TACOMA WATER
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Tacoma Water Seismic Planning

Tacoma Public Utilities

Public Utility Board Study Session

May 22, 2019

Presentation Overview

- Overview of seismic planning work
- Current-state findings: Damage and restoration estimates
- Level of Service discussion: policy & implications
- Key work ahead

Modern Resilience Planning

DOCUMENT	DRIVER
1996 Seismic Assessment	*Post Northridge Earthquake*
2003 Vulnerability Assessment	*Bioterrorism Preparedness and Response Act of 2002 (Post 9/11 – Malevolent Threats only)*
2015 All Hazards Vulnerability Assessment	*Proactive, with all-hazards perspective*
2016-2018 Phase 1 & 2 Forum Resilience Plans	*Proactive Regional Resilience Planning*
2019-2020 *New* All Hazards Vulnerability Assessment requirement	*America's Water Infrastructure Act (AWIA) of 2018 (New all hazards vulnerability assessment requirement)*

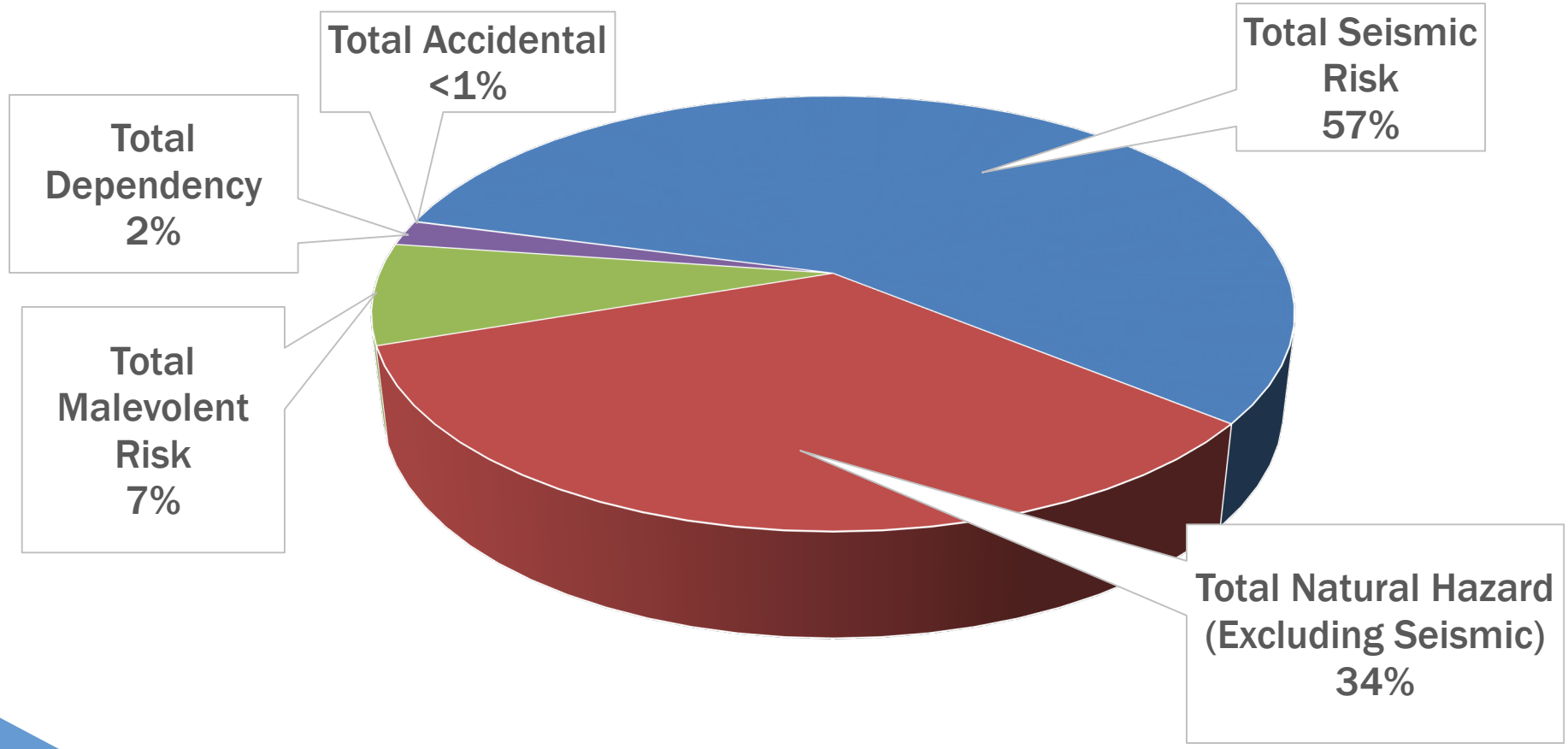
2015 All-Hazards Vulnerability Assessment

