Scenario Study Area

King, Pierce, Snohomish Counties

More than half state’s population.
- Six of the 10 largest cities in state.

Cornerstone of state’s economy.
- King County has 44 percent all jobs statewide.
- Major Employers: Boeing, Ports of Seattle and Tacoma, Microsoft, WaMu, Starbucks, Alaska Air Group, University of Washington, Military.
- WA is fifth largest exporter in nation.
- Ports of Seattle, Tacoma handle $52 billion waterborne international freight annually.
Estimated Losses

- Property, economic loss – $33 billion
- Deaths – 1,660
- Injuries – 24,000
- Buildings destroyed – 9,000
- Buildings unsafe to occupy – 29,700
- Buildings with restricted use – 154,500
- Property damaged by fire – $500 million
- Households displaced – 46,000
- People seeking shelter – 11,000
- Recovery time – Many years.
Key Response Concerns

• Urban search and rescue help needed.
• Lack of water inhibits firefighting.
• Cleanup of numerous hazardous materials, sewage spills.
• Standards of care adjusted for injured.
• Thousands of displaced individuals need shelter.
• Caring for vulnerable populations.
  — Disabled, seniors, school children.
• Communicating with non-English speaking people, ethnic communities.
Transportation and Recovery

• Correlation between transport damage & business disruption.
  – Northridge EQ, Great Midwest Flood: Transport disruption as costly as facility damage.
  – Kobe EQ: Transport, port damage slowed economic recovery of region.

• Port to Port study
  – Segments closed months to years.
  – Commerce movement difficult.
## Major Highways Near Seattle Fault

<table>
<thead>
<tr>
<th>Route</th>
<th>Vehicles per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate 5 (N-S through Seattle)</td>
<td>260,000+</td>
</tr>
<tr>
<td><strong>State Route 99 (N-S through Seattle)</strong></td>
<td>110,000+</td>
</tr>
<tr>
<td>Interstate 405 (N-S through Bellevue)</td>
<td>130,000+</td>
</tr>
<tr>
<td>Interstate 90 (Seattle east)</td>
<td>148,000+</td>
</tr>
<tr>
<td>State Route 520 (Seattle east)</td>
<td>100,000+</td>
</tr>
<tr>
<td>State Route 167 (north to Renton)</td>
<td>110,000+</td>
</tr>
</tbody>
</table>

**Alaskan Way Viaduct (SR 99)**

Built in 1950s on poor soils, near now-failing seawall. Damaged in 2001 EQ.

Replacement will take 6+ years.
Likely Impacts to Roads

**Damages**
- Parts of major highways experience major damage or bridge collapse.
- Local roads, bridges will experience damage.

**Immediate Impacts**
- Emergency services will be limited.
- Severe traffic congestion.

US 101 west of Olympia, M6.7 Nisqually Earthquake, 2001
Long-term Impacts

- Severe traffic congestion for 1 year or more
- 30 min. commutes could take hours
- Movement of goods will slow, affecting just-in-time inventories.
BNSF and UP handle about 200,000 tons/day, share a line south of Seattle.

Restoration of service may take much more than one week.

Loss of revenue is likely to exceed cost of repairs.
Seaports

Facilities on poor soils, fills. Damage expected to:
- Pier, wharves, seawalls
- Containers yards
- Cranes and other structures
- Buried infrastructure

Recovery:
- Multi-billion impact on local economy.
- Full economic recovery may take years (Kobe).

Port of Seattle, WA

Damage at Port of Kobe: Crane legs buckled, soils failed at container terminal
Airports

• EQ closes all airports immediately.
• Possibly a month or more to restore full operations.
• SeaTac International
  – Structural and non-structural damage
• Boeing Field & Renton Airport
  – Liquefaction and runway damage
  – Older structures may collapse
• Paine Field – Everett
  – Limited damage expected
Washington State Ferries

Major Concerns

- Piers and Terminal structures vulnerable.
- Liquefaction / Lateral Spreading similar to port damage.

Vulnerable Terminals

- Seattle/Colman Dock: Bremerton/Bainbridge routes
- Fauntleroy: Vashon/Southworth route

Planning

- System has contingency plans that can be implemented post-EQ.
- Use of other ferry terminals, port facilities will increase.
- Ferries may be used as an alternative mode of transportation.
Lifelines

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

Liquefaction will drive damage to underground pipelines.

