Seattle Public Utilities Case Study

Building Resilience to a Changing Climate:

A Technical Training in Water Sector
Utility Decision Support

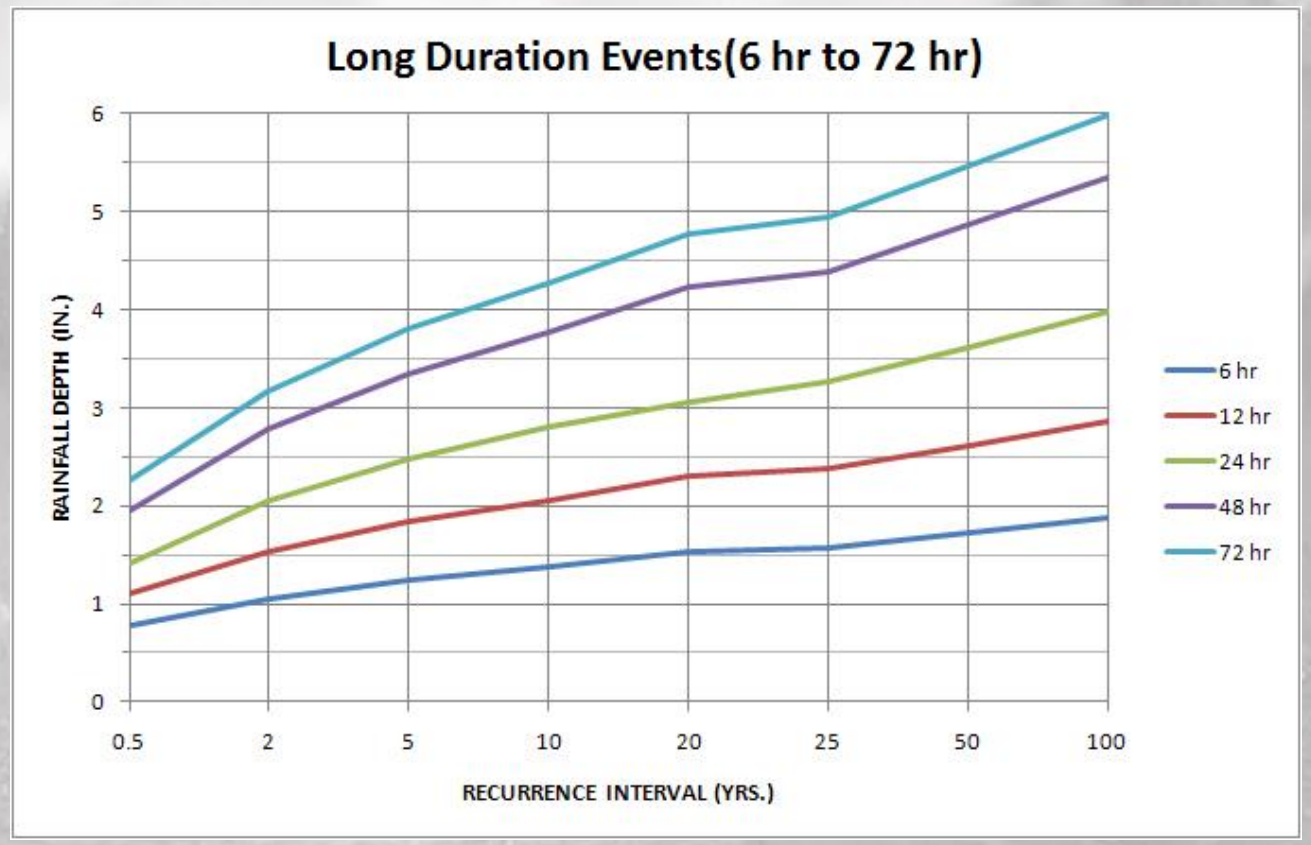
WUCA
Water Utility Climate Alliance
10 YEARS · 2008-2018

