



Using GIS and Hydraulic Modeling to Save Time and Add Value

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“...all models are wrong;
but some are useful.”

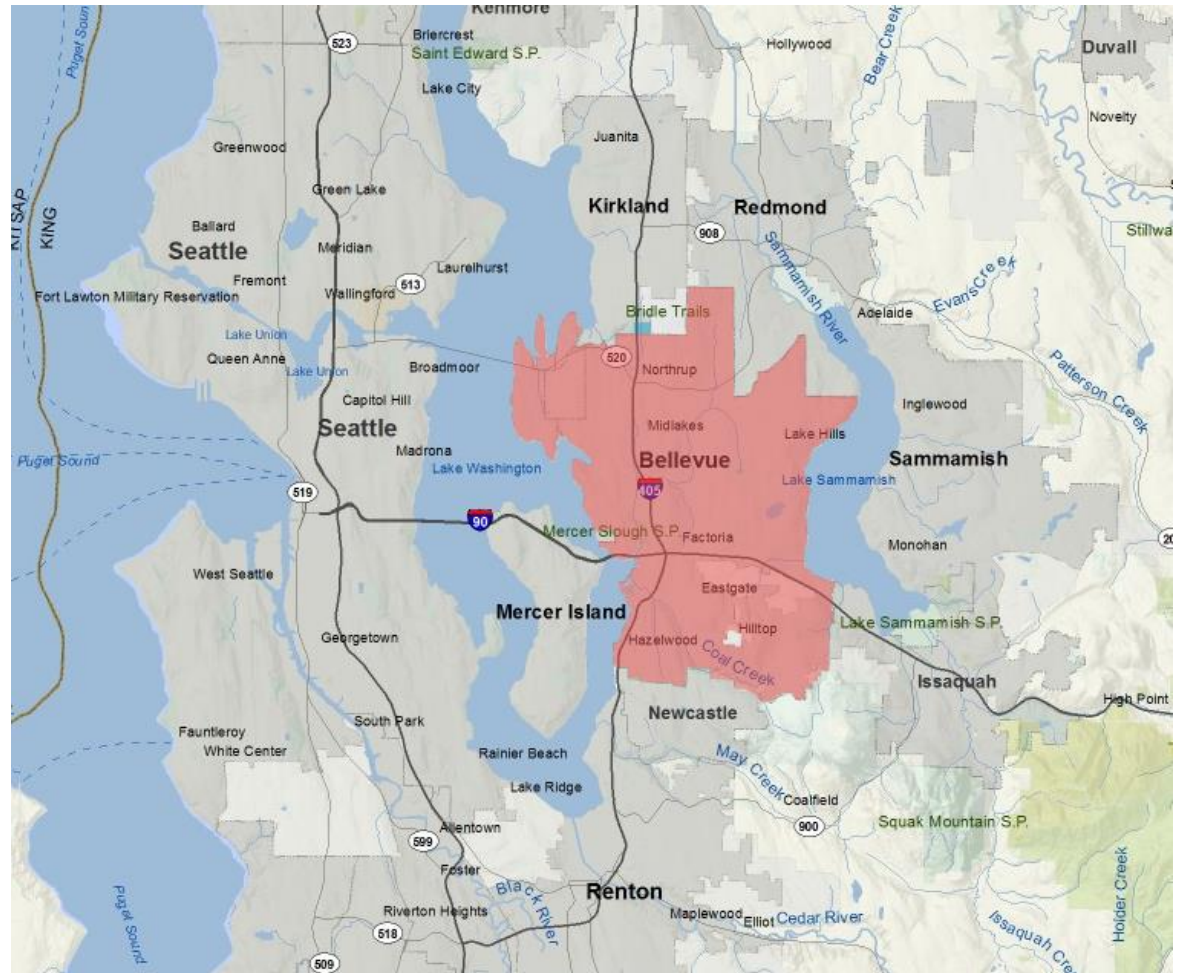
George E. P. Box
British Statistician, 1919-2013



