

# Seattle Public Utilities Resilience Planning

*March 2019*



# Presentation Outline

- Resilience framework
- Seismic program and background
- Seismic hazards
- Study findings
- Mitigation recommendations

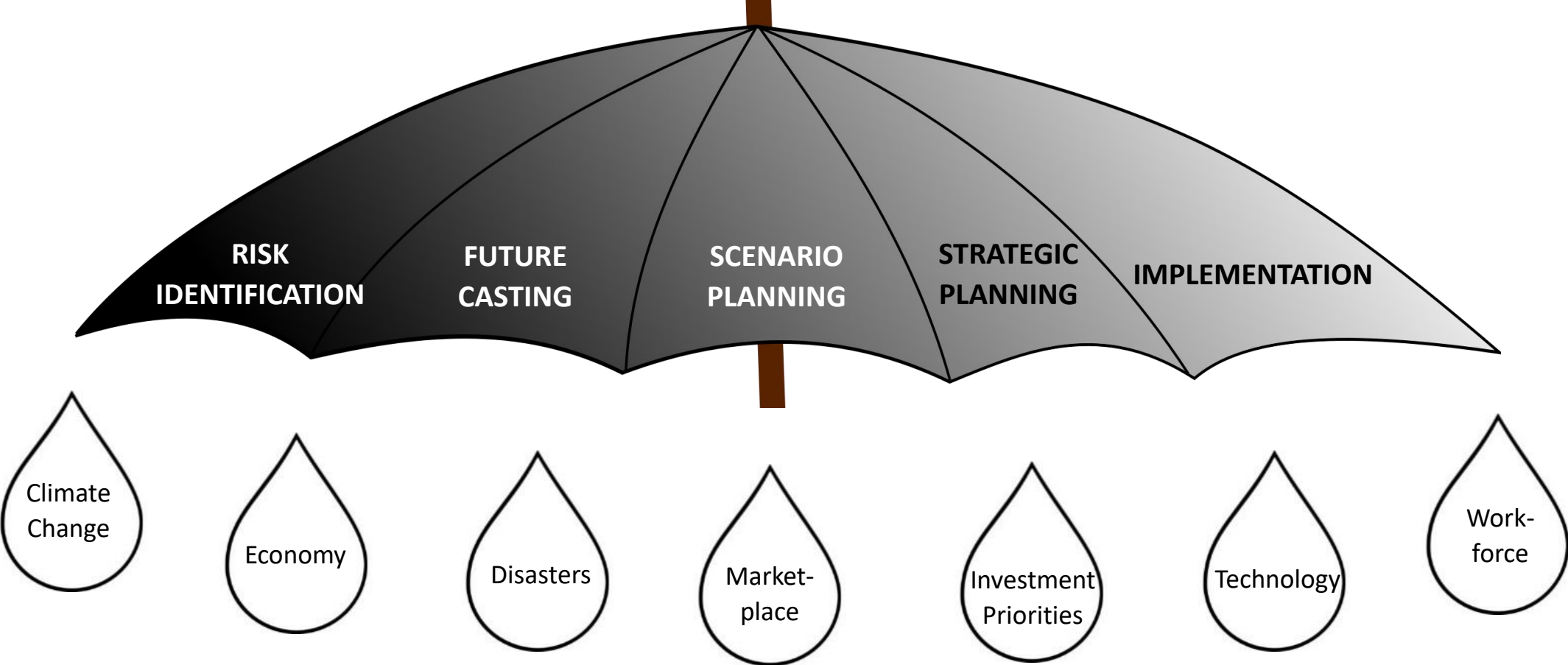


# Our Resiliency Principles

- Flexible
- Redundant
- Agile
- Collaborative
- Robust

- Diverse
- Equitable
- Resourceful
- Community-Centered
- Evolving

# SPU's Resiliency Framework



# SPU Seismic Program

- 30-year history; first seismic study in 1990
- \$100 million in seismic investments to date
- Pathway to building a more resilient drinking water system
- Part of SPU's Resiliency Framework
- Seismic projects part of overall capital budget
- Seismic planning citywide effort