Seattle Public Utilities

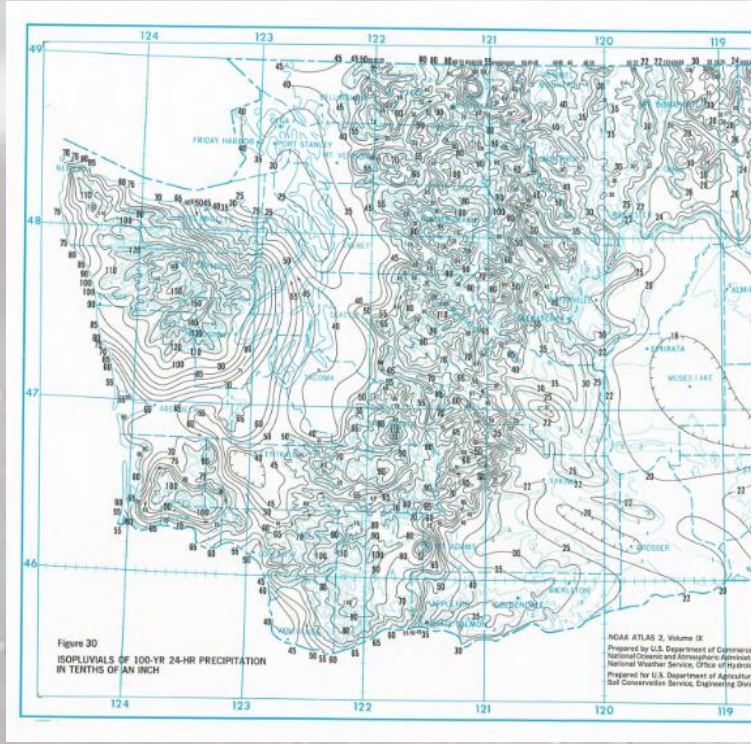
Outline

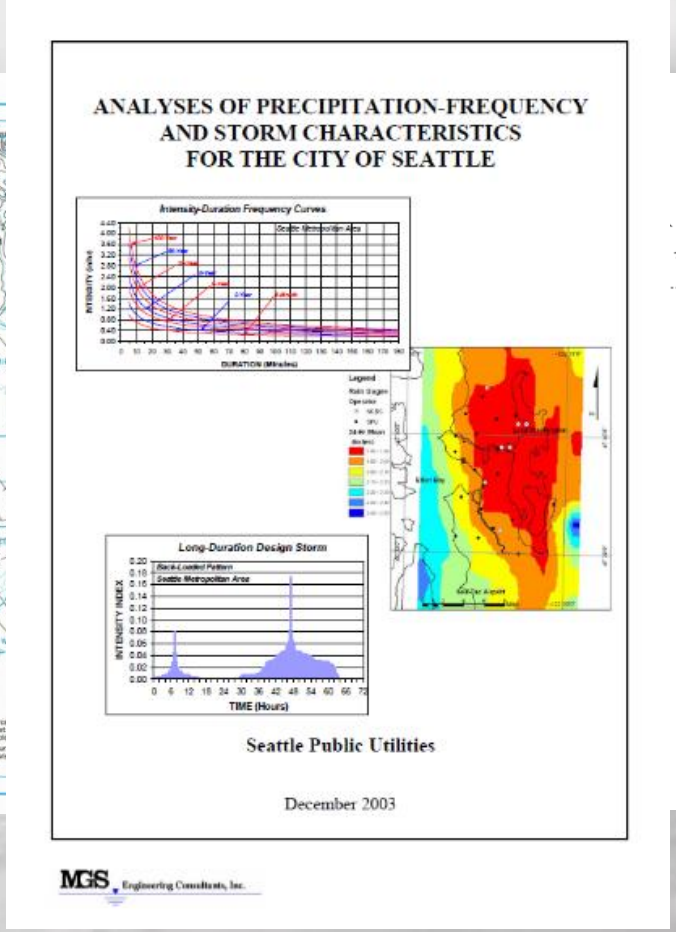
- Rainfall Statistics (IDF Curves)
- Future Rainfall (CPIDFs)
- Drainage System Planning
- Sea Level Rise Planning

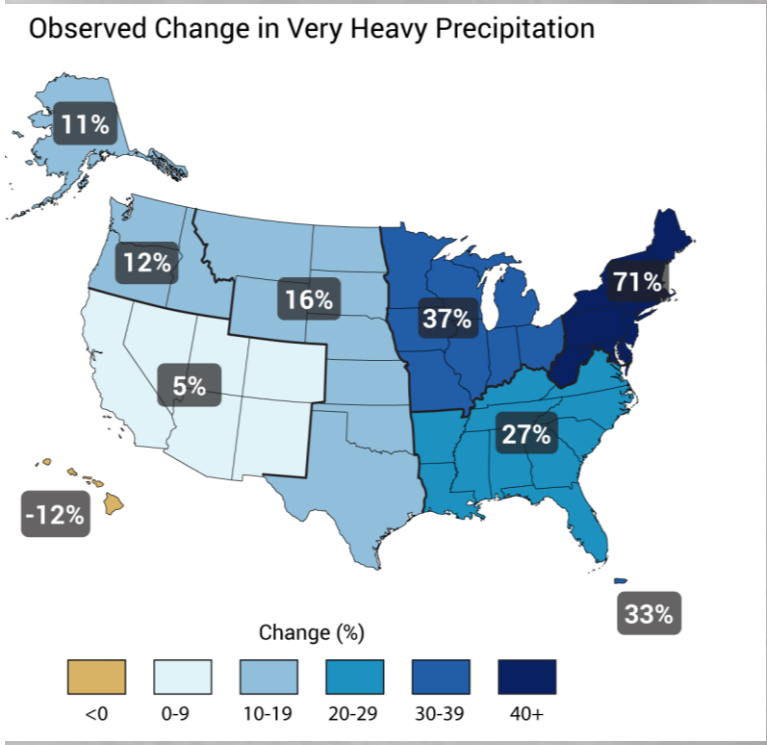
Intensity-Duration-Frequency Curves



Background Studies








DEAD
END

TETRA TECH

Seattle Public Utilities PROTECT OUR WATERS

Intensity Duration Frequency Curves and Trends for the City of Seattle

Technical Memorandum

December 29 2017

Seattle Public Utilities CSO Reduction Program

'Extreme' rainstorms becoming more common in Seattle, says city meteorologist

Originally published February 3, 2018 at 6:00 am *Updated February 3, 2018 at 9:34 am*

1 of 2 Big raindrops produce bubbles on First Avenue in downtown Seattle during a deluge this week. Four inches of rain in a 24-hour period used to be a once-in-a-century storm, according to Seattle Public Utilities,... (Steve Ringman/The Seattle Times) **More**

Our short showers and drizzle aren't going away. But the dayslong drenchings that sometimes soak the city? They've been happening more, according to a Seattle Public Utilities study.

