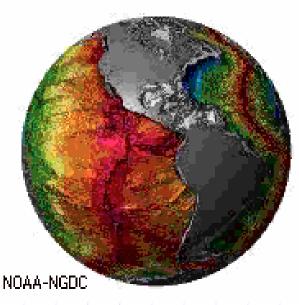
#### The Oregon Resilience Plan For Water & Wastewater Systems House Committee on Veteran's Services and Emergency Preparedness and

Senate Committee on Veterans and Emergency Preparedness

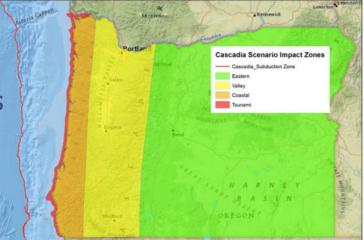


June 20, 2013

Michael Stuhr, PE Chief Engineer Portland Water Bureau

# Water & Wastewater Resilience Plan

- Co-chairs: Mark Knudson (TVWD) and Mike Stuhr (PWB)
- Participants included representatives of ~ 45% of state
  - Portland, TVWD, Salem, Gresham, Eugene, Coos Bay, Bend, Pendleton
  - PSU, OSU, U of P, multiple consultants
- Four zones: Tsunami, Coast, Valley, East
- Approach
  - Identify event (maps)
  - Identify requirements & expectations
  - Identify performance of existing systems
  - Identify interdependencies
  - Identify "gaps" in systems performance
  - Generate recommendations



Cascadia Scenario Impact Zones

# Why Are Water/WasteWater (W/WW) Systems Vulnerable?

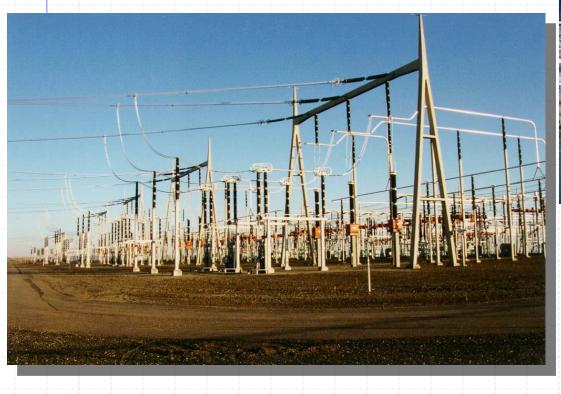
- Causes of damage
  - Tsunami (inundation)
  - Shaking (acceleration & velocity)
  - Permanent Ground Deformation (landslide, liquefaction, subsidence)
  - Cumulative effects
- System Vulnerability



