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STATEMENT FOR THE RECORD

**Before the United States House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Research and Technology**

***Earthquake Mitigation: Reauthorizing the National
Earthquake Hazards Reduction Program***

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**Huntington Beach Civic Center
2000 Main Street
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Introduction

Chairman Smith, Ranking Member Johnson, and members of the Committee on Science, Space, and Technology. Thank you very much for the opportunity to address the Committee on the National Earthquake Hazards Reduction Program (NEHRP).

With approximately 39 million people, California is the most populous state in the nation. If it were a separate country, it would have the world's fifth largest economy. It has the nation's largest industrial belt, stretching much of the way from Sacramento to San Diego and including global headquarters for computer, movie-television, and digital-entertainment industries. California is also the nation's largest agricultural producer.

California is vulnerable to a catastrophic disaster within the lifetimes of most residents. No community is fully immune. Though wildfires and floods are the most common disasters, earthquakes hold the greatest potential for large-scale destruction. A major disaster would pose significant challenges for restoring people's lives, restarting economic engines, repairing infrastructure, and creating sustainable redevelopment.

The California Governor's Office of Emergency Services is charged with leading the State of California's efforts to prepare, mitigate, respond, and recover from our ever-present earthquake threat. We rely on our federal, state, local, and non-profit partners to execute this mission. The NEHRP is a critical component of this effort.

The NEHRP program comprises of three stages: Research, Development, and Implementation. Through the Federal Emergency Management Agency (FEMA), Cal OES' uses the critical research developed by the National Institute for Standards and Technology (NIST), the National Science Foundation (NSF), and the US Geologic Survey (USGS), to better prepare residents, improve our building codes, and invest in new capabilities such as earthquake early warning to build a resilient California.

This testimony will focus on the earthquake threat to California, Cal OES' efforts to reduce damage that could be caused by earthquakes, and opportunities at the federal level to sustain and improve the NEHRP.

California's Earthquake Threat

Earthquakes are a significant concern for California for several reasons. First, California has a chronic and destructive earthquake history. Since 1950, only 8 percent (12) of federally declared disasters in the state were the result of earthquakes. During this time, however, earthquake disasters have claimed 203 lives and resulted in 18,962 injuries and over \$8 billion in Cal OES-administered disaster costs.

There are over 15,000 identified faults in California. Over 200 of these identified faults are considered very dangerous based on their slip rates in recent geological time (the last 10,000 years). More than 70 percent of the State's 40 million people reside within 30 miles of a known fault where strong ground shaking could occur in the next 30 years.

The San Andreas Fault is not the only significant fault/plate boundary in California. The seismicity north of the Cape Mendocino is controlled by faults associated with the Cascadia Subduction Zone, a large fault system offshore that separates the Juan de Fuca Plate to the west and the North American Plate to the east. This area is the most seismically active portion of the state. The Cascadia Subduction Zone is capable of producing great earthquakes (+8 magnitude) and last ruptured in the year 1700, causing what was likely an earthquake in the Magnitude 9 range. The subduction zone is also capable of generating a large tsunami.

Damage due to ground shaking produces significant amount of all building losses in typical earthquakes. Building damage can be both structural and/or non-structural (contents) and both types of damage can cause injury or loss of life. In addition, buildings are also vulnerable to ground displacements associated with primary fault rupture, liquefaction, differential settlement, and landslides. Inundations from tsunamis, seiches, and dam failures can also be major sources of loss to buildings and infrastructure.

Earthquakes large enough to cause moderate damage to structures—those around Magnitude 5.5—occur three to four times a year in California. For example, the Magnitude 6.5 San Simeon Earthquake of December 22, 2003 caused 2 deaths, 47 injuries, and \$263 million in damage. The Magnitude 6.5 Humboldt County earthquake on January 9, 2010, resulted in zero deaths, 35 injuries, and \$43 million dollars in damage. The Magnitude 7.2 El Mayor Cucapah earthquake (also known as the Sierra El Mayor earthquake) of April 4, 2010 was located in Northern Baja California at the former mouth of the Colorado River. This event shook not only Mexicali and Tijuana but also a large part of Southern California and parts of southwestern Arizona and Nevada. There were two confirmed deaths in Mexicali and 100 persons were injured between Baja California and Imperial County California. The total estimated damage in Southern California from the El Mayor-Cucapah event was \$91 million while the total estimated damage between southern California and Baja California was estimated to be \$1 billion with most of the damage impacting the agriculture industry and irrigation district in Baja California.

