Seattle Fault Earthquake Scenario

Conference

February 28, 2005

Earthquake Engineering Research Institute




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Lifelines

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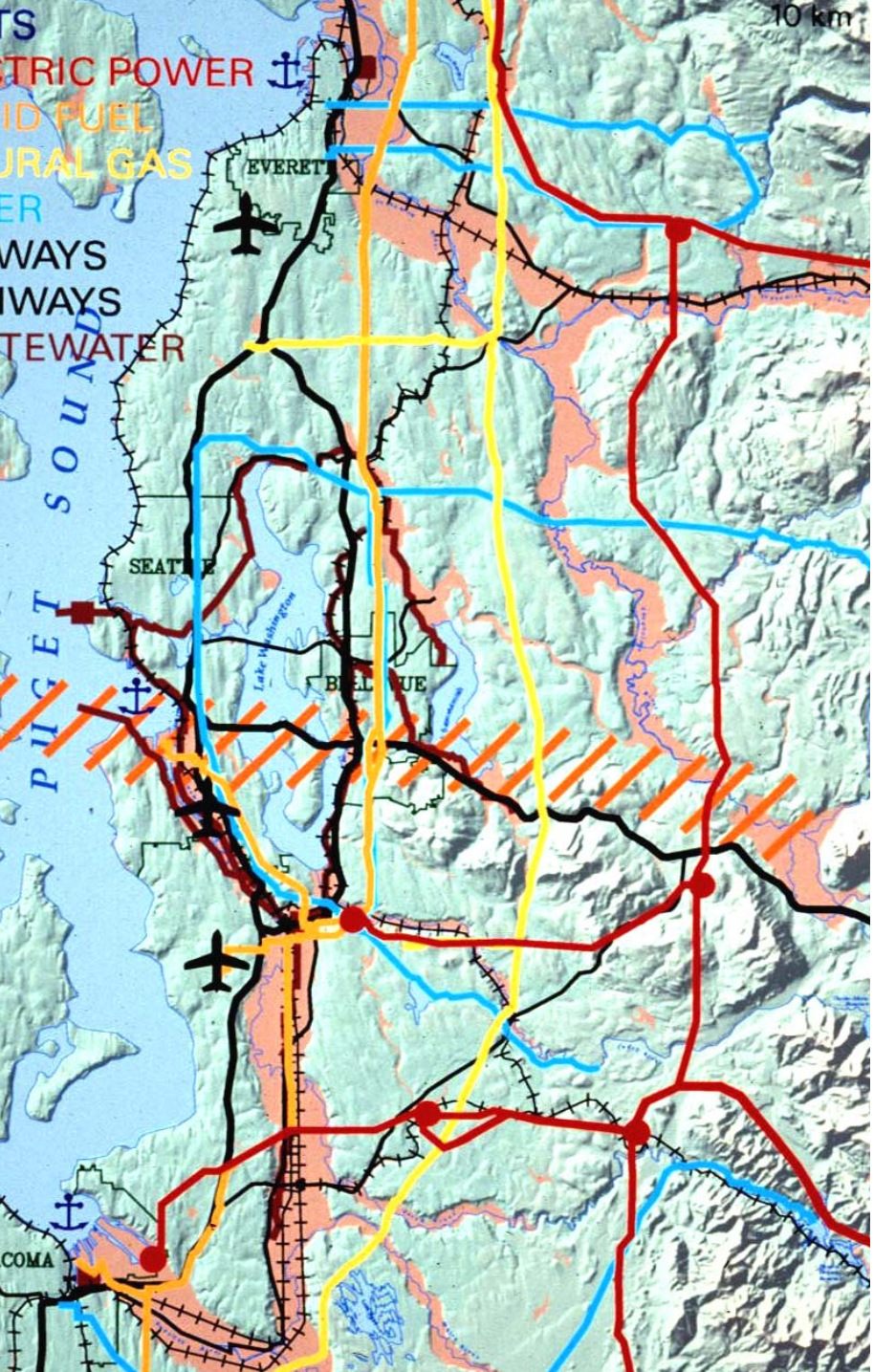
Lifeline Team

