Getting your Water Utility Ready for the Big Earthquake

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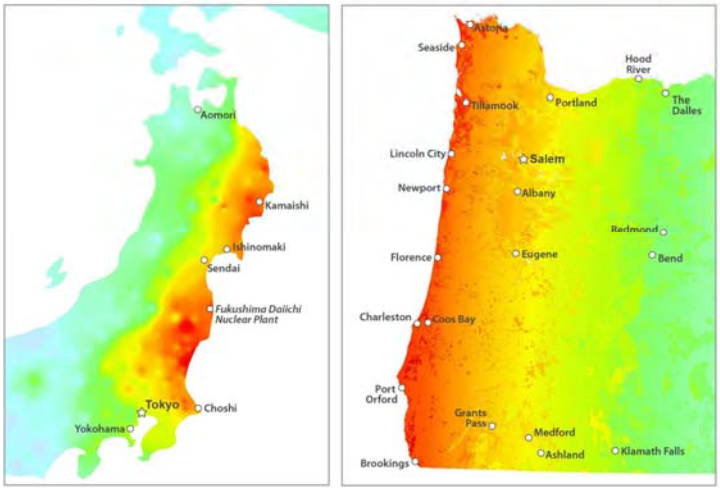
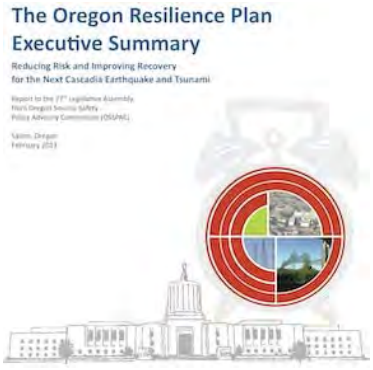
Expected Shaking in a Cascadia Event

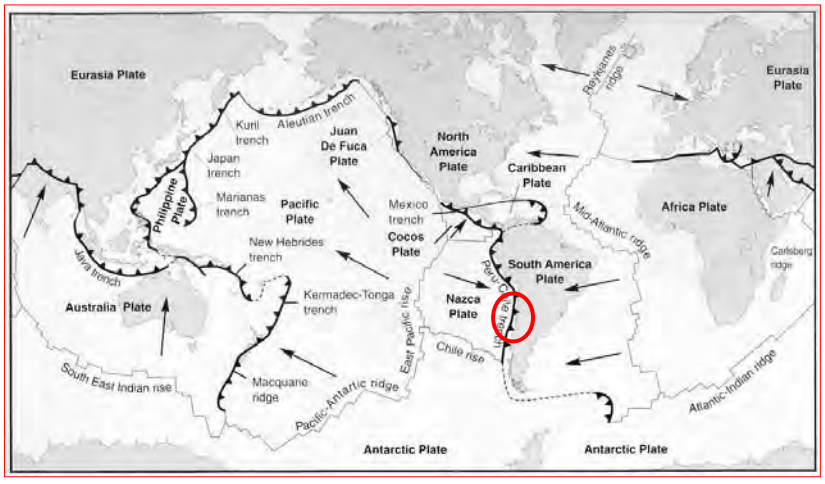


Estimation of time to restore services in the Valley

- Electricity
  - 1 to 3 months
- Police and Fire Stations
  - 2 to 4 months
- Top Priority Highways (partial)
  - 6 to 12 months
- Healthcare Facilities
  - 18 months
- Water and wastewater
  - 1 month to 1 year



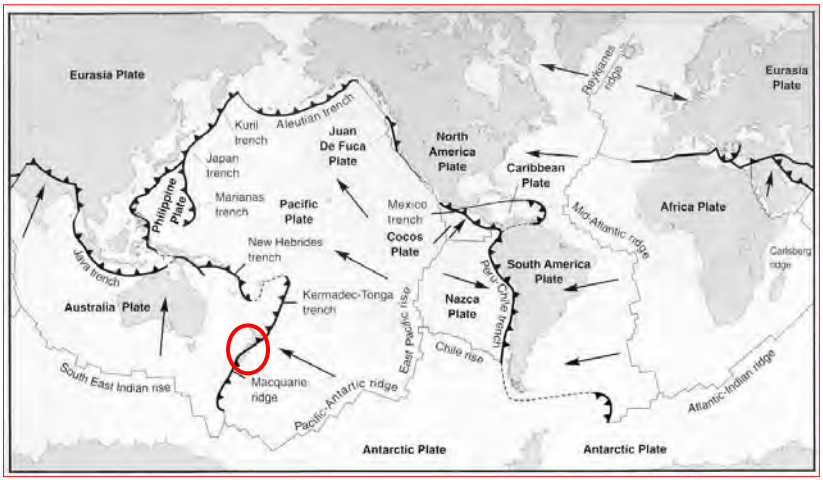
Personal Lessons from 2010 Chile Earthquake



Interviews from 2013, three years after

- Reinaldo, Rural Water Distribution
  - Biggest problem was delay in restoring electricity
    - Focus was restoration to cities, not rural communities
    - Couldn't even see a problem until power was restored
- Jose, ESSBIO
  - Need flexibility and redundancy in system
    - Add second water source at end of network
  - One week of planned effort took 3 weeks to execute
  - Soil type was critical in predicting pipe breaks
- Milo, Flood and Irrigation Control
  - Drinking water first, irrigation second, waste water third
  - Planning completed over a weekend, still two weeks to get crews out