# Large, complex systems, multiple failures Source, treatment, pumping, storage, distribution



# Recovery highly dependent on other systems Energy, transportation, people, equipment, financial





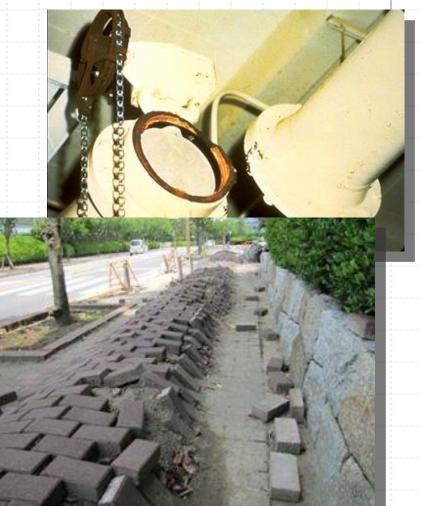


# Age, age, age (and condition)



## Pipelines vulnerable to structural damage





# Connections to structures



#### Leaks, breaks & damage "after the meter"



# Resiliency Goals (Valley)

#### TARGET STATES OF RECOVERY: WATER & WASTE WATER SECTOR

	Event	0–24 hours	1–3 days	3–7 days	1 week- 2 weeks	2 weeks- 1 month	1 month – 3 month	3 month – 6 month	6 month -1 year	1 year- 3 years	3 + years
Domestic water supply	-m.										
Potable water available at supply source. (WTP, wells, impoundment)		R	Y		G			x			
Main transmission facilities, pipes, pump stations, and reservoirs ("backbone") operational		G					x				
Water supply to critical facilities available.		Y	G				X				
Water for fire suppression – at key supply points.		G		X							
Water for fire suppression – at fire hydrants.				R	Y	G			X		
Water available at community distribution centers/points			Y	G	X						
Distribution system operational			R	Y	G				X		
Wastewater systems											
Threats to public health & safety controlled.			R	Y		G			X		
Raw sewage contained & routed away from population		R		Y			G		X		
Treatment plants operational to meet regulatory requirements					R			Y	G		х
Major trunk lines and pump stations operational					R		Y	G			Х
Collection system operational							R	Y	G	X	
	Event	0–24 hours	1–3 days	3–7 days	1 week– 2 weeks	2 weeks-1 month	1 month – 3 month	3 month – 6 month	6 month -1 year	1 year- 3 years	3 + year

#### **Evaluating Pipeline System Performance** PGA, Landslides & Liquefaction

Washington

#### Peak Ground Acceleration (PGA)

0.4 - 0.45

This map was prepared by The Oregon Department of Geology and Mineral 0 - 0.05 Industries (DOGAMI) for the use of the Oregon Seismic Safety Policy Advisory Commission in completing the Oregon Resilience Plan for Cascadia Subduction 0.05 - 0.1 Zone earthquakes. This map displays an estimate of the peak ground acceleration (PGA) to be expected from a magnitude 9.0 Cascadia earthquake 0.1 - 0.15 PGA is a quantitative measure of earthquake ground shaking that is widely use 0.15 - 0.2 by the engineering community for analysis and design. Non-technical users should refer to the companion Cascadia Damage Potential map that depicts th 0.2 - 0.25 severity of the scenario earthquake in terms of its effects on people and comm objects and structures. This PGA map was calculated using gridded 0.25 - 0.3 PGA values provided by Dr. Art Frankel of the USGS National Seismic Mapping Program and a map of Vs30 values that DOGAMI had previou 0.3 - 0.35 repared. Site amplification factors were calculated using the method 0.35 - 0.4 Boore and Atkinson, 2008 (EERI Earthquake Spectra Volume 24, No. 1

#### Permanent Ground Deformation (PGD) due to landslides



This map was prepared by The Oregon Department of Geology and Min Industries (DOGAMI) for the use of the Oregon Seismic Safety Policy Ad Commission in completing the Oregon Resilience Plan for Cascadia Su Zone earthquakes. This map displays an estimate of the probability of induced landsliding to be expected from a magnitude 9.0 Cascadia eart The probability was calculated using the methodology described in the MR4 technical manual, and provides results that are comparable to the for this landslide parameter. This map used a new landslide susceptib by DOGAMI that combines the HAZUS methodology with empirical rela geologic units in DOGAMI's Oregon Geologic Data Compilation (OGDC mapped landslides in DOGAMI's Statewide Landslide Information Datab (SLIDO version 2). The new map of expected peak ground acceleration calculated as part of the Plan scenario was used for the ground motion The Low category on this map includes the HAZUS 3% and 8% categori Medium class includes the 10% and 15% categories: the High class incl and 25% categories; and Very High includes the 30% category.

completing the Oregon Re This map displays an esti lateral spreading of liquef The deformation was calc MR4 technical manual, an this liquefaction paramete previously made by DOGA DOGAMI calculated as par 0-10 cm (0-4 inches); Med /erv hiał Very High, 100-1180 cm (3

High

### Evaluating Pipeline System Performance System Specific Pipe Performance Estimates

#### Estimate of main line leaks & breaks

- "Seismic Fragility Formulations for Water Systems" American Lifeline Alliance, 2011
- Based on empirical data from prior events
- Input: Peak Ground Velocity, Permanent Ground Deformation, length of pipe, pipe material
- Output: number of main leaks & breaks by pipe type