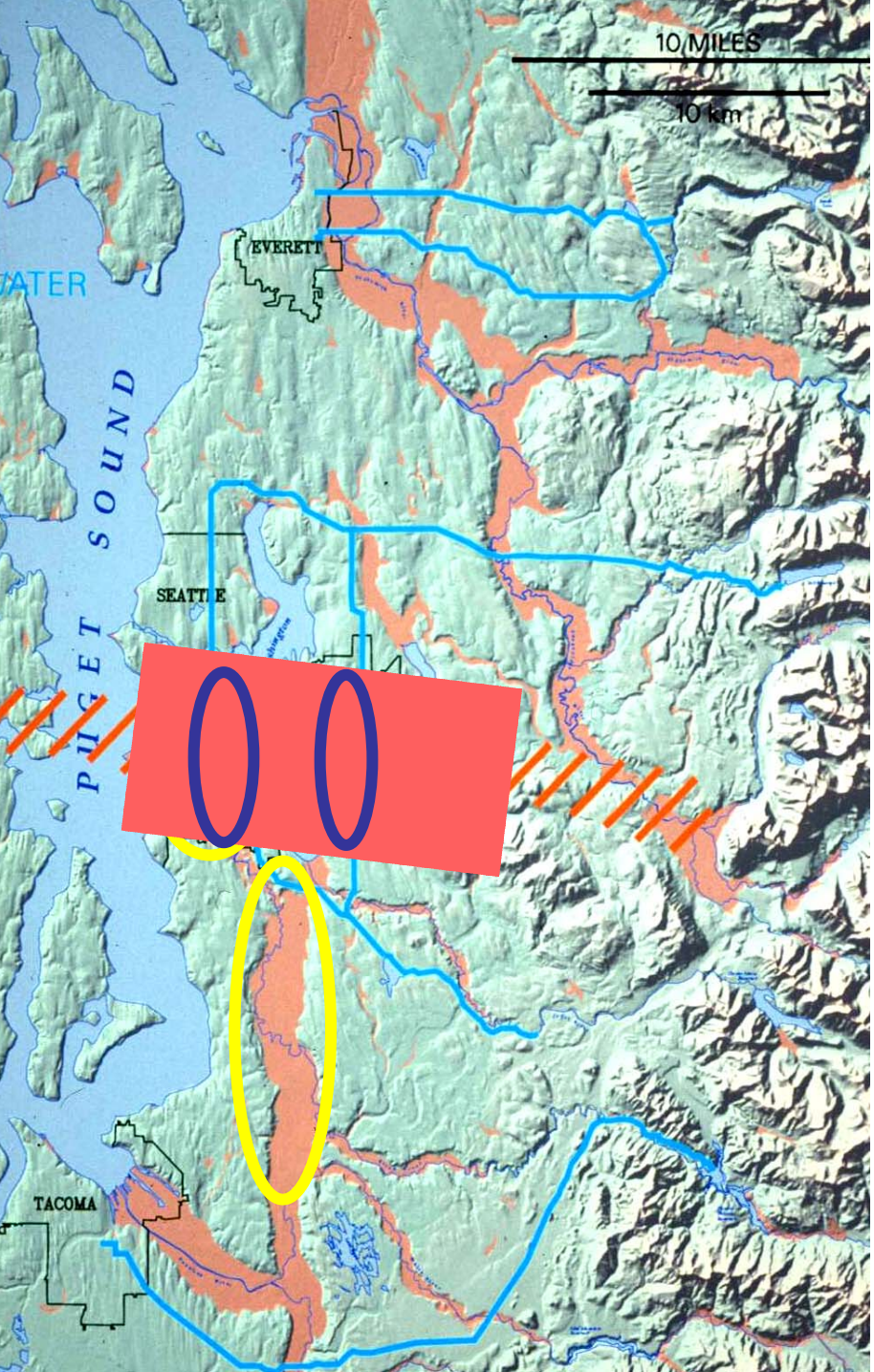
Engineer	Task	Organization
William Heubach	Water	Seattle Public Utilities
Leon Kempner	Electric Power	Bonneville Power Administration
Bob Peterson	Wastewater	King County Wastewater
Jane Preuss	Electric Power	Independent



Lifelines

- Water
- Wastewater
- Electric power
- Communications
- Liquid Fuel
- Natural Gas

- Pipeline network damage controlled by liquefaction
- Fault rupture damages N-S trending pipelines



Water

- Major supplies
  - Cascades (gravity)
  - Groundwater (pumping)
- Major N-S trending transmission lines severed.
- Pipeline systems in liquefiable soils.
- Tank damage due to shaking in areas with strong shaking.

