WASHINGTON STATE DEPT OF
NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

Testimony Submitted by
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To the United States House
Committee on Natural Resources
Subcommittee on Energy and Mineral Resources

Regarding the Legislative Hearing on Reauthorization of the
National Landslide Preparedness Act, H.R. 7003

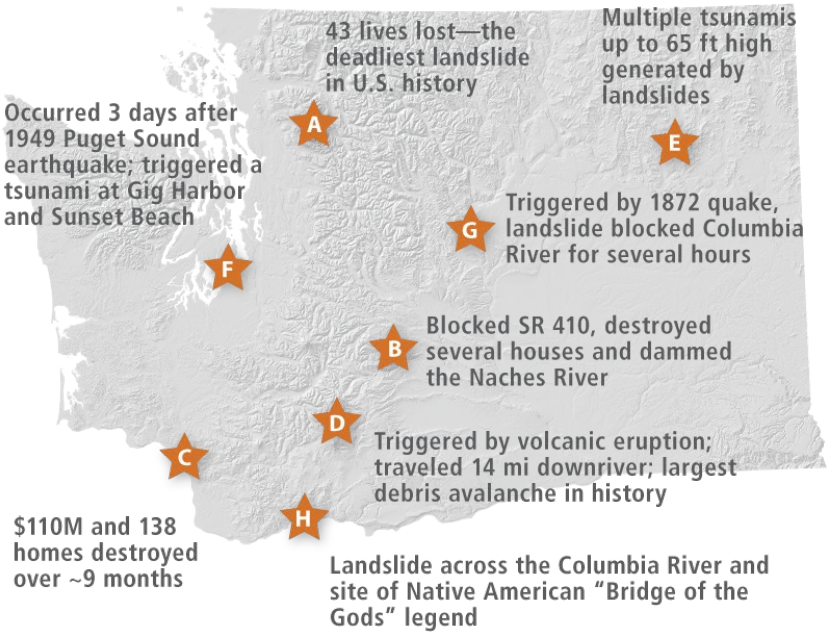
January 31, 2024

Mr. Chairman, members of the subcommittee, my name is Casey Hanell, State Geologist and Director of the Washington Geological Survey (WGS). Thank you for the opportunity to provide testimony on behalf of WGS and the Washington Department of Natural Resources (DNR) on the critical importance of the reauthorization of the National Landslide Preparedness Act, H.R. 7003.

Washington is one of the most landslide-prone states in the nation and has hundreds of thousands of known and unknown landslides. Several of these landslides have been among the most devastating and deadly in U.S. history, such as the 2014 SR530 landslide, also known as the Oso landslide, that resulted in 43 fatalities; the 1998 Aldercrest-Banyon landslide that destroyed 137 homes; and the 2009 Nile landslide that blocked the Naches River, wrecked 14 homes, and left a critical cross-state highway impassable (Figure 1). Our steep terrain and extreme winter precipitation events can produce thousands of rapidly moving landslides in a period of a few hours, affecting entire regions of the state simultaneously. Additionally, the geologic conditions in many parts of our state are also prone to chronic slow-moving landslides that tear apart homes, roads, and other infrastructure.

March 22, 2024, will mark 10 years since the Oso landslide, the deadliest landslide in US history. This slide tragically resulted in the deaths of 43 people and upended an entire community.

Because of that, we significantly ramped up our efforts to understand landslide hazards and associated risks. In the 10 years since the Oso Landslide, WGS started both a Landslide Hazards Program and a Lidar Program.



Slide or area name	Date
A: SR-530 (Oso)	Mar. 2014
B: Nile	Oct. 2009
C: Aldercrest-Banyon	Feb–Oct. 1998
D: Mount St. Helens	May 1980
E: Lake Roosevelt	1944–1953
F: Tacoma Narrows	Apr. 1949
G: Ribbon Cliffs	Dec. 1972
H: Bonneville	mid-1400s

Figure 1. (above) Several examples of significant historical landslides in Washington, demonstrating both the statewide nature of the hazard and the associated devastating consequences.

The Landslide Hazards Program uses lidar data to map landslides on a county-by-county basis and has completed landslide inventories in Whatcom, Snohomish, King, Pierce, Klickitat, and Skamania Counties (Figure 2). The mapping in these counties covers only 14% of the State, yet an astonishing 34,683 landslides were mapped. These inventories are used by planners, emergency managers, public works departments, and those who live or work where these hazards could impact their daily lives. They also assist local jurisdictions in making educated decisions about their assets, community safety, and growth management using the best-available science.

