



We develop seismic policies and share information to promote programs intended to reduce earthquake related losses.



A non-profit earthquake consortium for the western states

**Fall 2015
e-Newsletter
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**Western States
Seismic Policy Council**

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NATIONAL
EARTHQUAKE
CONFERENCE



Awards Nominations Open

Nominations Open for National Awards in Excellence



The award nomination period for the National Awards in Excellence that will be given at the 2016 National Earthquake Conference in Long Beach, California May 4-6, 2016 has opened. Every 4th year nominations for the WSSPC Awards in Excellence are solicited nationally and decided with additional input from WSSPC partners CUSEC, NESEC, and CREW. The awards recognize organizations and agencies in acknowledgment of their achievements as demonstrated through exemplary programs, projects, and products that address earthquake risk reduction within the United States. Award categories are: Mitigation, Response and Recovery, Plans/ Materials, Research, Multi-Jurisdictional Planning, and Outreach

Programs. The highest ranking award is selected for the Overall Award. The deadline for submitting nominations is January 4, 2016. Nomination forms and directions are available at: www.wsspc.org/awards/national-awards-in-excellence/.

WSSPC Opens Nominations for Lifetime and Leadership Awards

The nomination period is now open for the WSSPC Lifetime and WSSPC Leadership Awards. The WSSPC Lifetime Achievement Award is given to recognize outstanding leaders in earthquake risk reduction who are still practicing their profession. The recipient will have demonstrated throughout his or her career an extraordinary commitment, level of service, and contribution to the application of earthquake risk reduction to public policy.

The WSSPC Leadership Award is given to individuals within the WSSPC membership who have demonstrated sustained leadership benefitting the WSSPC community.

Nominations will be considered for awards if received by January 4, 2016. Nomination forms and eligibility are posted on the WSSPC website at: www.wsspc.org/awards/lifetime-leadership-awards/.

We Want To Hear From You!

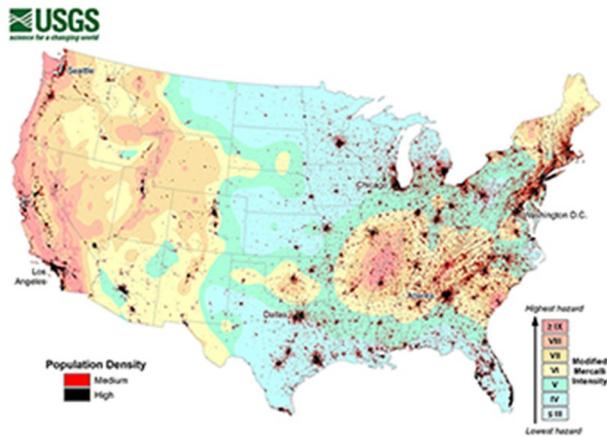
The WSSPC Newsletter comes out quarterly in January, April, July and October. We welcome articles of interest to the WSSPC community. If you have a successful project, new publications or tools you'd like shared in our Newsletter, please submit the information to news@wsspc.org at least 2 weeks before the beginning of the month of publication.



NEWS

USGS Report Shows Greater U.S. Population Exposure to Damaging Earthquakes Than Previous Estimates

A report released in August by the U.S. Geological Survey (USGS) shows that many more people may be at risk from damaging earthquakes than previously estimated. The study looked at changes in both the characterization of the earthquake hazard and the total population (numbers and spatial distribution) since 1996 for the 48 contiguous states. Three different recurrence intervals roughly equivalent to the 100, 500, and 2500 year events were evaluated for each of 4 different years of hazard maps. Five WSSPC member states are amongst the 10 states with the largest populations at risk for the strongest shaking based on the most recent data: California, Washington, Utah, Oregon and Nevada. And 9 of 11 WSSPC states are in the top 16 of states experiencing ground motions equal or greater than 0.4 g.



USGS map showing (1) the locations of major populations and (2) the intensity of potential earthquake ground shaking that has a 2% chance of occurring in 50 years.

Image: www.usgs.gov/blogs/features/usgs_top_story/nearly-half-of-americans-exposed-to-potentially-damaging-earthquakes/

Seismic Hazard:

The USGS National Seismic Hazard Maps (NSHM) have been used since 1976 as input for building-code ground motion maps and are updated on a six-year cycle. Update cycles include inclusion of improved hazard parameters, uncertainty information, and new data gleaned from earthquake events that have occurred since the previous map release. For this report, maps from 1996, 2002, 2008 and 2014 were used. A comparison of the maps showed that although the hazard characterization has changed over the years, with decreases in the central and eastern U.S. in the modeled hazard, the changes did not appear to be significant.

Peak ground acceleration (PGA) information was converted to Modified Mercalli Intensity (MMI) values for simplification for three different ground motion recurrence thresholds for each of the maps: frequent (50% probability of exceedance in 50 years), moderately frequent (10% probability of exceedance in 50 years) and relatively infrequent (2% probability of exceedance in 50 years). These MMI estimates were used as the hazard overlays for the exposure analyses.

Population Exposure:

LandScan population datasets from 1998, 2003, 2009 and 2013, the closest available to the same publication as the hazard maps as could be obtained, were used for analyses. This data revealed an increase in the U.S. population of approximately 17%, from 268 to 314 million, between 1998 and 2013. LandScan data also captured the changes in spatial distribution of the population.

A table showing the population exposed to ground shaking expressed as Peak Ground Acceleration (PGA)

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provided the widely reported finding that more than 143 million people could be exposed to potentially damaging events. Tables are included for population exposure for MMI levels V-IX for each of the 4 NSHM maps and the 3 recurrence intervals mentioned above.

Critical Infrastructure Exposure:

The researchers looked at three types of occupancy; schools (public and private), health care facilities, and fire stations, using the 2012 Homeland Security Infrastructure Program (HSIP) database for analysis. The analysis evaluated only exposure; i.e., structures that lie within a given level of hazard, and did not consider construction type, age, or any other factors that might affect actual building performance.

The report includes a table of the facility type exposure for MMI levels V-IX for each of the 3 recurrence intervals based on the 2014 hazard map. The data shows that more than 3,000 schools, 600 fire stations, and 100 health care facilities have a 50% chance of experiencing ground shaking levels of MMI VII or higher in the next 50 years. Of the schools in these hazardous areas, more than 70% are in California. Despite steadily improving seismic safety upgrades to schools in California first instituted in the 1930s, many of these structures may still be vulnerable to ground shaking.

Results:

The researchers clearly identify a number of generalizations that were made for use of the data nationwide that will influence results in various ways; these include:

- Induced earthquake activity from oil and gas recovery is not included in the hazard compilation.
- A uniform "firm rock" soil type is assumed rather than site specific soil conditions for hazard calculations.
- Building construction varies across the U.S. so vulnerability to levels of shaking by building type likely varies across the country.
- Alaska and Hawaii, as well as U.S. Territories, are not included; all have earthquake risk and would increase the total population numbers upwards for the U.S.

