OSU Emergency Management

A Layperson’s Overview of the Cascadia Subduction Zone Threat and Preparedness

EMERGENCY PREPAREDNESS MANAGER
MIKE BAMBERGER
737-4713
michael.bamberger@oregonstate.edu
emergency.oregonstate.edu
Introduction – Plate Tectonics

95% of earthquakes occur along the edges of the interacting plates

Source:

from Earthquakes by Bruce A. Bolt
Plate Tectonic Map of the Pacific Northwest – the “Cascadia” Region – 3 Earthquake Sources

Modified from 2010 issue of Cascadia, Oregon Dept. of Geology and Mineral Industries
During an Earthquake

Earthquake starts tsunami

Coast goes down

Seafloor goes up

Stuck area ruptures, releasing energy in an earthquake

Source: http://pubs.usgs.gov/circ/c1187/
Turbidites:
Adams (1990) finds “footprints” offshore

SHAKING LEAVES A DEEP-SEA DEPOSIT

1. River delivers sediment to the sea.
2. Sediment settles on the continental shelf.
3. An earthquake shakes the continental shelf and slope.
4. Shaken sediment descends submarine canyons as turbidity currents.
5. Turbidity currents merge where tributaries meet. Resulting deposits are visible in sediment cores.

Source: Atwater (2005); http://pubs.usgs.gov/pp/pp1707/
Turbidites caused by Cascadia earthquakes. This is a deep sea core near the Cascadia subduction zone. (picture from Chris Goldfinger, 2010)
Cascadia Subduction Zone Earthquakes

Turbidites show how much of the subduction zone ruptured in ~42 earthquakes over the last 10,000 years.

- 20 earthquakes ruptured all on the subduction zone.
- 2 to 3 earthquakes ruptured three quarters of the subduction zone.
- 19 earthquakes ruptured the southern half or quarter of the subduction zone.

(Modified from Goldfinger et al. (in press) by adding magnitude estimates and some labels)
Comparison of the history of subduction zone earthquakes along the Cascadia Subduction Zone in northern California, Oregon, and Washington, with events from human history. Ages of earthquakes are derived from study and dating of submarine landslides triggered by the earthquakes. Earthquake data provided by Chris Goldfinger, Oregon State University; time line by Ian P. Madin, DOGAMI.

Source: 2010 issue of Cascadia
Soft soils, and steep slopes can **AMPLIFY** **SHAKING**

Explanation of Map:
Red Zones = 25% amplification
Black Lines = shorelines
Earthquake Effects - Ground Shaking

Amplification by bay mud in San Francisco causes collapse of the Cypress Freeway.

Loma Prieta, CA 1989

Source: http://earthquake.usgs.gov/learn/topics/?topicID=57

KGO-TV News ABC-7
Northridge, CA

January 17, 1994
ShakeMaps do not take into account **liquefaction** (water-saturated sand or silt turning to quicksand or “quicksilt” during shaking).

Liquefaction can cause lateral spreading on even gentle slopes.

Heavy objects sink (concrete structures).

Light objects rise (fuel tanks).
Liquefaction

Earthquake shaking can cause soils to behave like a liquid and lose their ability to support structures.

1964 magnitude 7.5 Niigata earthquake in Japan
Earthquake Effects

• Rigid structures will break
  – Water lines
  – Gas lines
  – Sewage lines

• Buildings are built for life safety, not “earthquake proof”
  – Will stand and allow escape, but not built to continue business
  – Building codes continually improve to building techniques for identified building zones
Damaged, but life safety survivable
Loma Prieta Seminary, 1989

2001 Nisqually -- 1st Avenue and Vicinity, Seattle
Response

• If you feel an earthquake:
  – Drop, cover and hold

• Earthquake will seriously delay emergency response.
  – Strong ground motions for 3 to 5 minutes.
  – Liquefaction and earthquake force will cause extensive landslides, cutting lifelines
  – Most bridges will be damaged and damage may not be obvious to a lay observer
  – Nearly all buildings will be damaged by the earthquake, including those that may be designated as emergency shelters.
  – Coast will be cut up into “islands” by slides and bridge failure, probably for weeks.

KNOW THE RESOURCES IN YOUR ISLAND AND PLAN ACCORDINGLY
Select the best cover available

**Good**
- Protect the whole body
- Hard surface
- Able to support weight of falling objects
- Can exit from underneath afterwards

**OK**
- Doorway
  - Can swing and pinch
  - Nobody is 4 inches wide
  - Not all are load bearing
- Wall or furniture
  - Get low
  - Provides protection on 1 side
  - Might create a safe space if debris falls

**Poor**
- Laying down or standing in the middle of the room
- Squeezing under Cover that you cannot get back from (under bed)
Cautions related to earthquakes

• Cut feet
• Falling facades
• Fire alarms
  – Don’t pull during an earthquake, unless there is a fire
  – People will flee the building and greater chance of being hurt due to conflicting warning
• Aftershocks
  – Can be size 7 or 8 Mw
Tsunami

• And just when you thought the earthquake was bad enough!
Tsunami cont.

