

CALIFORNIA EARTHQUAKE EARLY WARNING  
**ADVISORY BOARD**

JUNE 22, 2017



*Cal* OES

GOVERNOR'S OFFICE  
OF EMERGENCY SERVICES



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## **AGENDA / PUBLIC NOTICE: CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD**



**Cal OES**  
GOVERNOR'S OFFICE  
OF EMERGENCY SERVICES

### **California Earthquake Early Warning Advisory Board** **Public Notice/Agenda**

June 22, 2017  
2:00 PM – PDT

**Meeting Site:**  
California State Capitol, Room 2040  
Sacramento, CA 95814

**Date of Notice: June 12, 2017**

**NOTICE IS HEREBY GIVEN** that the California Earthquake Early Warning Advisory Board will meet at the California State Capitol, Room 2040, as set forth below. The Bagley-Keene Open Meeting Act applies to meetings of the California Earthquake Early Warning Advisory Board, which are open to the public. Public participation, comments and questions are welcome for each agenda item. Agenda items may be taken out of order.

<b>Item</b>	<b>Agenda Topic</b>
I	Welcome – Call to Order – Introductions
II	Brief History of Earthquake Early Warning
III	California Program Update
IV	Vision for the Advisory Board
V	Public Comment
VI	Adjourn



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

*PUBLIC COMMENT:* Public comments will be limited to three minutes per person or organization. If the committee determines that there is not enough time to hear from all those wishing to present comments, the committee will select among those wishing to testify to ensure representation of a range of viewpoints and interests. Those providing public comment may choose to supplement their testimony with written statements that will be made part of the official public meeting record.

*SUGGESTIONS FOR SUBMISSION OF WRITTEN MATERIALS:* It is requested that written materials be submitted to the California Earthquake Early Warning Advisory Board Executive Officer prior to the meeting. If this is not possible, it is requested that at least 30 copies be submitted to the California Earthquake Early Warning Advisory Board Executive Officer. This material will be distributed to the California Earthquake Early Warning Advisory Board members.

*ACCESS TO THE HEARING:* The meeting is accessible to those with access and functional needs. A person who needs an access and functional needs-related accommodation or modification in order to participate in the meeting may make a request by contacting Tina Walker at (916) 845-8428 or sending a written request to the Governor's Office of Emergency Services at 3650 Schriever Avenue, Mather, CA 95655. Providing your request at least five (5) business days before the meeting will help ensure availability of the requested accommodation.

*For further information, please contact:*

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**General Information:**

Tina Walker, Program Manager and Advisory Board Executive Officer,  
California Earthquake Early Warning Program at (916) 845-8970 or via email at  
Tina.Walker@caloes.ca.gov

**Media Information:**

Brad Alexander, Public Information Officer, at (916) 845-8455 or via email at  
Brad.Alexander@caloes.ca.gov

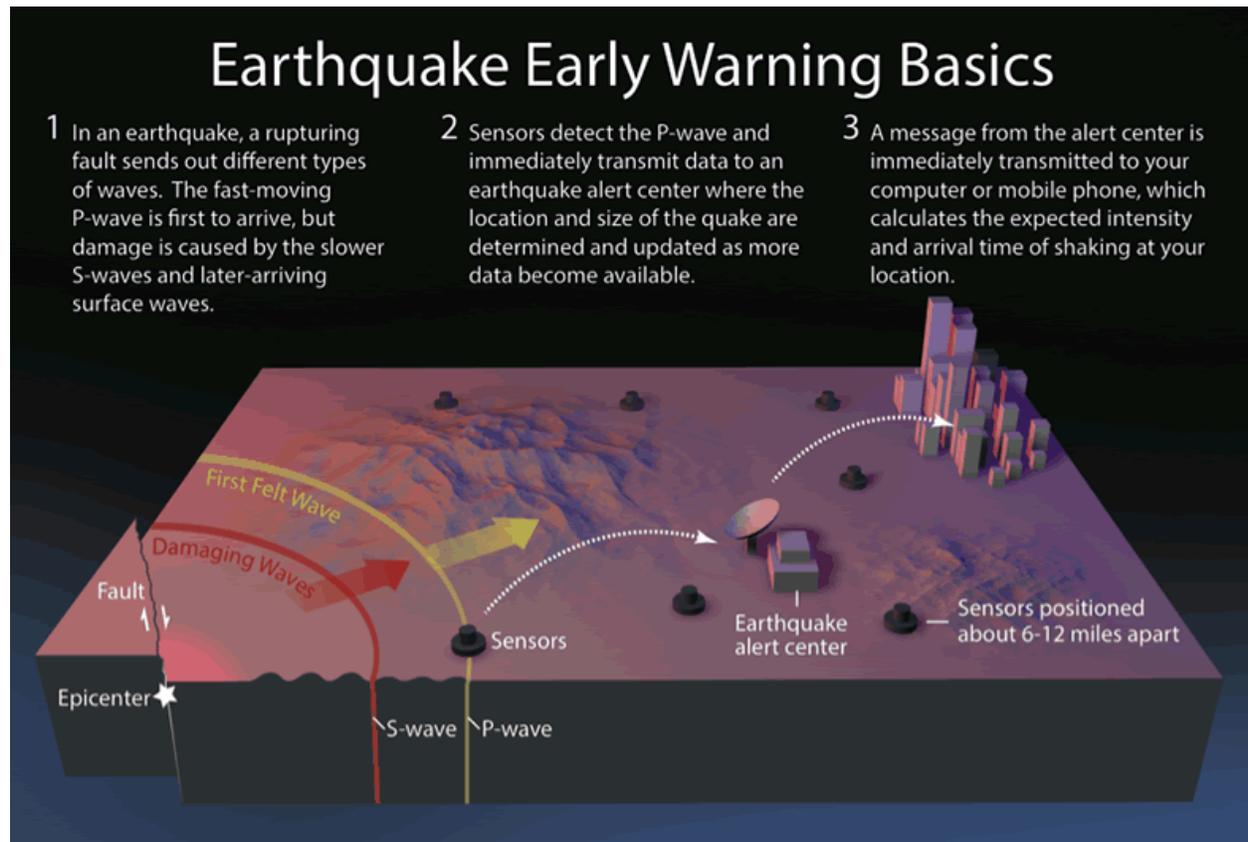


## EARTHQUAKE EARLY WARNING BASICS

### Overview:

Earthquake Early Warning (EEW) systems use science, state-of-the-art monitoring technology, and innovative delivery methods to alert people and devices before the anticipated strongest shaking arrives in affected regions. Seconds to minutes of advance warning can provide opportunity to take life-saving actions like **Drop, Cover, and Hold On**.

When an earthquake occurs, two main forms of seismic waves are produced. The strongest shaking resulting from S waves, that move more slowly, are preceded by weaker, less damaging P waves. Technology now exists that can detect the energy from P-waves to estimate the location and the magnitude of the earthquake and provide warning before the more destructive S-wave arrives. This makes it possible to detect a large earthquake and broadcast a warning to projected areas of impact before the strong shaking that radiates from the epicenter, or earthquake source.



USGS image created by Erin Burkett (USGS) and Jeff Goertzen (Orange County Register).



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## Potential Benefits:

- **Public Warning** – Alert individuals to **Drop, Cover, and Hold On** or safely stop vehicles.
- **First Responder Mobilization** – Open fire station doors for rapid deployment of emergency response equipment and personnel.
- **Medical Services** – Notify surgeons and dentists to stop delicate procedures and maintain critical medical facility operations.
- **Utility Infrastructure** - Safeguard energy sector grid and other utilities infrastructure for strong shaking with warning alarms and automatic controls to prevent combustions, flooding and loss of water distribution systems.
- **Mass Transit Systems** – Prevent fatal collisions by automatically slowing and stopping trains, clearing bridges and diverting inbound airport traffic.
- **Workplace Safety** – Evacuate employees to safe locations, initiate elevator recall procedures to ground floor, place sensitive equipment in safe mode, secure chemicals and hazardous materials and halt production lines to reduce damage.