# Seismic Hazards - Recent Earthquakes

|                       | Year | Magnitude | Impacts  |
|-----------------------|------|-----------|--|
| Loma Prieta, Bay Area | 1989 | 6.9       | Water outages mostly less than a few days; fire suppression water was an issue                         |
| Northridge, So. Cal   | 1994 | 6.7       | Over 100 fires; water system damage mostly in poor soil areas; outage: 8 to 13+ days                   |
| Kobe, Japan           | 1995 | 6.9       | 109 fires immediately after earthquake (another 88 in surrounding cities); 60+ days to restore service |
| Christchurch, NZ*     | 2011 | 6.2       | 45+ days to restore service  |
| Tohoku, Japan*        | 2011 | 9.0       | 345 fires; 45+ days to restore service   |

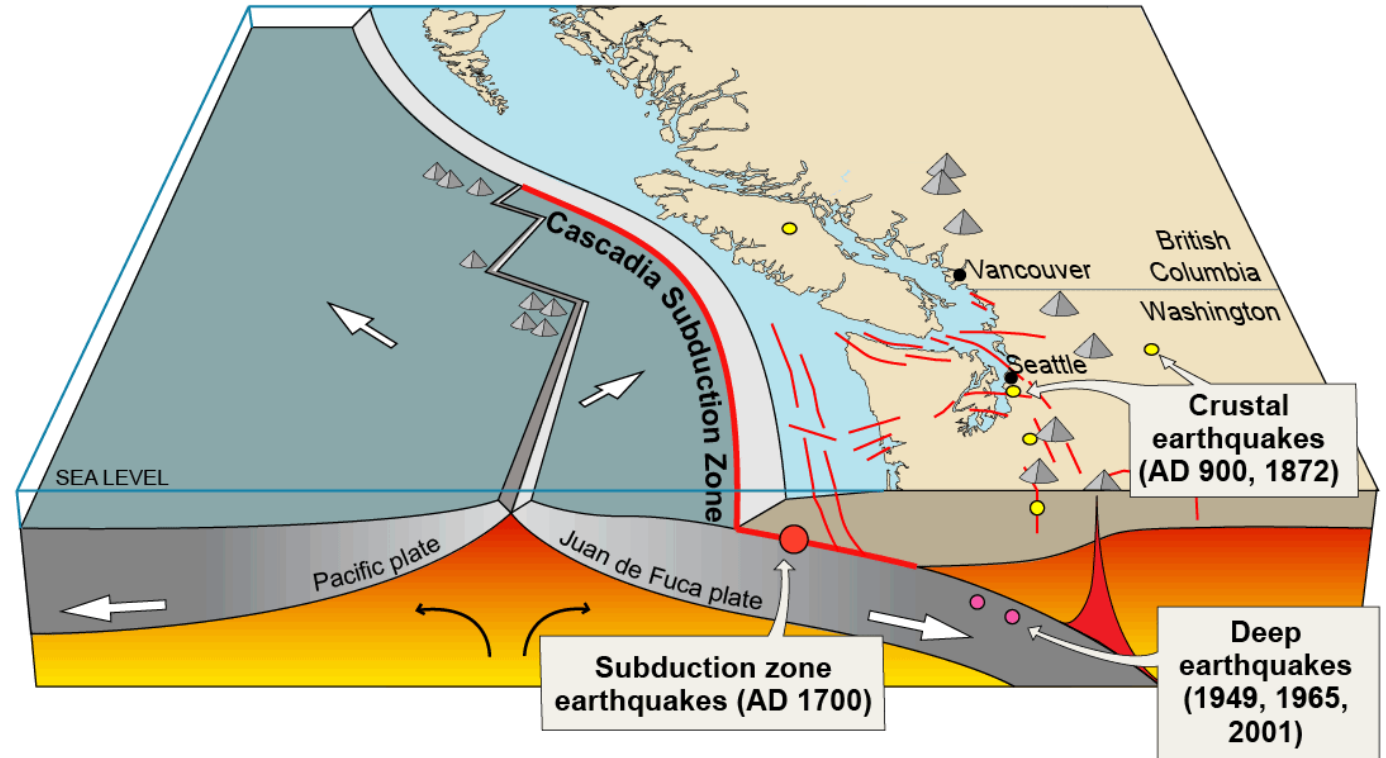
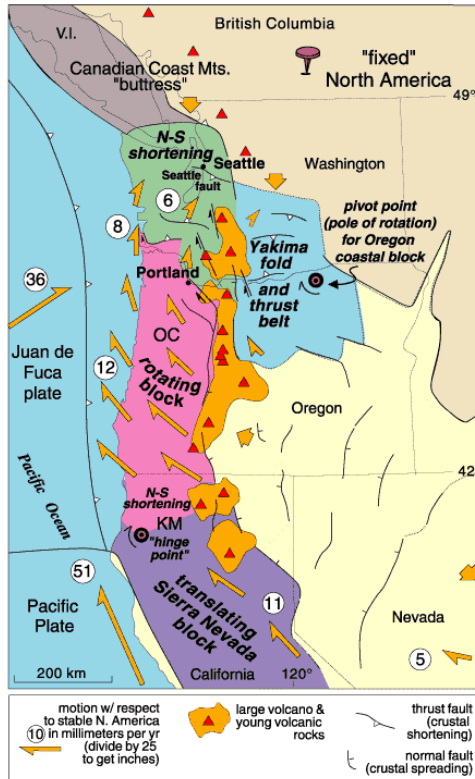
\*15%-20% chance of a Christchurch-like or Tohoku-like type event in Seattle in next 50 years