The results suggest that even with the improvements to the characterization of the ground shaking hazards, the overall modeled hazard levels haven't changed significantly - the risk has increased mainly due to increased population. Approximately 143 million people now live or work in areas with the possibility for damaging levels of shaking and more than 97 million (31% of the total population of the 48 states in this study), "are exposed to a shaking hazard level that may be relatively infrequent but has the potential to cause structural damage or casualties."

National level analyses like this study can help prioritize mitigation, preparedness, and other earthquake risk reduction activities and monies in those areas with the highest risk of losses, and serve to remind us that earthquakes are a national issue.

References:

Kishor S. Jaiswal, Mark D. Petersen, Ken Rukstales, and William S. Leith (2015) Earthquake Shaking Hazard Estimates and Exposure Changes in the Conterminous United States. Earthquake Spectra In-Press.
www.usgs.gov/blogs/features/usgs_top_story/nearly-half-of-americans-exposed-to-potentially-damaging-earthquakes/
www.cbsnews.com/news/nearly-half-of-americans-at-risk-of-an-earthquake/
http://earthquake.usgs.gov/learn/topics/merc_alli.php

ATC and USGS Hold Seismic Hazard User-Needs Workshop

The Applied Technology Council (ATC) / U.S. Geological Survey (USGS) Seismic Hazard User-Needs Workshop was held September 21-22 at the USGS campus in Menlo Park, California. WSSPC was a Co-Sponsor of this event which brought together USGS developers of the National Seismic Hazard Map (NSHM) and a diverse subset of the data user community to provide feedback on the latest (2014) model and associated products and tools.

The model is updated on a 6 year cycle which allows for incorporation of new data including: ground motions from recent earthquakes, attenuation relationships, and other improvements in characterization of ground motion that have occurred since the previous published version.

The workshop was divided into four sessions. The first session, Seismic Hazard Products and Their Intended Users, provided the USGS developers with an opportunity to describe the data model, explain changes and updates since the 2008 version, and discuss the additional products and tools derived from the data and available on the USGS website.

Following that, sessions were grouped by general use categories by use of the data at Individual Sites, Distributed Sites, and a session for Additional Uses. In these three sessions, representatives from various public and private data user groups reported on how they used the data, what products and tools were most valuable to them, and other data or products they would find useful.

Proceedings from the event will be made available in the near future.

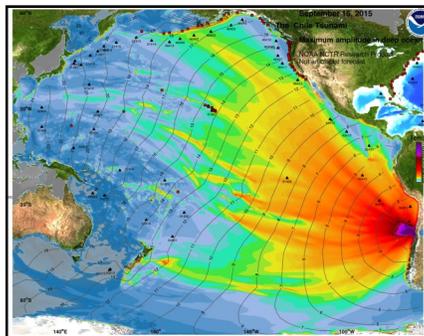
For more information:

www.atcouncil.org/53-projects/278-atc-127

<http://earthquake.usgs.gov/hazards/>

M8.3 Quake Off the Coast of Chile Kills 10 and Generates Tsunami

A M8.3 earthquake centered offshore 142 miles (229 km) NNW of Santiago, Chile killed at least 10 people and generated a tsunami. The September 16th quake occurred at approximately 8 p.m. local time in Chile and generated a maximum wave height of 15.6 feet locally at Coquimbo, Chile. Tsunami advisories were issued by the National Tsunami Warning Center (NTWC) and the Pacific Tsunami Warning Center (PTWC) for the state of Hawaii and parts of southern California. The USGS reports that the quake was on a thrust fault between the Nazca and South America plates.



More than one million people were evacuated from coastal areas in Chile due to the impending tsunami.

An advisory means that the tsunami may produce strong currents that are dangerous to those in or near the water. No major damage was reported in the U.S. from the tsunami.

References:

http://earthquake.usgs.gov/earthquakes/eventpage/us20003k7a#general_summary

www.nbcnews.com/news/world/8-3-magnitude-earthquake-strikes-coast-chile-n428736

<http://ptwc.weather.gov/text.php?>



SAVE THE DATE!

National Earthquake Program Managers Meeting
May 2-3, 2016

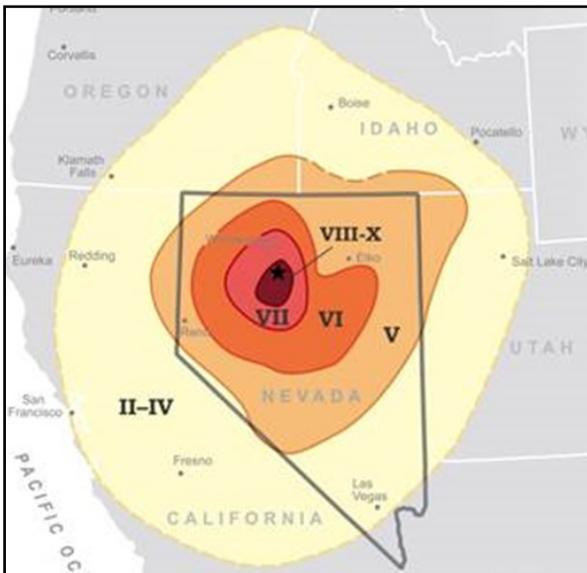
National Earthquake Conference
May 4-6, 2015



Hilton Hotel, Long Beach, California

October 2, 2015 Marks 100 Year Anniversary of Great Nevada Earthquake

The M7.3 Pleasant Valley Earthquake of October 2, 1915, was the largest recorded earthquake in Nevada's history. The quake caused significant damage to buildings in Pleasant Valley and Winnemucca with damage recorded up to 50 miles away from the epicenter. The shaking reportedly lasted 40-55 seconds and ground deformation effects included liquefaction, a 35 mile (56 km) surface scar, and vertical offsets of as much as 19 feet (5.8 m). A free public field trip to the rupture site will take place on Saturday, October 3. A special website for the centennial event has been created for the anniversary (listed under References below).



A Modified Mercalli Intensity map of the shaking effects of the 1915 earthquake .

Image: www.nbmg.unr.edu/Geohazards/Earthquakes/1915article.html

Craig dePolo with the Nevada Bureau of Mines and Geology suggests that "The centennial of the 1915 quake is an opportunity for Nevadans to reflect on earthquakes and earthquake safety. Nevadans need to take this large earthquake to heart. Earthquakes are not abstract concepts that can be ignored."

References:

www.nbmg.unr.edu/Geohazards/Earthquakes/1915centennial.html
www.unr.edu/nevada-today/news/2015/great-nevada-earthquake-in-pleasant-valley

Oregon Community's "Race the Wave 5K Run" Raises Tsunami Awareness

The coastal community of Cannon Beach, Oregon hosted the second annual tsunami awareness event which featured a run/walk along the tsunami evacuation route. Representatives from the American Red Cross (ARC), the Federal Emergency Management Agency (FEMA) and the Oregon Office of Emergency Management (OEM) were on hand to provide information to the public.