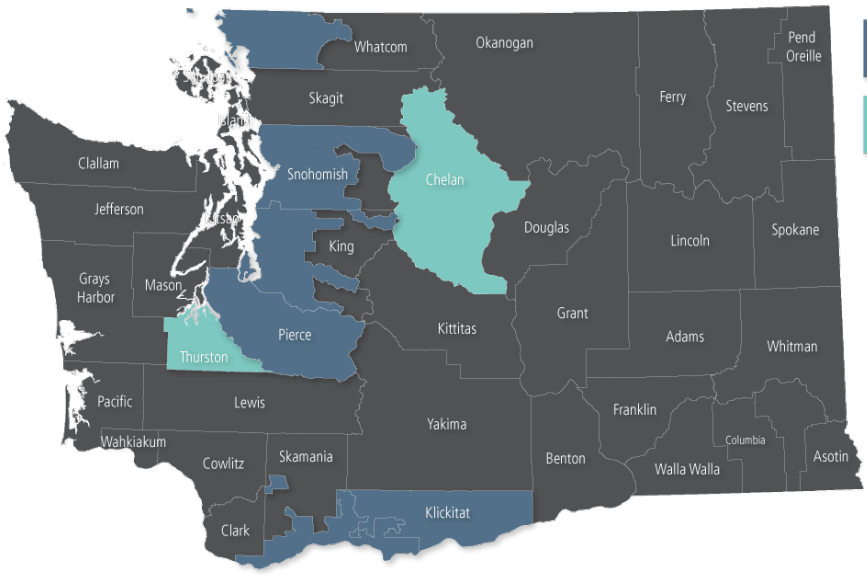


Figure 2. (left) Counties in Washington that have completed or in progress landslide inventories. Inventory work has only been completed for 14% of the state and 34,683 landslides have already been mapped.

In the FY23 federal budget, $1 million was appropriated to initiate the competitive grant program authorized by the National Landslide Preparedness Act. The grant program is currently under development within the United States Geological Survey (USGS). Once established, grant funding from this program will allow state and local funding to be leveraged with matching federal funding to accelerate the identification and understanding of landslide hazards and risks in Washington State and nationwide.

In addition to landslide inventory work, we are placing an increased focus on landslides that happen following wildfires, known as post-fire debris flows. Until recently, little research on post-fire debris flows was done in Washington State. Initial work in other areas of the Pacific Northwest shows that current models used for emergency post-fire debris flow hazard assessment, which were developed with data from outside the region, may be less accurate for Washington's geology and climate. More frequent and intense wildfire seasons in our state, combined with growing populations in the Wildland Urban Interface, put lives and infrastructure at greater risk from post-fire debris flow hazards. Debris flows can travel considerable distances, disrupting roadways and other infrastructure, destroying private property, and causing flooding (Figure 3). Due to their speed and magnitude, post-fire debris flows pose an immediate, critical threat to public safety.

Steep terrain and elevated wildfire risk in the northern portion of the eastern Cascades have historically resulted in a higher frequency of post-fire debris flows and flash floods relative to other parts of Washington. In Chelan County, debris flows and flash floods resulted in 14 fatalities at Squilchuck Creek (1925), 8 fatalities at Tenas Gorge (1942), and 4 fatalities at Preston Creek (1973). In Okanogan County on August 22, 2014, multiple debris flows originating from the Carlton Complex wildfire damaged homes and roads. Mud, boulders, and debris damaged approximately ten homes along State Highway 153.

Figure 3. (above) A cabin that was destroyed in 2022 following a post-fire debris flow from an upslope wildfire burn scar.

Climate change and drought are increasing the fire hazard to the western Cascades as well—in 2022, the Bolt Creek Fire in the western Cascade foothills of King and Snohomish Counties burned 14,820 acres of steep terrain, creating a growing concern for post-fire debris flows near these more densely populated areas. Since 2017, we have recorded 119 debris flow or flash flood events in 13 burn scars (Figure 4). The National Landslide Preparedness Act supports our efforts in mapping these hazards, both before and after the fire has passed, increasing preparedness, mitigation, and recovery.