Strong earthquakes of Magnitude 6 to 6.9 strike California on an average of once every two to three years. An earthquake of this size, such as the 1994 Northridge Earthquake (Magnitude 6.7) or the 1983 Coalinga Earthquake (Magnitude 6.5), is capable of causing major damage if the epicenter is near a densely populated area. The Northridge Earthquake caused over \$40 billion of disaster losses, 57 deaths, and 11,846 injuries. The 2014 Napa Earthquake (Magnitude 6.0) resulted in over \$300 million in damage, 1 death, and over 200 injuries.

Major earthquakes (Magnitude 7 to 7.9) occur in California about once every ten years. Two recent major earthquakes, the 1992 Landers Earthquake (Magnitude 7.3) and the 1999 Hector Mine Earthquake (Magnitude 7.1) caused extensive surface fault rupture but relatively little damage because they occurred in lightly populated areas of the Mojave Desert. In contrast, earthquakes of smaller magnitude but in densely populated areas, such as the 1989 Loma Prieta Earthquake (Magnitude 6.9), have caused extensive damage over large areas.

Based on the most recent earthquake forecast model for California, the USGS and other scientists estimate a 72- percent probability that at least one earthquake of Magnitude 6.7 or greater, capable

of causing widespread damage, will strike the San Francisco Bay Area before 2044. For the Los Angeles region, the same model forecasts a 60-percent probability that an earthquake of Magnitude 6.7 or greater will occur before 2044.

Cal OES' Efforts to Reduce Risk

Cal OES invests in reducing risks related to earthquakes throughout the emergency management phases. Cal OES' Earthquake and Tsunami program, which through partnerships with the California Geologic Survey, USGS, the University of Southern California's Southern California Earthquake Center (SCEC), and other universities use advances in earthquake knowledge to help prepare the public for the next seismic event. The most leveraged of these efforts is the annual ShakeOut event, of which over 10 million Californians practice earthquake protective measures known as "drop, cover, and hold on." What began as a one-time earthquake drill has now expanded into a worldwide event. The ShakeOut event registers over 52 million participants in over 60 countries and continues to grow every year.

Though Cal OES works hard to prepare, we know that responding to a large earthquake is inevitable. To meet this need, Cal OES has developed three seismic catastrophic plans. These plans include the Cascadia Catastrophic Earthquake and Tsunami Plan, the Bay Area Catastrophic Earthquake Plan, and the Southern California Catastrophic Earthquake Plan. All of these planning efforts rely on input from the scientific community. Specifically, the third California Earthquake Rupture Forecast (UCERF3) helps emergency managers understand the specific threat to each region and allow planners to determine the best way to move equipment and commodities to support disaster survivors.

Scientific studies on earthquake scenarios help create the impetus for local agencies to bolster their preparedness efforts. The Haywired scenario, developed by the USGS' Science Application for Risk Reduction and supported by a coalition of agencies including Cal OES, highlights the impact of a hypothetical Magnitude 7.0 earthquake occurring at 4:18 pm on the Hayward fault in the San Francisco Bay Area. The impact would be severe; estimates include 800 fatalities, 18,000 injured, 22,000 trapped in a stalled elevator, 2,500 trapped in severely damaged buildings requiring search and rescue, and as many as 80,000 single family dwelling fires occurring near the epicenter. The Haywired scenario expands to impacts beyond the initial response, detailing how utilities, critical infrastructure, and technology firms in Silicon Valley could be compromised for extended periods of time.

Earthquakes are not the only seismic event which threatens California. Near and distant shore tsunamis as well as California's seven high-risk volcanos provide a constant reminder that seismic threats are ever present. A large Cascadia Subduction Zone Magnitude 9.0 earthquake could cause untold damage to the northwestern part of California; in addition, the tsunami following within the hour could bring 20 feet of inundation to coastal communities further exacerbating the problem. The tsunami threat does not need to begin with an earthquake in California. In fact, estimates of a Magnitude 9.2 earthquake in the Alaskan Aleutian Islands could cause wave heights of up to 30 feet in some parts of California and cause damage along all of California's coastline. Damage from a volcanic event could have impacts beyond the initial communities, with agriculture and transportation compromised. While many may believe that a volcanic event is unlikely, California volcanologists would disagree. Recent estimates state that the likelihood of a

volcano eruption occurring in the next 30 years is 26%, which is the same as a Magnitude 6.7 or higher earthquake occurring on the San Andreas fault. Cal OES works with its scientific partners to further understand these additional seismic risks and plans for their consequences.