• Near Tsunami
  – Earth shaking is felt by local inhabitants
  – Respond with earthquake protection (Drop, Cover, Hold on)
  – After shaking, evacuate in-land
    • Estimated 15 minutes on Oregon Coast
    • Learn the evacuation zones before visiting the coast
  – Be prepared for long response/rescue times
Tsunami Maps
http://www.oregongeology.org/tsuclearinghouse/
Preparedness - Short term thinking

• We understand 72-hours
  • Preparedness fits in a backpack
  • Still within the Rules of 3 of survival

• But 7 days, 14 days, 30 days?
  • Mentally, we are not prepared
  • Provisionally, we are not prepared

• What happens if the earthquake happened:
  • October 15, 2016?
  • February 6, 2014?
  • December 6, 2013?
Change how we look at the disaster

What is being done to help me....

• I can’t get home due to bridges being closed
• I am at work when something happens
• My children are at.......  
• How will my building behave in an earthquake

Turn the thinking around:

• What are you doing to prepare yourself and areas that you can influence?
How do you prepare? What to prepare for?

• Pay attention to what you do every day and think, “How will I do this if I don’t have......?”

• Morning routine
  ➢ Wake up to alarm
  ➢ Go to bathroom
  ➢ Make hot beverage
  ➢ Look inside refrigerator
  ➢ Read newspaper/e-paper
Use the Rule of 3’s to guide planning

You can live –

• 3 Seconds without blood

• 3 minutes without air

• 3 hours without shelter

• 3 days without water

• 3 weeks without food
http://www.opb.org/aftershock/

Corvallis, OR

**YOUR COMMUNITY’S RECOVERY**
Experts project it could take several months to restore your community to its normal function based on damage to pipes, infrastructure, and the transportation corridors needed for recovery efforts.

<table>
<thead>
<tr>
<th>ONE MONTH</th>
<th>ONE YEAR</th>
<th>TWO YEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER &amp; SEWER</td>
<td>WATER AT DISTRIBUTION CENTERS</td>
<td>ELECTRICITY</td>
</tr>
<tr>
<td>WATER AT DISTRIBUTION CENTERS</td>
<td></td>
<td>NAURAL GAS</td>
</tr>
<tr>
<td>ELECTRICITY</td>
<td></td>
<td>POLICE &amp; FIRE</td>
</tr>
<tr>
<td>NAURAL GAS</td>
<td></td>
<td>HEALTHCARE FACILITIES</td>
</tr>
<tr>
<td>POLICE &amp; FIRE</td>
<td></td>
<td>TOP PRIORITY HIGHWAYS (PARTIAL RESTORATION)</td>
</tr>
</tbody>
</table>

**HOW TO PREPARE**
Given the hazards and preparedness level in your community, experts suggest keeping an emergency kit with enough supplies to last a minimum of two weeks. They also recommend connecting with community groups to boost your region’s overall resiliency.

**YOUR SUPPLY KIT**
Experts suggest you have the following:

- **2 weeks of supplies per person**
- **14 gallons of water per person**
- **42 meals per person**

For more information on making your kit, check out these emergency supply lists from OPR and American Red Cross.
Afterwards

• Develop Priorities to guide response
  – Life Safety
  – Stabilize the incident scene
  – Protect from further damage

• Applicable to:
  – Home
  – Work

• Response, at some level, could be days or weeks before you consider recovery
Some Emergency Management Thoughts

• Incidents are owned at the lowest level possible
• Governments build the infrastructure for people to use for life/work
  – Water
  – Sewer
  – Roads
  – Medical
  – Schools
• Government can not compete with businesses
Where are the Feds?

• Can provide assistance only when requested from the State AND

• State has to prove that local City, Count, and State resources are expended or will be expended if they respond

• Need a Presidential Declaration
  – Some Departments can support prior to PD
  – SBA, COE

• If post disaster, Damage Assessments have to be conducted prior to the PD
Assistance

• Individual Assistance
  – Whole community affected
  – Demographics considered
  – Federal grants to assist families
  – Usually where areas of high concentration to individuals
  – Cannot duplicate insurance benefits
Assistance cont.

• Public Assistance
  – Funds for local governments to respond and/or repair infrastructure
  – Thresholds of damage need to be met
    • County $3.57 per person damage
    • State $1.41 per person damage ($5,401,814)

• Small Business Administration
  – Low interest loans
  – Homeowners, renters, small businesses
  – A different set of threshold criteria must be met

Flow of Requests and Assistance
What about Hurricane Matthew?

• Severity of incoming storm was recognized and federal Departments were directed to pre-position assets
  – If no Presidential Declaration, Department would pay for the cost or Congress could allocate the money

• All resources that were pre-deployed were not utilized
  – Resiliency/preparedness of local response
  – Storm did not make landfall as some scenarios predicted
Take away

• Earthquake is coming
  – If not that, then flood, wind, snow, landslide, locusts, blight, etc...

• Individually and as a business, we have to prepare
  – Mentally
  – 14 days minimum preparation
  – Business continuity prioritization of tasks

• Federal assistance isn’t always guaranteed
  – Assistance provided on need
  – Higher density population, more likely to get federal resources due to # impacted
now take a big breath and relax

- A little bit of preparedness goes a long way!
- Questions?