References:

www.fema.gov/news-release/2015/09/17/fema-corps-raced-wave-cannon-beach
www.oregonlive.com/pacific-northwest-news/index.ssf/2014/09/cannon_beachs_race_the_wave_fu.html

Mauna Loa Alert Level Elevated

Increased earthquake activity along with ground deformation similar to previous eruption precursor events have led the U.S. Geological Survey's (USGS) Hawaiian Volcano Observatory (HVO) to raise the Volcano Alert Level from Normal to Advisory and the Aviation Color Code from Green to Yellow for Mauna Loa. These changes move the volcano from a noneruptive status to a level of "elevated unrest above known background level" but do not mean that an eruption is imminent. The volcano activity may stay constant, increase leading to higher potential for eruption, decrease back to quiescence, or fluctuate for many months or years.

References:

<http://khon2.com/2015/09/17/shallow-earthquakes-at-mauna-loa-elevate-alert-level/>
<http://hvo.wr.usgs.gov/activity/maunaloastatus.php>
<http://volcanoes.usgs.gov/activity/alertsystem/>

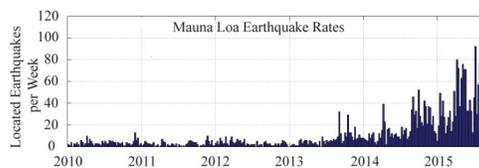


Image: <http://hvo.wr.usgs.gov/multimedia/uploads/multimediaFile-1238.jpg>

There are so many ways to stay connected!

Online- www.wsspc.org
Twitter- [@WSSPC](https://twitter.com/WSSPC)
Facebook- www.facebook.com/WSSPC

USGS Awards \$4 Million to 4 Universities for ShakeAlert Earthquake Early Warning System

Current earthquake early warning systems have shown that just a few seconds warning is enough time to slow down trains, open fire station doors, or move people to a safer location. The U.S. Geological Survey (USGS) gave a boost to the efforts to create a fully functioning early warning system for the west coast with \$4 million awarded to four west coast universities: University of California, Berkeley; California Institute of Technology; University of Oregon; and University of Washington. In addition, the USGS has spent \$1 million for additional sensor equipment for the project.

The money will be used to transition the existing prototype ShakeAlert system into full operational use for California, Oregon and Washington by upgrading and adding seismic stations, improving coordination and integration between states, and increasing data input options and processing speed. In addition, some of the money will be used to develop training and expand testing of the system beyond the 70 organizations across many disciplines who are already beta testing the system. The existing system successfully provided a 9 second warning to San Francisco for the August 24 M6.0 South Napa earthquake, approximately 35 miles away.

Currently the three west coast states have a total network of 624 seismometers which will be increased by 150 in the coming year. However, it is estimated that \$38 million would be required to reach a total of 1,675 sensors to complete the system for the three states as well as \$16 million per year to pay for staff and maintenance of the system following completion.

References:

www.seattletimes.com/seattle-news/science/regional-earthquake-early-warning-system-gets-a-funding-boost/
www.caltech.edu/news/preparing-earthquakes-shakealert-47455
www.usgs.gov/newsroom/article.asp?ID=4282#.Ve9Dp31LXFU
www.emergencymgmt.com/disaster/California-Earthquake-Warning.html
www.washington.edu/news/2015/07/30/four-west-coast-universities-funded-for-earthquake-early-warning-system/

China Working on Earthquake Early Warning Project in Nepal

Following the devastating April 25, 2015 Nepal (Gorkha) M_w 7.8 earthquake which killed more than 9,000 people and injured more than 23,000, the Nepal Academy of Science and Technology (NAST) and the Institute for Care-Life in China will partner to build a new Earthquake Early Warning system.

The project will include 120 sensors and a warning center facility and is expected to cost \$3 million. The system was created by Dr. Tun Wang, the director of the Institute of Care-Life who also set up the system that was implemented in 2010 in China following the 2008 Sichuan (Wenchuan) earthquake. The new system will cover approximately one third of Nepal.

It has been suggested that if the system had been operating at the time of the quake, there could have been as much as 18 seconds of warning time for the capital, Kathmandu, potentially saving many lives.

References:

www.chinadaily.com.cn/china/2015-08/05/content_21503526.htm
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www.nepalmountainnews.com/cms/2015/08/27/nast-installs-10-quake-warning-sensors/
https://en.wikipedia.org/wiki/April_2015_Nepal_earthquake
www.preventionweb.net/english/professional/news/v.php?id=31917

National Association of Insurance Commissioners Holds Special Session "All Things Earthquake"

The National Association of Insurance Commissioners (NAIC) national meeting held August 15-18, 2015 in Chicago, Illinois, featured a pre-conference special session by the Center for Insurance Policy and Research (CIPR) devoted to earthquakes. Topics included: earthquake exposures and challenges, science surrounding fracking-induced earthquakes, groundwater contamination issues related to fracking, opposing views on fracking and loss mitigation for earthquake exposure, and regulatory experiences and concerns with earthquakes.

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Oklahoma Insurance Commissioner John Doak hosted the event which featured a keynote address from Glenn Pomeroy, CEO of the California Earthquake Authority, scientific presentations and discussion, and stakeholder and regulator panels with participants from the energy and insurance industries. The increased earthquake activity in Oklahoma and concern over appropriate insurance coverage for earthquake damages related to oil and gas extraction prompted the focus on fracking.

The NAIC includes an Earthquake Study Group that is charged with a number of tasks and reports on the group's findings each year at the national meeting.

References:

www.naic.org/meetings_home.htm
http://naic.org/committees_c_earthquake.htm
www.bartlesvilleradio.com/pages/news/100522015/state-insurance-commissioner-is-better-prepared-for-earthquakes

British Columbia Earthquake Patterns Greatly Affected by Fracking

While much of the attention on hydraulic fracturing (fracking) has been centered on the United States, our neighbor to the North is feeling the effects as well.

British Columbia has had several earthquakes greater than M4 that have been attributed to the hydraulic fracturing process. The largest so far, M4.6 that occurred in August, has not officially been linked to fracking but was located 1.8 miles (3 km) from a fracking location. Monitoring for 14 months during 2013-2014 provided data for 231 seismic events in the Montney area (eastern British Columbia province) caused by wastewater disposal (38) and hydraulic fracturing (193). None of these events had any reported injuries or damage associated with them. Earthquakes are also on the increase in both number and magnitude in the Fox Creek area of the Province of Alberta.

