Oregon Tackles Cascadia

2017 Annual Meeting

*Moderator:* Carmen Merlo, Portland Bureau of Emergency Management
Oregon Tackles Cascadia Session Agenda:

1. Portland Water Bureau’s Seismic Vulnerability and Resiliency
   Teresa Elliott, Portland Water Bureau

2. Port of Portland Seismic Risk Assessment
   Tom Peterson, Port of Portland

3. Ensuring Strategic Emergency Response with Seismic Work
   Siobhan Kirk, Tualatin Valley Fire & Rescue

4. Resources Available for Small/Rural Communities to Address Seismic Risk
   Michael Howard, University of Oregon
Oregon Tackles Cascadia

Portland Water Bureau’s Seismic Vulnerability and Resiliency

Teresa Elliott, PE
Chief Engineer
Oregon Resilience Plan

- 50 Year Plan for State
- Assessment of Current State
  - Coastal Communities
  - Business
  - Critical Buildings
  - Transportation
  - Energy
  - Communications
  - Water/Wastewater
- Months to Years of Recovery
- 1/5 of Oregon GDP Lost
- 10,000’s Displaced
## Oregon Resilience Plan

<table>
<thead>
<tr>
<th>Critical Service</th>
<th>Zone</th>
<th>Estimated Time to Restore Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>Valley</td>
<td>1 to 3 months</td>
</tr>
<tr>
<td>Electricity</td>
<td>Coast</td>
<td>3 to 6 months</td>
</tr>
<tr>
<td>Police and fire stations</td>
<td>Valley</td>
<td>2 to 4 months</td>
</tr>
<tr>
<td>Drinking water and sewer</td>
<td>Valley</td>
<td>1 month to 1 year</td>
</tr>
<tr>
<td>Drinking water and sewer</td>
<td>Coast</td>
<td>1 to 3 years</td>
</tr>
<tr>
<td>Top-priority highways (partial restoration)</td>
<td>Valley</td>
<td>6 to 12 months</td>
</tr>
</tbody>
</table>
## Target States of Recovery

### Target States of Recovery: Water & Wastewater Sector (Valley)

<table>
<thead>
<tr>
<th>Event occurs</th>
<th>0–24 hours</th>
<th>1–3 days</th>
<th>3–7 days</th>
<th>1–2 weeks</th>
<th>2 weeks–1 month</th>
<th>1–3 months</th>
<th>3–6 months</th>
<th>6 months–1 year</th>
<th>1–3 years</th>
<th>3+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potable water available at supply source (WTP, wells, impoundment)</td>
<td>R</td>
<td>Y</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main transmission facilities, pipes, pump stations, and reservoirs (backbone) operational</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water supply to critical facilities available</td>
<td>Y</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for fire suppression—at key supply points</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for fire suppression—at fire hydrants</td>
<td>R</td>
<td>Y</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water available at community distribution centers/points</td>
<td>Y</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution system operational</td>
<td>R</td>
<td>Y</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Key to the Table

**Target Timeframe for Recovery:**

- **G** Desired time to restore component to 80–90% operational
- **Y** Desired time to restore component to 50–80% operational
- **R** Desired time to restore component to 20–30% operational
- **X** Current state (90% operational)
Portland’s Water System

2 Dams
100 miles of large pipe
2,200 miles of Smaller dia. pipe
58 Tanks

15,000 hydrants
40,000 valves
180,000 meters
38 pump stations
PWB Seismic Study Objective

- Comply with the Oregon Resilience Plan (ORP)
  
  i. Complete a seismic risk assessment of PWB’s water system.

  ii. Produce an infrastructure mitigation plan to meet or exceed the water recovery goals (target states of recovery) listed in the ORP.
PWB’s New Seismic Hazard Maps

- Four (4) PDF Maps along with four new ArcGIS layers in the City’s CorporateGIS system
  - Liquefaction Susceptibility
  - Lateral Spread
  - Liquefaction Ground Settlement
  - Landslide Deformation
Recommendations

- 50-yr program to bring system up to the ORP goals
  - Includes pre-event mitigation projects, especially to backbone
  - Isolating areas that are most likely to experience heaviest damage during CSZ EQ
- Post event responses
Conduit Improvements – Bridges, Interties, Trestles
Groundwater Reliability
Reservoir Improvements
Willamette River Crossing
Questions?