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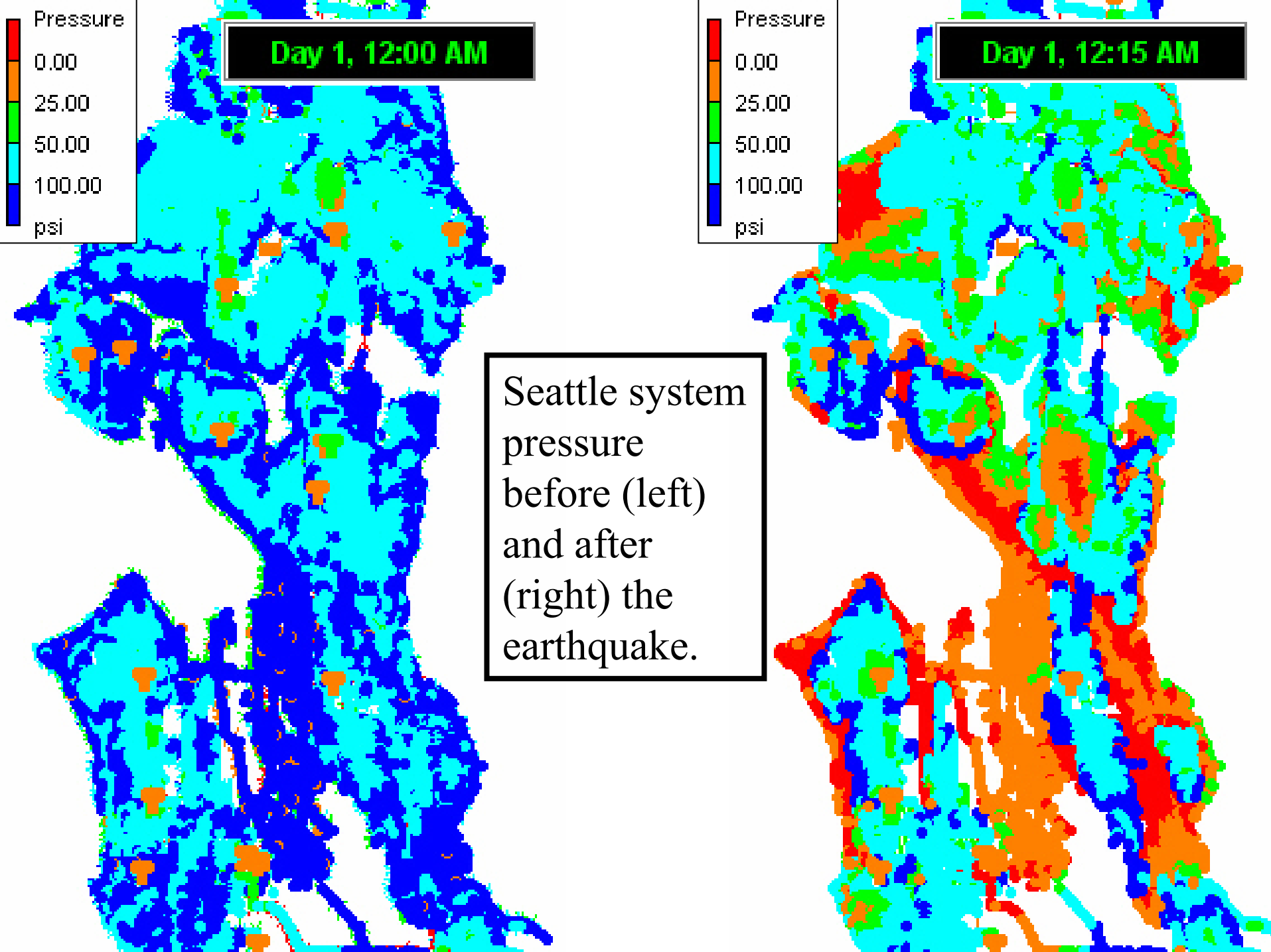