The Minister of Natural Gas Development, Rich Coleman, issued a statement stating that drilling operations would be stopped immediately when M4 or greater earthquakes are detected and can only be resumed when mitigation measures are agreed upon by the energy developer and the British Columbia Oil and Gas Commission. However, Dan Walker and Jeff Johnson from the Commission note that the options for mitigation are different for the different types of induced events. Induced earthquakes from wastewater disposal may be mitigated by reducing

injection rates or changing disposal zones or locations, while mitigation of hydraulic fracture induced events is limited to avoiding known active faults, altering hydraulic fracture parameters or suspending operations.

References:

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<http://theyee.ca/News/2015/07/21/Fracking-Industry-Changed-Earthquake-Patterns/>
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www.rcinet.ca/en/2015/09/01/earthquakes-and-fracking-a-danger-to-what-extent/

HAZARD MITIGATION & PREPAREDNESS

Portland Pilot Program Retrofits Homes

The City of Portland, Oregon, in partnership with Clean Energy Works (a non-profit home performance provider), initiated a pilot program that assisted 23 residents with earthquake retrofits to their homes. Half of the cost of retrofit was covered; the other half was borne by the homeowners. To continue the program, they have teamed with the Portland Bureau of Emergency Management and the Oregon Office of Emergency Management and plan to request additional grant money from FEMA to begin to chip away at the as many as 100,000 homes that may require some level of retrofitting.

References:

<http://www.katu.com/news/local/Federal-grant-to-help-secure-Portland-homes-in-case-of-major-earthquake-315121451.html>
<http://portlandtribune.com/pt/9-news/266595-140672-portland-homeowners-wanted-for-fema-earthquake-grant>

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May 4-6, 2015, Long Beach, California

San Francisco Soft Story Retrofit Program Update

San Francisco's soft story retrofit program reached another milestone September 15, requiring that buildings with educational, assembly or residential care uses obtain a building permit to retrofit their soft story weakness.

Approximately 5,000 buildings have been identified as requiring retrofit. The initial requirement to submit a screening form has had a 99% response rate.

The Mandatory Soft Story Retrofit Ordinance signed in April, 2013 and effective June 2013 " requires the retrofit for all San Francisco 'multi-unit soft-story buildings,' defined as: wood-frame structures, containing five or more residential units, having two or more stories over a 'soft' or 'weak' story, and permitted for construction prior to January 1, 1978."

The screened buildings have been prioritized into 4 tiers with different completion date requirements as follows:

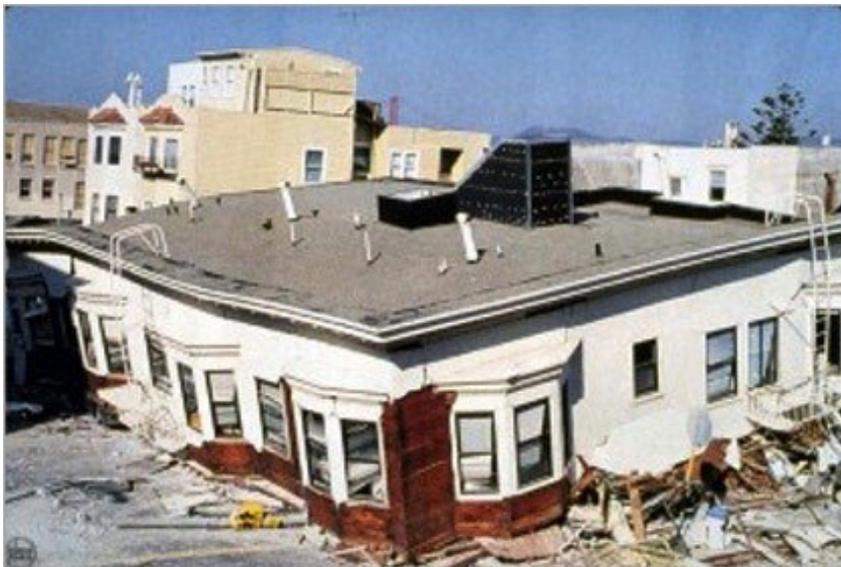
TIER	DESCRIPTION	NUMBER	PERMIT APPLICATION DUE	WORK COMPLETION DATE
I	Any building containing educational, assembly, or residential care facility uses	12	9/15/2015	9/15/2017
II	Any building containing 15 or more dwelling units	581	9/15/2016	9/15/2018
III	Any building not falling within another tier	3527	9/15/2017	9/15/2019
IV	Any building containing ground floor commercial uses, or any building in a mapped liquefaction zone	883	9/15/2018	9/15/2020

584 permit applications have already been submitted and 231 projects have been completed. Buildings that have already been strengthened may be exempted from the current program.

References:

www.sfgsa.org/index.aspx?page=6048

Email to P. Sutch, 07/31/15, 'Earthquake Safety Implementation Program: SUMMER 2015 UPDATE!'



Soft-story multi-unit buildings damaged or destroyed by the 1989 Loma Prieta earthquake.

Image: www.sfgsa.org/index.aspx?page=6048#Background

October is ShakeOut Month

There are many ways for individuals, businesses, schools, faith-based organizations, community groups, government agencies, and others to participate in the ShakeOut, to get prepared for earthquakes, and to share what you're doing with others so they can do the same. Sign up and learn more about ShakeOut events in your area at www.shakeout.org.

Viscous "Goo" Wall Dampers to Debut in San Francisco Hospital

Sutter Health's California Pacific Medical Center in San Francisco is the first building in the U.S. to be constructed with a viscous wall damper system, according to Degenkolb Engineers, the engineering firm that designed the project. The design calls for 120 of the 7-foot wide panels to be filled with polyisobutylene, a synthetic rubber "goo" that is heated and then pumped into the panels. Once the panels are installed in the 13-floor structure, they will act as shock absorbers and decrease the swaying movement of the building during an earthquake. The system is expected to absorb 80-90 percent of the earthquake's energy.

Although these types of systems have been in use in Japan for more than 20 years, Jay Love of Degenkolb explains that introducing new technology into existing building codes has been challenging. Testing of the system began 6 years before actual construction. The new construction is required of hospitals by the California Office of Statewide Health Planning & Development's (OSHPD) Seismic Compliance Program.

The new hospital is scheduled to open in 2019.

References:

www.sfchronicle.com/bayarea/article/SF-hospital-tests-new-goo-in-walls-to-absorb-6479235.php
www.citylab.com/tech/2015/09/a-new-san-francisco-hospital-is-using-goo-to-prepare-for-earthquakes/403447/
<http://sanfrancisco.cbslocal.com/2015/08/17/new-cpmc-hospital-using-goo-filled-walls-to-dampen-shaking-from-earthquakes/>
www.cpmc.org/about/press/news2013/demolition.html
http://oshpd.ca.gov/FDD/seismic_compliance/

Get Ready to Shake Out.

DROP! COVER! HOLD ON!

October 15, 10:15 a.m.