Earthquake Early Warning

Further, advances in scientific understanding of earthquakes and technological developments have resulted in the capacity to rapidly analyze earthquakes and provide products that are vital to emergency management and public safety. One such advancement is the capability to provide early warning of an earthquake a few to several seconds prior to the actual arrival of destructive ground motions from a large and damaging seismic event.

The seconds or minutes of advance warning can provide people with an opportunity to take actions like "Drop, Cover, and Hold On" to protect life and property from destructive shaking. An earthquake early warning system can give enough time to slow and stop trains and taxiing planes, to prevent cars from entering bridges and tunnels, to move away from dangerous machines or chemicals in work environments and to take cover under a desk, or to automatically shut down and isolate industrial systems.

Taking such actions before shaking starts can reduce damage and casualties during an earthquake. It can also prevent cascading failures in the aftermath of an event. For example, isolating utilities before shaking starts can reduce the number of fire initiations. This effort aligns with California's goals and objectives to protect lives and property.

The 2016-17 State of California budget passed by the Legislature and signed by the Governor, included \$10 million dollars in funding. The funding supported the installation of 183 new seismic sensors and 4 permanent positions to perform research on necessary technology and other technical aspects which will integrate public and private infrastructure, provide public education, and conduct education and training. Then in September 2016, Senate Bill 438 (Hill, 2016) was signed into law to further advance the development of the early warning system by establishing a governance structure to coordinate and direct activities related to the establishment of a CEEWS. The implementation of the California Earthquake Early Warning Program (CEEWP) establishes Cal OES as the lead for implementing CEEWS and ensuring its continued long-term success.

Cal OES released its earthquake early warning business plan on May 2, 2018, as required by CA Senate Bill 438 (Hill, 2016). The plan outlines five components: 1) detailed costs of the system and program, 2) identification of funding sources, 3) expected roles and responsibilities among sectors and organizations, 4) roll out schedule for public alerting, and 5) risk analysis. The business plan will shape the path forward with our partnering federal and academic institutions to further our shared goals.

NEHRP Essential to Continued Mitigation Efforts

NEHRP continues to be a critical program advancing Cal OES' earthquake preparedness and hazard mitigation objectives. In the past, Cal OES invested funding through the NEHRP program to achieve the following outcomes:

Increase statewide earthquake preparedness: With support from the Southern California

Earthquake Center at the University of Southern California, Cal OES hosts regional preparedness and hazard mitigation workshops, sector specific virtual workshops, and other meetings all leading to the annual ShakeOut event. Last year the event included over 10 million participants in schools, businesses, and other organizations, and inspires individuals and families to prepare for a large, disruptive earthquake.

Increase business resilience: Cal OES supports several QuakeSmart workshops, designed to help meet the specific preparedness needs for business owners.

Support social science research for earthquake early warning: Cal OES works with researchers from California State University Fullerton to conduct literature reviews, and conduct studies to determine the appropriate alert tones, phrases, and images to ensure successful adoption of protective measures.

Recommendations for NEHRP

Cal OES urges Congress to reauthorize the National Earthquake Hazard Reduction Program with an additional emphasis on implementation by state emergency management agencies.

In addition to generally reauthorizing NEHRP, Cal OES encourages FEMA to lower or eliminate the 50% match requirement for the NEHRP Direct State Assistance Program funding to enable State Earthquake Program Managers to successfully accomplish the intent of NEHRP. The State Assistance Program provides grant funds to States for core earthquake activities vital to the success of State programs. Without the funding of State Earthquake Programs, States' capability to protect lives and property could diminish. Due to the high match requirements, many states do not participate in this program.

In addition to renewing or restoring funding, it is important to increase emergency management representation on the NEHRP Advisory Committee on Earthquake Hazard Reduction (ACEHR). The Advisory Committee assesses "trends and developments in the science and engineering of earthquake hazards reduction; the effectiveness of NEHRP in performing its statutory activities; any need to revise NEHRP; and the management, coordination, implementation, and activities of NEHRP." All of these efforts intertwine with emergency management and would benefit from increased participation.

Cal OES also encourages NEHRP to expand the research categories authorized to include "applied research." This form of research is defined as the "aspect of scientific study where knowledge is tested to ensure its applicability to practical problems." In essence, Cal OES and partnering organizations could leverage additional research in this area to study the effectiveness of protective action campaigns, and adjust if necessary.

Conclusion

California is faced with a great risk for a large scale, damaging earthquake that is likely to affect a large percentage of its residents due to populations being located on top of many active faults. NEHRP is an essential component of California's earthquake mitigation strategy and allows the state to have a much broader footprint and touch, including partnerships.

Thank you for the opportunity to testify before you today.