

Geology in the Public Interest

Washington Division of Geology and Earth Resources; 1111 Washington St SE, Rm 148; MS 47007, Olympia, WA 98504-7007
360-902-1450; 360-902-1785 fax; geology@wadnr.gov; http://www.dnr.wa.gov/geology/



WASHINGTON STATE DEPARTMENT OF
Natural Resources

Doug Sutherland - Commissioner of Public Lands

Division of Geology and Earth Resources
Ron Teissere - State Geologist



Washington's complex geology gives rise to many geologic hazards—earthquakes, active volcanoes, landslides, and tsunamis. As Washington's geological survey, the Division of Geology and Earth Resources contributes to the safety and economic well-being of Washington's citizens by informing the public, government, and industry about the consequences of geologic events and the nature of the land around us, including the availability of important resources such as aquifers and sand and gravel. The Division has provided this information at very low cost to the taxpayer, supplementing its budget with more than \$1 million in grants over the last twelve years to help finance this work. Studies have shown that providing geologic information to the public more than pays for itself over time. For example, a benefit/investment analysis done for Oregon's geological survey showed that for every tax dollar spent, they brought in or saved the state about \$235.

The Division of Geology provides:

- Geologic mapping
- Geologic hazards mapping and response
- Inventory and regulation of mineral, oil and gas, and hydrothermal resources
- A complete library collection on the geology of Washington
- Publications on Washington geology

GEOLOGIC MAPPING

Geologic maps show the types and ages of rocks that occur at or near the Earth's surface (http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm). They show the locations of faults and folds, landslides, glacial deposits, and other regional or local features, depending on the scale of the map. Geologic maps are the most fundamental and important tool of earth scientists.

Our job as the state survey is to produce maps that cover whole areas of the state at various scales. We compile mapping done by others and add our own mapping to complete the coverage. We have finished all of

the state's 30- x 60-minute quadrangles (1:100,000 scale). Current mapping focuses on 7.5-minute quadrangles (1:24,000 scale). Our geologic maps are used for a broad range of practical applications.

Resource Mapping. Washington has an \$800 million per year mineral industry that includes sand and gravel, crushed stone, coal, metals, and industrial minerals such as diatomite, clay, silica, and olivine. Industry uses our maps and publications, along with other reports from our library, to help find new resources. The Division has published many mineral and other resource inventories. Recent emphasis has been on locating the sand, gravel, and quarry rock resources needed for highway and infrastructure construction.

GEOLOGIC HAZARDS

Division geologists actively identify, assess, and map geologic hazards (http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm) using modern geotechnical and geophysical methods. Our **hazard maps** are critical for land-use and emergency-management planning, disaster response, and building-code amendment. As our population grows, there is increasing pressure to develop in hazardous areas. Identification of these areas has never been more important.

In response to the Growth Management Act's mandate to use the 'best available science', our geologists educate local governments and townspeople in at-risk communities about geologic hazards to ensure they are taken into account in growth-management and disaster planning.

The Division is also among the first responders to disasters, helping staff the State Emergency Operations Center at Camp Murray and later documenting damage in the field.



Massive landslide on Perkins Lane along Magnolia Bluff in Seattle, one of the areas hardest hit during the winter storms of 1996-97. Photo by Hugh Shipman.



Debris from a parapet failure on the south side of the Washington Federal Savings building in downtown Olympia caused by the Nisqually earthquake of February 2001. Photo by Joe Dragovich.

Landslides. Landslides are a continuing problem along our hillsides, shorelines, and roadways. Just since 1996, landslides have caused hundreds of millions of dollars of damage in Washington. The Division is a leader in landslide hazard identification, mitigation, and emergency response. Our **landslide hazard maps** help prevent loss to property by showing those areas that are unsafe for building.

Earthquakes. Geologic evidence suggests that most of Washington is at risk from large earthquakes. In 1700, a mega-quake occurred on the Cascadia subduction zone just off the coast of Washington. The largest quake since European settlement was in a sparsely populated area east of the Cascades in 1872. Puget Lowland earthquakes in 1946, 1949, and 1965 killed 15 people and caused more than \$350 million in property damage, and the 2001 Nisqually earthquake caused more than \$2 billion in damage.

The Division produces **earthquake hazard maps** for at-risk urban areas and has just finished maps for every county in the state (<http://www.dnr.wa.gov/geology/hazards/hmgp.htm>). These maps show areas where earthquake damage from amplification of earthquake waves or soil liquefaction can be expected. Damage can then be mitigated by either reinforcing structures in these areas or not building there at all. GM-47, our Olympia map was tested by the Nisqually earthquake and successfully predicted the areas of greatest damage. Division geologists hold workshops to show cities and counties how to use these maps.

Volcanoes. In the past 12,000 years, Washington's five active volcanoes have erupted more than 200 times, producing ash, lava, and massive mudflows. The 1980 eruption of Mount St. Helens killed 57 people, blanketed eastern Washington with ash, and caused more than \$1 billion in damage.