- **Proximity Threat**
  - Rail
  - Other Targets
- **Dependency Threat**
  - Loss of Utilities
  - Loss of Suppliers
  - Loss of Employees

- **Natural Hazards**
  - Earthquake
  - Flood
  - Ice Storm/ Snow
  - Wildfire / Plant Fire
  - Lahar
  - Volcano
  - Drought
  - Tsunami

- **Malevolent Threats**
  - Diversion/Theft
  - Product contamination
  - Process Sabotage
  - Human Error
  - Aircraft / Marine / Automobile Attack
  - Assailant

2015 All-Hazards Vulnerability Assessment
Major risk categories



Water Supply Forum Resiliency Project

Preparing for Water Supply Disruption

EARTHQUAKE

WATER QUALITY

CLIMATE CHANGE

DROUGHT

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Earthquake Resiliency

Cascadia Subduction Zone

ANNALS OF SEISMOLOGY JULY 20, 2015 ISSUE

THE REALLY BIG ONE

An earthquake will destroy a sizable portion of the coastal Northwest. The question is when.

By Kathryn Schulz

When the 2011 earthquake and tsunami struck Tohoku, Japan, Chris Goldfinger was two hundred miles away, in the city of Kashiwa, at an international meeting on seismology. As the shaking started, everyone in the room began to laugh. Earthquakes are common in Japan—that one was the third of the week—and the participants were, after all, at a seismology conference. Then everyone in the room checked the time.

Seismologists know that how long an earthquake lasts is a decent proxy for its magnitude. The 1989 earthquake in Loma

The next full-margin rupture of the Cascadia subduction zone will spell the worst natural disaster in the history of the continent.