Bellevue's Water Service Area



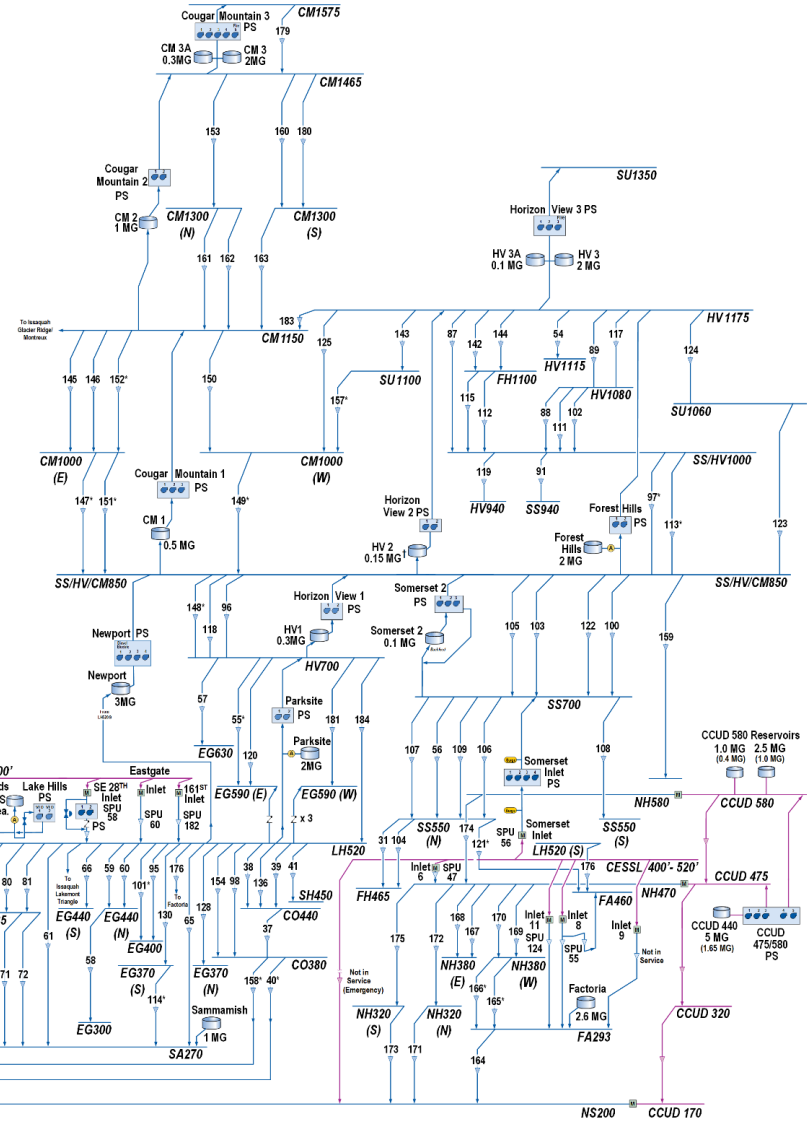
- 150,000+ Population
- 140,000+ Jobs
- 69 Pressure Zones
- 24 Reservoirs
- 22 Pump Stations
- 148 PRV Stations
- 620 Miles of Pipe
- Elevation 20' – 1,440'





Water System Hydraulic Profile

- Reservoir
Total Volume
(Volume Available to Bellevue)
- Pump Station
- Flow Meter
- Altitude Valve
- Pressure Reducing Valve (PRV)
- Emergency/Backup PRV
- Check Valve
- City of Bellevue System
- Adjacent Utility/Regional Supply
- Existing Volume (Future TBD)



700 ft
600 ft
500 ft
400 ft
300 ft
200 ft

1500 ft
1400 ft
1300 ft
1200 ft
1100 ft
1000 ft
900 ft
800 ft
700 ft
600 ft
500 ft
400 ft
300 ft
200 ft

New Model Costs

- Field Hydrant Testing
- Model Build
- Model Calibration
- Ongoing Updates/Maintenance



Field Hydrant Testing



- 70 Tests
- 2,500 hours
- \$130,000+ labor
- Site selection, field reconnaissance, erosion control, water quality mailing/notification, post-test flushing, fire alarm coordination...
 - ...and the field tests themselves





Build & Calibrate

- GIS: Sunk cost (already done)
 - Consultant: \$130,000 (Initial build 2/3 of system)
 - City Engineering Staff
 - Info gathering, QA/QC, build 1/3 of system
 - \$60,000 (900+ hours)
 - O&M Staff – not tracked
 - Software \$19,000 (floating license)
-
- \$210,000+/- Total Model Build (\$2015)
 - \$240,000 Inflated



