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The National Volcano Early Warning and Monitoring System

In 2019, Congress established a National Volcano Early Warning and Monitoring System (NVEWS; P.L. 116-9, §5001; 43 U.S.C. §31k). The law directed the Secretary of the Interior acting through the Director of the U.S. Geological Survey (USGS) to establish NVEWS to monitor volcanoes, warn U.S. citizens of volcanic activity, and protect citizens from "undue and avoidable harm" resulting from volcanic activity. Under consideration for the 119th Congress are oversight of and amendments to NVEWS and reauthorization of appropriations for NVEWS.

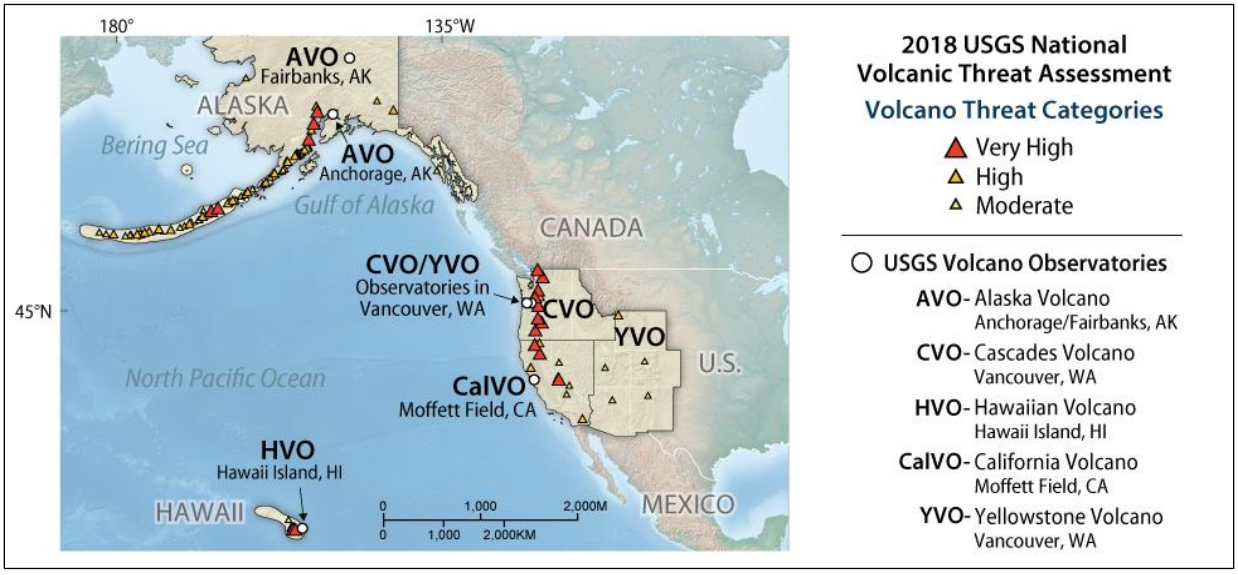
Some Members of Congress are interested in a volcano early warning and monitoring system because the nation faces threats from many active volcanoes. In 2018, the USGS published an updated volcanic threat assessment for 161 volcanoes in 14 states and U.S. territories using 24 factors describing a volcano's hazard potential and the exposure of people and property to these hazards. The assessment assigned five threat levels (very high, high, moderate, low, and very low) and ranked 18 volcanoes as very high and 39 as high (**Figure 1**). Eleven of the 18 very-high-threat volcanoes are in Washington, Oregon, or California; 5 are in Alaska; and 2 are in Hawaii. The high- and moderate-threat volcanoes are mostly in Alaska, and the more explosive Alaskan volcanoes can affect national and international aviation. The volcano ranked as the highest threat is Kīlauea, the Hawaiian volcano whose intense 2018 eruptions were accompanied by destructive lava flows and earthquakes.

A 2005 USGS assessment and framework for NVEWS asserted that many of the very-high- and high-threat volcanoes were not adequately monitored to provide early warnings to reduce risks. Congress directed the USGS to remedy these monitoring gaps and enhance warnings by establishing NVEWS. NVEWS is organized within the USGS Volcano Hazards Program (VHP). VHP studies, monitors, assesses, and warns the public about threatening volcanoes in the United States. VHP established a Volcano Science Center to operate the five volcano observatories (Alaska, California, Cascades, Hawaiian, and Yellowstone; see **Figure 1**) and supports a Volcano Disaster Assistance Program to assist with volcano threats in other countries.

NVEWS Authorization

The 2019 law established NVEWS and specified that the system's objective is to monitor U.S. volcanoes at a level commensurate with their volcanic threats. NVEWS has two purposes: (1) organize, modernize, standardize, and stabilize the monitoring systems of the five U.S. volcano observatories and (2) unify the monitoring systems of these observatories into a single interoperative system.

Figure 1. USGS Volcano Observatories and U.S. Volcanoes Posing Moderate or Higher Threat



Source: CRS, adapted from Peter F. Cervelli et al., USGS, *Five-Year Management Plan for Establishing and Operating NVEWS: The National Volcano Early Warning System*, Open-File Report 2021-1092.

Notes: Two high- and seven moderate-threat volcanoes in the Commonwealth of the Northern Mariana Islands are not shown. AVO monitors volcanoes in the Northern Mariana Islands. HVO monitors volcanoes in American Samoa (not shown). The light-tan shaded areas mark the areal coverage of each observatory and show the locations of threatening volcanoes that these observatories are responsible for monitoring. CVO monitors volcanoes in Washington, Oregon, and Idaho, and YVO monitors volcanoes in Yellowstone National Park, Wyoming, Utah, Colorado, New Mexico, and Arizona.