Teresa.Elliott@portlandoregon.gov
Port of Portland
Seismic Risk Assessment
Port Properties

- Troutdale Reynolds Industrial Park
- Portland International Airport
- West Hayden Island
- Terminal 6
- Terminal 5
- Rivergate Distribution Center
- Portland International Center
- Troutdale Airport
- Gresham Vista
- Portland International Center
- Swan Island Industrial Park
- Terminal 4
- Terminal 2
- Hillsboro Airport
- Gresham Vista
Port Risks, Liquefaction, lateral spreading, & structural damage
Airfield Risks Due to Liquefaction
Differential Settlement & Sand Boils
PDX Terminal Complex (Seismic Codes)
Terminal Complex Seismic Risk
Differential Settlement - Columns & Slab on Grade

Older parts of the terminal do not have enough ductility to accommodate the liquefaction settlement.

Up to 17” of pile settlement in the oldest part of the terminal.
Electrical, Natural Gas, & Water Lines
Storm & Sanitary Sewer Lines
Aviation Fuel

Map of the airport area showing:
- Fuel Tank Farm
- Fire Station
- Terminal
- Oregon Air National Guard
- Marine Drive
- North Runway
- South Runway
- Airport Way
- Crosswind Runway
- Cornfoot Rd
- Alderwood
- 82nd Ave
Port of Portland Risk Assessment – Project Approach

• 18 Port assets identified as critical to Port operations – list developed from business continuity planning efforts and advisory team steering efforts

• Each asset exposed to site specific set of EQ’s (aggregate risk) and consequences were analyzed by engineering team
  – Business disruption defined as “Port” and “Regional impacts” determined by asset down-time and Martin Study report
  – Asset damage due to ground motion and liquefaction

• Mitigation strategies for assets were developed which substantially reduce the expected damage.

• Benefit-Cost analyses were conducted to determine if the large mitigation costs can be justified
## Port Seismic Risk – Asset Values & Business Interruption

<table>
<thead>
<tr>
<th></th>
<th>Asset Values</th>
<th>Port Revenue</th>
<th>Regional Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost to Replace</td>
<td>Time to Replace</td>
<td>Annual Revenue</td>
</tr>
<tr>
<td>PDX</td>
<td>$2.0B</td>
<td>3</td>
<td>$114.7M</td>
</tr>
<tr>
<td>T4</td>
<td>$40M</td>
<td>3</td>
<td>$2.3M</td>
</tr>
<tr>
<td>T5</td>
<td>$45M</td>
<td>3</td>
<td>$4.0M</td>
</tr>
<tr>
<td>T6</td>
<td>$139M</td>
<td>2.5</td>
<td>$3.6M</td>
</tr>
<tr>
<td>HIO</td>
<td>$66M</td>
<td>1.5</td>
<td>$1.2M</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2.29B</strong></td>
<td><strong>$125.8M</strong></td>
<td><strong>$377.4M</strong></td>
</tr>
</tbody>
</table>
Terminal Complex - Seismic Codes

<table>
<thead>
<tr>
<th>Area(s)</th>
<th>Seismic Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, D2</td>
<td>1985</td>
</tr>
<tr>
<td>A, D1, T7, E, T6</td>
<td>1988</td>
</tr>
<tr>
<td>P1, T1</td>
<td>1991</td>
</tr>
<tr>
<td>B, C1, C2, C3, T2, Canopy &amp; Roadway</td>
<td>1994</td>
</tr>
<tr>
<td>T3, T4*, CCC</td>
<td>1997</td>
</tr>
<tr>
<td>HQP2</td>
<td>2006</td>
</tr>
</tbody>
</table>

* T-4, 1958 structure, recent seismic upgrade primarily deplaning level some upgrades to enplaning level during Oregon Market Redevelopment in 1986 and TAP in late 90’s.
# Key Buildings Seismic Performance

<table>
<thead>
<tr>
<th>Building</th>
<th>Year Built</th>
<th>Seismic Upgrade?</th>
<th>Liquefaction</th>
<th>LFRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - CUP</td>
<td>’72, ’92, ’94</td>
<td>1998</td>
<td>Short Piles</td>
<td>Force Capacity</td>
</tr>
<tr>
<td>3 - Concourse C</td>
<td>1999</td>
<td>NO</td>
<td>Long Piles</td>
<td>Ductility</td>
</tr>
<tr>
<td>4 - T1 Terminal Ticket Lobby</td>
<td>’73, ’96</td>
<td>1996</td>
<td>Short Piles</td>
<td></td>
</tr>
<tr>
<td>4 - T2 Terminal South Node</td>
<td>1999</td>
<td>NO</td>
<td>Long Piles</td>
<td></td>
</tr>
<tr>
<td>4 - T3 Terminal OMP South</td>
<td>’56, ’86, ’02</td>
<td>2002</td>
<td>Mixed Piles</td>
<td></td>
</tr>
</tbody>
</table>