Illustration by Christoph Niemann; Map

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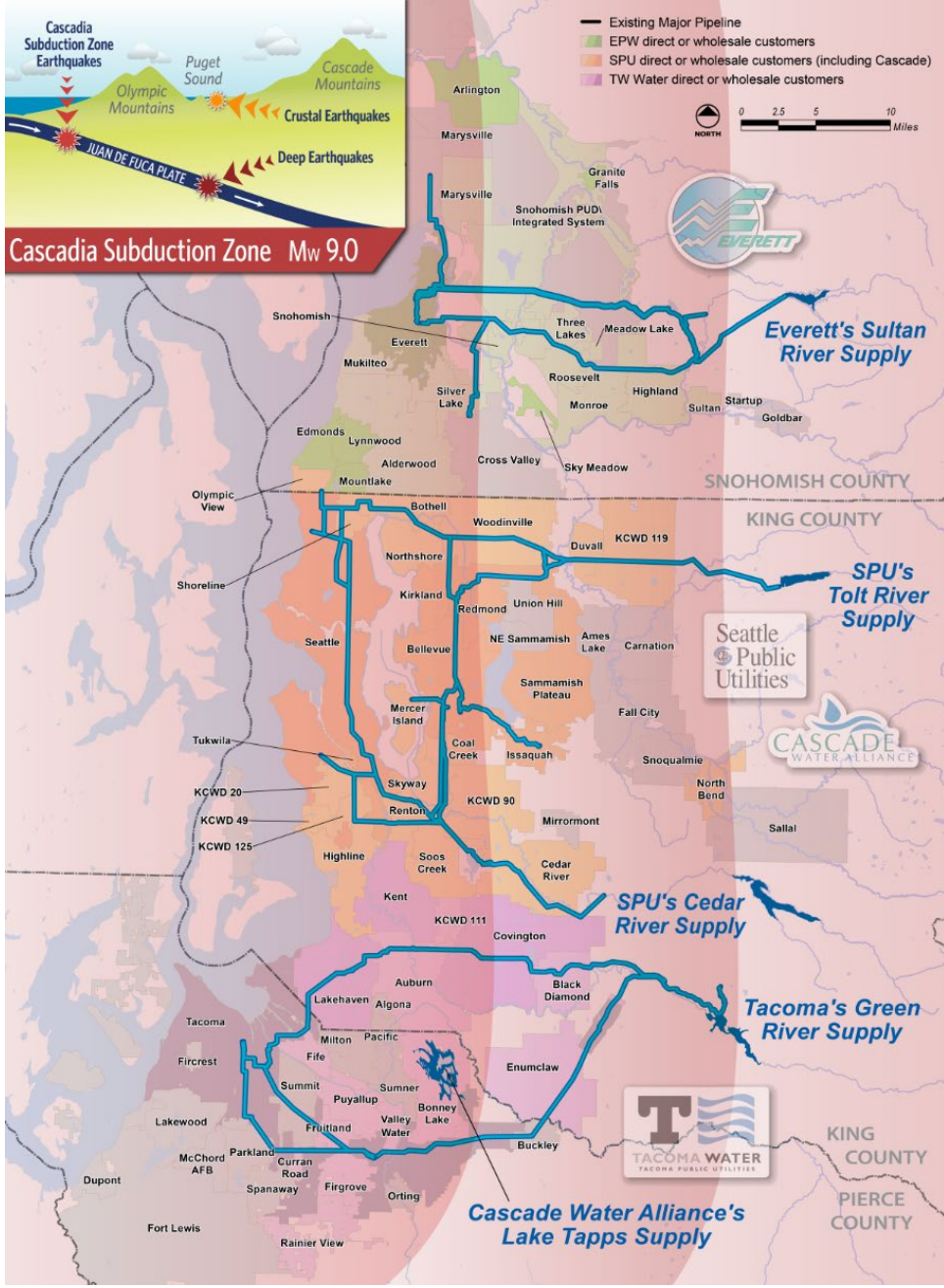