ShakeOut

Register at www.ShakeOut.org

RESEARCH

Arizona State University Announces New Geotechnical Engineering Research Center

Arizona State University (ASU) has received a five-year, \$18.5 million grant from the National Science Foundation (NSF) for a new Engineering Research Center (ERC). Research at the new Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) will focus on developing techniques based on natural biological processes that can be used to improve soils supporting buildings and infrastructure while reducing construction costs and impacts to the environment.

The CBBG has identified four major research areas: hazard mitigation, environmental protection and restoration, infrastructure construction, and resource development. Projects pursued under the Hazard Mitigation research area may improve building performance during earthquakes. Efforts to reduce soil liquefaction potential will be explored by using Microbially Induced Carbonate Precipitation (MICP) to strengthen soils. Other methods to improve soil stability and strength will include

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developing techniques that provide root-like structures for stabilization and the use of biocementation and biofilm development using indigenous bacteria.

ERCs, funded by the National Science Foundation, bring together scientists, industry and government agencies to develop engineering solutions to real-world problems. The NSF will provide the bulk of the funding for the center for up to 10 years. The center is expected to have located other funding sources and be self sustaining by that time.

References:

www.azcentral.com/story/news/local/temp/2015/08/10/asu-scores-engineering-research-center/31406925/
www.nsf.gov/news/news_images.jsp?cntn_id=135694&org=NSF
<http://biogeotechnics.org/>

Precariously Balanced Rocks Provide Clues to Local Fault Activity

Research on Precariously Balanced Rocks (PBRs) may lead to better understanding of local fault interaction as well as providing upper bounds for ground motions. As PBRs are relatively easily knocked over by ground shaking, they have not generally been found closer than 9 miles (15 km) from major faults.



Stack of precariously balanced rocks ~12 km from the San Andreas fault at its junction with the San Jacinto fault.
Image: <http://pubs.usgs.gov/of/2014/1250/downloads/of2014-1250.pdf>

Two areas of PBRs about 6 miles (10 km) from the junction of the San Andreas and San Jacinto faults were discovered and studied in an area in the San Bernardino mountains of southern California. A total of 36 PBRs in the study areas were examined. They were dated as 10,000 -18,000 years old, and would likely have experienced shaking from more than 50 large earthquakes. Past levels of expected ground shaking intensity were modeled using U.S. Geological Survey (USGS) ShakeMap scenarios for the area. Studies were done to determine how much force would be needed to topple the rocks. Based on these results, the scientists determined that the PBRs should have toppled over in the past.

Several scenarios were suggested to explain the unlikely existence of the PBRs so close to the faults; all imply interactions between the rupture patterns of the two faults leading to weaker shaking intensity at the PBR locations:

- The rupture could jump or "stepover" from one fault to the other, skipping the area of PBRs
- The rupture could stop or start at the fault junction, again skipping the areas of the PBRs

This research also has implications for regional seismicity and earthquake planning scenarios as an earthquake involving parts or all of two faults could generate greater levels of ground shaking felt over a much larger area than previously modeled.

References:

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<http://earthsky.org/earth/why-havent-earthquakes-toppled-these-balancing-rocks>
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Kodiak, Alaska High School Students Win NASA Competition

The 2015 winners of the NASA World Wind Europa Challenge, the Kodiak High School World Bridge Project team, were the first high school team ever to enter the contest which has entrant categories of "University" and "Professional".

The winning project, Global Earthquake Forecast System (GEFS), was designed to collect analyze and display 3-D magnetic field information in real time to look for fluctuations in the field that may possibly precede earthquakes.

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The data visualizations would also be available through the NASA World Wind application.

The NASA World Wind Europa Challenge is an international competition to build applications that use the agency's open source virtual globe technology, World Wind, and that meet the European Commission's Inspire Directive "establishing an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment."

Results from this project may be another potential source of earthquake early warning information and could one day help save lives.

References:

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www.edlinesites.net/pages/America_Bridge_Project/Europa_Challenge
www.gsdi.org/node/1613
<http://inspire.ec.europa.eu/>
<http://eurochallenge.como.polimi.it/>

Vibrating Barrier Being Developed to Reduce Earthquake Damage to Buildings

Researchers from the University of Brighton (UK) have developed a new device designed to protect existing buildings, including historic structures, from earthquake damage, without requiring direct retrofitting of the structure itself. The "vibrating barrier" (ViBa) is a "passive control" device which does not need any power source; existing examples of passive control methods include viscous dampers and base isolation systems.

Most earthquake resisting systems are designed for use in new building construction and are not easily or cheaply adapted to use in existing structures without significant alteration to the structure. Concerns around alteration of buildings and cost make seismic safety particularly difficult in areas with many historically important structures or in developing countries.

The ViBa is described as a box which "contains a solid central mass held in place by springs that allow it to move back and forth in order to absorb vibrations." The device works using structure-soil-structure interaction with the idea of the combination of buildings and soil all being elements of a system for seismic vibration control rather than individual entities. The ViBa would be buried in the soil and

connected to one or more building foundations. ViBas theoretically could be deployed as a network to protect multiple buildings and, conceivably, an entire city.

Results of modeling, analyses and shake table experiments suggest that ViBa technology could absorb between 40% and 80% of the ground motions.

At this time, the concept is still a work in progress. The author cites several impediments (size and cost) as well as areas in need of further study (possible effects on surrounding buildings) before a system could be tested in real world conditions. But as the system could be designed to protect multiple buildings, some of the costs could be shared.

References:

<http://rspa.royalsocietypublishing.org/content/471/2179/20150075>
<http://theconversation.com/our-new-anti-earthquake-technology-could-protect-cities-from-destruction-44028>
www.psfk.com/2015/07/earthquake-protection-vibrating-barrier-university-of-brighton-viba.html

Cascadia Initiative Seismometer Deployment Yields Results

The Cascadia Initiative has provided better characterization and understanding of the Cascadia Subduction Zone (CSZ). The four-year deployment of seismometers onshore and offshore in the Pacific Northwest from northern California to Vancouver Island, British Columbia, began in 2011 and was funded by the National Science Foundation (NSF). The purpose of the project included learning more about "megathrust" earthquakes and particularly the threat posed by the CSZ. Other study areas were volcanic arc structure and the interaction of the Juan De Fuca and Gorda tectonic plates.

The project added 27 new inland seismic stations, upgraded 232 other land stations, and deployed 60 new seismometers on the ocean bottom. The sensors were located across the spreading center as well as the subduction zone and provided coverage across an entire plate.

The data collected from this project is available to the scientific community through the Incorporated Research Institutions for Seismology (IRIS) website and has already spawned a wide range of research papers and uncovered much new information including:

- Small earthquakes in a "locked" part of the CSZ that were not detected by land-based instruments; these data will help researchers better understand the strain conditions for the area.
- Seafloor pressure monitors allow the study of the effects on fault behavior where pressure from subduction is squeezing water from and transforming rock at the trench where the Juan de Fuca plate is bending under the North American plate.
- Use of offshore instruments including seafloor pressure gauges for detection and observation of tsunamis in the region.
- Seismic imaging of offshore structures at the subduction zone.