2003

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	0.13	0.17	0.20	0.26	0.30	0.35
15 min	0.21	0.28	0.31	0.39	0.44	0.51
30 min	0.30	0.38	0.44	0.53	0.60	0.68
1 hour	0.42	0.51	0.58	0.70	0.79	0.89
6 hours	1.08	1.26	1.38	1.56	1.74	1.86
24 hours	2.16	2.40	2.88	3.36	3.60	4.08
72 hours	3.13	3.77	4.23	4.91	5.42	5.93

2017

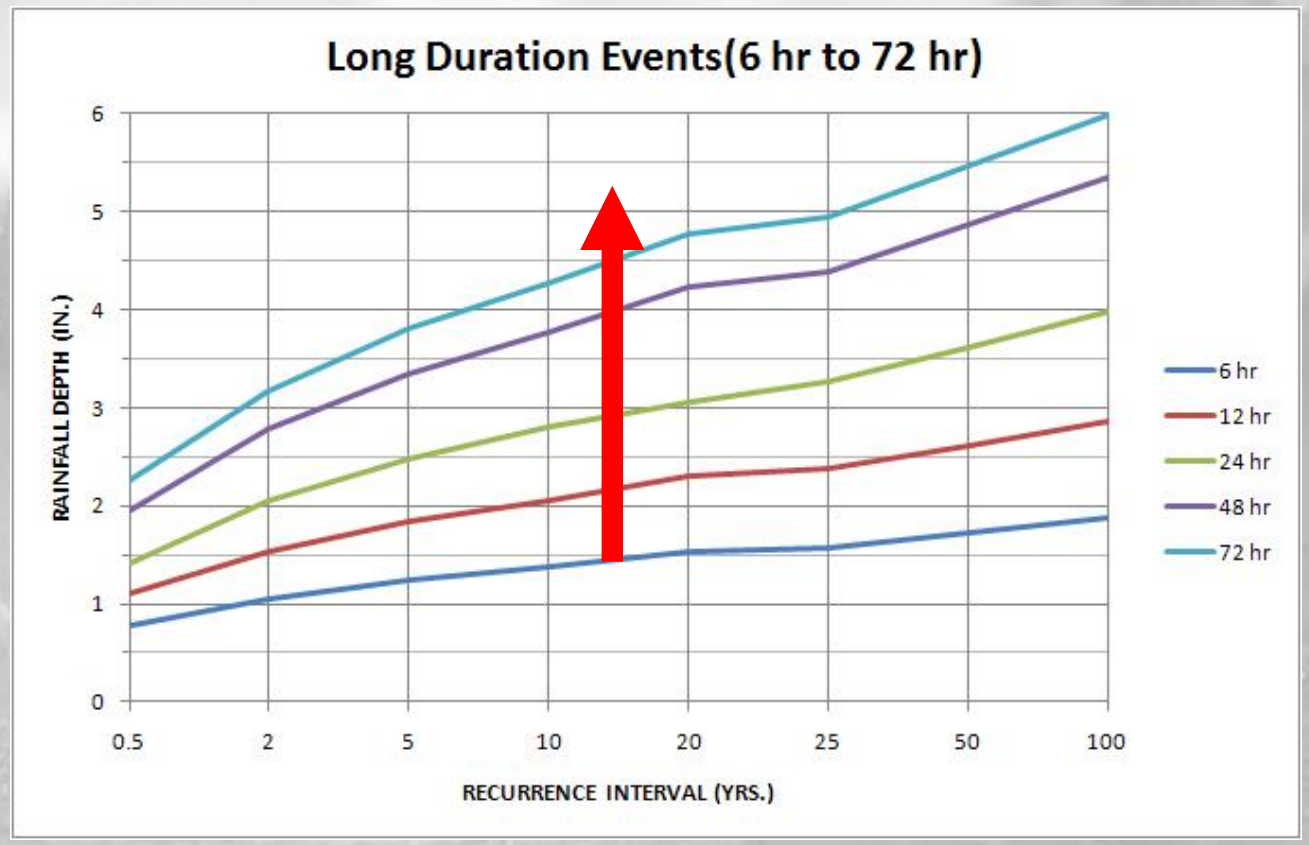
Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	0.11	0.15	0.18	0.21	0.24	0.27
15 min	0.20	0.27	0.32	0.39	0.44	0.49
30 min	0.28	0.37	0.43	0.52	0.59	0.67
1 hour	0.39	0.50	0.58	0.68	0.77	0.85
6 hours	1.01	1.33	1.55	1.86	2.10	2.35
24 hours	1.99	2.69	3.24	4.03	4.70	5.47
72 hours	3.00	3.87	4.47	5.25	5.85	6.46