## Limitations:

The earthquake early warning system in California will be able to provide up to 90 seconds of warning prior to strong shaking. The length of time warning given to any location, before or after shaking begins, depends on a number of factors including:

- **Distance** between the epicenter and the closest seismic sensor station. Generally the first waves to arrive at a station are the less damaging P waves that travel 2.5-4.5 miles per second on average. The more damaging S waves travel at approximately 1-3 miles per second. The closer a station is to the source, the more rapidly the ground motion measurements from an earthquake are identified and the information about the earthquake is sent to the data processing center.
- **Data transmission speed** over the sensor network from the ground sensors to the processing centers for dissemination to end users. Data from multiple stations must be collected and analyzed by the regional seismic networks to issue a warning. Ground motion information must be transferred from each station to the processing center. The existing network utilizes a variety of methods to send data back to the processing center to improve robustness, which includes radio links, phone lines, public/private internet, and satellite links. Delays from packaging and transmitting the data from the station to the processing center and the processing center to the recipient must be reduced to provide useful warning time.
- **Geological conditions** including type of fault, depth of earthquake event and geological features in the surrounding areas. Real-time ground motion information received from the stations is used to detect an earthquake and rapidly determine the location and magnitude of the event. Multiple algorithms (a mathematical procedure used to compute a desired result) are used to estimate the earthquake information as rapidly as possible.



## COMPARISON TO INTERNATIONAL SYSTEMS:

Earthquake Early Warning systems currently exist in Mexico, Japan, Turkey, Romania, China, Italy and Taiwan. The largest systems that are most closely compared to what will be implemented in California exist in Japan and Mexico. Each system is tailor-made for local faults and thus California's system will be unique to our state's features.

### Emergency Warnings

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A key step in the process of earthquake early warning is to provide notice to the public in a broad, expedited manner. This requires new forms of alerts and warnings that have not been used in the past.

#### Basics

Historically, public warning systems in the United States were designed based on available technologies and individual hazards rather than around a standardized warning system. The year 2000 release of the National Science and Technology Council report "Effective Disaster Warnings" was a turning point toward viewing warnings as an integrated, interoperable component of emergency management. This shift prompted the development of the Common Alerting Protocol and the Integrated Public Alert and Warning System Profile, a broadly adopted international technical standard, developed in a private-public partnership called the Organizations for the Advancement of Structured Information Standards (OASIS). Wireless emergency alerts are disseminated, in standard form, to emergency alert system participants that include radio, television, cable, broadcast, satellite, and wireless providers. This shared data format, adaptable to all warning media and all hazards, is now integrated into the majority of individual warning systems.

#### Latency

Latency is defined as the time interval between the input of a signal and its delivery via a given information system. The majority of warnings currently in use exhibit latencies measurable in minutes due to delays in their message processing and transmission mechanics. Since the benefit of EEW is derived from the ability to get information to warning recipients faster than seismic waves propagate, most existing warning dissemination systems are of limited value in that application. Technologies deemed usable for EEW require latencies measured in seconds, not minutes. This prompted the development of new standard for warning systems that could transmit alerts more quickly than wireless emergency alert (WEA).



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## Cell Phone Warnings

The new standard of alerts is required for achieving the most universal public notification of earthquakes in cellphones. Cellphones will provide the most direct form of notification method since many people carry them a majority of the time.

There are three main factors affecting the timeline for implementation of earthquake early warning on handheld cellular devices. The factors include:

- A. Updating the interface between the seismic lab and cellular carriers;
- B. Cellular carriers reprogramming their networks to deliver warnings;
- C. Cellular phone manufacturers updating the hardware in hand held phones to receive a new form of alert that is transmitted much more quickly than the existing WEA structure.

The Alliance for Telecommunications Industrial Standards (ATIS), a national industry standardization body, is currently developing new standards that will provide warnings more quickly than possible with the current wireless emergency alert system. The standards that are currently being developed must be adopted and then incorporated into the design and manufacturing process of new cell phones before they come to market, much less reach a high level of adoption by the general public.

Primary EEW alerts will be very simple, pre-programed displays that alert the user to potential shaking and include protective action recommendations, but there will be no details about the source of the earthquake. More information can be included, with fewer constraints, in the following WEA message.

## Emerging Technologies

The Governor's Office of Emergency Services' (Cal OES) California Earthquake Early Warning Program is pursuing another delivery method utilizing the bandwidth that was created during the transition to digital TV signal. Datacasting has the potential to provide notifications to industrial and institutional facilities and trigger automated or manual mitigation actions like shutting off gas lines or raising firehouse doors. This technology could also eventually be adapted to provide local "over the top" notification to cellphones connected to facility Wi-Fi networks. Pilot projects are in development in conjunction with the American Public Television Stations and local Public Broadcasting Stations.



## **ADVISORY BOARD CONSERIDERATIONS:**

### **Near Term Considerations (2017)**

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- Address site access, permitting and possible regulatory flexibility for sensor installation.
- Define "limited public rollout" parameters and finalize deployment schedule with community and public/industry input.
- Finalize a permanent financing strategy.

### **Medium Term Considerations (2018)**

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- Continue sensor installation.
- Implement limited public roll out along with commensurate public education, outreach and training.
- Develop and/or approve standards for applicability in CA:
  - Alert dissemination standards (speed, reliability, security, accuracy).
  - Alert presentation standards (phrasing, visualization, "branding" elements).
  - Standards for institutional and industrial use of alerts.
  - Technical Performance Standards.
- Establish diverse public notification paths, including wireless, as well as redundant/diverse data paths.
- Establish and implement system security requirements.
- Develop reliability and performance improvement targets.

### **Long Term Considerations (2019 and beyond)**

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- Complete full public rollout.
- Implement long term reliability and performance targets.
- Continue public education and training.
- Evaluate all program components on continual basis and conduct research and development to enhance EEW.
- Manage ongoing network operations, maintenance and upgrades.



## CURRENT PROGRAM STATUS:

### State Spending to Date by Program Functional Areas

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#### **System Operation:** *Total Funding Allocated: \$6,483,000*

- **Sensor Equipment/Installation Proposals**  
California Geologic Survey (CGS) will upgrade 70 seismic stations.  
California Institute of Technology (Caltech) will install 10 new seismic stations.  
United States Geological Survey (USGS) will install 70 seismic stations.  
University of California Berkeley will install 33 new seismic stations.

#### **Education and Training:** *Total Funding Allocated: \$2,260,000*

- **Public Awareness Campaign**  
California Broadcast Association will assist in the development and broadcast television and radio ads highlighting the benefits and informing the public about the benefits of earthquake early warning.
- **Outreach to Science Teachers**  
CGS will assist in warning development and lead workshops targeted towards science teachers to help educate students and families.
- **Research**  
CSU Fullerton will identify gaps in existing research. Sample topics include: threshold for public alert, lower alerts for training purposes, how alert should sound to maximize adoption, etc.

#### **Research and Development:** *Total Funding Allocated: \$420,000*

- **America's Public Television Stations Datacasting Pilot**  
APTS will purchase equipment to attach to KQED, KPBS antenna, install equipment, and purchase end-user equipment to pilot datacasting capability.
- **State Microwave Pilot**  
Cal OES will purchase radio equipment to connect select sensors to state microwave and increase capacity to send signal to Caltech servers in Pasadena, CA. Additional interconnect projects with USGS Menlo Park.

#### **Funding/Business Plan:** *Total Funding Allocated: \$220,000*

- **Business Plan**  
The business plan will include: long term funding plan/estimated costs; expected roles and responsibilities for various program participants (i.e., public safety, private sector, etc.); expected time schedule for completing system with alerts; a risk analysis.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

### **Earthquake Early Warning Seismic Sensor Status**

The vision for the earthquake early warning system in California, that was articulated in the May 2016 *California Earthquake Early Warning System Project Implementation Framework*, set a target of 1,115 seismic sensors statewide to achieve the optimum sensor density spacing for earthquake early warning. The optimum sensor density spacing for network is about 10km (6 miles) in urban areas and 20km (12 miles) in rural areas and, when possible, within 5km (3 miles) of active faults. This target was set to optimize coverage and provide warnings in the most expeditious manner to protect lives and property for residents of the state of California.

There are 549 EEW-capable stations that make up the CEEWS with public warning capabilities primarily limited to the Los Angeles and San Francisco Bay areas. Cal OES is utilizing a portion of the General Funding provided by the 2016-2017 fiscal year budget in contracts with its California Integrated Seismic Network (CISN) partners to install or upgrade at least 183 sensors, allowing them to contribute to the system in real time. The funding will be allocated in a collaborative effort to fill gaps and expand coverage by the United States Geological Survey (USGS), the California Geologic Survey (CGS), the University of California Berkeley and California Institute of Technology (Caltech).