Mount St. Helens from the Pumice Plain, about one mile north of the mountain, on April 16, 1983. Photo by Pat Pringle.

Mount Rainier is our most dangerous volcano because of the large population close to the mountain. Previous lahars (mudflows) from Mount Rainier have run down Puget Lowland valleys as far as Renton, Tacoma, and Olympia. The Division has mapped and determined the age of many of these events to present a much clearer picture of their size and frequency.

Lahars from Glacier Peak have flowed through the Skagit Valley all the way to La Conner. Recent mapping in Skagit and Whatcom Counties has identified previously unrecognized, young lahars from Glacier Peak that would obliterate small towns such as Darrington and destroy sections of Interstate 5 should they occur today.

The Division collaborates with the U.S. Geological Survey's Cascades Volcano Observatory to produce volcano hazard maps and develop response plans for each volcano. The Division is the state geological survey and is a key part of the emergency response plan for volcano hazards.

Tsunamis. The coast of Washington is at risk from tsunamis from both local and distant quakes. In 1964, the Washington coast suffered \$600,000 damage from a tsunami caused by the great Alaska earthquake. Our current technology gives us several hours warning for tsunamis produced by distant quakes, but a local earthquake on the Cascadia subduction zone could generate a tsunami that would strike our coast with great force within a few tens of minutes.

The Division has produced eight **tsunami hazard maps** showing projected flooding in at-risk communities (http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm). We are currently working on **tsunami evacuation brochures** for the southern Washington coast.

Coal Mine Subsidence. Abandoned coal mines underlie at least 50,000 acres in King, Kittitas, Lewis, Pierce, Skagit, and Whatcom Counties. Some of these mines are near the surface and pose a risk to buildings or other structures from mine collapse. Our extensive **coal mine map collection** is invaluable in guiding development in these areas (OFR 94-7, <http://www.dnr.wa.gov/geology/pdf/ofr94-7.pdf>).

Abandoned Metal Mines. There are more than 3800 abandoned metal mines in Washington. The mines were worked and abandoned before there was a requirement for reclamation and cleanup. Mine hazards include water quality degradation from high concentrations of heavy metals and physical hazards such as vertical pits, caving shafts, and collapsing underground workings.

We are investigating these sites for the Inventory of Inactive and Abandoned Mine Lands and publishing our findings on each mining district as the work is done. (See Mining and Exploration/Inactive and Abandoned Mine Lands at http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm.)

RESOURCE REGULATION

Surface Mine Reclamation. There are about 1200 active surface mines in Washington, primarily sand and gravel operations (IC 94, <http://www.dnr.wa.gov/geology/pdf/ic94.pdf>). The Division monitors these mines to ensure reclamation and future beneficial use.

The Division has produced a 'best management practices' manual for surface mining to educate miners in the art and science of reclamation (OFR 96-2, <http://www.dnr.wa.gov/geology/pdf/bmp.pdf>). We also hold workshops to train miners on particular aspects of reclamation.

Oil and Gas Regulation. About 600 oil and gas wells have been drilled in Washington (IC 75, <http://www.dnr.wa.gov/geology/pubs/ic75.pdf>), although there has been no large-scale commercial production. The oil and gas regulatory program supervises exploration and drilling and ensures that these activities are done in a manner that protects the environment and conserves resources.

GEOLOGY LIBRARY

Geologic research is expensive and time-consuming. Fortunately, research reports typically retain their value and usefulness for many years.

The Division's Geology Library has the state's largest collection about the geology of Washington, and more than 1000 items



The main adit at the Lockwood Pyrite mine, showing acid mine drainage with dissolved metals. Photo by Mac McKay.

are added each year. A full **library catalog** is online at <http://www.dnr.wa.gov/geology/washbib.htm> and the **geologic map index** is at <http://www.dnr.wa.gov/geology/mapindex.htm>.

The Geology Library is open to the public. It is a reference library only. Items may not be checked out but may be consulted on site.

The library has many unique and exhaustive collections—for example, the periodically updated U.S. Geological Survey topographic maps. Master's and doctor's dissertations and theses are important original sources of geologic information but are usually held only by the originating university. The library has copies of almost all of these works that cover the geology of Washington.

Government and industry on all levels need quick access to geologic and geotechnical information to address growth-management issues and decide where to build roads and other public lifelines. Our users often have very little time to do their studies and certainly cannot afford to do original research. For them, time is money. They rely on existing reports, which they can find most efficiently through us. Their work would be much more difficult and expensive without ready access to our library.

PUBLICATIONS

The Division publishes the results of mapping and other research. We also publish the online newsletter, *DGER News*. All of our in-print publications are in our publications list (<http://www.dnr.wa.gov/geology/pubs/publist.pdf>); out-of-print publications can be found in our online bibliography (<http://www2.wadnr.gov/dbtw-wpd/washbib.htm>). Our current goal is to make as many of our publications as possible available digitally on CD or on our website (<http://www.dnr.wa.gov/geology/>). ■