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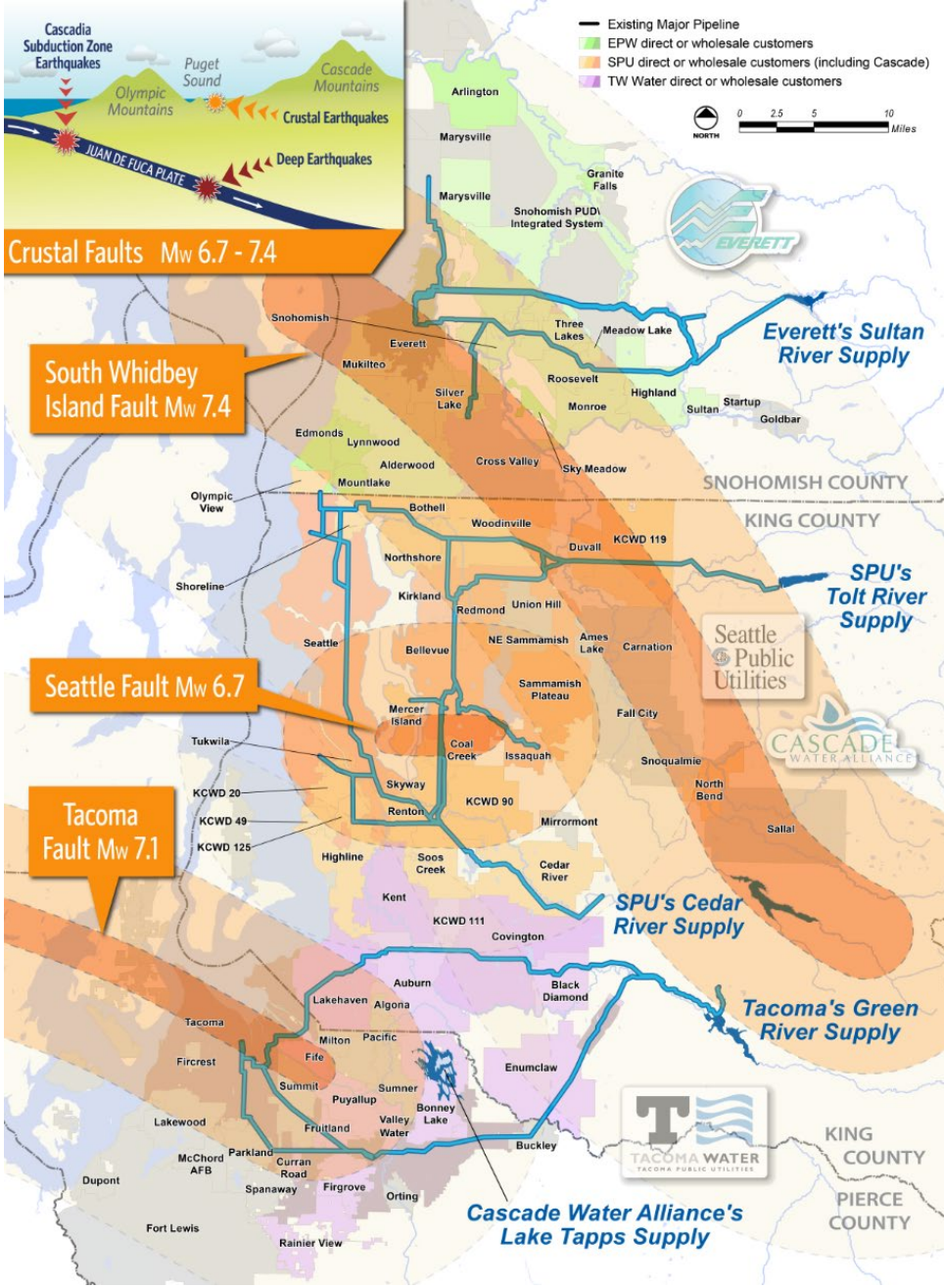
Earthquake Resiliency