References:

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www.sciencedaily.com/releases/2015/08/150818131526.htm
<http://cascadia.uoregon.edu/welcome>
www.iris.edu/hq/

New Study Models Tsunami Effects of Two Faults Offshore in Southern California

A new tsunami inundation study from researchers at the University of California, Riverside and the U.S. Geological Survey suggests a larger hazard than previously modeled in the Ventura area. The new study uses a M7.7 scenario based on connectivity of the Pitas Point and Lower Red Mountain faults located off the coast roughly between Santa Barbara and Ventura, California. The results suggest that a tsunami from this type of event could be up to 23 feet (7 m) in height and flood as far inland as 1.2 miles (2 km) but would have local rather than regional effects. The cities of Ventura and Oxnard would be particularly at risk due to significant coastal areas of low elevation.

The results of this study show more areas of inundation than the 2009 Tsunami Inundation Maps based on modeling done by the University of Southern California for the California Governor's Office of Emergency Services and California Geological Survey (CGS). However, Rick Wilson from CGS notes that the source and inundation modeling from the study are preliminary and still being reviewed. Wilson also mentioned that although the modeled inundation results may be

different, the evacuation planning maps created by the cities based on the previous models were conservative in nature and do include the newly modeled trouble spots. The State will continue to review the new model results and update their work if appropriate.

References:

<http://blogs.agu.org/geospace/2015/08/19/new-study-shows-significant-tsunami-strength-for-parts-of-southern-california/>
www.latimes.com/local/lanow/la-me-ln-earthquake-tsunami-ventura-20150819-htmstory.html
www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Ventura
Rick Wilson, personal communication

PEOPLE & TRANSITIONS

Pat Quealey is the new Assistant Deputy Minister at Emergency Management British Columbia. We welcome Pat to WSSPC!

RESILIENCE & RECOVERY

Oregon Creates Earthquake Resilience Officer Position

In July, 2015, the State of Oregon signed HB 2270 into law, creating the office of State Resilience Officer. The act states that "The office of State Resilience Officer shall direct, implement and coordinate seismic safety and resilience goal setting and state agency planning and preparation to improve seismic safety and resilience." The position will be appointed by and reside in the office of the Governor.

References:

www.opb.org/news/article/2015-marks-banner-year-for-earthquake-preparedness-in-oregon/
<http://gov.oregonlive.com/bill/2015/HB2270/>
www.oregon.gov/omd/oem/pages/ossprac/ossprac.aspx

Aging Water Infrastructure Damaged During "Moderate" Earthquake

The August 17 M4.0 Hayward Fault earthquake near Oakland, CA was not unusual, nor was the shaking. The event was quantified as Modified Mercalli Intensity (MMI) V (moderate) for the epicentral area and surrounding cities. But even this relatively low level event resulted in 9 water line breaks as reported by the East Bay Municipal Utility District (EBMUD). The pipes were made of non-ductile cast-iron, and susceptible to ground movement from earthquakes. However, even without earthquakes, the agency reports an average of 2-3 main breaks daily. A spokesperson for EBMUD said that "The average age of cast-iron pipes in the EBMUD system is about 80 years old, with some pipes dating as far back as the 1880s".

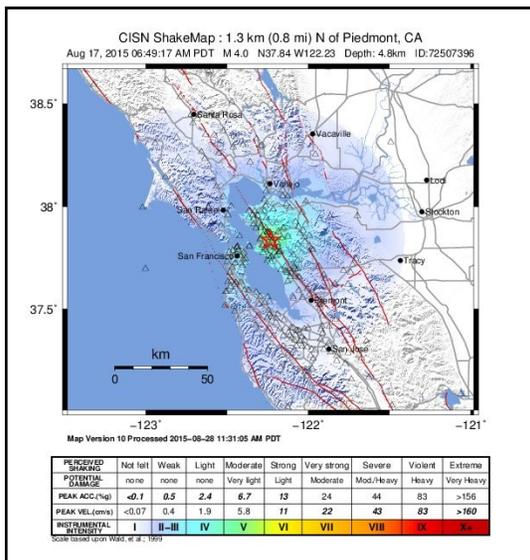


Image: http://earthquake.usgs.gov/earthquakes/eventpage/nc72507396#impact_shakemap

With water pipes and other infrastructure aging across the country and failing on a daily basis under normal use conditions, earthquake activity will likely cause significant damage to these already weakened systems.

References:

www.mercurynews.com/my-town/ci_28658825/ebmud-says-earthquake-ruptured-water-mains
www.contracostatimes.com/breaking-news/ci_28658836/ebmud-says-earthquake-ruptured-water-mains
http://earthquake.usgs.gov/earthquakes/eventpage/nc72507396#general_summary

Scientists and Emergency Managers Say Pacific Northwest Megaquake Concerns Overstated by New Yorker Article

The recent *New Yorker* article focusing on the potential extent of damage from a Cascadia Subduction Zone (CSZ) earthquake in the northwest is getting some pushback from experts who say that the article is too alarmist and frightens the public into thinking little has been done to mitigate the consequences of such a disaster. This is far from the truth according to many scientists and emergency managers.

For instance, scientists refute the comment that the area is "overdue" for a large quake stating that the return interval for earthquakes in the area is not tightly constrained. In addition, the USGS Earthquake Science Center also took issue with the comment from the article that "everything west of Interstate 5 will be toast" suggesting that while there will be much damage, it is not likely to reach the worst case scenario portrayed in the article.

While there is no question that a large CSZ earthquake will likely cause a lot of damage to buildings and infrastructure as well as many deaths and injuries, much has been done to prepare for earthquakes and tsunamis over the years. Warning systems for tsunamis have been installed along many portions of the coast. Schools, businesses, government agencies, tribes, and residents participate yearly in the ShakeOut preparedness drill. Improved seismic safety provisions in building codes mean many newer buildings should perform well in a quake. And much planning has already occurred; staging areas identified, emergency communications options, secondary base locations and training and exercise activities continue. To this end, a large-scale functional exercise called Cascadia Rising is planned for June 2016, based on a M9.0 CSZ earthquake and tsunami event (see following article). All these activities point to a region that is both well aware of, and preparing for, the potential for a very large earthquake.

References:

www.emergencygmt.com/disaster/As-fears-of-West-Side-megaquake-danger-grow-states-emergency-planners-unshaken.html
www.times-standard.com/opinion/20150801/about-that-new-yorker-article
<http://community.fema.govdelivery.com/connect.ti/cascadiarising2016/>

Unreinforced Masonry Building and School Seismic Safety Concerns Highlighted in Pacific Northwest

The July 2015 *New Yorker* article brought a lot of attention to the Pacific Northwest and inspired a number of articles and news reports on seismic safety of buildings in the region. Here's a synopsis of several of the issues that made the news.