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# Earthquake Early Warning in California



**Tina Curry, Deputy Director**

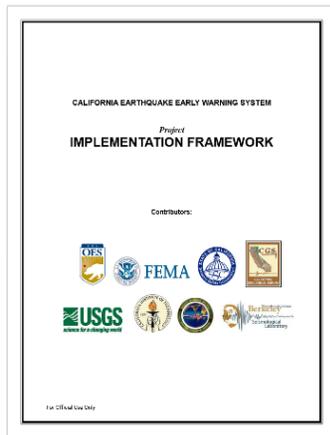
CA Governor's Office of Emergency Services  
CA Earthquake Early Warning Advisory Board  
June 22, 2017

## What's Been Done in CA

- **ShakeAlert Prototype**
- **State Legislation:**
  - ✓ Cal OES as lead (SB 135)
  - ✓ EQ Safety Fund (SB 494)
  - ✓ Governance (SB 438)
- **2016/17 Budget**  
**\$10 million**
- **Implementation Framework**
- **Benefits Study completed**



# CA Implementation Framework



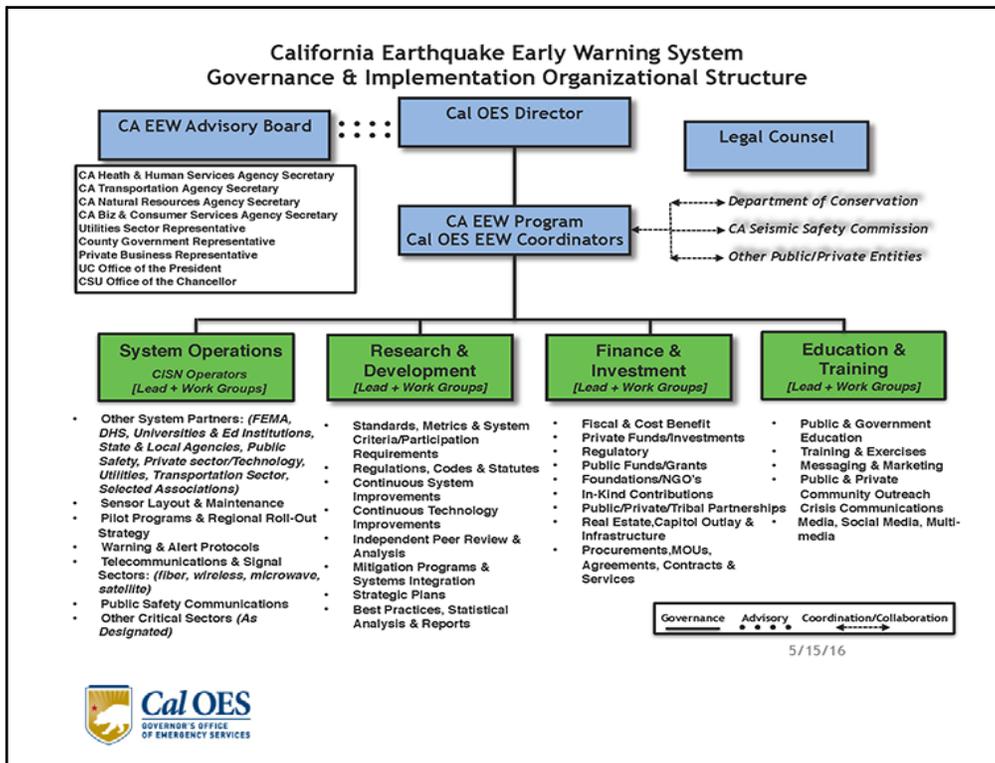
- Unified effort of the CA EQ Early Warning Steering Committee that convened from 2013-16.
- Describes how CEEWS will be rolled out for public use.
- Describes how CEEWS will build upon the California Integrated Seismic Network (CISN) and the ShakeAlert prototype.
- A framework that encompasses a system description, roles and responsibilities of the public and private sectors, and an implementation strategy.
- Foundation for remaining work to fully deploy CEEWS in California.



# Benefits study

- Multiple individuals representing 14 key sectors interviewed.
- Key findings included:
  - Life safety is view as the primary benefit
  - Development of system performance standards are important
  - Viewed as a major public safety infrastructure project with a collaborative planning and implementation model
  - Liability protection is a concern
  - Viewed as a social entitlement where access should be free and open
  - The need for a stable and consistent funding source is a factor in views of overall system reliability





# Earthquake Early Warning 101

**Doug Given, Project Chief**

United States Geological Survey, Earthquake Early Warning

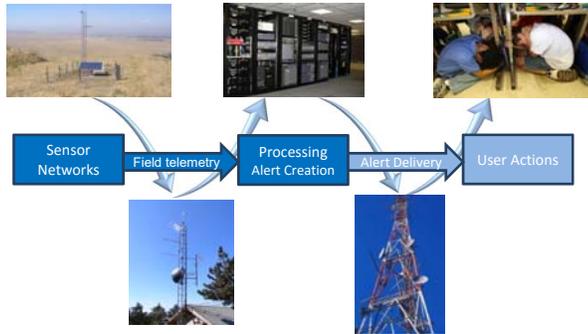
CA Earthquake Early Warning Advisory Board

June 22, 2017



# ShakeAlert

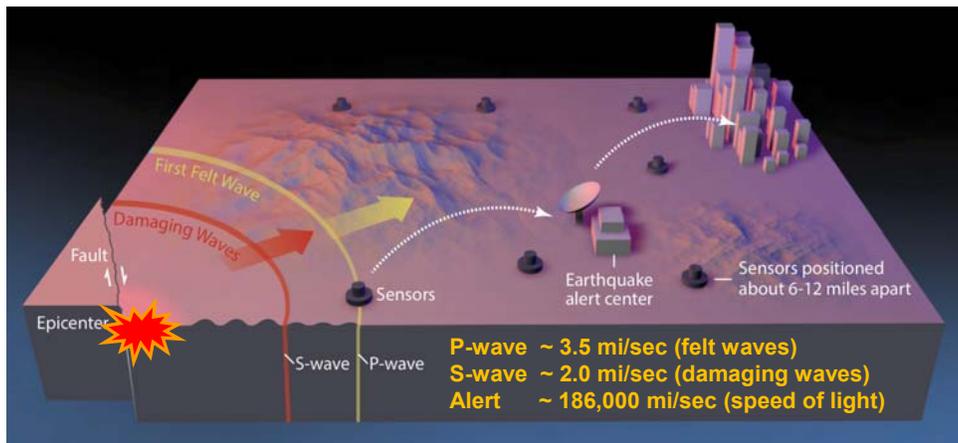
## Earthquake Early Warning System



- Development Path
- 2006-2012 – R & D
  - 2012 – Demo System
- Progress depends on funding levels
- 2016 – CA Production Prototype
  - 2017 – Full West Coast Prototype
  - 2018 – Limited Operations
  - ???? – Full Operation

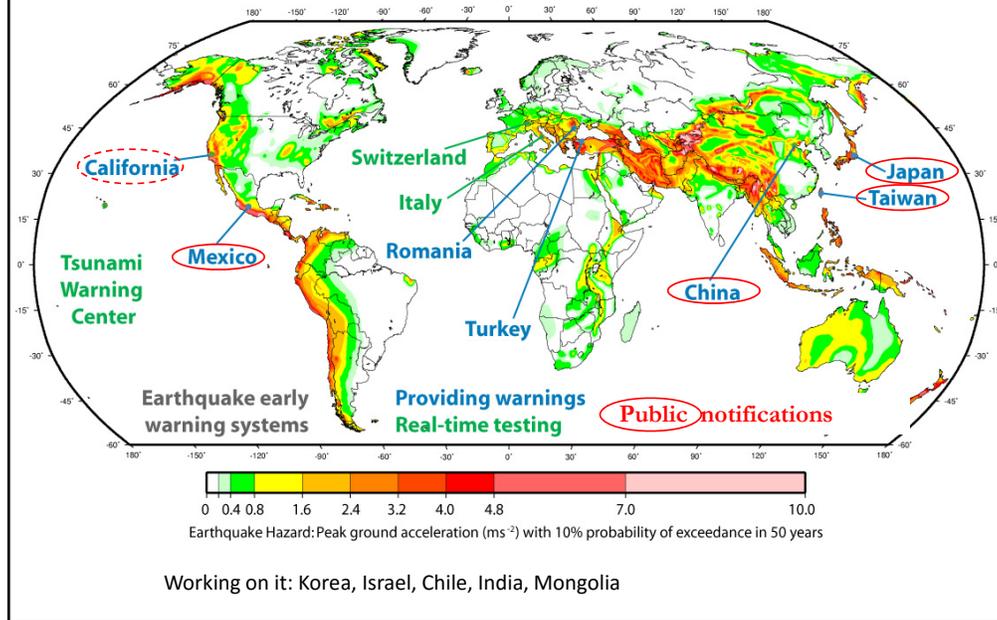


## Earthquake Early Warning (EEW) Concept



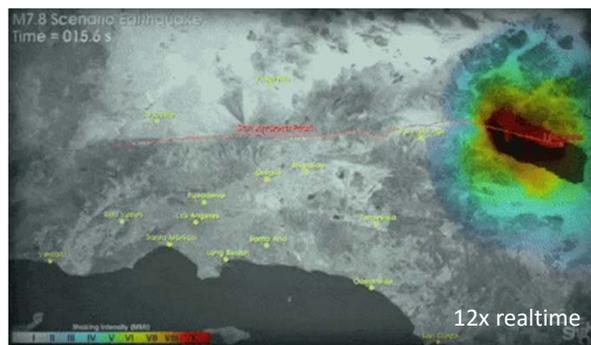
*Sensors closer to the epicenter = more warning time*