Surface (Crustal) Faults:

- South Whidbey Island Fault
- Seattle Fault
- Tacoma Fault



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Earthquake Resiliency

Physical Damage	Restoration Time	Economic Impact	Likelihood
Extensive damage to water system facilities, Over **100 transmission pipeline breaks/ leaks** Up to **6,000 distribution system breaks/ leaks**	**Up to 60 days to restore water**	Cost of water system damage **could exceed $2 billion.**	**14 percent** chance of Mw9.0 Cascadia Subduction event in next 50 years **15 percent** chance of Mw6.5 or larger surface fault event in next 50 years

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2015 All-Hazards Vulnerability Assessment
Seismic System Performance

Alaska 1964

Mw 9.2
Duration 4 minutes
$2.3 Billion in Damage
Subduction – type EQ

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Figure 4-9. Water System Restoration Time – Cascadia Scenario (500 Year Return Period)

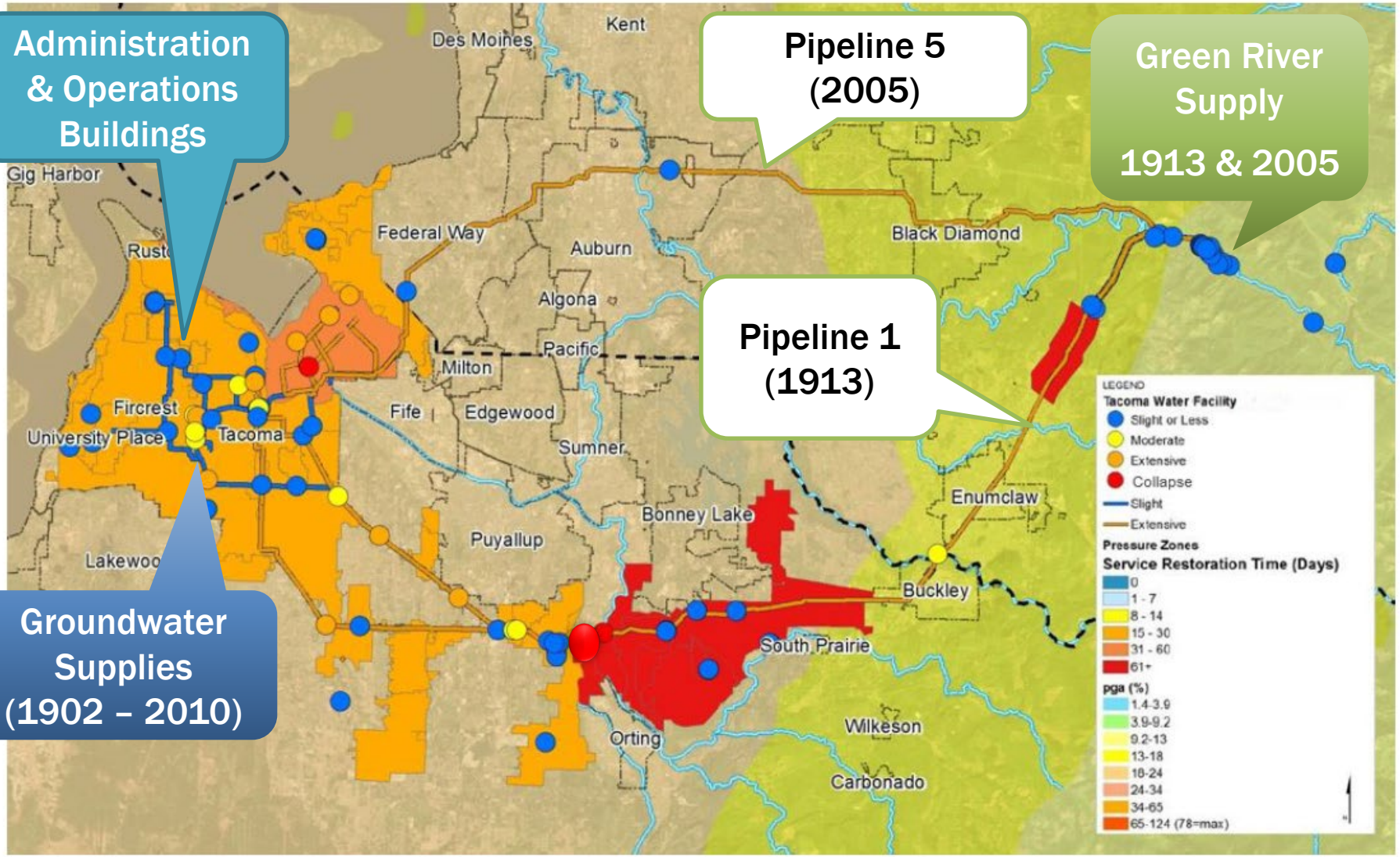


Figure 4-9 depicts the estimated water system restoration time in the Cascadia scenario for each distribution zone, as well as critical facilities. The longest outages are again anticipated for distribution zones to the south and east along Pipeline 1. Areas including Bonney Lake, Fennel Creek, Prairie Ridge, and Cumberland show prolonged customer outage lasting more than 61 days. Additionally, the 251 – Low Zone is expected to have customer outage estimated at 40 days, which falls in the 31 to 60 day range.

Service restoration time (4 seismic scenarios – Tacoma Water)