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	-16%	-14%	-14%	-23%	-25%	-30%
15 min	-3%	-3%	3%	-1%	-1%	-4%
30 min	-8%	-4%	-2%	-2%	-2%	-1%
1 hour	-7%	-2%	-0%	-3%	-3%	-5%
6 hours	-7%	5%	11%	16%	17%	21%
24 hours	-9%	11%	11%	17%	23%	25%
72 hours	-5%	3%	5%	6%	7%	8%

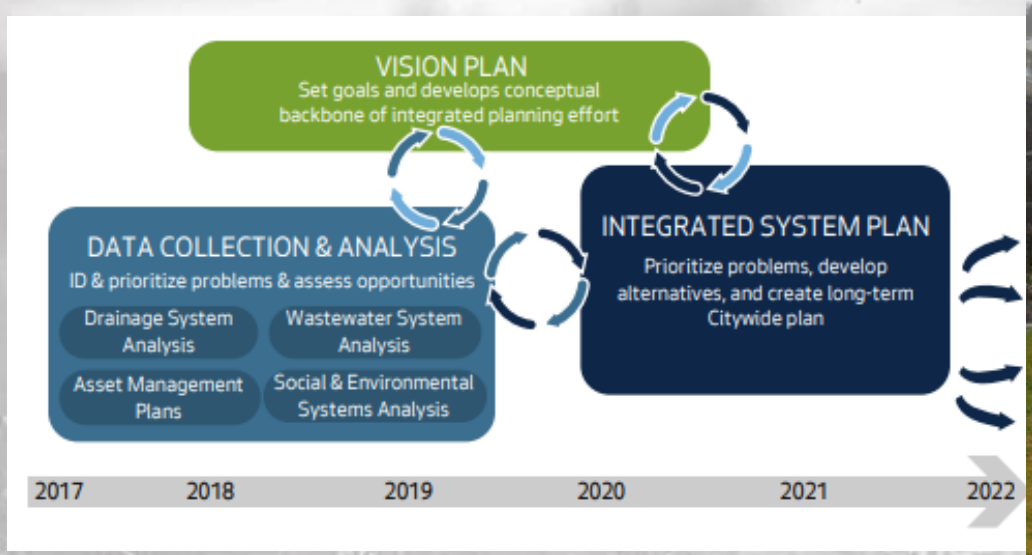
IDF Curves Summary

- Anecdotal evidence for increasing extremes
- Outdated statistics, poor communications and planning
- Local plus regional approach (waiting for NOAA)
- Results consistent with research: long-duration extremes have intensified

"Climate Perturbed" IDFs



Integrated Planning



Climate Change and Urban Drainage—Past

- Insufficient modeling resolution
- 2009 "scaling factor" was based on Clausius-Clapeyron, mixed w/ other uncertainties
- Ad hoc, nebulous planning

Climate Change and Urban Drainage—Present

- CMIP5, RCP 8.5
- CPIDFs for intense events (22 GCMs)
- Monthly factors for non-intense events (39 GCMs)
- All rain gages perturbed (25^{th}, 50^{th}, and 75^{th} %iles)