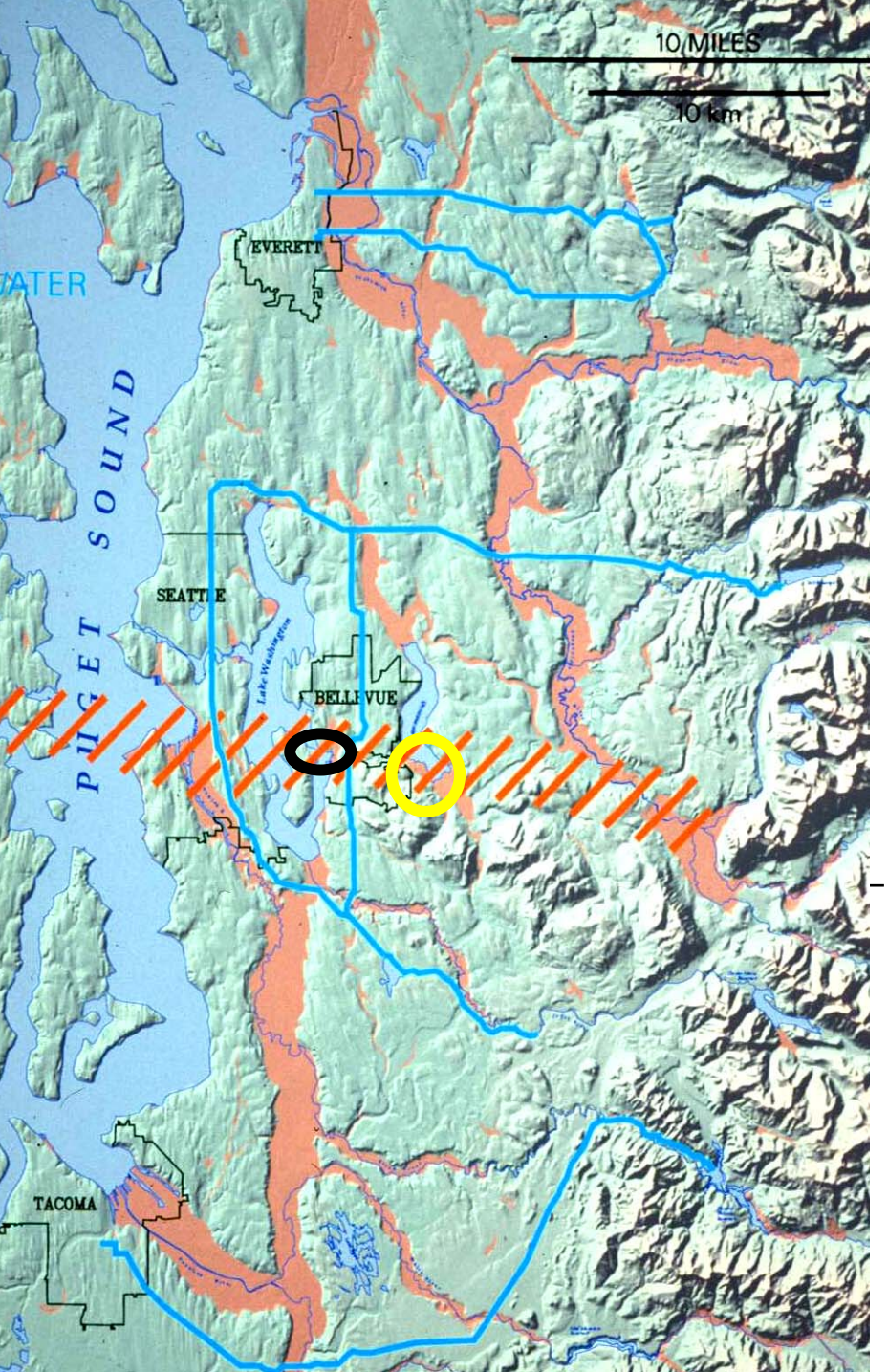
Water System Damage