**Force Capacity** is a comparison of original design Code force vs current Code design force.

**LIQUEFACTION**
- Short Piles
- Long Piles
- Mixed Piles

**LFRS**
- Force Capacity
- Ductility

Legend:
- Green: Good
- Yellow: Fair
- Red: Poor
CUP example – Current State Anticipated Structural Damage

- Estimated Downtime = 12 months
- Damage to interior and exterior non-structural elements and utilities
- Settlement of non-pile supported tunnel
- Damage to slab-on-grade and structure from liquefaction settlement
- Damage to equipment in yard from liquefaction settlement
Seismic Risk Mitigation CUP – Structural Mitigation Scheme

Mitigation Estimated Cost = $16.2M

- Add micropiles for slab-on-grade support at key equipment (typical)
- Install micropiles at building columns (typical)
- New concrete shear wall and/or flying buttress (typical)
- Encase existing tunnel in new pile-supported concrete tunnel
- Replace brick and concrete masonry exterior wall with metal panel, or similar system (typical)
- Diaphragm and drag tie reinforcing at Mezzanine and Roof levels
- Install flexible connections at utilities entering the building (typical)
- Add micropiles for slab-on-grade support at key equipment in yard (typical)
Seismic Risk Mitigation - Retrofits for PDX Buildings

At 475-year Shaking Level

Retrofits are most effective at CUP, T1, and T3. (Concourses C1, C2, C3 already perform well.)

Individual building benefits / cost estimates are complicated by the “systems” effects in the business interruption model, including runway closures.
Seismic Resiliency – Next Steps

• Need for Port policy and targets integrated with state and regional plans and expectations

• Infrastructure strategy – phased investments over 50 years
  – Identify critical facilities, infrastructure and conduct risk assessment
  – Establish resilience targets
  – Recommend phased and strategically prioritized investments

• Develop financial strategies for funding – FEMA grants

• Prioritize and integrate strategies into planning and capital improvement projects
Operations Resiliency Goals

Aviation

• 30% of current activity levels, 5 MAP, 65,000 operations
• Airport Design Group III, no international flights
• 14 gate terminal complex
• Roadways,
• Vehicle parking (close in, remote, employees)
• Bussing, fueling & related maintenance facilities

Marine

• Focus on regional recovery, not recovery of revenues
• Allow 4M tons of throughput two weeks after the event
Building Performance Goals

Operational

Immediate Occupancy

Life Safety

Collapse Prevention

Port of Portland
Seismic Risk Assessment
Runway Mitigation Strategies:
Jet- and Silicate-grouted Soils: No Settlements or Ground Damage
Questions?
Ensuring strategic emergency response with seismic work.

Siobhan Kirk
Capital Program Manager

Tualatin Valley Fire & Rescue
An Owner’s Perspective

- Who We Are
- Tackling Capital Projects
- Going Above Code to Ensure Emergency Response
Who We Serve?

- **11 Cities**
- **4 Counties**
- **25 Career Fire Stations**
- **2 Operating Centers**
- **1 Command Center**
- **497K+ Residents**
- **390 Sq. Miles**
- **43,363 Incidents in 2016**

Partnerships in 2016 Improve Regional Response
Our Mission

TVF&R is committed to creating safer communities through prevention, preparedness and effective emergency response.
PLANNING FOR THE FUTURE

Fast & Effective Response
Establishing a Plan
Relocate TVF&R Command & Business Operations Center
Voluntary Upgrades
Safety Measures
Rebuild Existing Fire Stations
New Stations

- Land Acquisition
- Station Construction
Seismic Upgrade of Existing Stations & Facilities
Seismic Performance Levels

Operational  Immediate Occupancy  Life Safety  Collapse Prevention

Loss

Graphic by Ron Hamburger, EQE International

0% 100%

FEMA

nehrp
Work in Progress

Temporary Quarters
Examples of Seismic Work
Accountability

- Online Project Updates
- News Coverage
- Open Houses
- Annual Newsletter
- Budget Reports
Overcoming Challenges
Siobhan.Kirk@tvfr.com
503-259-1219
Resources available for small/rural communities to address seismic resilience