Scaling Factors

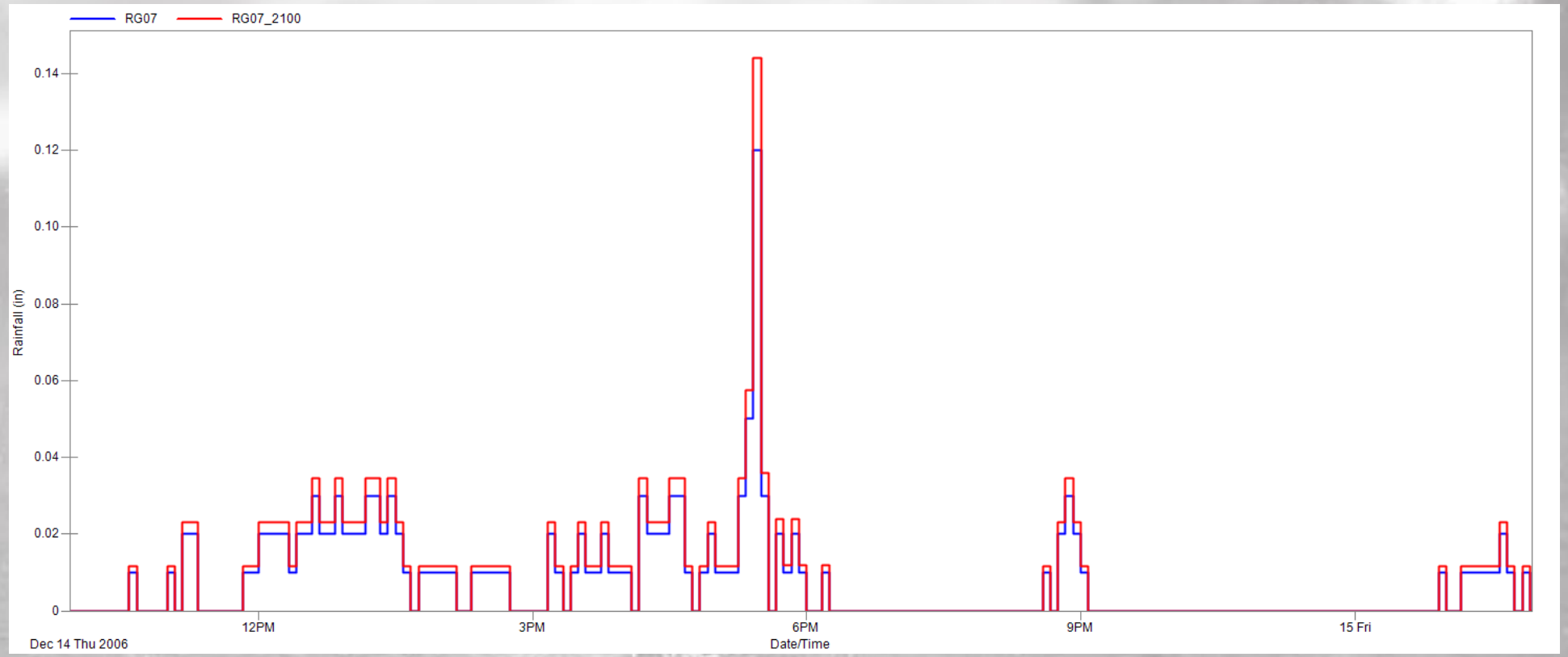
Monthly Rainfall

	2035			2100		
	25%	50%	75%	25%	50%	75%
January	-1.5%	5.7%	11.7%	-5.5%	20.7%	42.2%
March	-2.9%	0.9%	7.9%	-10.5%	3.3%	28.7%
August	-18.2%	-9.2%	2.4%	-65.7%	-33.1%	8.7%
November	0.3%	8.7%	13.7%	1.2%	31.5%	49.5%

