

# DECEMBER 2007 STORMS

In December 2007, a series of snow, wind and rainstorms battered western Oregon and Washington, causing severe flooding, landslides, and wind damage. The Chehalis River flooded, closing Interstate 5 between Seattle and Portland for four days, and floodwaters washed out roads and bridges and flooded homes and businesses. An area of our timberlands in the Chehalis River headwaters, known as the Willapa Hills, received extraordinarily high rainfall and suffered thousands of landslides. The storm raised questions about whether timber harvesting exacerbates landslides and flooding, and whether the laws and voluntary standards that govern timber harvesting on steep and unstable slopes are adequate.

## RESEARCH ON THE STORM

Meteorologists followed the 2007 storm closely and analyzed it both as it took place and in later research papers. They describe an extreme and unusual event. For example:

- [A study for Oregon State University's Institute for Natural Resources](#), citing a report by George Taylor, the former Oregon State Climatologist, concluded:
  - *"The December, 2007 storm was an unusual combination of very wet and very windy. As such, it is one of the highest ranked storms ever experienced in the Northwest..."*
- University of Washington Professor Clifford Mass described it as a "monster" windstorm that "savaged" Washington's coast in his [blog](#), while noting in his book on Pacific Northwest weather:
  - *"Many locations received all-time record rainfall for a twenty-four hour period, exceeding the one-day totals of the February 1996 event. Some sites in the Willapa Hills collected 14-18 inches of rain over the two-day event. The Chehalis River and its tributaries were particularly hard hit, with some stream gauges indicating flows double that of previous records."<sup>1</sup>*
- Meteorologists Tye Parzybok, Beth Clarke, and Douglas Hultstrand include the 2007 storm as a case study in their article, [Average Recurrence Interval of Extreme Rainfall in Real-time](#):
  - *"Two powerful storms brought extremely heavy rain and high winds to the Pacific Northwest during early December 2007. The intense low pressure areas fed an 'atmospheric river' of very moist tropical air into the region. Orographic lifting caused copious amounts of rain to fall across western Oregon and Washington. Several rivers in northwestern Oregon and western Washington surpassed major flood stages. Rainfall intensities at 12- and 24-hours were particularly intense... Twenty-four hour rain values approached twenty inches in the Willapa Hills region, which equated to an [average return interval] of 500+ years."*

## RESEARCH ON LANDSLIDES

Shortly after the storm, scientists started two research studies on the relationship between forest practices and landslides: one by Weyerhaeuser scientists, focusing on the landslides on our land, and one by a cooperative group of scientists sponsored by the Washington Forest Practices Board (which writes the rules regulating forest practices) focusing on the effectiveness of Washington's regulations.<sup>2</sup> Our study is completed and was published in 2010 in *Forest Ecology and Management*.<sup>3</sup> The cooperative study is still underway.

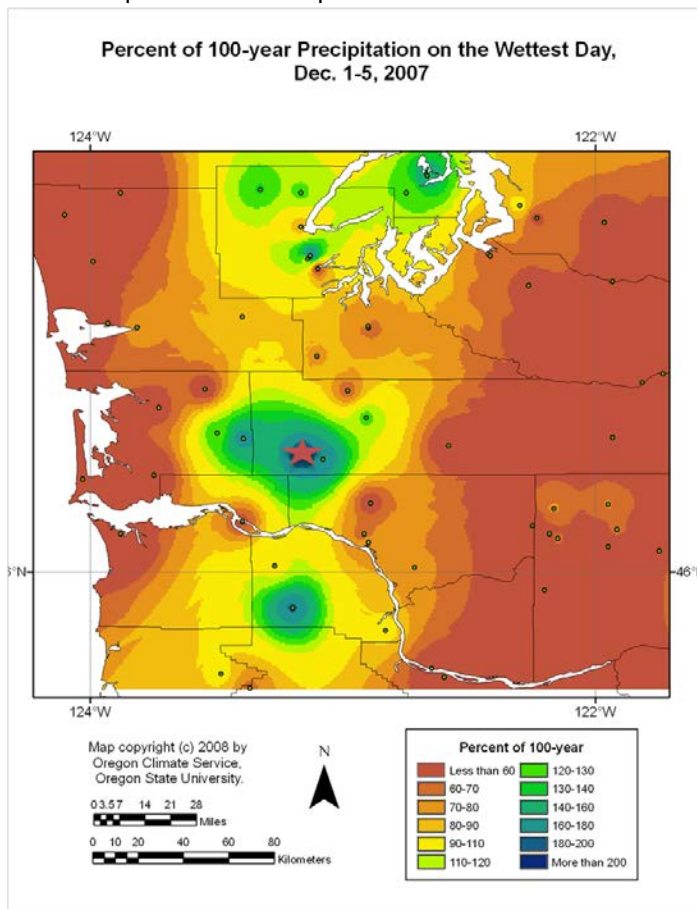
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<sup>1</sup> See page 41 of Cliff Mass's book, *The Weather of the Pacific Northwest* (2008).