# Who in the World is Doing EEW?



# Big Earthquakes Are Not Simple

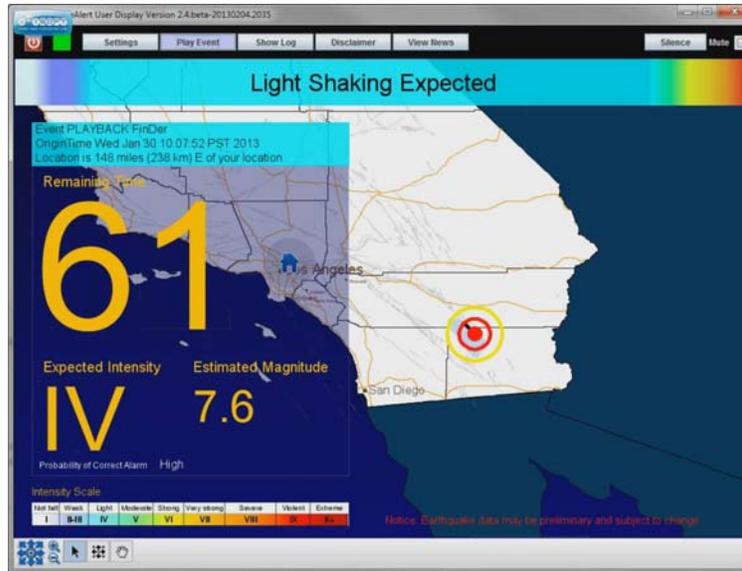
- Big earthquakes are not points
- Fault rupture grows with time
- You can't know how big it will get until it's done
- Affected area is not symmetrical
- Local geology amplifies shaking



Shakeout Scenario, M7.8  
 - Rupture length = 180 miles  
 - Time to rupture = ~1:30 min.

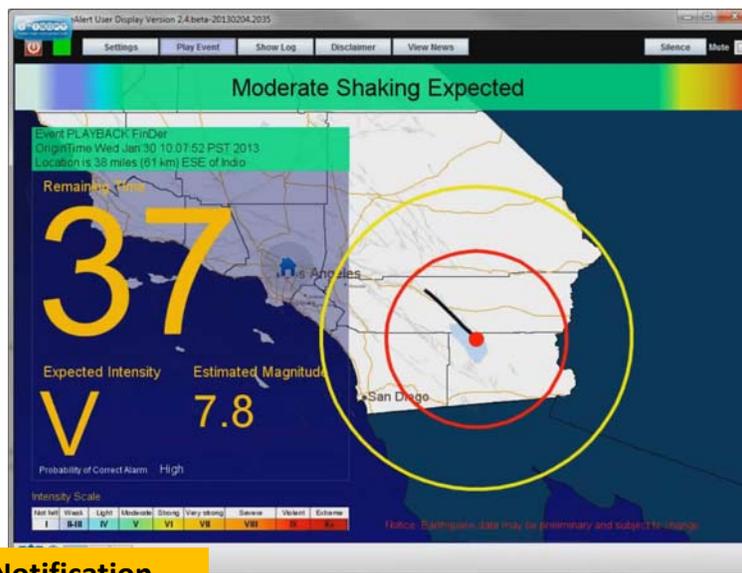
# UserDisplay – ShakeOut M7.8

## Real-time Finite Fault Solution



# UserDisplay – ShakeOut M7.8

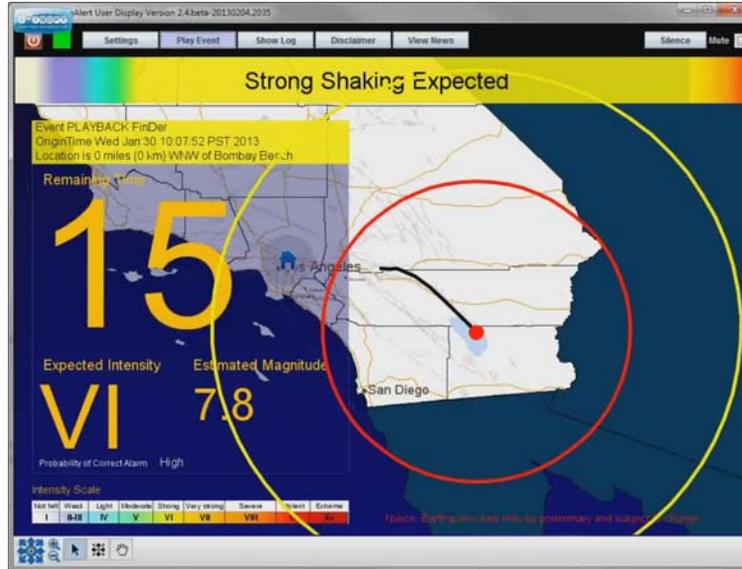
## Real-time Finite Fault Solution



**System/Notification**

# UserDisplay – ShakeOut M7.8

## Real-time Finite Fault Solution



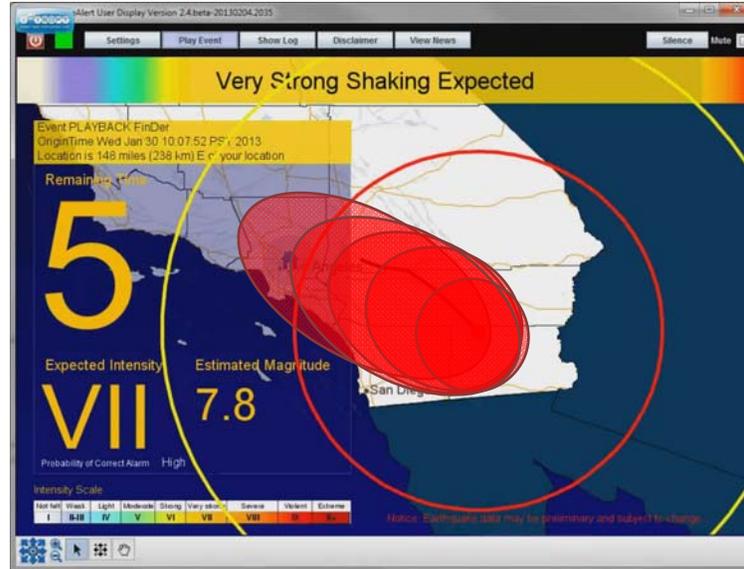
# UserDisplay – ShakeOut M7.8

## Real-time Finite Fault Solution



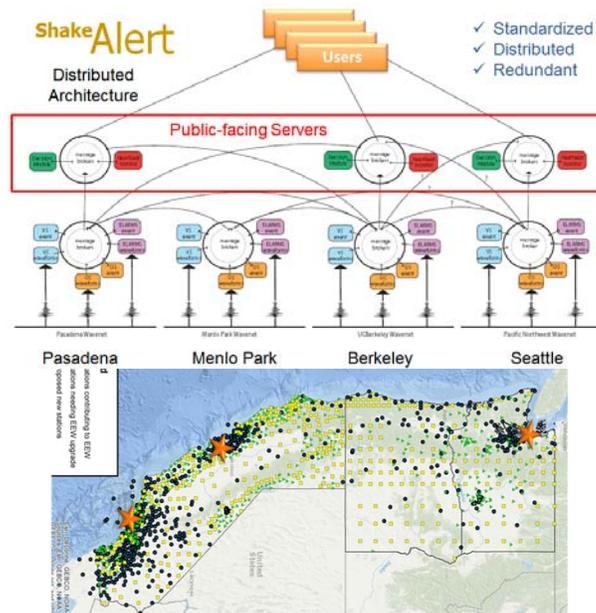
# UserDisplay – ShakeOut M7.8

## Real-time Finite Fault Solution



# Production Prototype V1.2

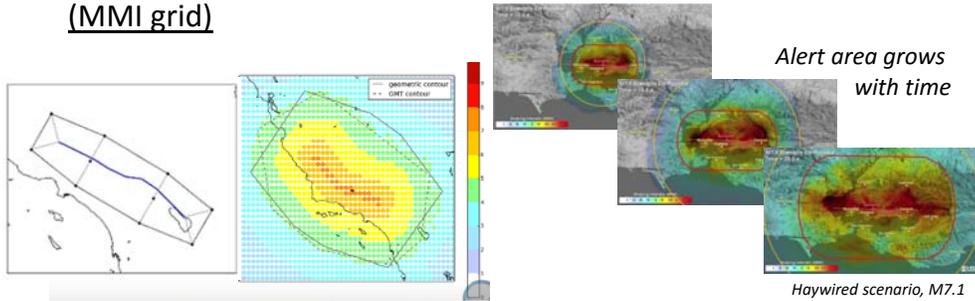
- CA live Feb. 2016
- PNW live Apr. 2017
- Redundant operational and alert centers
- 711 stations now (549 in CA)
- 1,675 planned (1,115 in CA)



