Landslide Hazard

Landslides are a common hazard in and around Oregon. In fact, a prominent theme of the 1996 flood disaster was that a significant amount of building damage affected structures outside of identified flood hazard areas. Many of the 5,000 Clackamas County applicants eligible for FEMA housing assistance grants were not floodplain cases, but were landslide and erosion losses.i

Causes and Characteristics of the Hazard

Geographic Extent: Slope Stability (Map 5) was used to determine the geographic extent of potential landslides hazards in the County. About 32% of the total acres in Clackamas County are in moderate to high landslide hazards areas. These are concentrated in areas of high slopes, and close to river valleys.

Risk Assessment

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

History of the Hazard

In many parts of Clackamas County, weathering and the decomposition of geologic materials produces conditions conducive to landslides. Human activity has further exacerbated the landslide problem in many parts of the county. A study conducted by Dr. Scott Burns at Portland State University found that changes to the slope through cutting or filling increased the risk of landslides in 76% of the 701 inventoried landslides in the Metro region. The study documented 48 landslides that occurred in Oregon City in February 1996, and found that only about half the slides were considered natural.[ii]

Landslides in Clackamas County are not a localized problem. For example, sediment generated by the slides can affect regional water quality. During the winter of 1972, a relatively small landslide on the north fork of the Bull Run River in the western Cascades introduced a large volume of silt and clay into Portland's main water supply reservoir. Consequently, the city's water supply was discolored for several weeks.[iii]

Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying bedrock as it, along with climate, dictates hazardous terrain. Without proper planning, landslides will continue to threaten the safety of people, property, and infrastructure.

Development coupled with natural processes such as heavy rainfall or rapid snowmelt can cause landslides or re-activate historical landslide sites. The County has received four Presidential Disaster Declarations since 2002, three of which included major landslide damage to county roads and infrastructure.

Hazard Identification

Mapping: The NHMP uses soil stability overlaid with percent slope to identify potential landslide hazard areas. Map 5 shows slope stability for Clackamas County.

Although the DOGAMI Senate Bill 12 maps showing debris flow hazard areas were developed, they were not published or adopted, as there was not adequate guidance for implementing the measures outlined in the legislation at the local level. DOGAMI provided the data to local governments for reference, and the debris flow hazard areas for Clackamas County are shown in Map __.

2009 Landslide that ignited a fire and destroyed a rural residence. Source: Clackamas County.

Probability of Future Occurrence

Hundreds of landslides have occurred in past 150 years. The HMAC recognizes the historical frequency of landslides with a high severity ranking of seven and ranks the probability of future occurrences with a very high of nine. The HMAC estimates the frequency of 2-3 major events landside every year.

Climate change will likely play a factor in the potential increase in future landslide hazards due to variability of severe weather.

Vulnerability Assessment

The vulnerability assessment is based on Map 5: Slope Stability. Only those community assets exposed to moderate or high hazard zones are discussed, as low hazard zones are not of primary concern.

Risk to Life & Property: Low to Moderate

According to County GIS, there is approximately $10.2 billion in market value comprising 16% of County parcels exposed to moderate and high landslide hazards which represents about 22% of the total market value for all parcels in the county.

Although only seven vulnerable population sites (six of which are preschools) are exposed to landslide hazards, the threat to life is slightly greater than that of flooding, since fast-moving landslides (debris flows) can occur without warning, and people cannot outrun them.

Risk to Critical Facilities and Infrastructure: Moderate

The key infrastructure exposed to moderate and high landslide hazards are dams, bridges, cell towers, and substations. The greatest risk to this infrastructure would be dam failure, as the cascading effects on the downstream environment could be catastrophic. Four dams are in the high hazard zones, and four are in moderate hazard zones. However, the dams are built to sustain earthquake hazards, and likely would be able to withstand the weight of landslides.

There are two bridges in high hazard areas and three that have moderate landslide hazards. Disruption to these bridges could hinder emergency response and evacuation efforts in these areas.

Ten cell towers are in moderate to high hazard zones, and fifteen substations are in moderate to high hazard zones. Failure of these critical pieces of infrastructure could result in communication deficiencies and power outages.