# New Developments since 1990

- Seattle Fault Zone, Cascadia Subduction Zone
- Earthquake experience (e.g., Northridge, Japanese, Chilean and New Zealand events)
- Potential for mass availability of earthquake-resistant pipe in U.S.



# Earthquake Source Zones



| Source                    | Max. Size | Recurrence         |
|---------------------------|-----------|--------------------|
| ● Subduction zone         | M 9+      | 200–600 years      |
| ● Deep Juan de Fuca plate | M 7+      | 30–50 years        |
| ● Crustal faults          | M 7+      | Hundreds of years? |

- ▲ Volcano
- Active crustal fault
- Active plate boundary fault

\*figure modified from USGS Cascadia earthquake graphics at <http://geomaps.wr.usgs.gov/pacnw/pacnweq/index.html>



# Seismic Vulnerability Assessment, Goals

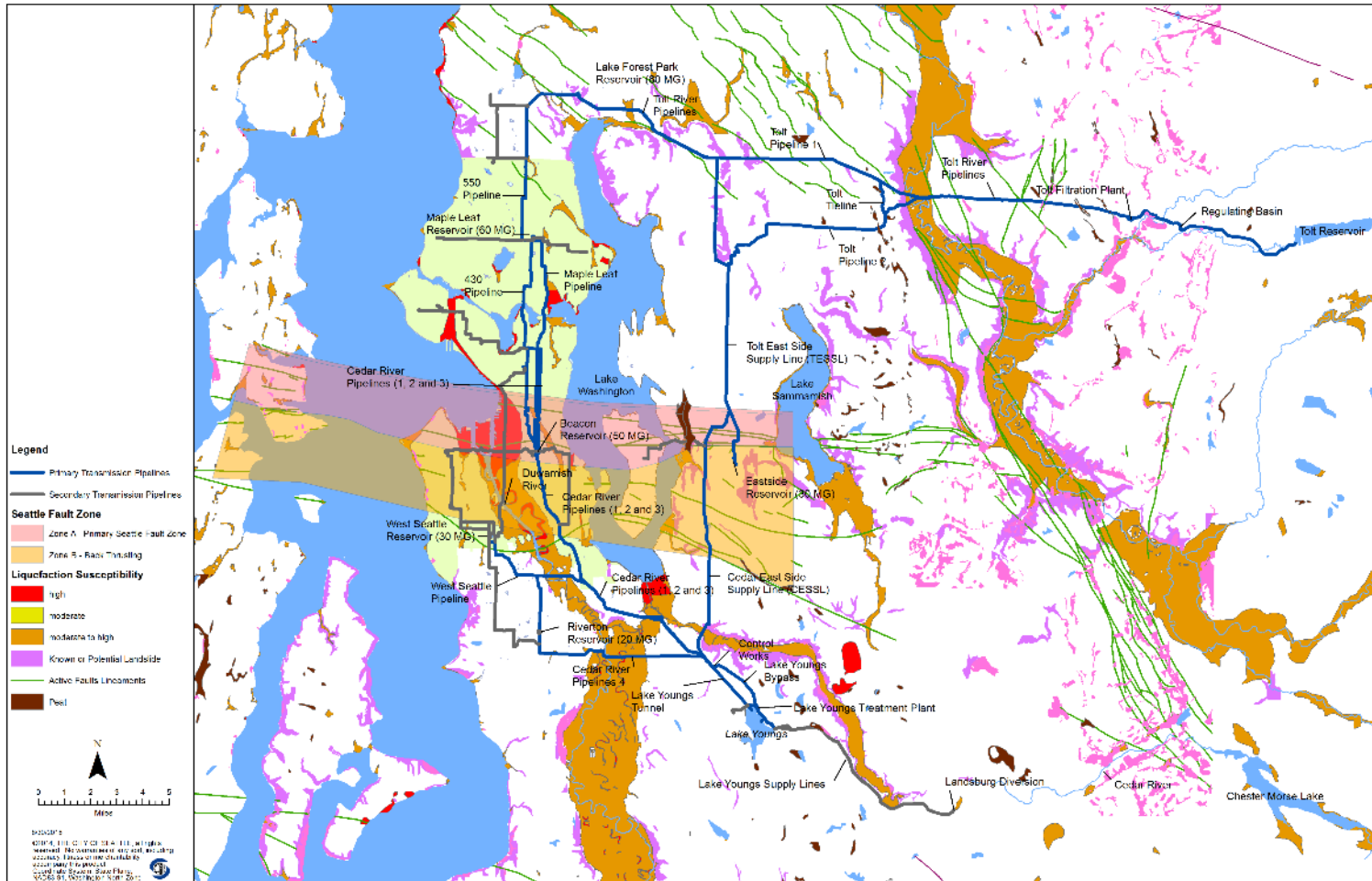
- Seismic vulnerability assessments for water system facilities
- Hydraulic modeling of post-earthquake performance
- Establish post-earthquake performance goals
- Develop planning level mitigation measures, cost estimates and schedule
- Define seismic design standards for water transmission and distribution pipelines

# Earthquake Likelihood in 50 Years

- 15% to 20% chance of catastrophic earthquake, similar to 2011 Christchurch or Tohoku earthquakes
- 85% chance of at least one intraplate earthquake “similar” to the 2001 Nisqually earthquake



# SPU Water System Seismic Hazard Map



# Earthquake Vulnerability Assessment

- Loss of Cedar and Tolt transmission systems likely