Fault rupture will damage N-S trending pipelines.
Building Performance Factors

- Type of system (tilt-up, pre-cast, shear wall)
- Primary material (steel, concrete, wood)
- Year designed/built (year and code)
- Type of soil (soft soil vs. rock)
- Layout (irregular, regular, soft-story, high-rise)
- Quality of design, construction
Building Damage Estimates

- Significant damage to structures on poor soils.
- 4,000+ commercial structures with extensive damage.
  - Pre 1970-vintage buildings.
  - Tilt-ups
  - Unreinforced masonry
- About 20 percent of housing stock at least moderately damaged.
  - 46,000 households displaced (est. 115,000 people)
- Long-term impact on industry and economy.
School Damage Projections

At least moderately damaged

- King County – 55 percent
- Snohomish County – 22 percent
- Pierce County – 17 percent

Immediate concern

- Caring for thousands of children while parents try to reach them.

Intermediate and long-term concerns

- Where, when to house students to continue education and allow parents to return to work.
- Potentially expanding use of online education, home schooling for some students.
## Hospital Damage Projections

Table 6-1: Estimate of Number of Available Hospital Beds at Various Time Periods Following Event

<table>
<thead>
<tr>
<th>Time After Event</th>
<th>King County (4,400 Total Beds)</th>
<th>Pierce County (1,400 Total Beds)</th>
<th>Snohomish County (500 Total Beds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Beds Available</td>
<td>% Beds Available</td>
<td># Beds Available</td>
</tr>
<tr>
<td>1 Day</td>
<td>1,100</td>
<td>25%</td>
<td>1,110</td>
</tr>
<tr>
<td>3 Days</td>
<td>1,370</td>
<td>31%</td>
<td>1,160</td>
</tr>
<tr>
<td>7 Days</td>
<td>1,720</td>
<td>39%</td>
<td>1,230</td>
</tr>
<tr>
<td>30 Days</td>
<td>2,910</td>
<td>66%</td>
<td>1,340</td>
</tr>
<tr>
<td>90 Days</td>
<td>3,470</td>
<td>79%</td>
<td>1,390</td>
</tr>
</tbody>
</table>
Table 6-2: Projected Damage to Fire Stations

<table>
<thead>
<tr>
<th>Peak Ground Acceleration</th>
<th>% of Stations with Reduced Functionality</th>
<th>% of Stations Not Useable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 0.75g</td>
<td>More than 70%</td>
<td>20% to 30%</td>
</tr>
<tr>
<td>Between 0.45g and 0.75g</td>
<td>60% to 70%</td>
<td>10% to 20%</td>
</tr>
<tr>
<td>Between 0.30g and 0.45g</td>
<td>30% to 40%</td>
<td>Less than 10%</td>
</tr>
<tr>
<td>Between 0.15g and 0.30g</td>
<td>10% to 20%</td>
<td>Less than 5%</td>
</tr>
<tr>
<td>Less than 0.15g</td>
<td>Less than 10%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Some stations are in unreinforced masonry buildings in areas of poor soils.

Undamaged stations may find their garage doors jammed shut by the ground shaking.
Community Recovery Issues

• Restoring damaged transportation systems critical to recovery.
• Returning people to their homes.
• Federal (Stafford Act) disaster aid is limited.
  – Public Agencies face 25 percent match for repairs.
• Debris disposal.
• Economic revitalization:
  – Timing, funding of rebuilding, redevelopment.
  – Maintaining business viability.
  – Some businesses will fail, some will relocate.
• Restoring historic resources will be challenging.
  – Pioneer Square → poor soils
• Land-use: how best to protect and/or develop critical areas.
Individuals – The Bottom Line

• Those with fewest social, economic resources will have greatest difficulty recovering.
• Potential recovery, rebuilding resources:
  – Personal finances.
  – Insurance proceeds (State of Washington):
    • 10-20% covered for earthquake.
    • 25-30% covered for flood.
  – Government assistance is limited:
    • SBA Emergency Loans (credit worthy).
    • $28,800 FEMA grants (not credit worthy).
• Expect increased foreclosures, bankruptcies.
• Expect increased problems resulting from stress.
• Expect many will relocate outside the affected area.
Preparing for next disaster

• SoundShake ’08 earthquake exercise.
• Increasing involvement with private industry.
• Expanding outreach, communication with different cultures, in different languages.
• Establishing state-wide logistics and resource management framework.
• Updating state emergency plans to include catastrophic events.
• Developing scalable template for evacuations.
• WSDOT increasing pace of bridge retrofit program.
Questions?

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Scenario website
http://seattlescenario.eeri.org/documents.php