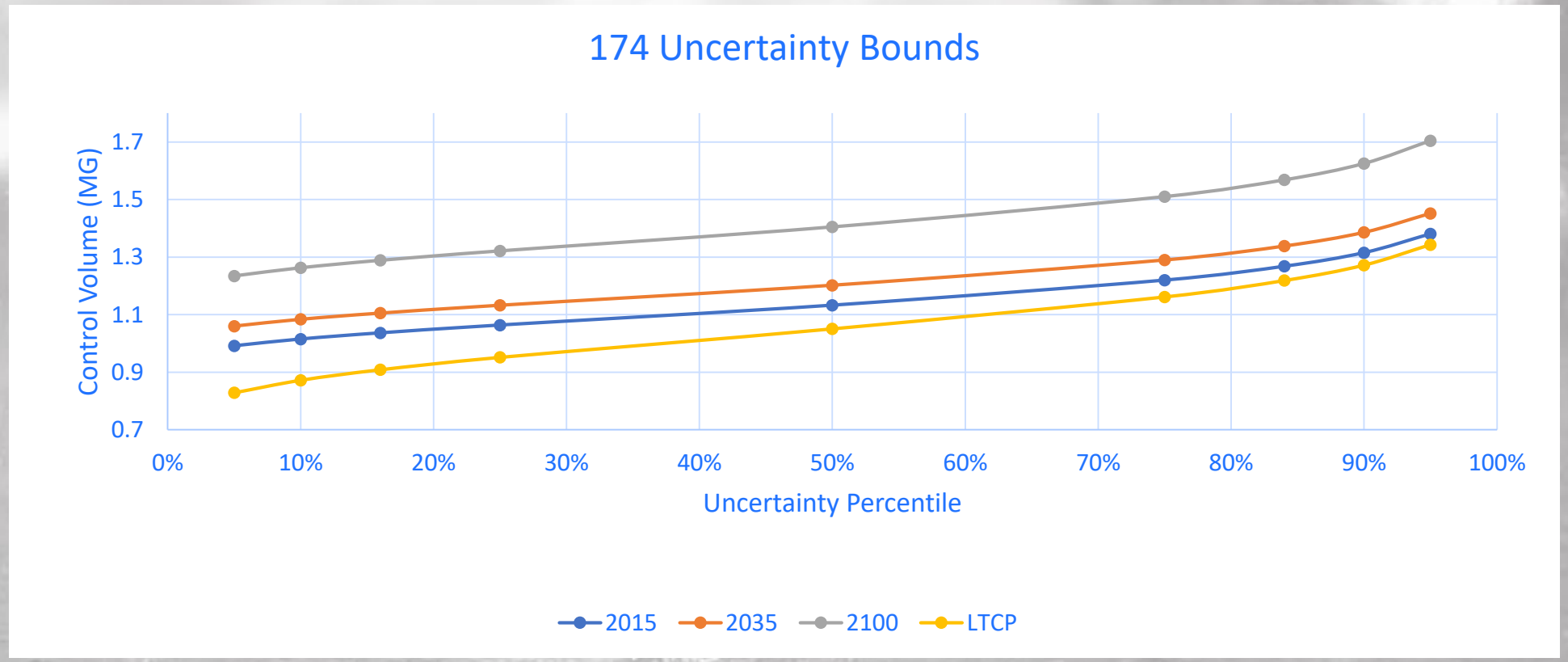
CPIDFs

	2035			2100		
Return Period	25%	50%	75%	25%	50%	75%
2	4.3%	5.6%	6.2%	15.6%	20.1%	22.3%
5	4.1%	5.5%	6.5%	14.8%	19.7%	23.5%
10	3.9%	5.5%	6.9%	14.2%	19.7%	24.9%
25	3.7%	5.5%	7.5%	13.5%	20.0%	27.2%
50	3.6%	5.6%	8.1%	12.9%	20.3%	29.2%
100	3.4%	5.7%	8.7%	12.3%	20.6%	31.4%