UNIVERSITY OF OREGON
COMMUNITY SERVICE CENTER (CSC)

Michael Howard, AICP, CFM
PRESENTATION OVERVIEW/GOALS

• Introduce Resilience and Recovery Concepts

• Resources
  • Federal
  • State
  • Local
  • Private sector
THE CSC LINKS THE ENERGY, EXPERTISE AND INNOVATION OF THE UNIVERSITY OF OREGON WITH THE PLANNING AND PUBLIC POLICY NEEDS OF OREGON COMMUNITIES.
THE CLASSROOM AND THE COMMUNITY

• The classroom provides a foundation for community-based learning
  • Analytical skills
  • Theory, history

The community provides the framework and motivation for learning
  • Real problems
  • Real people
CSC FOCUS AREAS

- Natural Resources
- Social Planning
- Community and Economic Development
- Energy
- Food Systems
- Housing
- Transportation
- Parks & Recreation Planning
- Natural Hazards and Community Resilience
What is Resilience?

The ability to anticipate, absorb, adapt to, and recover from disruptions.
RESILIENCE OF WHAT?

• Emergency Services (evacuation, response, recovery)

• Citizens, property and infrastructure

• Energy and transportation systems

• Food and water systems

• Social systems

• Local Economy

• Natural systems

Photo Credit: Horning Geosciences; Source: Oregon Resilience Plan
How do you achieve Resilience?

Stockholm Resilience Center - Seven Principles:

- Maintain diversity and redundancy
- Manage connectivity
- Manage slow variables and feedback loops
- Foster complex, adaptive systems thinking
- Broaden participation
- Encourage learning
- Promote polycentric governance systems
Magnitude 9.0 Paradigm Shift

Can we learn from other similar events or do we have to learn the hard way?
RESOURCES AND TOOLS
WHAT IS HAPPENING?

• State Office of Resilience
• Seismic Rehab Grants (SRGP)
• ODOT bridge retrofits
• Recent updates to tsunami inundation maps
• DLCD Tsunami Land Use Guide
• Cascadia Rising exercise
• Building Codes Division Earthquake Inspection Program
RESOURCES – FEDERAL

• Federal Emergency Management Agency (FEMA)
  • Pre-Disaster Mitigation Grant Program (PDM) - http://www.fema.gov/pre-disaster-mitigation-grant-program
  • Hazard Mitigation Grant Program (HMGP) - http://www.fema.gov/hazard-mitigation-grant-program
RESOURCES – FEDERAL

• Federal Emergency Management Agency (FEMA)

• General Information – www.fema.gov/private-sector

• Tools for Business (e.g. COOP) - www.ready.gov/business

• Small Business Resource – www.fema.gov/small-business-toolkit

• Small Business Administration Disaster Loan Program (SBA) - https://www.sba.ogv/loans-grants/see-what-sba-offers/sba-loan-programs/disaster
RESOURCES – FEDERAL

• Economic Development Administration (EDA)
  • Restore Your Economy - http://restoreyoureconomy.org/

• Housing and Urban Development
  • Community Development Block Grants
    • CDBG-Disaster Recovery
    • CDBG Entitlement communities program
  • HOME Investments Partnerships Program (HOME)
  • Affordable housing grants
The nearly one-hundred year old water reservoir (10 million gallons) was substantially improved through this seismic retrofit for another one hundred years of operation.
RESOURCES – STATE

• Department of Land Conservation and Development (DLCD)
  • Technical Assistance Grants (TA) -
    https://www.oregon.gov/LCD/Pages/grants.aspx

• Infrastructure Finance Authority
  • Seismic Rehabilitation Grant Program -
    http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehap/
RESOURCES – STATE

- OMD-Office of Emergency Management
  - Oregon Local Disaster Assistance Loan and Grant Account
  - Debbie Moller, Private Sector Program Manager 503-378-3734, debbie.moller@state.or.us
STATE CASE STUDY: ROSEBURG HIGH SCHOOL GYM (SRGP)

$1.5 Million SRGP Grant

Total Cost: $2.2 Million (remainder paid by school district)

Photo Credit: KPIC 4 News
RESOURCES – LOCAL

• Comprehensive Plan
• Development/Zoning Code
• Annual Budget (local bonds)
• Transportation System Plan
• Capital Improvement Plan
• Business Continuity and Operations Plans
• Urban Renewal Plans
• Facilities Maintenance Plans
LOCAL CASE STUDY: WALDPORT HIGH SCHOOL (LINCOLN CO SD)