# ShakeAlert Data Products

All products are XML messages served via ActiveMQ

- Event – Source Parameters
  - Point Source:  
Latitude/longitude, depth, Magnitude, origin time
  - Finite fault:  
2D line when FinDer is added
- Alert Polygons (CAP format)
  - Multiple alert levels
  - Simple polygons
  - Updates over time
- Others – as needed
- Ground motion intensity maps (MMI grid)



## Mass Notification Technologies

*Alerts “by all available means”*

### Transport Technology

- Internet, Wi-Fi
- IPAWS (FEMA)
  - WEA (cellular broadcast)
  - EAS – TV & Radio
- New cell standards (ETWS)
- Over-the-top apps
- Push notification systems
- Digital Radio - “DataCasting”

### Issues and limitations

- Fragile, congestion
- Voluntary, too slow
  - New FCC rules may enhance capabilities and speed up
- ATIS\* working group, 3-7 years
- High volume = slows delivery
- Need info from Google, Apple
- Testing by Cal OES, need receiver



No current technology was designed for low latency mass notification

\*ATIS: Alliance for Telecommunications Industry Solutions is the cellular industry standards org.

## Constraints on ShakeAlert

- Funding & Staffing
- Earthquake physics
- Sensor coverage
  - Access, permits, NEPA
- Data Telemetry
  - Access, speed, fragility
- Detection & Alerts
  - Speed vs. certainty
  - False, missed, late alerts
- System Testing
  - Lack of historical data sets
  - Measuring performance is complex
- Mass alerting technology
  - IPAWS, ETWS, apps
- Public response
  - Comm, Ed & Outreach (CEO)
- End user implementation
  - Cost/benefit
  - Need enabling technology



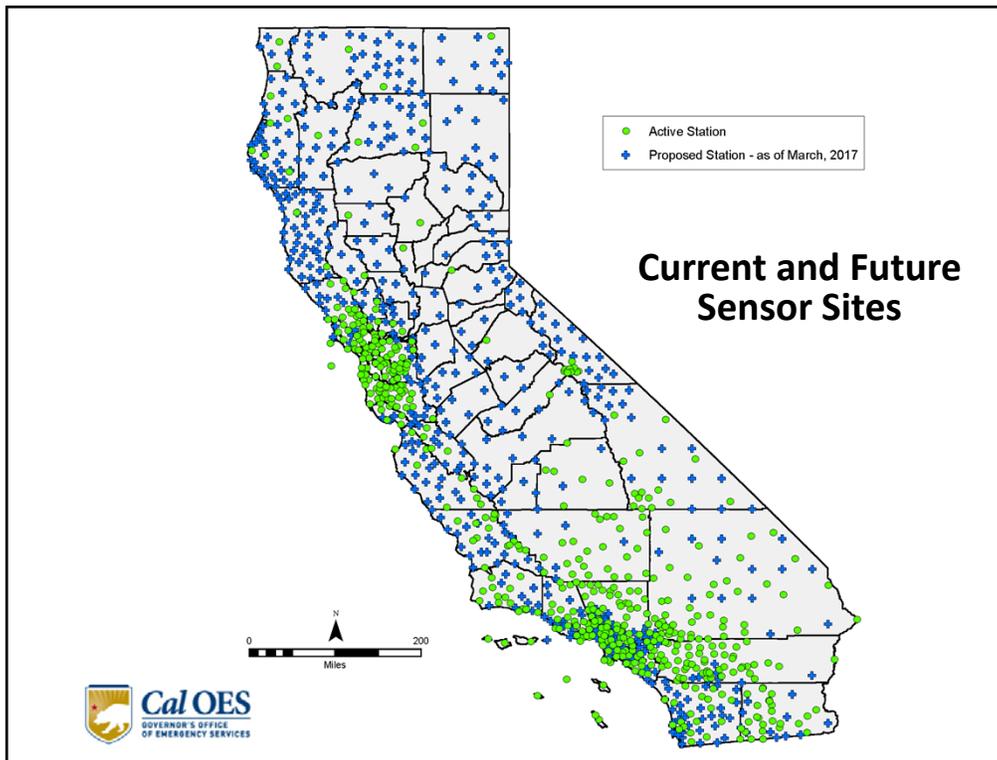
## California Program Update



**Ryan Arba, Earthquake and Tsunami Branch Chief**  
CA Governor's Office of Emergency Services  
CA Earthquake Early Warning Advisory Board  
June 22, 2017

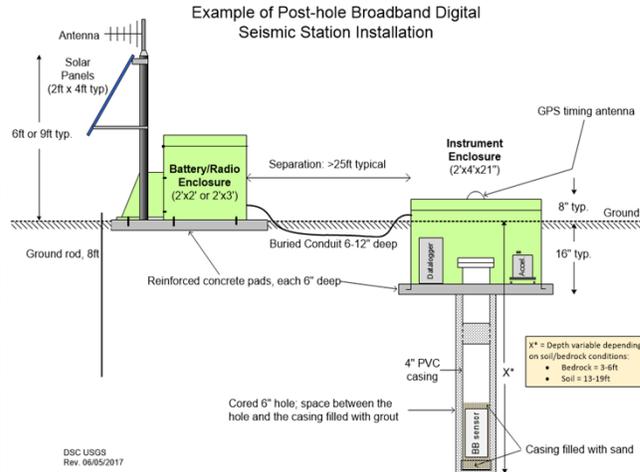
# Program Functional Areas

- System Operations
- Research and Development
- Education and Training
- Finance



# Seismic Sensors

Seismic sensor set-ups may vary based on the landscape, geological features, telemetry capabilities and contracted partner's equipment experience.

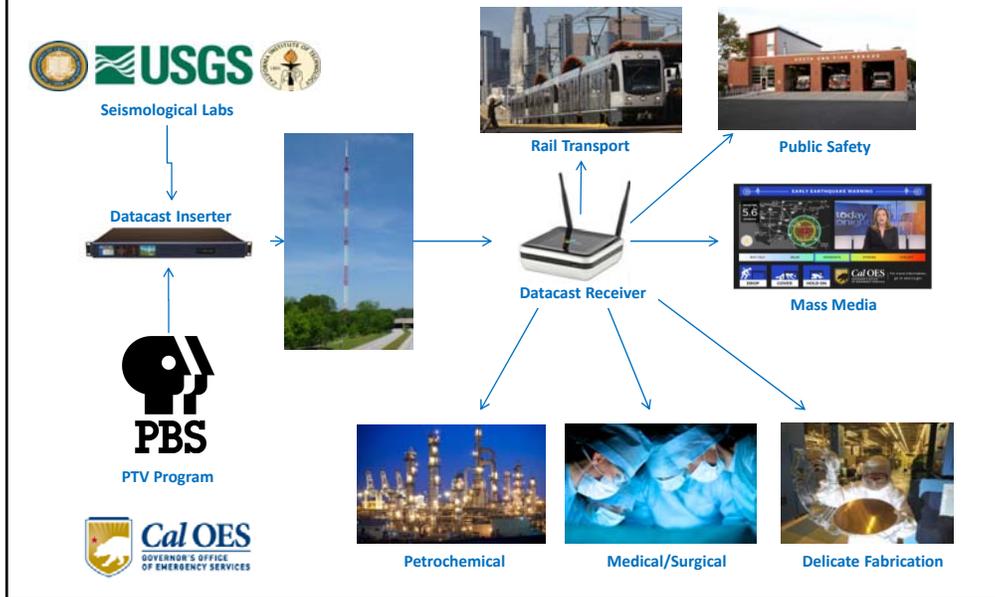


# Warning and Delivery Methods

- Internet and Datacast Methods
  - Industrial and Institutional Users
    - Warn schools and individual workforces
  - Automated Responses
    - Raise fire station doors
    - Shut off utilities
- Cell Phone Alerts
  - Alert the general public