Portland, Oregon Unreinforced Masonry Buildings (URMs)

URMs have long been identified as the building type most likely to suffer major damage or collapse during earthquakes. In March 1992, a M5.6 earthquake caused damage to URMs including a school only 50 miles from Portland. URM retrofit requirements were established in 1995 (Title 24.85) and updated in 2004, but the Portland Bureau of Development Services estimates that fewer than 20% of the URMs identified in 1995 have been either seismically upgraded or demolished since the initial implementation of the code.



Some cities in Oregon have already started seismic rehabilitation program to strengthen the fire stations that are susceptible to serious damage in an earthquake. Fire Station #1, the largest in Portland, was retrofitted in 2009. It should now be in working order after an earthquake, serving downtown Portland.

Image; www.oregon.gov/OMD/OEM/ossnac/docs/Oregon_Resilience_Plan_Final.pdf, (Peck Smiley Ettlin Architects)

In December of 2014, the city of Portland's City Council launched a new Seismic Retrofit Project with tasks including updating the URM inventory, reviewing the current risk, codes, and needs, and ultimately providing policy recommendations including proposed code changes and financial incentive options to support implementation. A report released in April, 2014 by the Retrofits Standards Committee identifies approximately 1800 URM buildings which include residential apartment buildings, businesses, schools, places of worship, and theaters. The report includes a "Proposed Mandatory Seismic Strengthening Program" including building classification and upgrade tables, implementation strategies and cost analyses. The final recommendations are to be provided to the City Council in the summer of 2016.

Portland, Oregon Public Schools

A recent news report found that although the Portland Public School District, with 48,000 students, has been implementing seismic upgrades to their buildings, there is still much work to be done. A statewide study published in 2007 included a visual survey of public school buildings and found that nearly half were at "high risk" of collapse in a major quake. That percentage held true for the Portland Public School District which found that nearly half of their buildings were also in the "high" or "very high" risk category. Most of the school buildings were built prior to seismic design codes. The upgrades that have been completed have dealt with the "very high risk" buildings but may not be up to the current life safety code standards. Lack of funding has hampered the district's progress; however, some help is on the way. The state of Oregon approved \$175 million in grants for seismic upgrades to public schools statewide this past summer as well as making available \$125 million for matching funds.

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Beaverton School District, Oregon

The Beaverton School District plans to build seven new schools over the next few years and all will incorporate the recommendations from the 2013 Oregon Resilience Plan. The buildings will be built to a higher seismic standard than required by code in the hopes that earthquake damage will be less and allow the buildings to be put back into use quickly. Rather than being built to Seismic Risk Category III, which is typically used for schools, the new high school is being built to Seismic Risk Category IV which is the level used for essential facilities. This school should be able to be used as an emergency shelter post-disaster and includes an extra large generator. The Resilience Plan calls for recovery of the state's schools to have a recovery target of 30-60 days. The \$90 million overall cost of the structure was only increased by 1% by the upgrades to higher resiliency.

Seattle, Washington URM's

Despite damage to URM's in the 2001 Nisqually earthquake followed by surveys in 2007 and 2012 which identified more than 800 URM buildings, little progress has been made in the city of Seattle in retrofitting these potentially dangerous buildings. An estimated 17,000 – 58,000 people could be affected by earthquake damage to these structures which include apartment buildings, places of worship, and businesses.

Attempts to pass regulations requiring retrofitting have not been successful. Mandated retrofits for a life safety standard were recommended in 2008 by a URM technical committee but have not been adopted.

The estimated 15% or fewer of the buildings that have been retrofitted were most likely upgraded due to building code requirements triggered by remodels or repairs.

A committee was formed in 2012 to work on retrofit issues including standards and financial incentives. The city's Department of Planning and Development Unreinforced Masonry Buildings website provides a project timeline and link to the January 2013 Draft Policy Recommendations, but no further updates have been posted since the January 2013 data. Part of the problem seems to be a lack of complete data; neither a complete URM building inventory nor a list of completed structural upgrades to existing building stock is currently available.

References:

www.newyorker.com/magazine/2015/07/20/the-really-big-one
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www.portlandoregon.gov/pbem/66306
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www.katu.com/news/investigators/Portland-Public-Schools-working-to-get-all-buildings-earthquake-safe-challenged-by-funding-323532491.html
<http://blogs.asce.org/oregon-asce-members-make-resiliency-a-priority-in-school-district/>
www.oregon.gov/OMD/OEM/osspace/docs/Oregon_Resilience_Plan_Final.pdf
www.seattletimes.com/business/real-estate/citys-old-brick-buildings-could-see-huge-damage-in-big-quake/
www.seattle.gov/dpd/codesrules/changestocode/unreinforcedmasonrybuildings/whatwhy/default.htm

Rockefeller Foundation 100 Resilient Cities Challenge - Is your city ready to build resilience?

The 100 Resilient Cities Challenge seeks to find 100 cities that are ready to build resilience to the social, economic, and physical challenges that cities face in an increasingly urbanized world. Is your city ready to become resilient?

We can't predict the next disruption or catastrophe. But we can control how we respond to these challenges. We can adapt to the shocks and stresses of our world and transform them into opportunities for growth. If your city applies for the 100 Resilient Cities Challenge, it could be one of 100 cities eligible to receive funding to hire a Chief Resilience Officer, assistance in developing a resilience strategy, access to a platform of innovative private and public sector tools to help design and implement that strategy, and membership in the 100 Resilient Cities Network.

The deadline to apply is November 24, 2015. Ignite the urban resilience movement.

For more information: www.100resilientcities.org/pages/100-resilient-cities-challenge#/_/

FEMA Plans Cascadia Rising Exercise for 2016

The Cascadia Rising Cascadia Subduction Zone (CSZ) Catastrophic Earthquake and Tsunami Functional Exercise, based on a M9.0 earthquake scenario with accompanying tsunami, is scheduled for June 7-10, 2016. The Cascadia Region is defined in the scenario document as "...the area west of the Cascade Mountains stretching from Northern California, through Oregon and Washington and into British Columbia". Agencies from the states of Washington, Oregon, and Idaho and the Canadian Province of British Columbia as well as active-duty military, FEMA and local emergency management offices will be involved.

The exercise will focus on issues of coordination and integration between all levels of government but will also include private sector coordination. At risk are more than 8 million people as well as some large companies such as Boeing, Microsoft, Starbucks, Amazon, and Nike.

The scenario, designed to identify potential impacts and estimate damages, represents just one possible set of outcomes; nonetheless it provides a cohesive basis for an exercise. In addition to providing overall totals for expected losses, the scenario breaks down the losses separately for Oregon and Washington.