- Loss of Eastside Supply Line likely
- Distribution pipeline failures
  - M7 SFZ Scenario:  $\pm$  2000 failures
  - M9 CSZ Scenario:  $\pm$  1400 failures
- Most terminal reservoirs remain functional
- Loss of over one dozen critical facilities
- Loss of water pressure throughout direct service area within  $\pm$  24 hours

# Mitigation Approach – Next 15 to 20 Years

- Enhance emergency preparedness and response planning
  - Earthquake-specific response plan
  - Significantly augment pipeline repair material stocks
  - Assess adequacy/improve emergency drinking water
- Develop/implement isolation and control strategies
  - Reservoir isolation valves
  - Explore isolating areas of large amounts of pipe damage
  - Add valves to make isolation easier
- Keep Roosevelt and Volunteer as non-potable emergency storage

# Mitigation Approach – Next 50-Plus Years

- Build it right
  - Use earthquake-resistant pipe when pipe is replaced
  - Design new facilities to remain functional
- Upgrade vulnerable critical facilities
  - Most vulnerable transmission pipelines locations
  - Critical facilities

# Capital Projects

- \$15 to \$20 million per year – 50+ years
- Options analysis for all projects
  - Cost and functional tradeoff between:
    - Full upgrades – functional after design EQ
    - Upgrades – non-functional but repairable
    - Operational/response: expect significant damage, but able to repair quickly