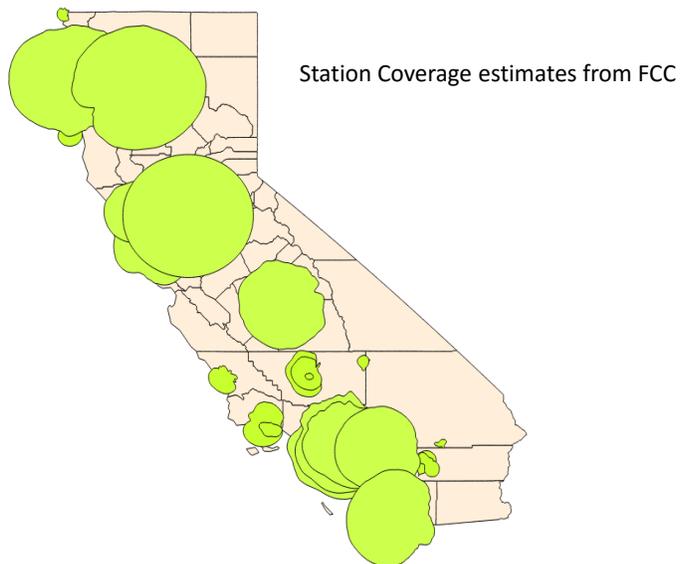


# Datacast Pilot



# CEEWS Datacast

## Estimated Coverage once Fully Implemented



# State Microwave Pilot

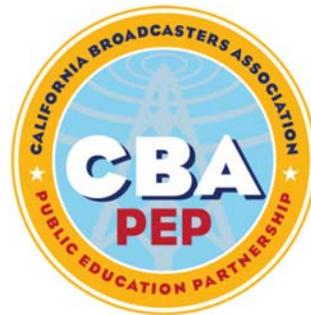


- Connect sensors to seismic lab using the state microwave
- Benefits
  - Increase capability
  - Redundancy
  - Speed
- Locations
  - USGS/Caltech in Pasadena
  - USGS in Menlo Park



# Public Education, Outreach and Training

- Public Service Announcements
  - Television
  - Radio
- Community Engagement
- Public and Industry Input



## Business Plan

- Due to Legislature February 2018
- Components
  - Cost analysis and proposed funding options
  - Program roles
  - Expected program schedule
  - Risk analysis
- Immediate next step: stakeholder interview



## Near Term Considerations

- Sensor build out – site access, permitting and regulatory flexibility
- Deployment schedule – community engagement and public/industry input
- Financing strategy
- Development and/or review early warning technology standards



# Earthquake Early Warning in California

Tina Curry, Deputy Director

Ryan Arba, Earthquake and Tsunami Branch Chief  
Ryan.Arba@caloes.ca.gov

Tina Walker, California Earthquake Early Warning Program Manager  
Tina.Walker@caloes.ca.gov





# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## ANNEX A: ADVISORY BOARD MEMBERSHIP

### A. Voting Members

- a. Secretary John Laird, California Natural Resources Agency
- b. Secretary Diana Dooley, California Health and Human Services Agency
- c. Secretary Brian Kelly, California Transportation Agency
- d. Secretary Alexis Podesta, Business, Consumer Services and Housing Agency
- e. Vice President, Electric Distribution Barry Anderson, Pacific Gas and Electric Company, representing the utility industry
- f. Executive Director Ann Kronenberg, San Francisco Department of Emergency Management, representing county government
- g. Assembly Speaker appointment representing the interests of private businesses (Vacant)

### B. Non-voting members

- a. President of the University of California
- b. Chancellor of the California State University



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## ANNEX B: SB 438 (HILL) OF 2016

### CHAPTER 803

An act to amend Section 8587.8 of, and to add Sections 8587.11 and 8587.12 to, the Government Code, relating to earthquake safety.

[Approved by Governor September 29, 2016. Filed with Secretary of State September 29, 2016.]

### LEGISLATIVE COUNSEL'S DIGEST

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SB 438, Hill. Earthquake safety: statewide earthquake early warning program and system.

(1) The California Emergency Services Act requires the Office of Emergency Services, among other things, to develop in collaboration with specified entities a comprehensive statewide earthquake early warning system in California through a public-private partnership, as specified. The act requires the office to identify funding for the system through single or multiple sources of revenue, and requires those sources to exclude the General Fund and to be limited to federal funds, funds from revenue bonds, local funds, and funds from private sources. Under the act, the requirement that the office develop the system is not operative until funding is identified, and is repealed if funding is not identified by July 1, 2016. The act establishes the California Earthquake Safety Fund in the State Treasury to be used, upon appropriation by the Legislature, for seismic safety and earthquake-related programs, including the statewide earthquake early warning system.

This bill would discontinue the requirement that the funding sources for the system exclude the General Fund and be limited to federal funds, funds from revenue bonds, local funds, and funds from private sources. The bill would delete the provisions providing for the repeal and the contingent operation of the requirement that the office develop the system.

This bill would establish, within the office, the California Earthquake Early Warning Program and the California Earthquake Early Warning Advisory Board to support the development of the statewide earthquake early warning system, as specified. The bill would require the board to include 7 voting members, as specified, and the Chancellor of the California State University, or his or her designee, who would serve as a nonvoting member. The bill would authorize the President of the University of California, or his or her designee, to serve as an additional nonvoting member of the board. The bill would require all members to serve without compensation, but would require reimbursement for actual and reasonable travel and meal expenses to attend board meetings. The bill would require the board to comply with existing state open meeting and public record disclosure laws and would prohibit the disclosure of any information in a public record that is a trade secret, as defined, of a private entity cooperating with the board or participating in the statewide earthquake early warning system or the program. The bill would make legislative findings in support of its provisions.



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

(2) Existing constitutional provisions require that a statute that limits the right of access to the meetings of public bodies or the writings of public officials and agencies be adopted with findings demonstrating the interest protected by the limitation and the need for protecting that interest.

This bill would make legislative findings to that effect.

**Digest Key**

Vote: MAJORITY Appropriation: NO Fiscal Committee: YES Local Program: NO

**Bill Text**

**THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:**

**SECTION 1.**

The Legislature finds and declares all of the following:

- (a) Effective and sustainable implementation of a statewide earthquake early warning system, as funded through the California Earthquake Safety Fund, requires a governance structure that coordinates the multiple entities involved in establishing and operating the different functional areas of the system, including, but not limited to, system operations, research and development, finance and investment, and training and education.
- (b) Each of the functional areas necessary for a statewide earthquake early warning system consists of designated working groups that include subject matter experts and stakeholders in the public and private sectors.
- (c) The California Earthquake Early Warning Advisory Board is intended to advise the Director of Emergency Services on implementation of the earthquake early warning program.

**SEC. 2.**

Section 8587.8 of the Government Code is amended to read:

**8587.8.**

(a) The Office of Emergency Services, in collaboration with the California Institute of Technology (Caltech), the California Geological Survey, the University of California, the United States Geological Survey, the Alfred E. Alquist Seismic Safety Commission, and other stakeholders, shall develop a comprehensive statewide earthquake early warning system in California through a public-private partnership, which shall include, but not be limited to, the following features:

- (1) Installation of field sensors.
- (2) Improvement of field telemetry.
- (3) Construction and testing of central processing and notification centers.
- (4) Establishment of warning notification distribution paths to the public.
- (5) Integration of earthquake early warning education with general earthquake preparedness efforts.

(b) In consultation with stakeholders, the Office of Emergency Services shall develop an approval mechanism to review compliance with earthquake early warning standards as they are developed. The development of the approval mechanism shall include input from a broad



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

representation of earthquake early warning stakeholders. The approval mechanism shall accomplish all of the following:

- (1) Ensure the standards are appropriate.
- (2) Determine the degree to which the standards apply to providers and components of the system.
- (3) Determine methods to ensure compliance with the standards.
- (4) Determine requirements for participation in the system.
- (c) The Office of Emergency Services shall identify funding for the system described in subdivision (a) through single or multiple sources of revenue.