2010-2011 Christchurch Earthquakes

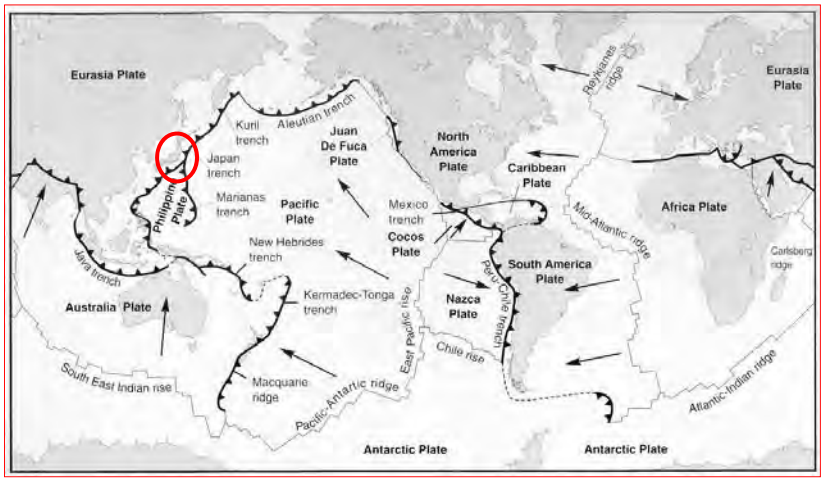



Darfield Earthquake

Interviews from 2013, two years after

- David, Lifelines Expert
  - Must find way to get records and equipment out of damaged buildings
  - Strong communities rebuilt must faster
  - Gravity sewers were the biggest persistent problem
- David, Local Water District
  - Years worth of repairs in 6 days
  - Hindsight, would have done more temporary fixes
    - Aftershocks and settlement resulted in too many re-repairs
- Tony, National Lifelines Program
  - Real work occurs at the regional level
  - Network redundancy is the key

2011 Japan Earthquake



Interviews from 2011 and 2013

- Local Resident, Suburb North of Tokyo
  - "They say we have water, but we don't have sewer. If we don't have sewer, we really don't have water"
- Yasuko, Water/Wastewater Researcher
  - Restoration was delayed in liquefaction due to indecision
  - Insurance did not pay for temporary fixes
  - Use areal approach for distribution systems based on soil type
    - Location of shut-off valves
- Fumio, Tsunami Expert
  - 2m inundation depth is tipping point for repairs
  - Evacuation plans based on "wetted area," less than an inch deep

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Cascadia Lifelines Program at OSU

A targeted research consortium aimed at improving Oregon's resilience in a cost- and value-informed manner

Oregon Department of Transportation

PGE

NW Natural
We grew up here.

BONNEVILLE POWER ADMINISTRATION

PORT OF PORTLAND
Possibility. In every direction.

EWEB

Tualatin Valley Water District

PORTLAND WATER BUREAU

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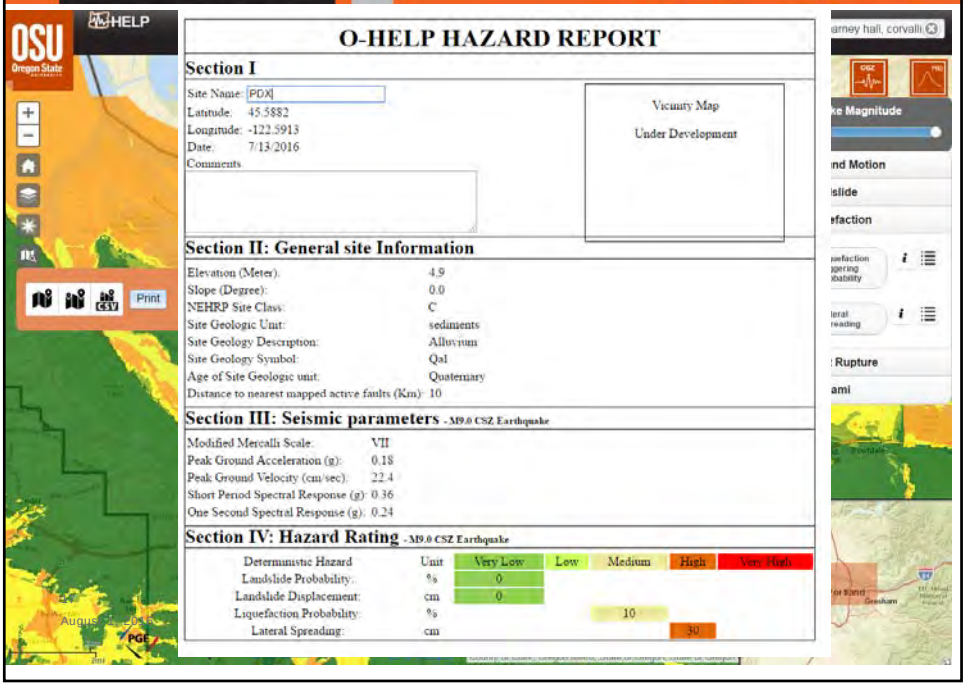

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EWEBs Legacy Power Pole Project

- Materials characterization – before loading
  - Corrosion potential
  - External damage assessment
- Materials characterization – after loading
  - Mechanical properties
  - Microstructural analysis
- Structural testing
  - Deformation response
  - Soil-structure interactions
  - Structural capacity

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August 1, 2016

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Affordable retrofit of unreinforced masonry structures project

Non-retrofitted specimen

Retrofitted specimen

Thank you!