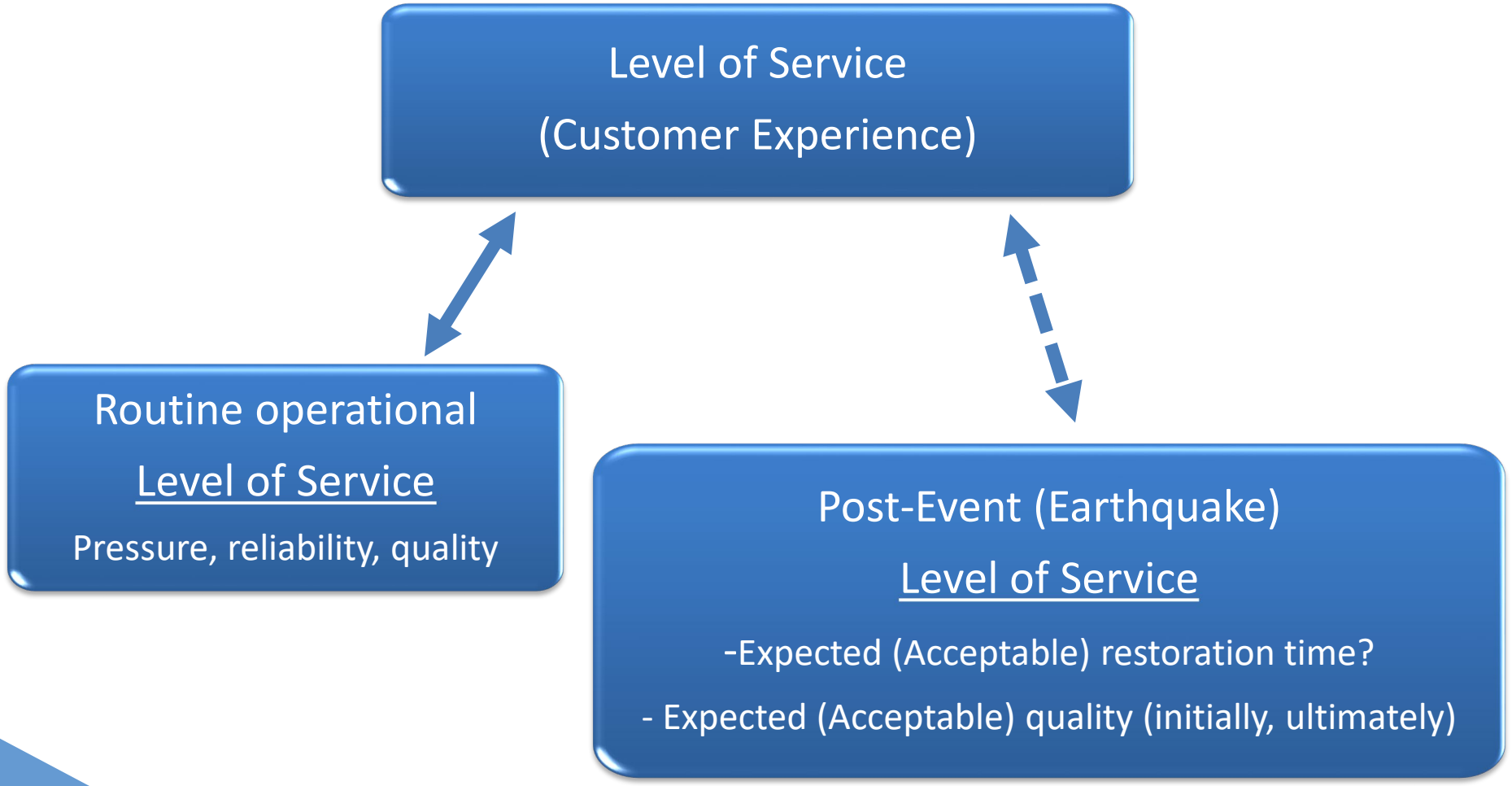
Table 4-3. Post-Earthquake Scenario System Restoration Times Summary

Percent Service Restored	Days after EQ Event			
	Cascadia	Deep Benioff	Shifted Tacoma	SWIF
50%	21	15	31	0
75%	25	29	33	0
90%	27	31	37	0
99%	67	37	71	9

The outage times were based on the expected damage, and the estimated restoration times of critical components required to restore service.

Source: Tacoma Water Seismic Vulnerability Assessment

Level of Service



Conceptual Level of Service Goals

Table 6-1. Cascadia Scenario compared to Preliminary Target Long-Term PE-LOS Goals for Example 500-Year Return Earthquake

System Function	Event Occurs	0-24 Hours	1-3 Days	3-7 Days	1-2 Weeks	2-4 Weeks
Potable water available at supply source		▲	● ✕		◆	
Main transmission facilities, pipes, pump stations, and reservoirs operational		◆				✕
Water supply to critical facilities available[1]		●	◆			
Water for fire suppression at key supply points		◆				✕
Water for fire suppression at fire hydrants				▲	●	◆ ✕
Water available at community distribution centers/points			● ✕	◆		✕
Distribution system operational			▲	●	◆	✕

◆ Desired time to restore component to 80-90% operational

● Desired time to restore component to 50-60% operational

▲ Desired time to restore component to 20-30% operational

✕ Tacoma Water Anticipated Results (80-90% Operational)

✕ Tacoma Water Anticipated Results (20-30% operational)

[1]*Further evaluation required to evaluate scorecard for Water supply to critical facilities*

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Conceptual Level of Service Goals

Table 6-2. Shifted Tacoma Scenario compared to Preliminary Target Long-Term PE-LOS Goals for Example 2,500-Year Return Earthquake