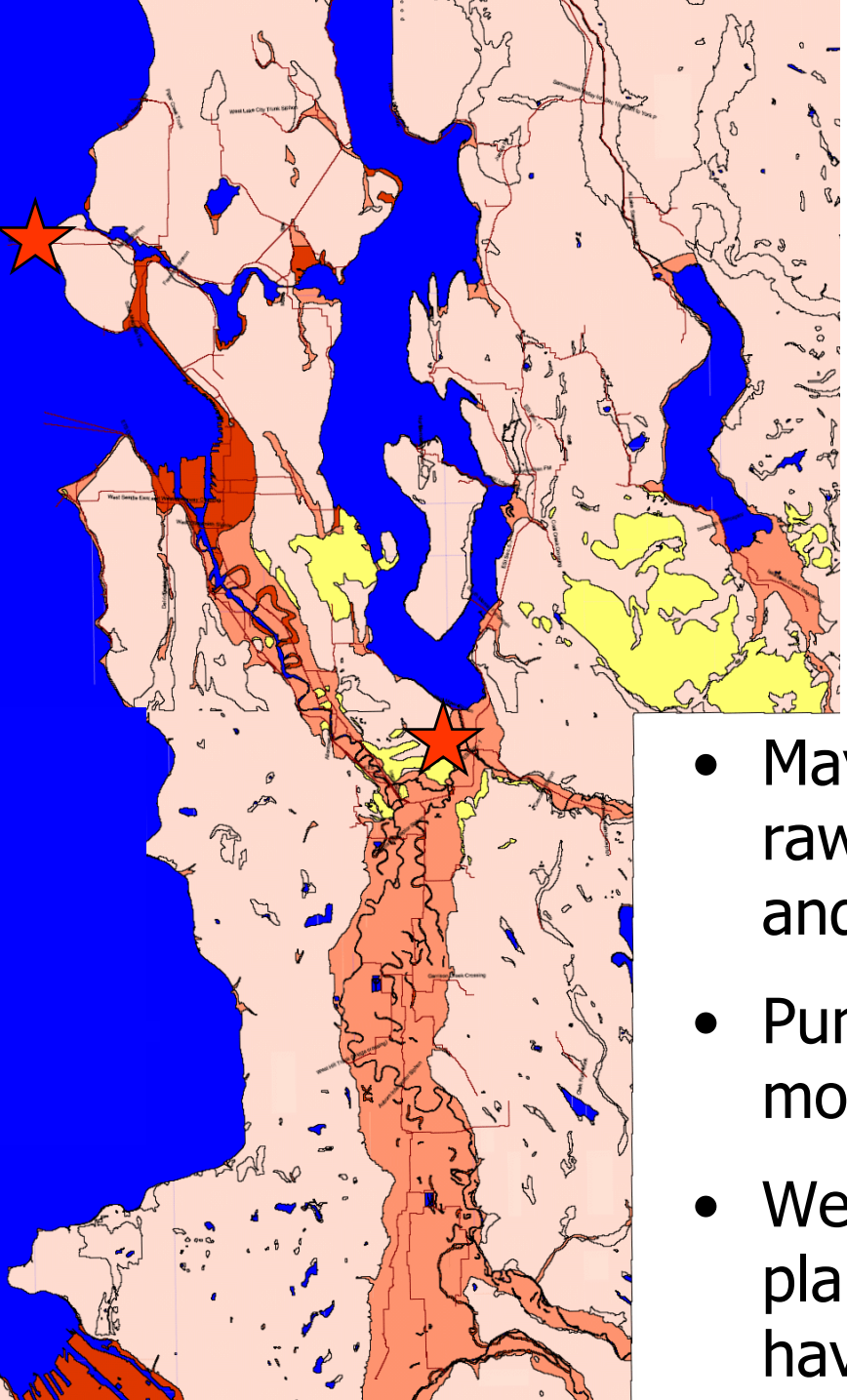


Seattle system pressure before (left) and after (right) the earthquake.



Water – cont.

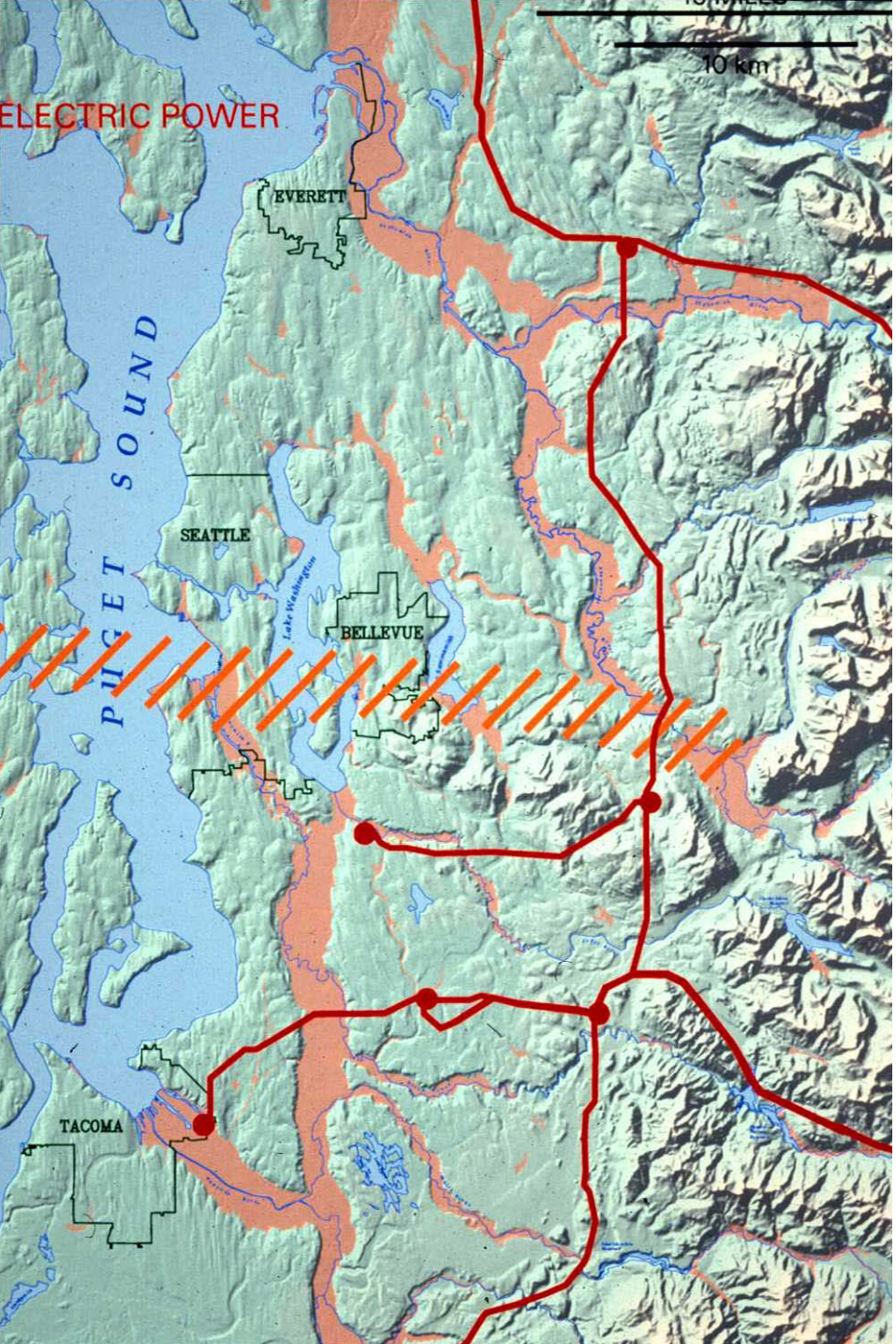
- Well supplies for Issaquah and Sammamish Plateau.
- Mercer Island water supply impacted by surface fault rupture
- Widespread outage immediately after the event for 1 – 3 days.
- Weeks outage in some pockets.