Perturbing Past Events



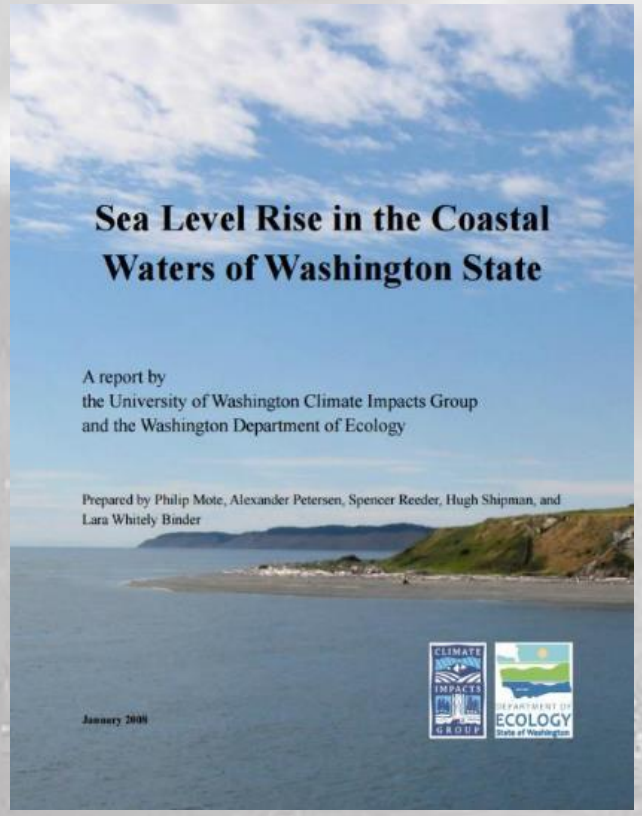
Perturbing Control Volumes

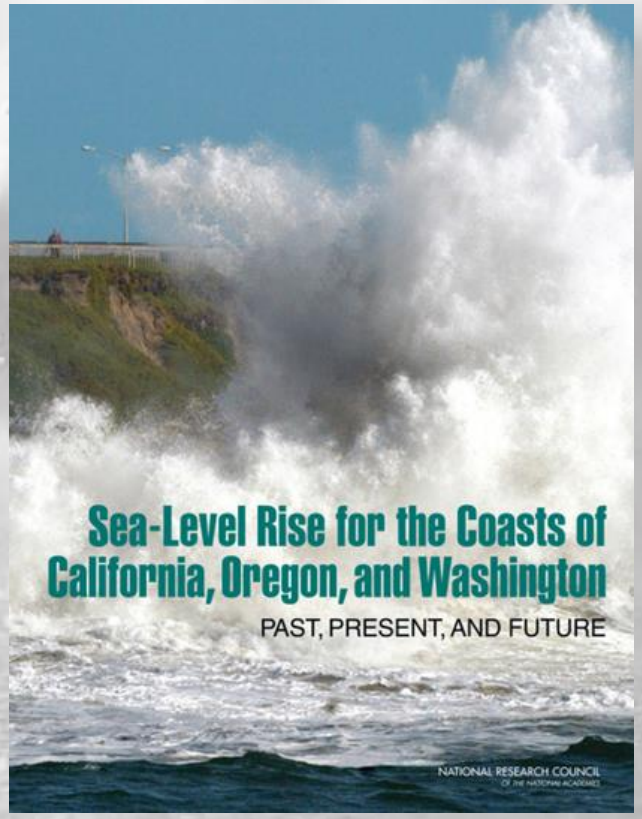


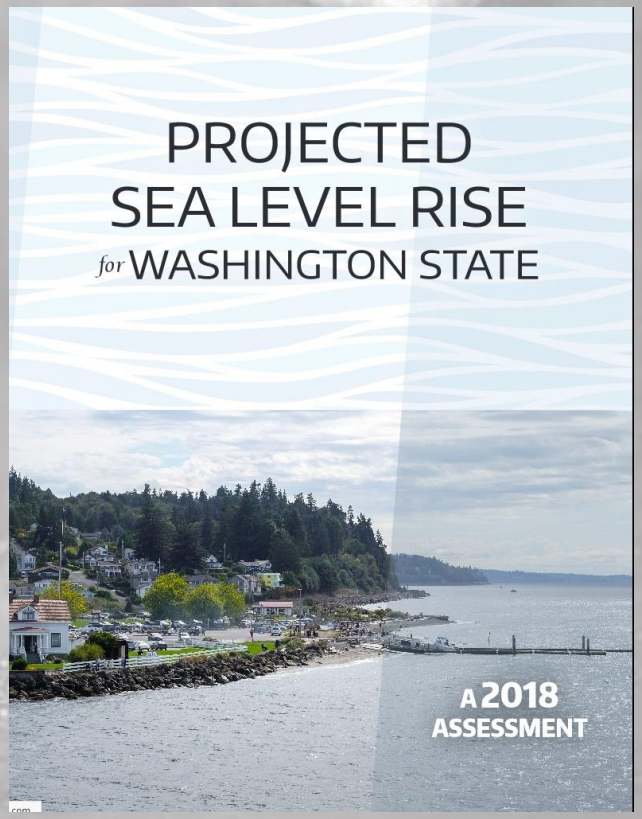
CPIDFs Summary

- Resolved modeling concerns
- New scaling factors being used across the utility
- Updated control volumes for all combined sewer overflow basins
- Assessing costs and levels of service
- Developing sizing guidance

Sea Level Rise







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West Marginal Way SW
26th Ave SW
37th Ave SW
35th Ave SW
SW Spokane St
SW Andover St
SW Adams St
SW Genesee St
WEST SEATTLE GOLF COURSE
Puget Way SW
East Marginal Way S
Colorado Ave S
Alaskan W
1st Ave S
4th Ave S
6th Ave S
Airport Way
S Holg
S Horton St
SEATTLE
S Hanford St
S Idaho St
S Edmunds St
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esri

Sea Level Rise Summary

- Localized best available science
- Mapping only as first step
- Understanding time of emergence and risk tolerance
- Developing guidance