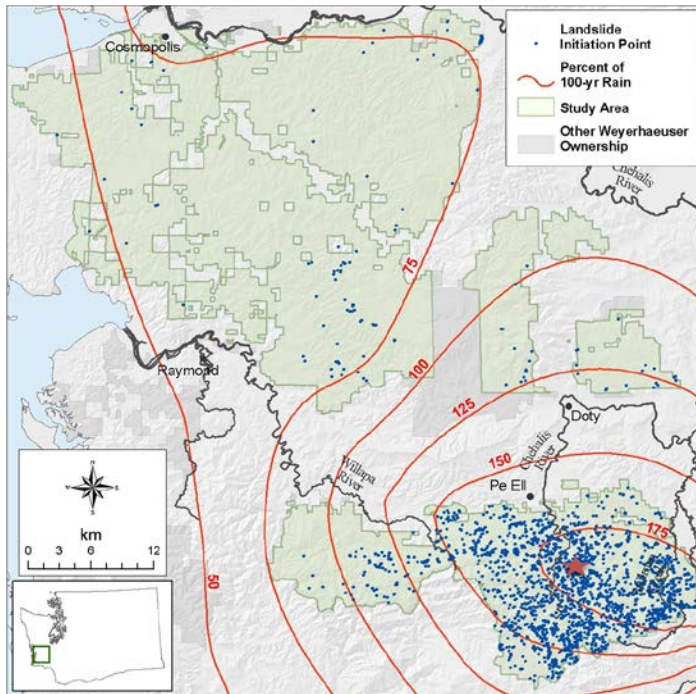
<sup>2</sup> Read more on the Department of Natural Resources' Active Cooperative Monitoring, Evaluation & Research Committee Projects site: [Unstable Slopes Rule Group - Mass Wasting Effectiveness Monitoring Program](#).

The following are the key findings of our study:

- Confirming the results of earlier research on landslides in forested terrain, accurate studies must use ground-based inventory data and can't be based on aerial photography alone. Detections using aerial photography overlook landslides occurring in mature forest. Ground-based efforts correct for these biases and produce reliable estimates of landslide density across rainfall magnitude and topography.
- Landslides are inevitable, naturally occurring events in the Pacific Northwest, and the study confirmed that they are more likely to occur on steeper hillslopes and during major storms.
  - In areas with high rainfall, higher landslide densities occurred on steep slopes (greater than 70 percent gradient) compared to lower grade slopes.
  - The highest number of landslides occurred in the areas with extreme rainfall. This is illustrated by the figures below. The first image is from Oregon State University Institute for Natural Resources' Final Report (noted above) and shows the areas with the highest rainfall in dark blue. The second image is from our study and shows the location of landslides on our land. The red star shows the same spot on each map.



<sup>3</sup> Ted R. Turner, Steven D. Duke, Brian R. Fransen, Maryanne L. Reiter, Andrew J. Kroll, Jim W. Ward, Janette L. Bach, Tiffany E. Justice and Robert E. Bilby, *Landslide Densities Associated with Rainfall, Stand Age, and Topography on Forested Landscapes, Southwestern Washington, USA, Forest Ecology and Management* 259, 2233 (2010).