Model Maintenance

- GIS: Sunk cost (ongoing)
 - City Engineering Staff*
 - Import GIS, QA/QC
 - Update settings
 - \$16,500 (218 hours) in 2018
 - O&M Staff – not tracked
 - Software: \$5,600 annual fee
 -
-
- \$22,000+ total annual maintenance
 - *Higher-value labor than previous model; updates instead of iteration





Total Investment

- \$370,000 Upfront (\$2019)
 - Field Testing
 - Build
- \$22,000/Year Maintenance
 - Software
 - Model Updates (Labor)





New Model Benefits

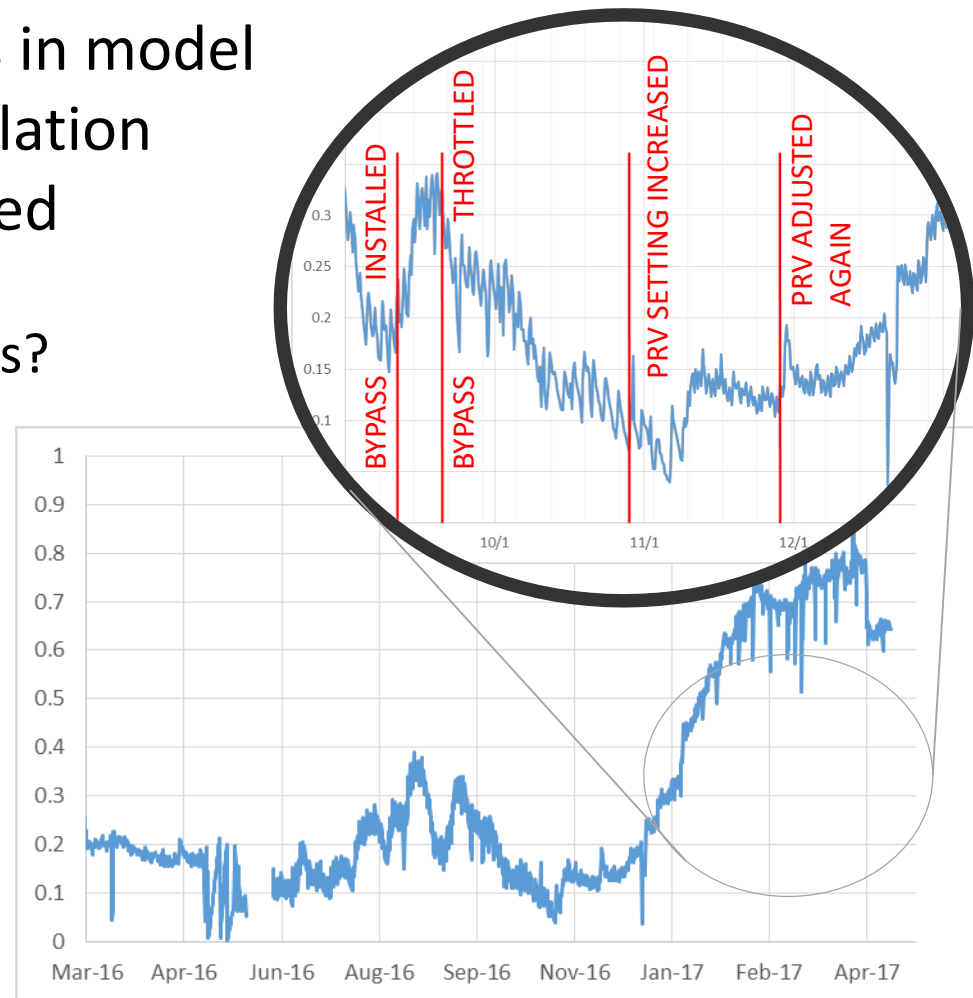
- Eliminated iterative analysis for hydrants
Perform system wide and map, vs 1.5 hour/each
x 161 (in 2016) = \$15,000 labor saved
- Analysis for new sprinklers
Save 15 min/each without manual iteration
x 280 (in 2016) = \$4,500 labor saved
- Fire Department Permitting
Save 15 min/each x 441
\$7,000 labor saved
- \$26,000+ annual labor savings