Wastewater System

- King County Wastewater provides whole collection and treatment in the highly impacted area. Cities and Districts provide collection.
- Collection systems in valleys vulnerable to liquefaction.
- May result in significant discharge of raw sewage into streams, rivers, lakes, and the sound lasting for months.
- Pump stations in liquefiable areas may move.
- West Point and Renton treatment plants are new/ upgraded, and should have limited damage.

Pipelines and manholes float in liquefiable soils.



Electric Power

- Biggest retail suppliers in impacted area – Seattle City Light (SCL), and Puget Sound Energy.
- BPA produces hydro, operates the major power transmission system.
- Most energy generated outside the region.
- Transmission lines are robust but are vulnerable to geotechnical failures in the mountains. (BPA lines in red)
- Substations are vulnerable. (BPA substations – red dots)

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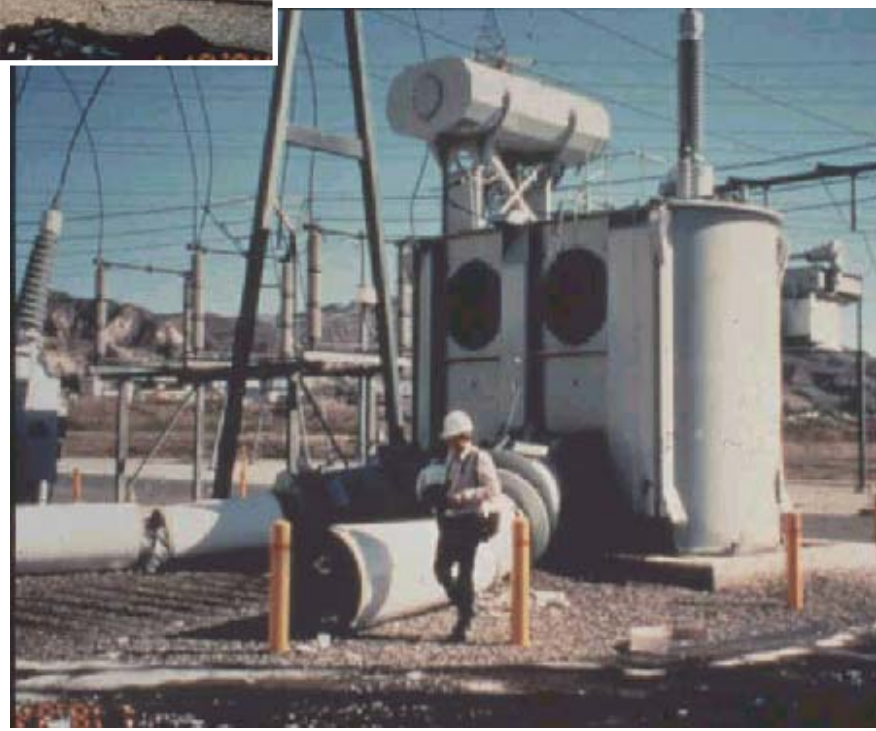
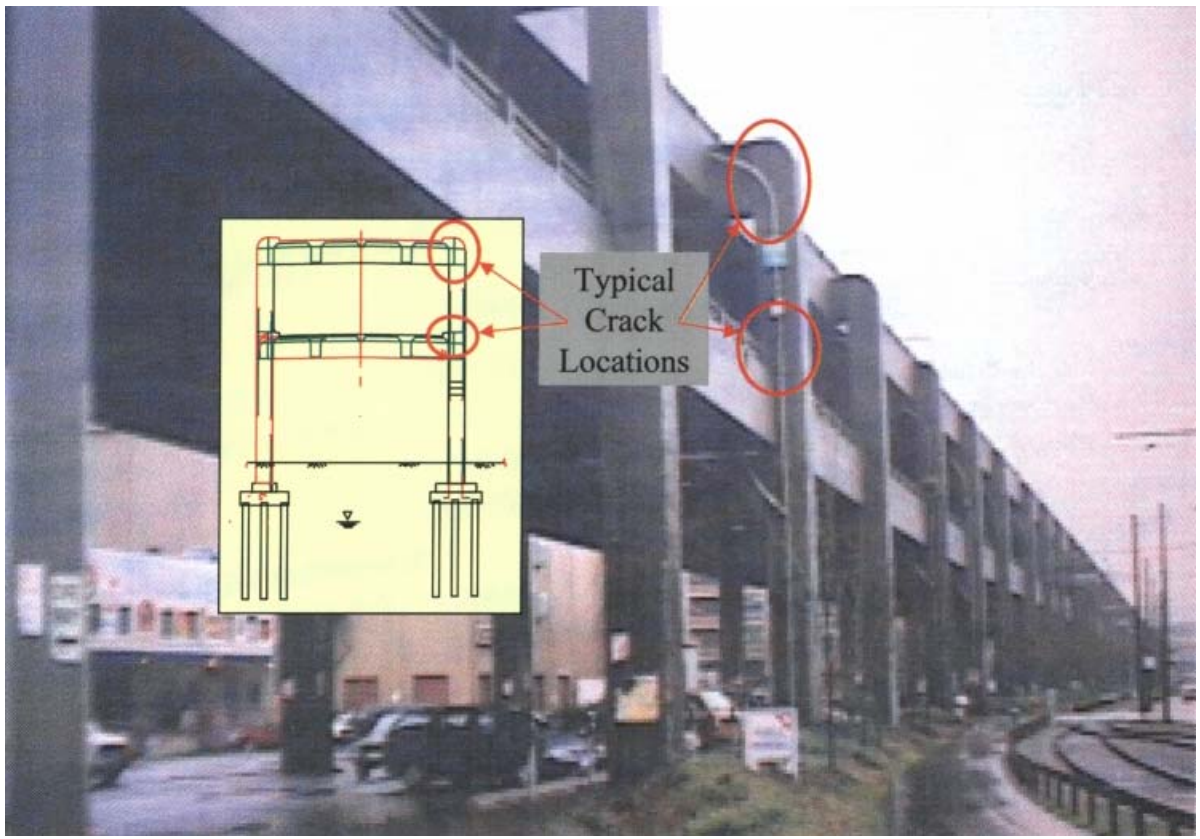
Electric Power - Substations