Total earthquake injuries are estimated at over 20,000 individuals with over 1,100 deaths. A tsunami as large as 30-40 feet (9-12 meters) could be generated and due to the proximity of the source to the coast, could arrive within 20-30 minutes in some areas. The scenario identifies over 86,000 residents within the tsunami inundation zone with a possibility of 15,000-20,000 deaths and injuries due to the tsunami alone. Also included in the report are damage estimates for transportation systems, water resource infrastructure, electric power systems, natural gas systems, refined fuel systems, critical public safety facilities, emergency operations centers, fire stations, police stations, supporting infrastructure, law enforcement and corrections personnel, hospitals, schools, water and waste water treatment facilities, hazardous materials facilities, communication systems, buildings, and

estimates of shelter needs.

Anne Rosinski, Chair of the California Earthquake Clearinghouse, sees the Cascadia exercise as an opportunity for the Clearinghouse members and all interested parties from WSSPC states and others to participate in a clearinghouse exercise and practice sharing observations and knowledge among emergency responders and the engineering and scientific communities. Contact Anne at Anne.Rosinski@conservation.ca.gov for more information.



Expected ground shaking intensities from a M9.0 Cascadia Subduction Zone earthquake.
Image: [Cascadia_Rising_2016_Exercise_Scenario_Document_Low_Res.pdf](#)

References:

<http://community.fema.govdelivery.com/connect.ti/cascadiarising2016/>
www.washingtonepin.org/external/content/document/5163/2454186/1/Cascadia_Rising_2016_Exercise_Scenario_Document_Low_Res.pdf
www.californiaeqclearinghouse.org/

RESOURCES & PUBLICATIONS

The Nevada Bureau of Mines and Geology has a new website for the centennial of the 1915 Pleasant Valley Earthquake.

www.nbmgs.unr.edu/Geohazards/Earthquakes/1915centennial.html

Scenario for a Magnitude 7.0 Earthquake on the Wasatch Fault – Salt Lake City Segment, EERI Utah Chapter, June 2015.

www.quake.utah.edu/Reports/EERI%20Scenario%20-%20FINAL%20VERSION.pdf

State of Oregon Office of Emergency Management, Cascadia Playbook Overview.

www.oregon.gov/OMD/OEM/public_information/OEM%20Cascadia%20Playbook%20Overview.pdf

The Wyoming State Geological Survey has announced a new interactive agency website.

www.wsgs.wyo.gov/

AlertSeattle emergency alert and notification system now available for City of Seattle residents.
<http://alert.seattle.gov/>

New free smartphone app for earthquake early warning based on Stanford University Quake Catcher Network.

www.zizmos.com/

Policy Adoption Survey

Are we meeting our Policy Goals?

WSSPC's Strategic Plan includes measures of success, one of which is to survey WSSPC members each year to determine which current policy recommendations have or have not been adopted.

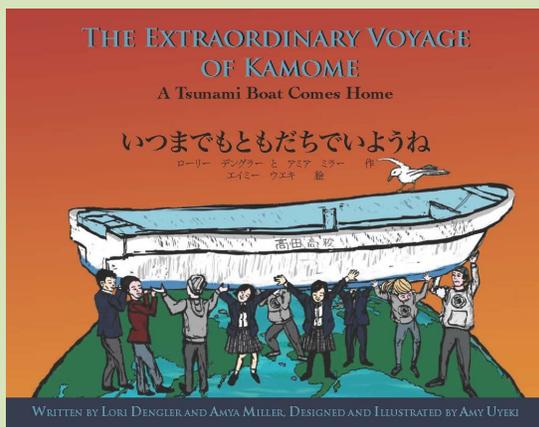


A survey will be sent to all WSSPC member agencies in the coming months.

Featured Publication: The Extraordinary Voyage of Kamome: A Tsunami Boat Comes Home

On April 7, 2013, a little over two years after the magnitude 9 Tohoku-oki Japan earthquake triggered a massive tsunami off the coast of northeastern Japan, a lone boat washed up on the shores of Crescent City, California. The confirmation of the boat as belonging to a high school in Rikuzentakata was first step in an amazing story that has linked two tsunami-vulnerable communities on opposite sides of the Pacific and initiated friendships between high school students in Rikuzentakata. This story is now told in a bilingual Japanese - English children's book to be released by Humboldt State University Press in November, 2015. Co-authored by Humboldt State University Emeritus Geology Professor Lori Dengler and Amya Miller, the Director of Global Public Relations in Rikuzentakata, the book features illustrations by Arcata artist Amy Uyeki.

This sweet story, intended for lower elementary grades, is intended to provide a window for discussing earthquakes, tsunamis, marine debris, preparedness and cultural awareness in the classroom and within families. A website Humboldt.edu/kamome is under development with photographs and documentation of the true story of Kamome and links to curriculum and preparedness information. To receive a free advance copy or for distribution information, please contact kamome@humboldt.edu or leave a message at (707) 826-6019.



CONFERENCES, WORKSHOPS & EVENTS

State of Alaska 2015 Preparedness Conference

October 6-9, 2015

Anchorage, Alaska

For additional information: <https://ready.alaska.gov/preparedness/Conferences/Fall2015>

Alfred E. Alquist Seismic Safety Commission Meeting

October 8, 2015

Eureka, California

For more information: www.seismic.ca.gov/

The Great ShakeOut Earthquake Drills: California, Washington, British Columbia, Nevada, Oregon, Arizona, New Mexico, Alaska, Guam, Idaho, Colorado, Hawaii, CNMI, Wyoming, American Samoa

October 15, 2015

For additional information: www.shakeout.org/index.html

The Great Montana ShakeOut

October 21, 2015

For more information: www.shakeout.org/montana/

The Great Yukon ShakeOut

October 22, 2015

For additional information: www.shakeout.org/yukon/index.html

Nevada Earthquake Safety Council-Utah Seismic Safety Commission Meeting

November 10, 2015

Reno, Nevada

International Association of Emergency Managers Annual Conference

November 13-18, 2015

Clark County, Nevada

For more information: <http://iaemconference.info/2015/>

WSSPC Board Meeting

November 18, 2015

Sacramento, California

8th Annual HAZUS User Conference

December 9-11, 2015

Atlanta, Georgia

For additional information: www.hazusconference.com/

2nd Conference on Improving the Seismic Performance of Existing Buildings and Other Structures (co-sponsored by WSSPC)

December 10-12, 2015

San Francisco, California

For additional information: <http://atc-sei.org/>

2016 EERI Annual Meeting

April 5-8, 2016

San Francisco, California

For additional information: <https://www.eeri.org/>

National Earthquake Program Managers Meeting

May 2-3, 2016

Long Beach, California

For additional information: <http://eqprogram.net>

National Earthquake Conference

May 4-6, 2016

Long Beach, California

For additional information: <http://earthquakeconference.org/>

Cascadia Rising 2016 Functional Exercise

June 7-10, 2016

For additional information: <http://community.fema.gov/delivery.com/connect.ti/cascadiarising2016/>



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If you have a newsworthy item for our e-Newsletter, please forward it to
Johanna Fenton, Program Manager at: news@wsspc.org