Relocated school outside of the Tsunami Inundation Zone (2006)

• 2007 DOGAMI RVS rated facility as having “High” collapse potential (>10%)

• Located on low ground within the “Small” Tsunami scenario

• Escape routes landslide prone

• Building moved to a site on a bluff outside tsunami zone and shared with Crestview Heights Elementary

• $15.3 Million
  • Up to $15 million in interest free Qualified School Construction Bonds
  • $3 Million PDM (FEMA)

• 11.5 acre former site is permanent open space

Source: gLAS Architects, LLC

Old Site

New Site
LOCAL CASE STUDY: GRANTS PASS RESERVOIR

Built new 5MG reservoir to address 1.5MG deficit on site of previous reservoir

AWWA D110 standards selected for seismic zone:

- vertical pre-stressing tendons,
- seismic cables at the wall-to-floor connections, and
- circumferential strand wrapping
- flexible expansion joints.

Bond secured at low rate keeping water rates about the same.
RESOURCES – OTHER

• Institute for Business and Home Safety (IBHS)
  • Open For Business - Small Business Tool Kit
  • Fortified for Safer Business – Voluntary Building Code
THANK YOU!

Community Service Center
University of Oregon
csc.uoregon.edu

Mike Howard, AICP, CFM
mrhoward@uoregon.edu
ADDITIONAL SLIDES IF TIME
SOBERING BUSINESS STATISTICS

- 40% never reopen (FEMA)
- 25% failure rate within one year (FEMA)
- 90% failure rate after two years (US SBA)

Christchurch NZ, 2011 – The Central Business District is still closed today.
ECONOMIC DEVELOPMENT IDEAS

◆ Partner with local businesses
  ◆ Businesses have a lot at stake in Eugene. They also employ local residents. Give business a seat at the table when considering how to protect future economic development investments.

◆ Leverage external funding!
  ◆ Have an Urban Renewal District? Main-Street Initiative? MUPTE? If so, can you use those funding tools / incentives to retrofit buildings, elevate critical equipment or build to higher code standards?

◆ Incentivize investments in business resilience
  ◆ Reduce business license fees for businesses that have business continuity plan; 1% reduction in property taxes (or other tax) for businesses that have an employee preparedness training program; expedite plan review for hazard retrofit/mitigation projects.

The average loss for firms WITH resiliency investments was $487,000 compared with $3.4 million for those without...
KEY BUSINESS STRATEGIES

• Inform local businesses about the need for continuity planning.

• Coordinate with local chambers of commerce and community development agencies to form a business continuity subcommittee

• Encourage businesses to develop, test and implement business continuity plans.
KEY BUSINESS STRATEGIES

• Inventory local businesses capable of providing services, material, and equipment needed in the event of a natural disaster.

• Solicit, pre-approve and contract with local businesses, contractors and vendors for services, materials and equipment following a disaster.

• In cooperation with large employers, business clusters, or dense commercial areas located within hazard zones, develop strategy to harden, elevate, re-locate or otherwise mitigate natural hazard impacts.
EDA GUIDANCE

CFR 303.7

• As a performance-based plan, the CEDS will serve a critical role in a Region's efforts to defend against economic dislocations due to global trade, competition and other events resulting in the loss of jobs and private investment.

• ... each CEDS must promote Regional resiliency and be unique and responsive to the relevant Region.
WHAT EDA REQUIRES

CEDS Elements

(a) summary of regional economic development conditions
(b) in-depth regional SWOT analysis
(c) strategies and implementation plan that is consistent with applicable State and local economic development or workforce development strategies
(d) performance measures used to evaluate the Planning Organization’s successful development and Implementation of the CEDS.

The CEDS should also include how it is supporting and advancing economic resilience in the region.
INTEGRATE RESILIENCE INTO THE CEDS (NADO)

- Detailed analyses of regional vulnerabilities in SWOT assessments
- Inclusion of regional disaster preparedness and recovery efforts
- Strategies to diversify the economy or realign the workforce to support emerging industries
- Resilience objectives built off of statewide initiatives or related regional planning efforts
- Or, all of the above.
RESOURCES – HISTORIC

- Federal Emergency Management Agency (FEMA)
  - General Information (policy, guidance, etc.)
- Preservation Leadership Forum
  - Preparing for Climate Change Reading List
- National Trust for Historic Preservation
  - General Main Street Preparation Articles
  - Flood Response for Historic Buildings
- Heritage Preservation – National Institute for Conservation
  - Resources for Response and Recovery