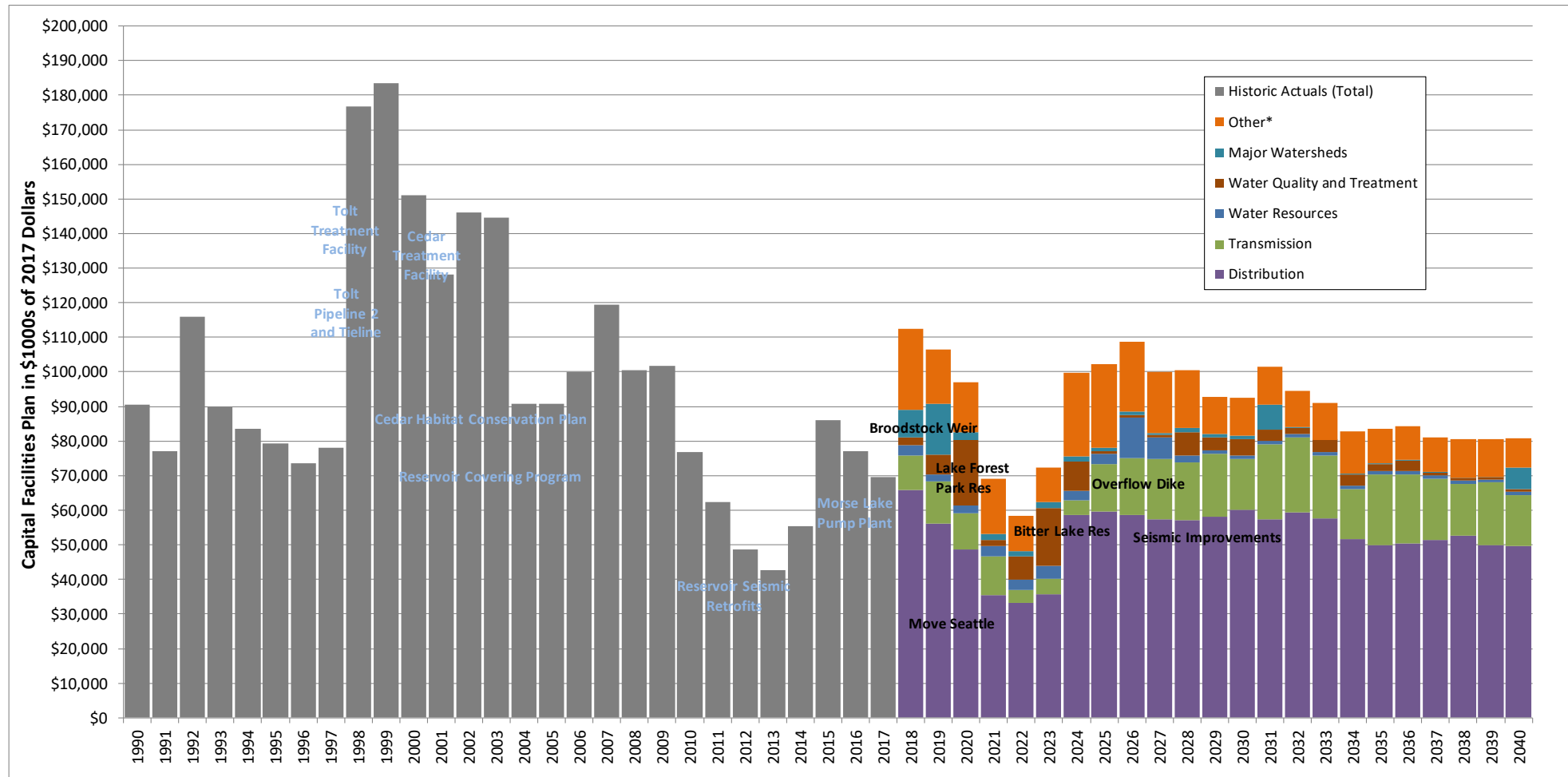


# Capital Projects

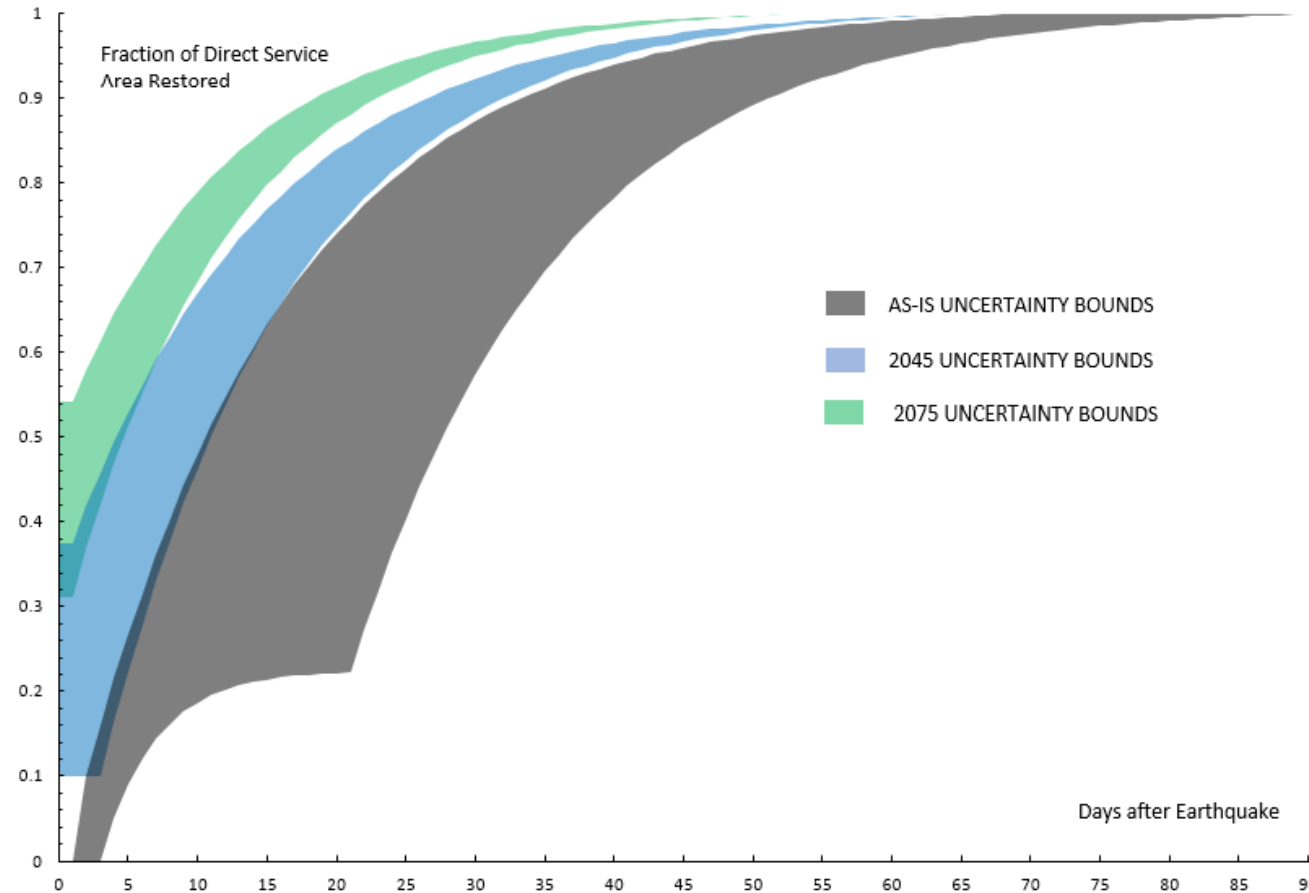
- Many drivers for capital projects, including seismic
- 2019 Water System Plan shows 20-year CIP projections, including seismic



# Capital Projects



# Direct Service Area Restoration Projected Improvement



# Summary

- Resilience planning a foundational issue at SPU
- New information about and better understanding of seismic risk and Seattle's regional drinking water system
  - Provides a path to a more resilient drinking water system
  - Short- and long-term planning; infrastructure upgrades
  - \$15 to \$20 million per year for next 50 years, with individual projects being reviewed with wholesale customers
    - Spending folded into capital improvement budget
    - SPU can help with wholesale customers' distribution system seismic programs, continue to coordinate regional planning

# Questions?