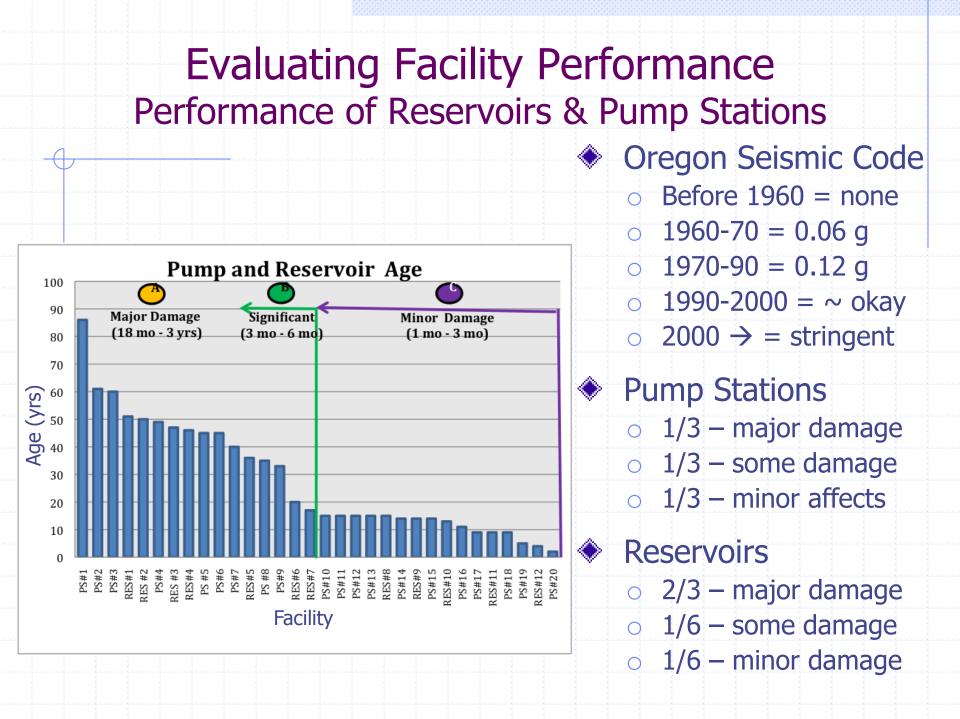
#### Estimate of service line leaks & breaks

- Based on anecdotal data for similar events
- About 7% of all service lines fail (2% on utility side & 5% on customer side)

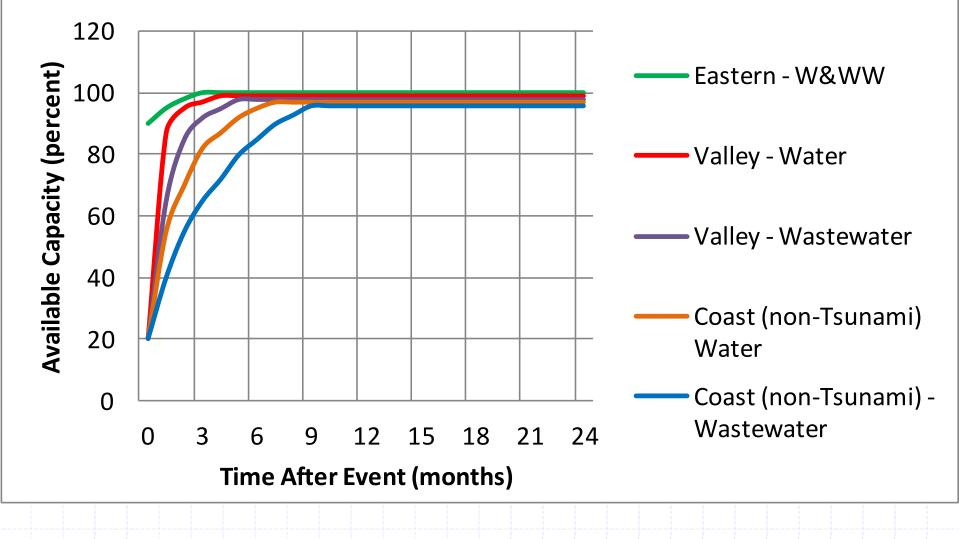
# Water Pipeline System Performance

Characteristic	Main Lines	Services		
Length, Number	4,592 miles	385,600 connections		
Number of Breaks	2,656	7,712 (utility side)		
Number of Leaks	941	19,280 (customer side)		
Total Leaks & Breaks	3,597	26,992		