System Function	Event Occurs	0-24 Hours	1-3 Days	3-7 Days	1-2 Weeks	2-4 Weeks	1-3 Months
Potable water available at supply source		▲	✕	●		◆	
Main transmission facilities, pipes, pump stations, and reservoirs operational		●	◆			✕	
Water supply to critical facilities available[1]			●	◆			
Water for fire suppression at key supply points		●	◆			✕	
Water for fire suppression at fire hydrants					▲	●	◆ ✕
Water available at community distribution centers/points			▲	● ✕	◆	✕	
Distribution system operational				▲	●	◆	✕

◆ Desired time to restore component to 80-90% operational

● Desired time to restore component to 50-60% operational

▲ Desired time to restore component to 20-30% operational

✕ Tacoma Water Anticipated Results (80-90% operational)

✕ Tacoma Water Anticipated Results (20-30% operational)

[1]*Further evaluation required to evaluate scorecard for Water supply to critical facilities*

Conceptual Level of Service Goals

Table 8. PE-LOS Goals for a CSZ Earthquake Scenario. (Attain within 50 years and establish interim milestones leading to these goals.)

System Component	Service Provided		Immediately After	24 Hours	3 Days	7 Days	14 Days	1 Month
Water Supply	Supply transmission system, provide local distribution source (wells), fill tank trucks.	Quantity	Storage	Storage	50% AWD[1]	50% AWD[1]	50% AWD[1]	AAD
		Quality	Non-Potable[4]	Non-Potable[4]	Non-Potable[5]	Non-Potable[5]	Potable	Potable
Transmission to End Points[2]	Supply terminal reservoir, wholesale meters along transmission line, provide fire suppression along transmission lines. Includes critical facilities (pump stations, treatment etc.)		50% AWD[1]	50% AWD[1]	50% AWD[1]	50% AWD[1]	AWD	AAD
Transmission/Supply to Major Regional Essential Services[3]	Serve essential customers (e.g. hospitals).		50% AWD[1]	50% AWD[1]	50% AWD[1]	50% AWD[1]	50% AWD[1]	AWD
Backbone	Supply special seismic resistant lines to essential customers, service to community distribution points, provide fire suppression along backbone.		Individual utility decision					
System Storage	Support backbone and local distribution		limited water from storage for fire, drinking		Individual utility decision			
Distribution	Service to individual customers - residential, business, industrial. Water to fire hydrants for fire suppression.		Individual utility decision					

AWD = Average Winter Demand; AAD = Average Annual Demand

Notes:

1. Percentages represent the estimated percent of total delivery. Not all areas will be feasible to serve within the first month.

2. Transmission to End Points includes one or more transmission pipelines providing the noted level of service connecting the supplies to and including the first terminal reservoirs downstream from each supply. At the utility's discretion, additional transmission pipeline segments and reservoirs can be included in this criterion.

3. Transmission/Supply to Major Regional Essential Services includes a supply, and transmission line supplying water to hospitals designated as essential by the utility. The supply and transmission may be dedicated to supply to essential services and be different than the supply and transmission system serving the overall utility service area. Additional facilities in addition to hospitals such as nursing homes, may be designated by the utility.

4. Water supply and water held in terminal reservoir are expected to be potable immediately after the event. However, there could be short-term disruptions/damage to water

The Policy Discussion:
Establishing a Post-Event Level of Service Goal

- Considerations
  - Time span to achieve the identified service level
    - 50-70 years may be a realistic goal
  - Preferred evaluation and goal development process
    - Board, Council, Public
  - Needed information
    - Relationship between service level goal and cost to achieve
    - Priority order of work

Key work ahead

Infrastructure

- Focused hardening of groundwater supply and operations center components.
- Continued development and policymaker adoption of target Post-Earthquake Levels of Service, and a seismic resiliency investment plan to achieve those targets over a period of time.
- Priority decisions with respect to hardening supply to hospitals.
- Build seismic resilience more directly into infrastructure renewal.

Programmatic

- Continued Development of a robust Emergency Management capability.
- Continued and sustained relationships with Emergency Managers & Responders at all levels of government.
- Conversations with customers and employees about realistic expectations and personal preparedness.