Section 5001 of P.L. 116-9 established three system components for NVEWS: (1) a 24-hour, 7-day-a-week operational national volcano watch office; (2) a national volcano data center (NVDC); and (3) an external grants program to support volcano research. The law established an advisory committee composed of representatives of relevant agencies and members of the scientific community to assist the USGS in implementing the system. The law directed the USGS to enter into cooperative agreements with academic institutions and state agencies as volcano observatory partners. In addition, the law required a five-year management plan for the system and an annual report describing the activities carried out under authorities provided in the law.

The law directed the USGS to modernize monitoring systems at existing volcano observatories to incorporate emerging technologies, such as digital broadband seismometers, real-time global navigation satellite system (GNSS) receivers, radar interferometry, and spectrometry to measure gas emissions from volcanoes. These technologies are intended to provide accurate and real-time measurements of volcanic activity, enabling better assessments of the timing and location of volcanic eruptions.

In 2022, Congress passed legislation (P.L. 117-263, Title CV: Volcanic Ash and Fumes, §10501) that amended NVEWS to direct cooperation and coordination between the USGS's NVEWS and the National Oceanic and Atmospheric Administration's (NOAA's) Volcanic Ash Advisory Centers (VAACs) to strengthen monitoring and warning of volcano hazards in the atmosphere; atmospheric volcano hazards may pose risks to people, property, and aviation, locally and potentially regionally and globally.

Status of Implementation

The USGS has submitted several reports and plans about the implementation of NVEWS. The USGS submitted a five-year plan for establishing and operating NVEWS to Congress in 2020, annual reports to Congress charting the progress of NVEWS, a 2024 recommended monitoring plan, a 2024 USGS *Volcano Science Center Response Plan for Significant Volcanic Events*, and a VHP five-year plan. Through these reports and plans, the USGS has detailed updates to monitoring systems; the establishment of a National Volcano Information System, which is expected to serve the dual purposes of an NVDC and a 24/7 Volcano Watch Office; and efforts to establish advisory committees and external grants (pursuant to P.L. 116-9, §5001).

The NVEWS five-year plan identified 34 very-high- or high-threat volcanoes from the 2018 volcanic threat assessment that the USGS would focus on upgrading and adding monitoring capabilities for to satisfy in part the objectives of NVEWS. From 2019 to 2024, the USGS continued the development and installation of a next-generation lahar detection system on Mount Rainier (a *lahar* is a mix of water and rock that flows down a volcanic slope and can cause damage), upgraded to digital telemetry for all monitoring of Alaska's volcanoes; improved the monitoring networks at Cascades volcanoes in Oregon and Washington; upgraded the monitoring network on Kīlauea Volcano; and established a cooperative agreement regarding GNSS stations for monitoring California volcanoes.

In addition to some annual appropriations for VHP and NVEWS, Congress provided the USGS with supplemental appropriations to repair volcano monitoring networks damaged in natural disasters. Congress provided supplemental appropriations in FY2019 (P.L. 116-20), including $73.4 million for repairing the volcano monitoring network and establishing and building new Hawaiian Volcano Observatory (HVO) facilities after HVO facilities and monitoring were damaged by the 2018 Kīlauea eruption. Congress also provided $4.3 million (P.L. 116-20) to improve Alaska Volcano Observatory's facilities and monitoring network after the damaging 2018 magnitude 7.1 earthquake near Anchorage, AK.

NOAA completed an implementation plan to collaborate with the USGS to improve volcanic smog forecasts, lahar warnings, quantification of ash hazards, sharing of near-real-time data, volcanogenic tsunami and submarine eruption forecasts, and the efficacy of warning products. NOAA estimates a cost of about $91 million over five years to modernize and add new capabilities to support NVEWS.

Issues for Congress

Congress may be interested in appropriations to support NVEWS and VHP to reduce volcanic risks. P.L. 116-9 authorized appropriations of $55 million for FY2019 through FY2023 for NVEWS. The NVEWS five-year plan provided a cost estimate of $55 million for establishing and operating NVEWS. The USGS did not receive $55 million over FY2019 to FY2023 for NVEWS in annual appropriations but did receive some annual appropriations for NVEWS and some supplemental appropriations to repair damaged volcano observatories and monitoring networks. According to the USGS, without sufficient funds, some or all of the 34 threatening volcanoes may remain under-monitored, and the USGS may not be able to provide sufficient warning of volcanic activity.

The 119th Congress may consider the future of programs and appropriations for the activities that various federal agencies, and in particular the USGS, perform to support the monitoring and warning of volcano hazards affecting the United States. S. 1052, introduced on March 13, 2025, would reauthorize NVEWS, authorizing total appropriations for the USGS of $75 million until FY2033, adding the Chief of the Forest Service as a coordinating agency, extending the period of authorization of sums necessary for NOAA to carry out its NVEWS activities to FY2034 and amending NVEWS by adding "infrasound arrays, visible and infrared cameras, and advanced digital telemetry networks" to the emerging technologies the USGS should apply to modernize NVEWS. Another measure, H.R. 3176 would reauthorize appropriations of $55 million for NVEWS from FY2026 to FY2030. Congress may assess its options for oversight by evaluating the efficiency and effectiveness of NVEWS activities to reduce volcano hazards' impacts on lives, property, aviation, and economic activity.

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