Cougar Mtn Chlorine Residual



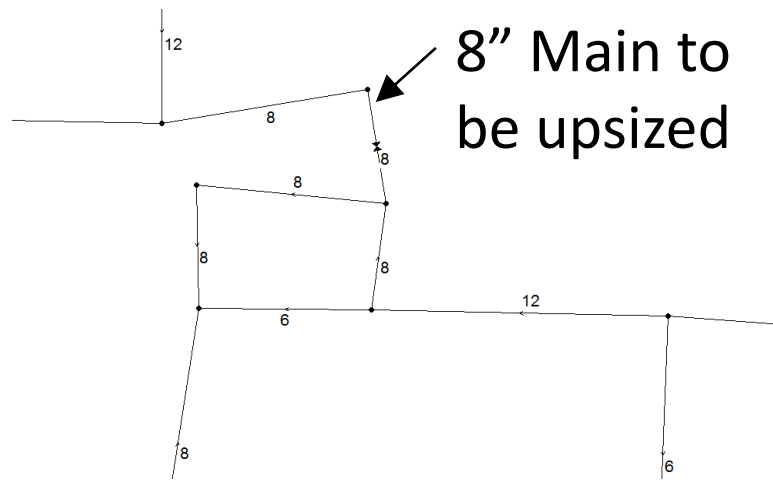
- Struggled with 0.0-0.2 mg/L
- Identified PRV adjustments in model
- Tested in field – clear correlation
- Results better than predicted
 - Aided by cooler weather?
 - Pump setpoint adjustments?
- \$20,000/year add'l power
- Savings
 - \$400,000 injection facility not needed
 - No more flushing \$40,000 labor + \$6,000 water in 2014-15
 - Sleep at night



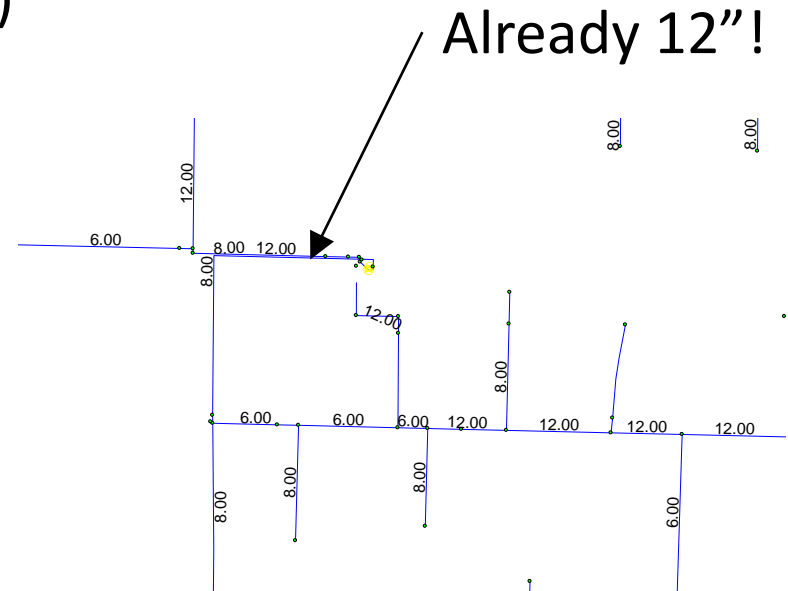
SE 7th Improvements Not Needed!



- Old model not systematically updated
- GIS data was accurate
- New model saved wasted design effort
- Savings: \$50,000 (or more ??)