### **SEC. 3.**

Section 8587.11 is added to the Government Code, to read:

#### *8587.11.*

- (a) There is in state government, within the office, both of the following:
  - (1) The California Earthquake Early Warning Program.
  - (2) The California Earthquake Early Warning Advisory Board.
- (b) The following definitions apply to this section and Section 8587.12:
  - (1) "Board" means the California Earthquake Early Warning Advisory Board.
  - (2) "Program" means the California Earthquake Early Warning Program.
  - (3) "System" means the statewide earthquake early warning system.
- (c) (1) The board shall be composed of the following eight members:
  - (A) Seven voting members, as follows:
    - (i) The Secretary of the Natural Resources Agency, or his or her designee.
    - (ii) The Secretary of California Health and Human Services, or his or her designee.
    - (iii) The Secretary of Transportation, or his or her designee.
    - (iv) The Secretary of Business, Consumer Services, and Housing, or his or her designee.
    - (v) One member who is appointed by, and serves at the pleasure of, the Speaker of the Assembly and represents the interests of private businesses.
    - (vi) One member who is appointed by, and serves at the pleasure of, the Governor and represents the utilities industry.
    - (vii) One member who is appointed by, and serves at the pleasure of, the Senate Committee on Rules and represents county government.
  - (B) The Chancellor of the California State University, or his or her designee, shall serve as a nonvoting member of the board.
- (2) The President of the University of California, or his or her designee, may serve as a nonvoting member of the board.
- (3) The members of the board shall serve without compensation, but shall be reimbursed for actual and reasonable travel and meal expenses to attend board meetings.
- (d) (1) The board shall convene periodically and advise the director on all aspects of the program, including, but not limited to, the following functional areas of the program:
  - (A) System operations.
  - (B) Research and development.
  - (C) Finance and investment.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

(D) Training and education.

(2) The board shall utilize committees, groups, and organizations, including, but not limited to, the California Institute of Technology, the California Geological Survey, the University of California, the United States Geological Survey, and entities participating in the critical infrastructure sectors to fulfill the objectives of the program by supporting the functional areas of the system.

(3) The board shall inform the public regarding, and provide the public with the opportunity to engage the board on, the development and implementation of the system.

(4) The board shall consult with program participants, state agencies, departments, boards and commissions, private businesses, postsecondary educational institutions, and subject matter experts, as necessary, to advise the board on the development, implementation, and maintenance of the system.

(e) (1) Except as otherwise provided by law, the California Integrated Seismic Network shall be responsible for the generation of an earthquake early warning alert and related system operations.

(2) The board shall, in conjunction with the director, determine the appropriate methods to provide the public with an earthquake early warning alert.

(f) (1) The board shall comply with the Bagley-Keene Open Meeting Act (Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3) and the California Public Records Act (Chapter 3.5 (commencing with Section 6250) of Division 7 of Title 1).

(2) Notwithstanding any law, including, but not limited to, the California Public Records Act (Chapter 3.5 (commencing with Section 6250) of Division 7 of Title 1), any information in a public record that is a trade secret, as that term is defined in Section 3426.1 of the Civil Code, of a private entity cooperating with the board or participating in the system or with the program is confidential and shall not be disclosed.

### **SEC. 4.**

Section 8587.12 is added to the Government Code, to read:

#### ***8587.12.***

(a) On or before February 1, 2018, the office, in consultation with the board, shall develop and submit a business plan for the program to the Senate Committee on Governmental Organization, the Assembly Committee on Governmental Organization, the Senate Committee on Budget and Fiscal Review, the Assembly Committee on Budget, and the Legislative Analyst's Office. The business plan shall include, but not be limited to, all of the following elements:

(1) The funding plan for the program and the estimated costs associated with the program. The funding plan shall include, but not be limited to, all of the following:

(A) Specific cost estimates for each component of the program, including, but not limited to, education and outreach costs, staff costs, and the capital costs, operation costs, and maintenance costs of the system.

(B) Identification of specific sources of funding, including, but not limited to, federal funds, funds from revenue bonds, local funds, general funds, special funds, funds from private sources, and funding from any written agreements with public or private entities to fund components of the program.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

- (2) The expected roles and responsibilities of various program participants, including, but not limited to, private sector partners and local emergency personnel.
  - (3) The expected time schedule for completing the system and when it can start to provide alerts.
  - (4) A discussion of all reasonably foreseeable risks the program may encounter, including, but not limited to, risks associated with the program's finances, the reliability of the system, access to land for sensor placement, and changes in technology. The plan shall describe the office's strategies, processes, or other actions it intends to utilize to manage those risks.
- (b) On or before February 1, 2019, and annually thereafter, the office shall report to the Legislature any changes to the business plan from the prior year and shall provide a general report on progress of the program and the implementation of the system. The report shall include, but not be limited to, all of the following:
- (1) The overall progress of the implementation of the system.
  - (2) An update on funding acquired and expended.
  - (3) An update on contracts and requests for proposals.
  - (4) A summary of recommendations made by the board to the office.

### **SEC. 5.**

The Legislature finds and declares that Section 3 of this act, which adds Section 8587.11 to the Government Code, imposes a limitation on the public's right of access to the meetings of public bodies or the writings of public officials and agencies within the meaning of Section 3 of Article I of the California Constitution. Pursuant to that constitutional provision, the Legislature makes the following findings to demonstrate the interest protected by this limitation and the need for protecting that interest:

The development and implementation of the California Earthquake Early Warning System will help mitigate the loss of lives and property due to an earthquake. The need to protect the proprietary rights of owners of trade secrets relating to systems or products that may be incorporated into the California Earthquake Early Warning System and used within the California Earthquake Early Warning Program and the need to encourage the participation of those owners in the development and implementation of that system and program outweigh publicly disclosing those trade secrets.



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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## ANNEX C: SB 494 (HILL) OF 2015

### CHAPTER 799

An act to amend Section 8587.8 of, and to add Section 8587.9 to, the Government Code, relating to emergency services.

[Approved by Governor October 11, 2015. Filed with Secretary of State October 11, 2015.]

### LEGISLATIVE COUNSEL'S DIGEST

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SB 494, Hill. Emergency services: seismic safety and earthquake-related programs. Existing law creates, within the office of the Governor, the Office of Emergency Services which, under the Director of Emergency Services, coordinates disaster response, emergency planning, emergency preparedness, disaster recovery, disaster mitigation, and homeland security activities. Existing law requires, subject to the identification of funding by January 1, 2016, various entities, including the Office of Emergency Services, through a public-private partnership, to develop a comprehensive statewide earthquake early warning system in California that includes certain features, including the installation of field sensors. Existing law repeals this early warning system requirement on January 1, 2016, if the funding is not identified. It also requires the office to file with the Secretary of State a determination that funding was not identified by January 1, 2016.

This bill would instead require the identification of funding for the earthquake early warning system to occur by July 1, 2016, and would make conforming changes.

This bill would create the California Earthquake Safety Fund and would require moneys in the fund, upon appropriation by the Legislature, be used for seismic safety and earthquake-related programs, including the earthquake early warning system described above. The bill would authorize the fund to accept federal funds, funds from revenue bonds, local funds, and funds from private sources for purposes of carrying out its provisions, and would make conforming changes.

#### Digest Key

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Vote: MAJORITY Appropriation: NO Fiscal Committee: YES Local Program: NO

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#### Bill Text

**THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:**

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#### SECTION 1.

Section 8587.8 of the Government Code is amended to read:  
8587.8.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

(a) The Office of Emergency Services, in collaboration with the California Institute of Technology (Caltech), the California Geological Survey, the University of California, the United States Geological Survey, the Alfred E. Alquist Seismic Safety Commission, and other stakeholders, shall develop a comprehensive statewide earthquake early warning system in California through a public-private partnership, which shall include, but not be limited to, the following features:

- (1) Installation of field sensors.
- (2) Improvement of field telemetry.
- (3) Construction and testing of central processing and notification centers.
- (4) Establishment of warning notification distribution paths to the public.
- (5) Integration of earthquake early warning education with general earthquake preparedness efforts.

(b) In consultation with stakeholders, the Office of Emergency Services shall develop an approval mechanism to review compliance with earthquake early warning standards as they are developed. The development of the approval mechanism shall include input from a broad representation of earthquake early warning stakeholders. The approval mechanism shall accomplish all of the following:

- (1) Ensure the standards are appropriate.
- (2) Determine the degree to which the standards apply to providers and components of the system.
- (3) Determine methods to ensure compliance with the standards.
- (4) Determine requirements for participation in the system.

(c) The Office of Emergency Services shall identify funding for the system described in subdivision (a) through single or multiple sources of revenue that shall be limited to federal funds, funds from revenue bonds, local funds, and funds from private sources. The Office of Emergency Services shall not identify the General Fund as a funding source for the purpose of establishing the system described in subdivision (a), beyond the components or programs that are currently funded.

(d) Subdivisions (a) and (b) shall not become operative until the Office of Emergency Services identifies funding pursuant to subdivision (c).

(e) (1) If funding is not identified pursuant to subdivision (c) by July 1, 2016, this section is repealed unless a later enacted statute, that is enacted before January 1, 2017, deletes or extends that date.

(2) The Office of Emergency Services shall file with the Secretary of State its determination that funding was not identified pursuant to subdivision (c) by July 1, 2016.