- Also as expected, the density of landslides was larger in younger stands (the 0-5 and 6-10 year age categories) than in older stands (the 11-20, 21-30, 31-40, and 41+ categories). This effect was limited, however, to the areas with extreme rainfall levels – above about 150 percent of 100-year rainfall.
- Very few landslides occurred at rainfall levels up to a 100-year average return interval, regardless of stand age or slope gradient. This is an encouraging sign that Washington's rules are effective, because they require the "100-year storm" as a design standard for culverts and bridges.

## REGULATORY RESPONSE

The 2007 storm produced an outpouring of relief efforts led by the state and communities affected, and [in which we participated](#). A month after the storm, the Washington State Senate began hearings, including a visit to our lands. We testified at the hearing and prepared and submitted a [report](#) prepared by our hydrologist. In 2008, the Washington Forest Practices Board began a review of its regulatory approach to steep and unstable slopes.

Washington law requires a review by a qualified geologist in areas predicted to be potentially unstable, and restricts logging and road building on the landforms found to be prone to landslides. The areas requiring review are defined in two ways: first, the forest practices rules identify a set of default landforms that are presumed to be potentially unstable until reviewed; and second, if a watershed has undergone a detailed watershed analysis, the landforms identified in the watershed analysis replace the default landforms.

The Forest Practices Board sponsored the cooperative research described above to determine how well its approach performed under the test of the 2007 storm. That is, how accurately did the models used in the rules predict landslides? How well did the on-the-ground prescriptions used by landowners stand up to the storm? The Board also held hearings, and in 2011 adopted changes to its rules governing watershed analysis. The Board will consider further changes to the rules in 2013 based on the final results of the research.

In the meantime, in March 2010, we agreed with the Washington Department of Natural Resources, the agency that enforces the forest practices rules, to supplement our approach to steep slopes in the two watersheds affected most heavily by the 2007 storm. [We agreed to treat as potentially unstable both the landforms identified in the watershed analyses in the two basins and the default landforms in the rules.](#)

## **VOLUNTARY STANDARDS**

Our timberlands in Washington are certified under the Sustainable Forestry Initiative (SFI®), a voluntary forest certification standard. Our practices are audited by QMI-SAI Global, an independent auditor. In July 2008, QMI-SAI brought in an independent licensed engineering geologist to focus on the results of the storm. The auditors found no instances of non-conformance with the SFI standard. They did, however, recommend improvements in processes and documentation. We implemented those recommendations, which were audited again in July 2009.

In October 2009, the Sierra Club filed a [complaint](#) and [appendix](#) against our SFI certification based on the 2007 storm. We [responded](#) in November 2009. As required by the process for complaints under the SFI program, QMI-SAI reviewed the issues raised by the Sierra Club in its 2010 audit of our operations, and [responded](#) to the Sierra Club in November 2010. QMI-SAI rejected the complaint, concluding that we had appropriate systems in place to comply with the SFI standard before the 2007 storm, and we had appropriately improved our practices and procedures in response to the storm.

## **MANAGEMENT RESPONSE**

In response to the scientific research, regulatory changes, independent audits, and the availability of new technology, we have made changes in our consideration of potentially unstable slopes. These include:

- Updating our geological screening process to use new technologies, including LIDAR-derived maps, as well as existing geologic models, watershed analysis results, and rule-identified default landforms.
- Creating more systematic checklists, better documenting our geologic reviews, and making information more readily available to our employees in the field.
- Reviewing harvest plans to distribute more evenly the proportion of young stands on steeper slopes across the landscape over time.

We also have begun new scientific research to understand how watershed processes recover after an extreme event like the 2007 storm. These include studies on stream temperature, the recovery of fish populations, and the responses of invertebrate communities as indicators of primary productivity. We expect the results to inform our own practices and contribute to work by the Forest Practices Board and other agencies in the Pacific Northwest.