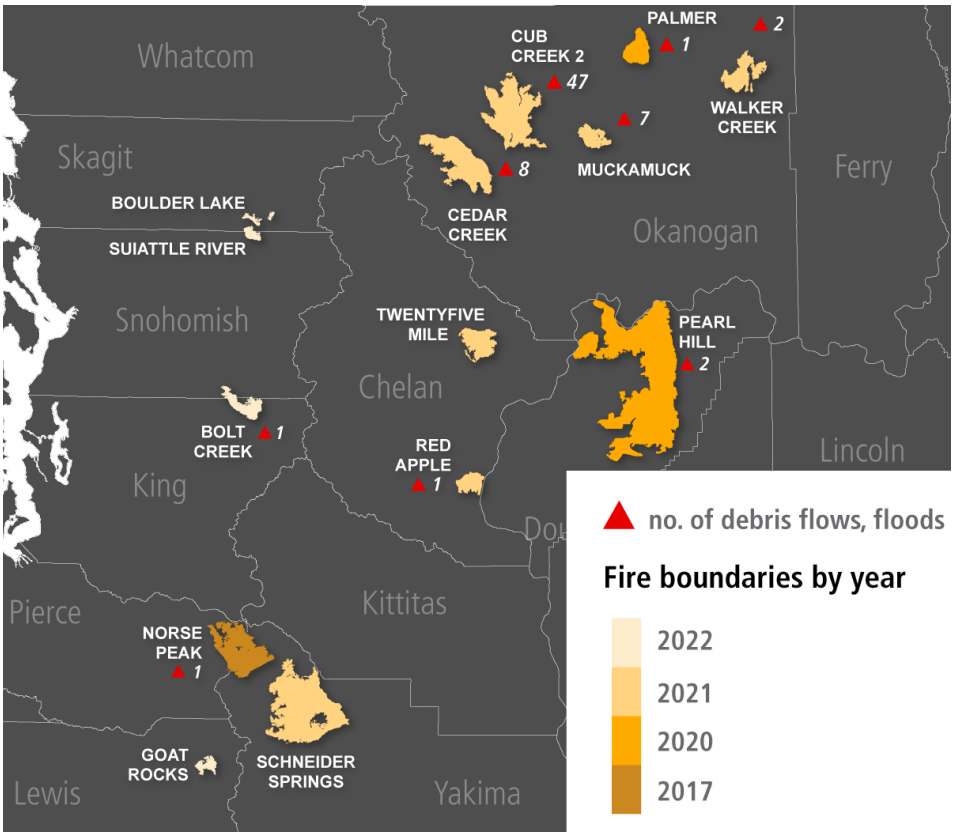


Figure 4. (left) Map showing a selection of major wildfires from 2017 to 2022 and the number of debris flows and flash floods along separate drainages documented within the 2022 field season alone.

Figure 5. (below) A rain gauge being installed in a burn scar to help improve early warning to communities downstream.

To improve regional hazard assessments and early warning efforts in the years following a fire, my agency is actively monitoring burned areas to correlate rainfall rates to the timing of debris flows and flash floods. By collecting data from on-the-ground observations, rain gauges, telemetered weather stations, and motion-activated cameras, we are building an inventory of geologic hazard events and associated weather conditions (Figures 5 and 6).

Figure 6. (above) In early summer of 2023, a game camera installed by WGS captured a debris flow within the Cedar Creek burned area. The image on the left shows the stream on the alluvial fan weeks before the debris flow occurred, shown on the right. This debris flow impacted several homes and the common road for a community, which had already dealt with three previous debris flow events in recent years. Because a weather station was also deployed nearby, we can further refine rainfall thresholds and improve timing of emergency alerts to at-risk communities.

Since the establishment of the Washington Geological Survey's Lidar Program in 2015 in response to the Oso Landslide, the Survey has been collecting, compiling, processing, and distributing lidar data, not only to assist in identifying landslides, but for the benefit of the State.

A USGS-sponsored national study (Dewberry, 2022[1]) was recently conducted to understand the costs, benefits, and future needs with respect to lidar. Data[2] for each state show the potential benefits from access to high-quality elevation data. For Washington State alone, the benefits are at least $9,460,000 annually, or $18,920,000 per biennium (Figure 7). Overall, lidar data and high-quality terrain data could provide $13.5 billion in annual benefits for the nation.