OLD MODEL

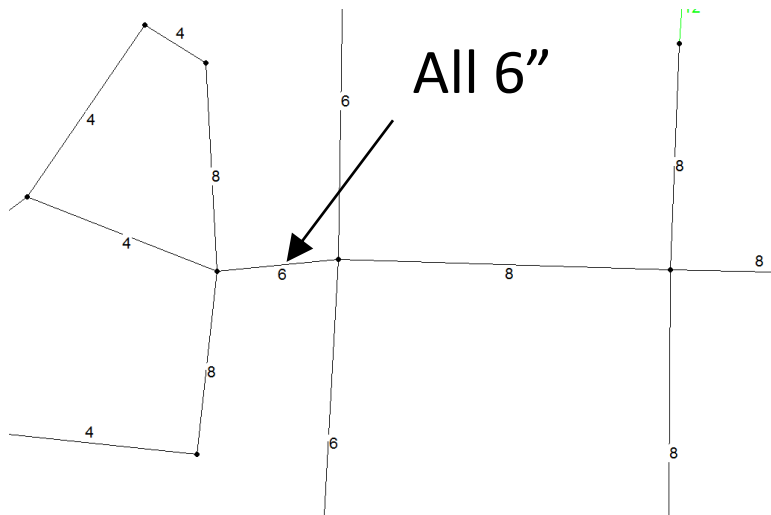


NEW MODEL

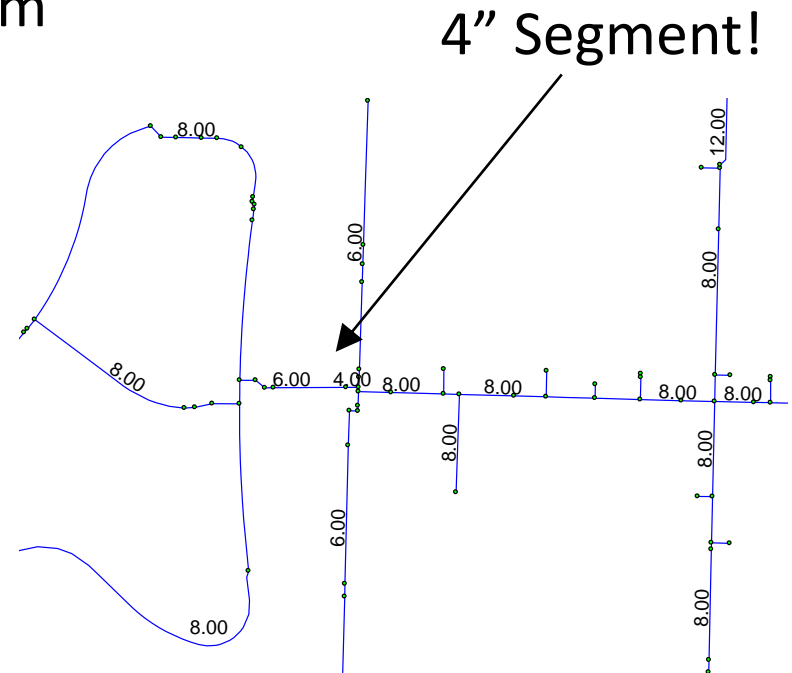


Belfair Lane – Fire Flow Restriction

- Old model was skeletonized
- GIS data was accurate
- New “all pipes” model revealed previously unrealized problem
- Benefit?



OLD MODEL

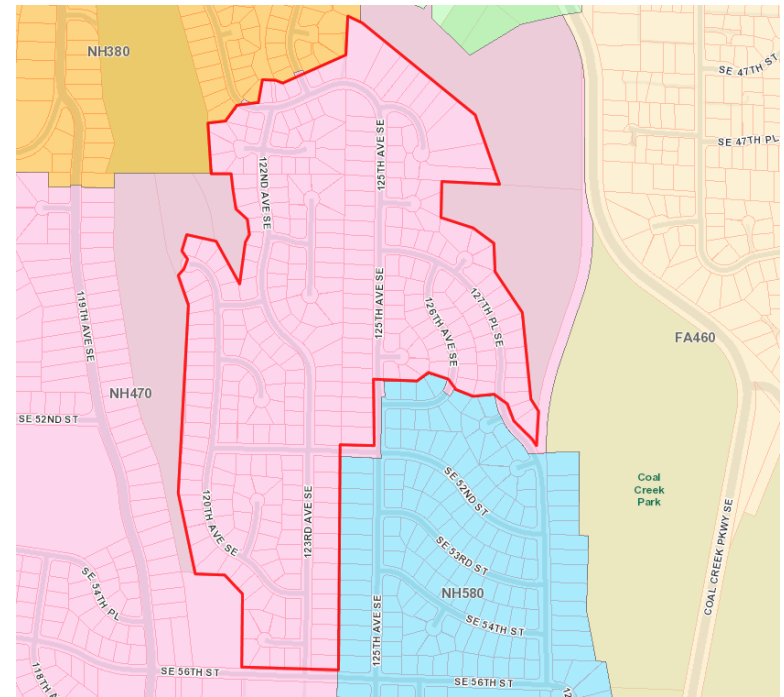


NEW MODEL



Newport Hills 470 Zone

- Model Highlighted Neighborhood with multiple previously un-realized problems:
 - Low Fire Flow
 - Lack of Redundancy
- 300+ houses prioritized