### **SEC. 2.**

Section 8587.9 is added to the Government Code, to read:

#### **8587.9.**

(a) The Legislature finds and declares that there is a critical need for a consistent and coordinated approach to seismic safety and earthquake-related programs in the State of California through the Governor's Office of Emergency Services. These programs may include, but are not limited to, earthquake response, recovery, warning, mitigation, planning, research,



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

preparedness, training and exercises, hazard grants, public information, and education. This approach includes the coordination of state agencies and departments that have responsibilities to monitor and respond to, and to recover from, earthquakes and to assist the citizens and businesses in California. In order to facilitate the requirements of Section 8587.8, the Legislature establishes the California Earthquake Safety Fund within the State Treasury.

(b) (1) The California Earthquake Safety Fund is hereby created in the State Treasury. Upon appropriation by the Legislature, the moneys in the fund shall be used for seismic safety and earthquake-related programs, including the statewide earthquake early warning system described in Section 8587.8.

(2) Pursuant to subdivision (c) of Section 8587.8, the California Earthquake Safety Fund may accept federal funds, funds from revenue bonds, local funds, and funds from private sources for purposes of carrying out the provisions of this section.



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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**ANNEX D: SB 135 (PADILLA) OF 2013**

CHAPTER 342

An act to add and repeal Section 8587.8 of the Government Code, relating to earthquake safety.  
[Approved by Governor September 24, 2013. Filed with Secretary of State September 24, 2013.]

**LEGISLATIVE COUNSEL'S DIGEST**

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SB 135, Padilla. Earthquake early warning system.

There is in state government, pursuant to the Governor’s Reorganization Plan No. 2, operative July 1, 2013, the Office of Emergency Services. Existing law requires the office to develop and distribute an educational pamphlet for use by kindergarten, any of grades 1 to 12, inclusive, and community college personnel to identify and mitigate the risks posed by nonstructural earthquake hazards.

This bill would require the office, in collaboration with various entities, including the United States Geological Survey, to develop a comprehensive statewide earthquake early warning system in California through a public-private partnership and would require the system to include certain features, including the installation of field sensors. The bill would require the office to develop an approval mechanism, as provided, to review compliance with earthquake early warning standards as they are developed. The bill would require the office to identify funding sources for the system. The bill would prohibit the office from identifying the General Fund as a funding source to establish the system, beyond those components or programs that are currently funded. The bill would make these provisions contingent upon the office identifying funding sources for the system, as provided. If no funding sources are identified by January 1, 2016, the bill would repeal these provisions.

**Digest Key**

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Vote: MAJORITY Appropriation: NO Fiscal Committee: YES Local Program: NO

**Bill Text**

**THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:**

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**SECTION 1.**

(a) The Legislature finds and declares all of the following:

(1) According to the United States Geological Survey, California is one of the most seismically active states, second only to Alaska.

(2) California has experienced dozens of disastrous earthquakes, which have caused loss of life, injury, and economic loss. Some of the most significant earthquakes in California’s history include:

(A) The 1906 San Francisco earthquake, which, at a magnitude of 7.8, resulted in an estimated 3,000 deaths and over \$500 million in property losses.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

- (B) The 1971 San Fernando earthquake, which, at a magnitude of 6.7, resulted in at least 65 deaths and caused property damage of over \$500 million.
- (C) The 1989 Loma Prieta earthquake, which, at a magnitude of 6.9, caused 63 fatalities and over \$6 billion in property damage.
- (D) The 1994 Northridge earthquake, which, at a magnitude of 6.7, claimed the lives of 60 people and caused estimated property damage of between \$13 and \$32 billion.
- (3) About 90 percent of the world's earthquakes and over 80 percent of the world's largest earthquakes occur along the Circum-Pacific Belt, also known as the Pacific Ring of Fire. The Pacific Ring of Fire includes the very active San Andreas Fault Zone in California.
- (4) The Uniform California Earthquake Rupture Forecast (UCERF) released in 2008 predicted a 99.7 percent likelihood of a magnitude 6.7 or larger earthquake in California in the next 30 years.
- (5) A 2013 study published by the California Institute of Technology (Caltech) and the Japan Agency for Marine-Earth Science and Technology discovered that a statewide California earthquake involving both the Los Angeles and San Francisco metropolitan areas may be possible.
- (6) Japan, Taiwan, Mexico, Turkey, Romania, Italy, and China either have or are working on earthquake early warning systems that are capable of saving lives and helping to mitigate loss.
- (7) The Office of Emergency Services, Caltech, California Geological Survey, University of California, United States Geological Survey, and others have been conducting earthquake early warning research and development in California. They operate the California Integrated Seismic Network, which has a demonstration earthquake early warning capability.
- (8) By building upon the California Integrated Seismic Network and processing data from an array of sensors throughout the state, a fully developed earthquake early warning system would effectively detect some strength and progression of earthquakes and alert the public within seconds, sometimes up to 60 seconds, before potentially damaging ground shaking is felt.
- (9) An earthquake early warning system should disseminate earthquake information in support of public safety, emergency response, and loss mitigation.
- (b) It is the intent of the Legislature that the establishment of an earthquake early warning system pursuant to this act shall not result in any undue burden upon the General Fund and that, to the maximum extent possible, the Office of Emergency Services shall seek other sources for funding the implementation of Section 8587.8 of the Government Code.

### **SEC. 2.**

Section 8587.8 is added to the Government Code, to read:

#### **8587.8.**

(a) The Office of Emergency Services, in collaboration with the California Institute of Technology (Caltech), the California Geological Survey, the University of California, the United States Geological Survey, the Alfred E. Alquist Seismic Safety Commission, and other stakeholders, shall develop a comprehensive statewide earthquake early warning system in California through a public-private partnership, which shall include, but not be limited to, the following features:

- (1) Installation of field sensors.



## CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

- (2) Improvement of field telemetry.
- (3) Construction and testing of central processing and notification centers.
- (4) Establishment of warning notification distribution paths to the public.
- (5) Integration of earthquake early warning education with general earthquake preparedness efforts.
  - (b) In consultation with stakeholders, the Office of Emergency Services shall develop an approval mechanism to review compliance with earthquake early warning standards as they are developed. The development of the approval mechanism shall include input from a broad representation of earthquake early warning stakeholders. The approval mechanism shall accomplish all of the following:
    - (1) Ensure the standards are appropriate.
    - (2) Determine the degree to which the standards apply to providers and components of the system.
    - (3) Determine methods to ensure compliance with the standards.
    - (4) Determine requirements for participation in the system.
  - (c) The Office of Emergency Services shall identify funding for the system described in subdivision (a) through single or multiple sources of revenue that shall be limited to federal funds, funds from revenue bonds, local funds, and private grants. The Office of Emergency Services shall not identify the General Fund as a funding source for the purpose of establishing the system described in subdivision (a), beyond the components or programs that are currently funded.
  - (d) Subdivisions (a) and (b) shall not become operative until the Office of Emergency Services identifies funding pursuant to subdivision (c).
  - (e)
    - (1) If funding is not identified pursuant to subdivision (c) by January 1, 2016, this section is repealed unless a later enacted statute, that is enacted before January 1, 2016, deletes or extends that date.
    - (2) The Office of Emergency Services shall file with the Secretary of State its determination that funding was not identified pursuant to subdivision (c) by January 1, 2016.



# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

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# CALIFORNIA EARTHQUAKE EARLY WARNING ADVISORY BOARD

## **ANNEX E: PROGRAM RESOURCES**

### **California Earthquake Early Warning System – Project Implementation Framework**

[http://www.seismic.ca.gov/meeting\\_info/071216MeetingInfo/CEEWS%20Implementation%20Framework%20May%202016.pdf](http://www.seismic.ca.gov/meeting_info/071216MeetingInfo/CEEWS%20Implementation%20Framework%20May%202016.pdf)

### **California Earthquake Early Warning Benefit Study**

[http://peer.berkeley.edu/publications/peer\\_reports/reports\\_2016/CaOES-CSSC1604-PEER201606-CAEEWS-Benefits-Study\\_FINAL\\_8.31.16.pdf](http://peer.berkeley.edu/publications/peer_reports/reports_2016/CaOES-CSSC1604-PEER201606-CAEEWS-Benefits-Study_FINAL_8.31.16.pdf)

### **USGS Technical Implementation Plan for the Shake Alert Production System – An Earthquake Early Warning System for the West Coast of the United States**

<https://pubs.usgs.gov/of/2014/1097/pdf/ofr2014-1097.pdf>

### **ATIS-0700020: ATIS Feasibility Study for Earthquake Early Warning**

<http://www.atis.org/newsroom/EarthquakeFeasibilityStudy.pdf>