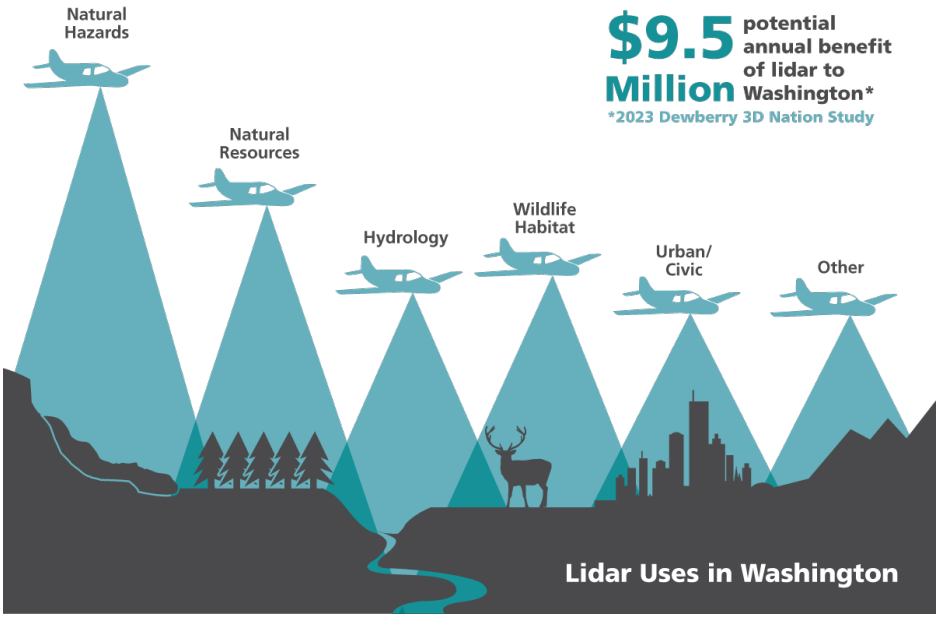


Figure 7. (left) Examples of lidar uses in Washington that are part of the $9.5 million potential annual benefits of statewide lidar coverage.

WGS has relied heavily on USGS 3DEP funding to support this work. Between 2016 and 2024, Washington State has collaborated with 3DEP on seven large-area lidar collections to support the goal of statewide lidar acquisition and refresh. This partnership has resulted in 32,632 square miles of lidar coverage for the state (Figure 8). 3DEP has also separately participated in at least four federal partner collections in Washinton, adding an additional 22,351 square miles of lidar coverage. Dollar for dollar, 3DEP has almost matched the State's investment toward this critical goal—since 2016, 3DEP has contributed at least $5.2 million to Washington State's lidar in addition to the State's $7.1 million investment, which means that Washington truly appreciates and needs this program's partnership and support.