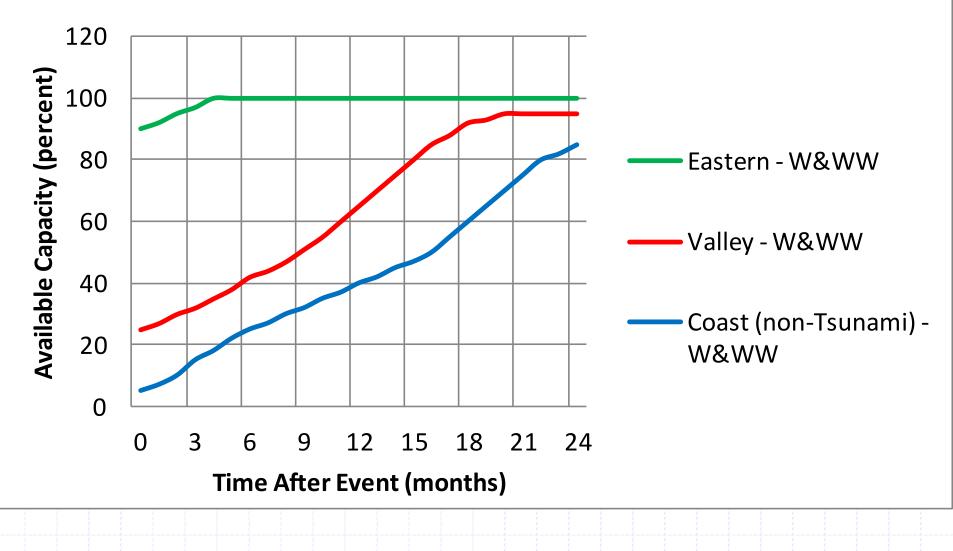
- Unprecedented number of pipeline failures
  Equivalent of ~16 years of breaks
- Will required ~3 months to repair
  - Assumes 3 hrs/break, 12hrs/d, 7d/wk, unlimited materials, equipment & transportation
  - Does not include repairs to customer-side



## Resiliency Goals Water & Wastewater System Performance



### Existing Condition Water & Wastewater System Performance



# Findings & Conclusions

- Significant gap between goals and existing state
  If CSZ EQ occurs today, it will result in dramatic change in "life as we know it" for W & WW
  Water generally better prepared than
- wastewater
- Eastern Oregon limited impacts
- Tsunami Areas take years to recover if ever
- Coast critically impacted; up to 3 years
- Extensive impacts to Valley; 6 months 1 year

# Findings & Conclusions

Resiliency upgrades will improve recovery times

Focus on system "backbone" & water supply to critical facilities

Costs will be significant but can be managed

# Recommendations

- Reset public expectations for recovery times Recommend Water/Wastewater utilities join ORWARN
  - Require seismic response plans by all sectors
  - Include business continuity, employee & family support
  - Require seismic assessments for all systems
  - Part of periodic update of master plans

## Recommendations

- OHA/DEQ require Water/Wastewater utilities to complete seismic risk assessment and mitigation plans as part of periodic updates to existing facility plans
- OHA/DEQ require Water/Wastewater utilities to include seismic design as part of system design
   OHA/DEQ work with Water/Wastewater utilites to define appropriate service levels, goals and expectations for post-EQ regulatory compliance

# Recommendations

Encourage public health agencies, water and wastewater utilities to plan for significant water quality impacts to the Willamette and Columbia Rivers.