Community Hazard Issues

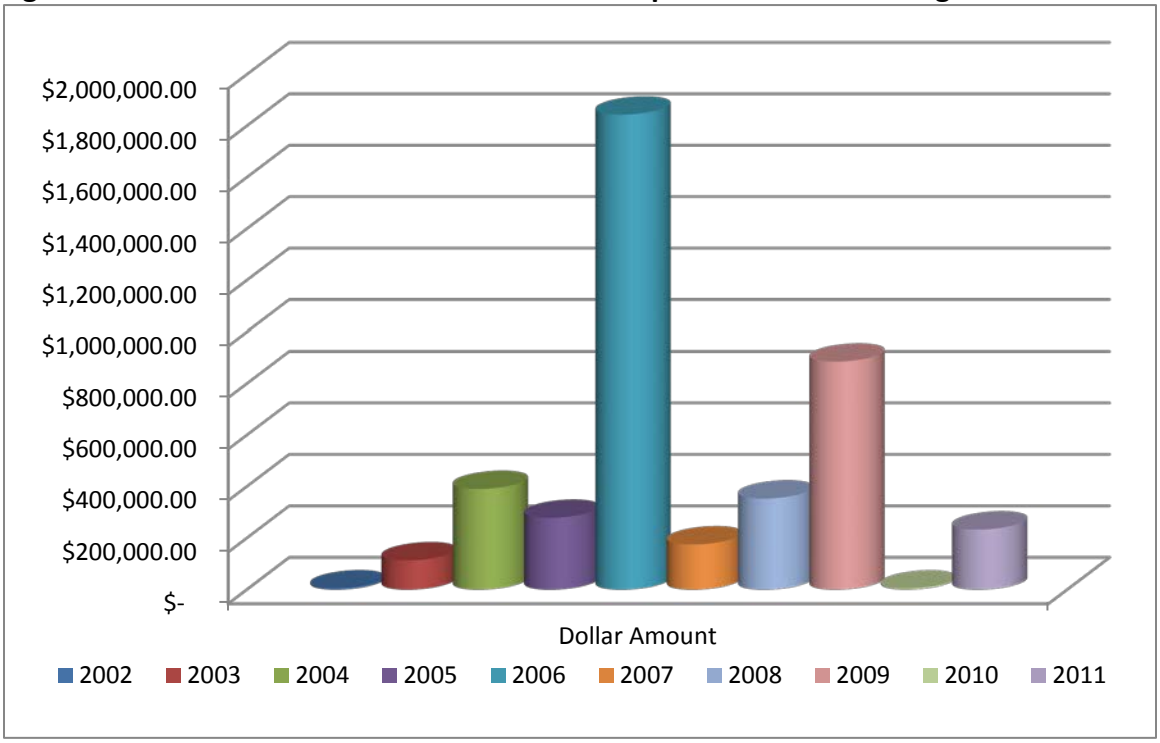
Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.[iv]

Roads and Bridges

Large losses incurred from landslide hazards in Clackamas County have been associated with roads. The Clackamas County Roads Division is responsible for responding to slides that inhibit the flow of traffic or are damaging a road or a bridge. The roads department does its best to communicate with residents impacted by landslides, but can usually only repair the road itself, as well as the areas adjacent to the slide where the county has the right of way.

It is not cost effective to mitigate all slides because of limited funds and the fact that some historical slides are likely to become active again even with mitigation measures. The county Roads Division alleviates problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides. This type of response activity is often the most cost-effective in the short-term, but is only temporary. Unfortunately, many property owners are unaware of slides and the dangers associated with them.

Figure LS-1: Annual Clackamas Landslide Road Repair Costs 2002 through 2011



Source: County Department of Transportation and Development.

Existing Hazard Mitigation Activities

Clackamas County is currently working with DOGAMI on developing a series of landslide hazard susceptibility maps using a FEMA Hazard Mitigation Grant Program. This project will cover most of the northwestern portion of the County where the majority of development occurs. DOGAMI will be employing LiDAR technology to provide a bare earth representation of historic landslide scars and to be the basis for updating landslide inventory maps, and to create susceptibility maps for deep-seated and shallow-seated landslides, as well as debris flows. This project is scheduled to be completed by the end of December 2013.

Landslide Mitigation Action Items

Landslide actions are listed in Section 3 Mitigation Strategy. For detailed information regarding each action, please refer to Appendix A – Action Items.

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[i] Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan* (2000) Oregon Emergency Management.

[ii] Burns, Burns, James, and Hinchke. Landslides in Portland, Oregon Metropolitan Area (resulting from Storm of 1996: Inventory, Map Data, and Evaluation.)

[iii] Schlicker, Ht., and Finlayson Ct. (1979) Geologic and Geohazards of NW Clackamas County. Bulletin 99. DOGAMI, OR.)

[iv] *"All Hazard Mitigation Plan: Clackamas County, Oregon"*. G&E Engineering Systems Report 32.07.01, Revision 0. September 23, 1998.