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Appendix

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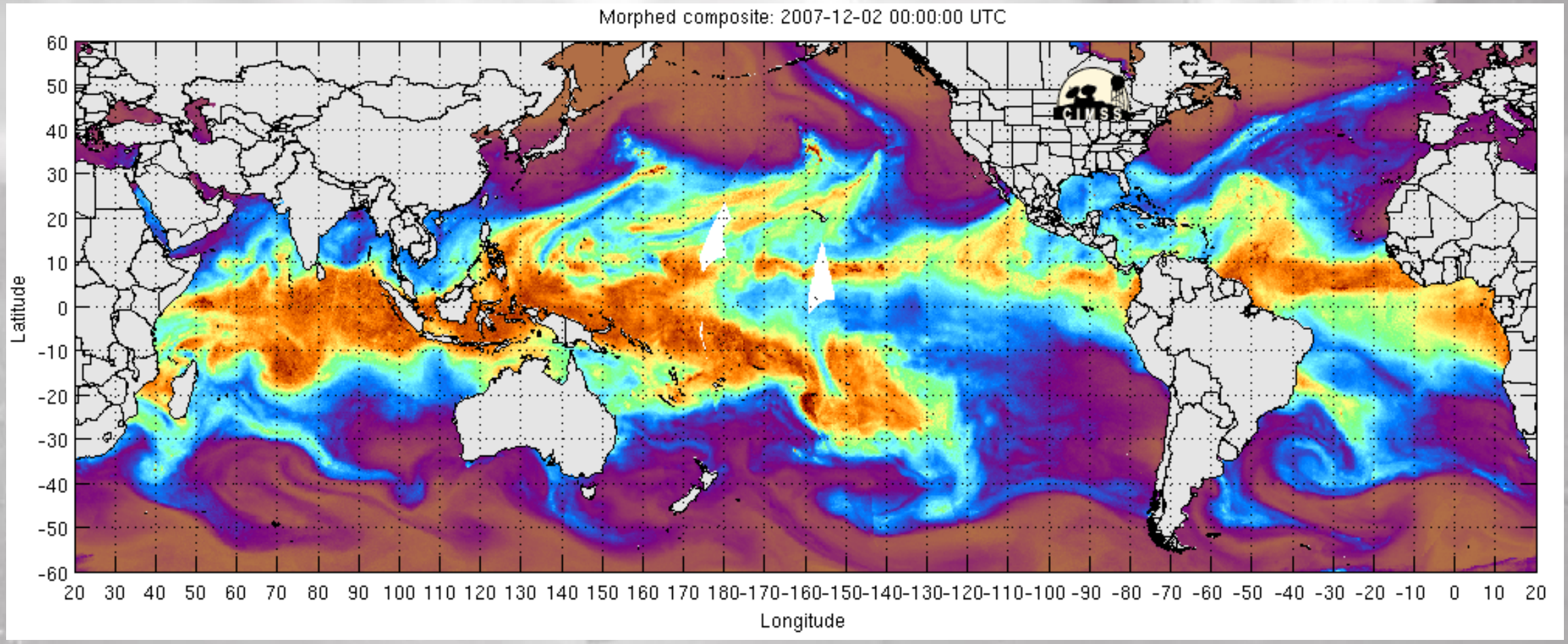
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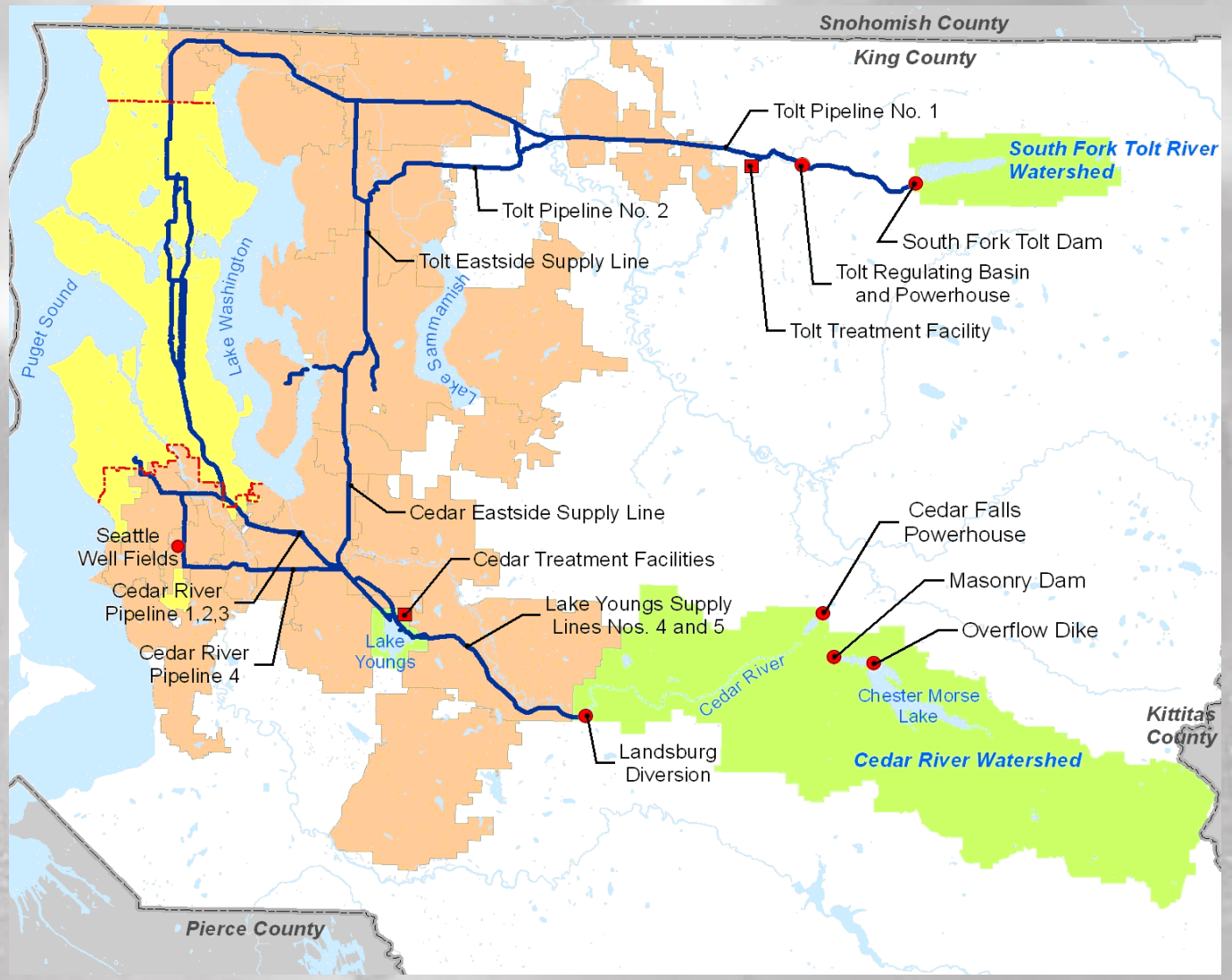
Longitude


ARMS
Ryder


GMC

12/04/2018


Snohomish County
King County
Tolt Pipeline No. 1
South Fork Tolt River Watershed
Tolt Pipeline No. 2
South Fork Tolt Dam
Tolt Eastside Supply Line
Tolt Regulating Basin and Powerhouse
Tolt Treatment Facility
Puget Sound
Lake Washington
Lake Sammamish
Cedar Eastside Supply Line
Cedar Falls Powerhouse
Seattle Well Fields
Cedar Treatment Facilities
Masonry Dam
Cedar River Pipeline 1,2,3
Lake Youngs Supply Lines Nos. 4 and 5
Overflow Dike
Lake Youngs
Cedar River
Cedar River Pipeline 4
Chester Morse Lake
Kittitas County
Landsburg Diversion
Cedar River Watershed
Pierce County

12/04/2018