High voltage (230 and 500 kV) substations are highly vulnerable even to moderate shaking levels; transformers and porcelain insulators may take months to repair if damaged. Live tank circuit breakers, rigid busses, and wires (slapping together) are vulnerable.



Electric Power – cont.

- Regional outage of 24-72 hours or more, due primarily to self protecting systems.
- If BPA lost more than several substations, outages could last for weeks in some areas.



- SCL is somewhat self-reliant. A significant part of their in-town system runs on/below the Alaska Way Viaduct.
- If it collapsed, temporary power restoration could take up to 2 weeks.

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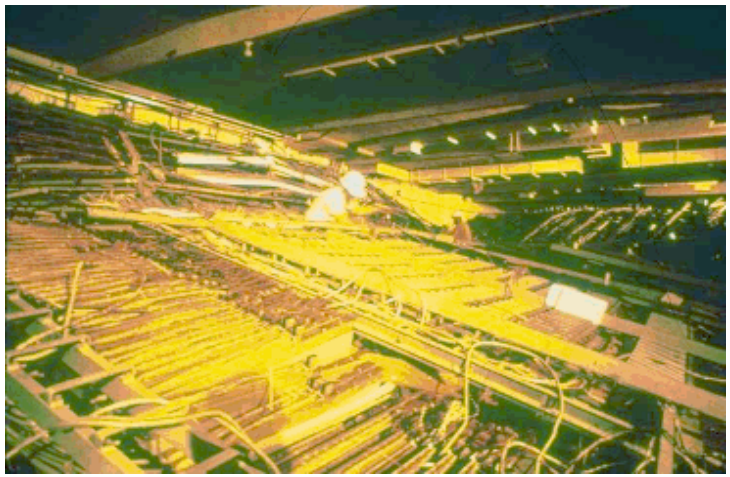
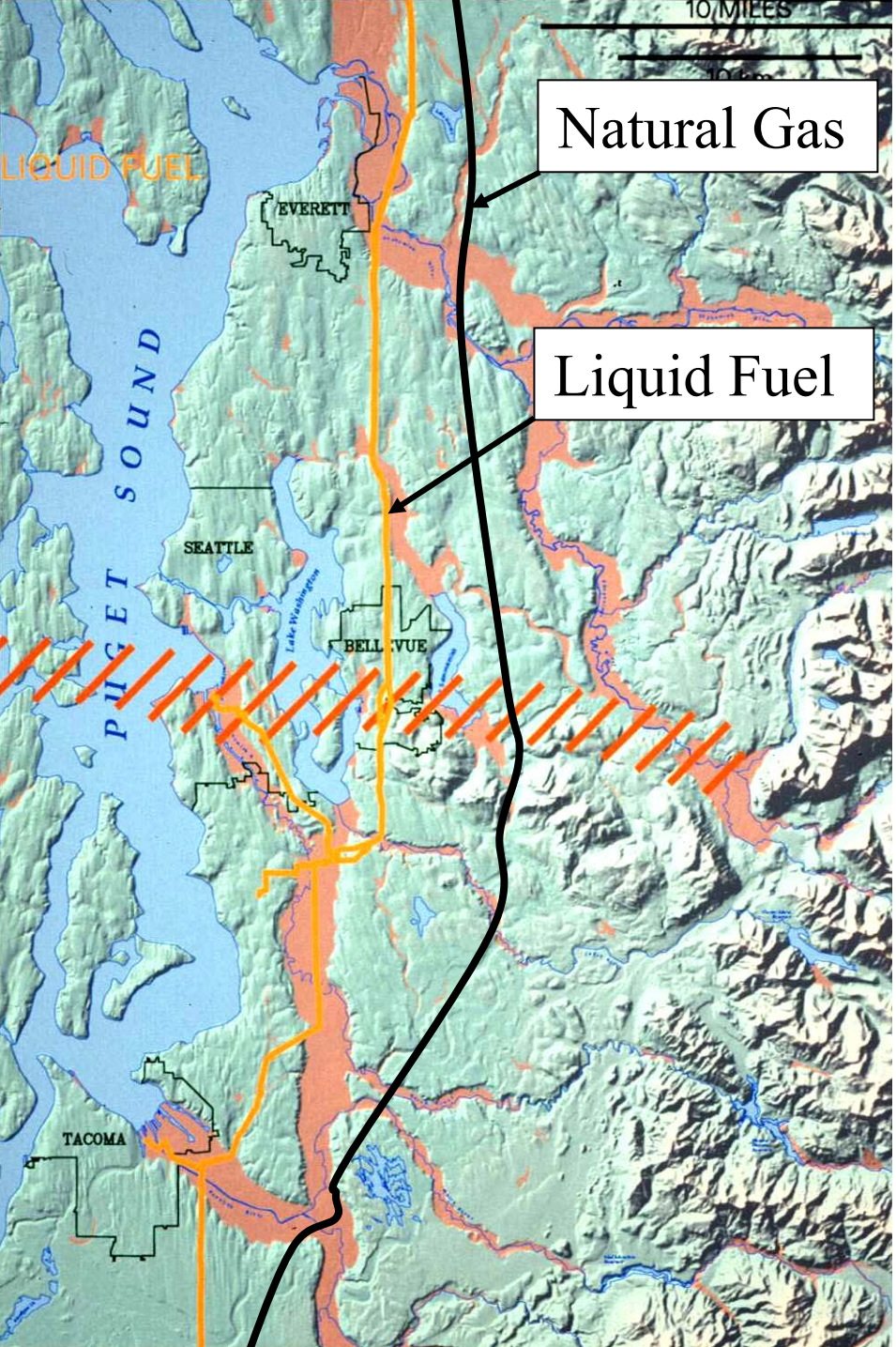
Telecommunications



- All systems overloaded
- Wire – Baby Bells used Bell Labs criteria. Systems are robust.
- Structural integrity of Central Offices unknown (i.e.- nodes linking Qwest long distance carriers, cellular.
- Wireless – basic earthquake anchorage, emergency power is a concern.



Natural Gas and Liquid Fuel

- Williams Pipelines transmit natural gas at high pressures.
- BP/Arco(Olympic) Pipeline transmits liquid fuel.
- Both pipelines may be vulnerable at the fault crossings.
- Otherwise, steel gas transmission pipeline primarily on stable soils – may be OK.
- PE and PVC gas distribution lines should have limited damage.



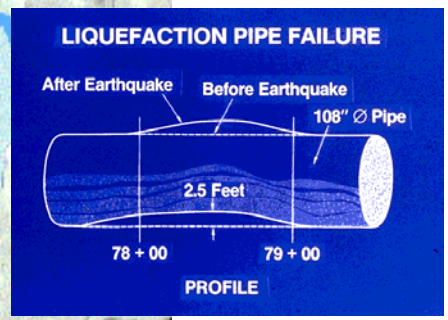

Natural Gas and Liquid Fuel – cont.

- Modern oil and gas transmission pipelines have performed well in past earthquakes, but have seen limited ground deformations.
- Most gas pipeline failures in the Northridge Earthquake were on old gas-welded joints (photos), but ground deformations were limited to < 1 foot.
- Liquid fuel pipelines vulnerable in liquefiable soils in Renton, down through the Kent Valley and along their alignments to the air and marine ports.

Renton Lifeline Cluster

- Water (blue)
- Wastewater (dark red)
- Liquid Fuel (yellow)
- Power (red)
- Transportation (black)

- High liquefaction susceptibility (pink)



Pipeline floated in 1965 Seattle Earthquake

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