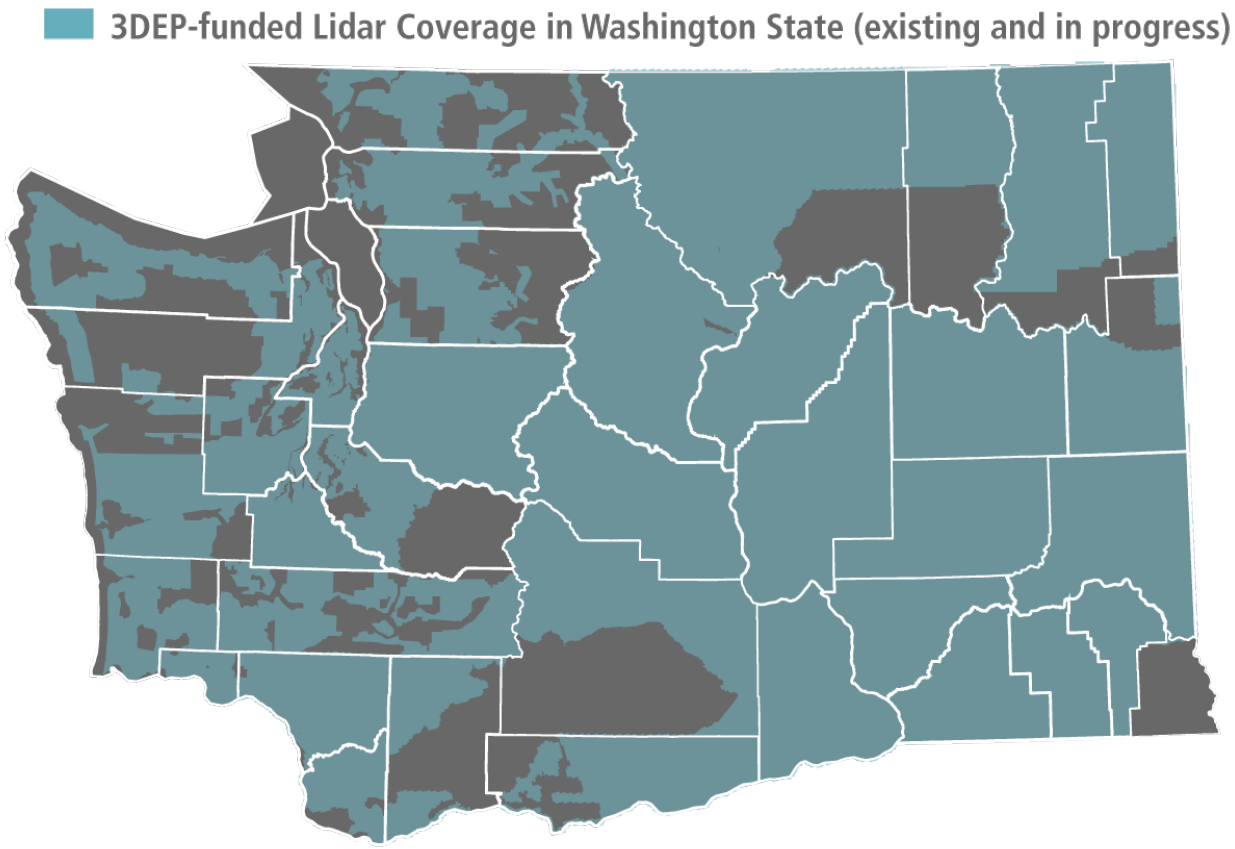


Figure 8. (above) Map showing lidar coverage acquired in partnership with 3DEP for the state.

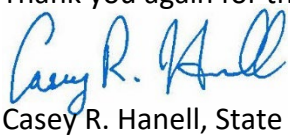
WGS is continuously receiving requests for more frequent lidar collection, as most natural resource, habitat, forestry, or conservation decisions in Washington use lidar as critical input to workflows and analyses. WGS is keenly aware of lidar needs and applications by local and state partners across the state who actively help WGS to determine future collections, priorities, and standards[3]. From these relationships, we know that the ideal statewide refresh rate for lidar is between five and ten years to see the ways our land is constantly changing. So, while Washington State has nearly achieved statewide lidar coverage, a greater, longer-term effort is imperative to ensure that collection is repeated on a predictable and useful timeline for the many uses across the state.

In addition to landslides, lidar is integral to WGS's work to assess other geologic hazards such as tsunami inundation and active faults which have the potential to generate earthquakes. It's also relied upon heavily to produce geological maps, conduct geothermal assessments, map critical minerals, and to regulate surface mines. Local jurisdictions require high-quality lidar data and refresh for urban growth planning and change detection. Local utilities use this data for grid hardening projects and planning. Conservation districts use this data to assist agriculture and irrigation districts in efficient land and resource management. State land managers use this data to determine forest health, assess timber harvest slope stability, and to site critical infrastructure. And numerous partners use this data to plan, manage, and determine the effectiveness of habitat restoration projects. The Washington Department of Ecology is also relying on 3DEP lidar data to update hydrology and stream network data through the USGS Elevation Derived Hydrography Program.

Through WGS partnership with 3DEP and participation in the federal/state interagency 3DEP Working Group, Washington has positioned itself to be a strong partner and advocate for achieving state and federal goals. Working with 3DEP expands our collection areas and reduces refresh timelines, taking a planned ten-year refresh cycle and reducing it to six years or fewer. And just as importantly, WGS values the ability to provide input on when, where, and what quality standards are used to help meet the needs of Washington partners.

The National Landslide Preparedness Act is important because landslides in Washington are frequent, posing significant threats to life and infrastructure. Inventories, susceptibility, and hazard maps for the state are far from complete, with 86% of the state yet to be mapped. Nationwide collaboration that includes funding for lidar and landslide research allows us to learn more about these hazards, saving lives and money. If the National Landslide Preparedness Act expires, we worry we will lose momentum on these important efforts.

Thank you again for the opportunity to provide testimony,



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[1] Dewberry, 2022, 3D Nation Elevation Requirements and Benefits Study [accessed July 26, 2023, https://www.dewberry.com/services/geospatial-mapping-and-survey/3d-nation-elevation-requirements-and-benefits-study]

[2] Carlson, T., 2023, The 3D Elevation Program—Supporting Washington's economy: U.S. Geological Survey Fact Sheet 2022–3075, 2 p., accessed July 24, 2023, https://doi.org/10.3133/fs20223075.

[3] Washington Geological Survey, 2023, Washington State Lidar Plan: Washington Geological Survey, 29 p., accessed January 23, 2024, https://www.dnr.wa.gov/publications/ger_wa_lidar_plan_2023.pdf/.