#### **Landslides Hazards [Comprehensive Plan 7.3-4]**

- i. Minimize ground disturbance during construction by retaining natural vegetation and topographic features such as natural drainage swales, rock outcroppings and ridge lines, to the greatest extent possible, and by using measures to minimize runoff during development and after construction.

*Completed. Community Development Code contains the following sections that address this action measure: Greenway Management; Sensitive Lands Overlay; Drainage Standards; Weak Foundation Soils; Hillside Protection Standards; Flood Management. Also, regular text and map updates are completed as necessary.*

- ii. Require expected surface water runoff for all development to be controlled on site, where practical, in order to protect property, stream channels and stream corridors from present and future runoff and sedimentation.

*Completed. Drainage standards. This is reviewed by the Engineering Division in the Public Works Department for all building permits and land use applications. The standards are out of date; new best practices should be incorporated as a text amendment. The code and design manual for the developing Surface Water program could be used instead. Drainage standards could be removed.*

- iii. Promote slope and soil stability and use of the natural drainage system in areas of landslide potential, by retaining areas of existing vegetation to the greatest extent possible.

*Completed. The Building Official requires a geotechnical report for properties mapped with weak foundations soils. The Engineering Division also requires an infiltration report to address on-site stormwater management for most development.*

- iv. Maintain a current inventory of landslide and unstable soil hazards.

*Completed. Update in process using new DOGAMI LIDAR maps. Data currently used by the GIS Department for more accurate topographic mapping.*

- v. Reduce soil erosion problems by inspecting construction site controls, responding to complaints and providing enforcement.

*Completed. The City separated erosion control standards in its own chapter, LOC Chapter 15. There is a half-time staff position to review and approve erosion control plans. Staff coordinates erosion control with Division of State Lands for projects over a certain size.*

- vi. Reduce intensity of development from that permitted by the zoning code or previous development approval, if necessary, to eliminate or reduce an erosion, landslide or unstable soil hazard.

*Completed. Hillside Protection standards regulate and/or restrict development on slopes with known landslides, potential landslides, and slopes with erosion potential. These standards mainly impact undisturbed slopes.*

- vii. Create a public awareness program to educate developers and the general public regarding the importance of erosion control, the City's erosion control program, and ways in which they can promote erosion control.

*Completed. Ongoing educational efforts.*