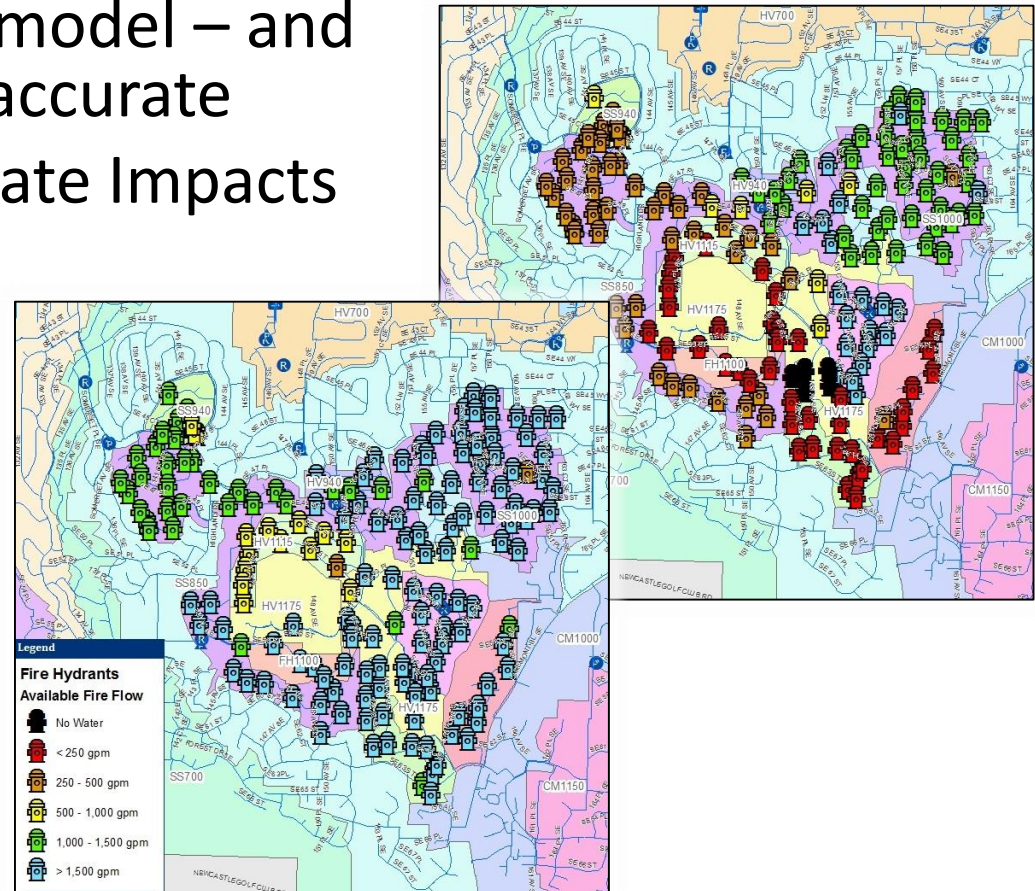


Shutdown Analysis



- Reservoir cleaning, pipeline repair, capital improvements, etc
- Not possible with old model – and if it was, wouldn't be accurate
- Evaluate & Communicate Impacts
 - High quality maps
 - Half-day effort
- Can evaluate multiple scenarios to support operational decisions
- Value???

REDUCED SERVICE
(TEMPORARY)



NORMAL CONDITIONS



Fire Department Rating

- WA Surveying & Rating Bureau
- Fire Dept audit, determines local homeowner's insurance rates
- Analyzed 154 hydrants, Less than 1-day effort analyze, document
- Fire Dept received Class 2 Rating (Top 5 in WA); 35% of score due to water





Model Cost vs. Benefit

+ Return on investment

Reduced Risk: Priceless

Costs	Benefits	
\$370,000 upfront \$22,000 annual	\$\$\$ Saved on Discreet Projects (already more than upfront costs) \$26,000 annual labor savings Unrealized problems identified Perceived problems not an issue New capabilities to assist O&M	Staff training & experience Improved relationships (Fire Dept, permitting staff, etc) Pretty pictures for storytelling Reverse QA/QC of GIS data Future uses... <i>gift that keeps on giving</i>

Sector-Specific Water Use

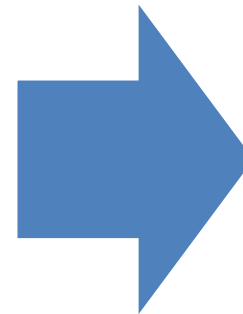


Billing Data

Parcel GIS

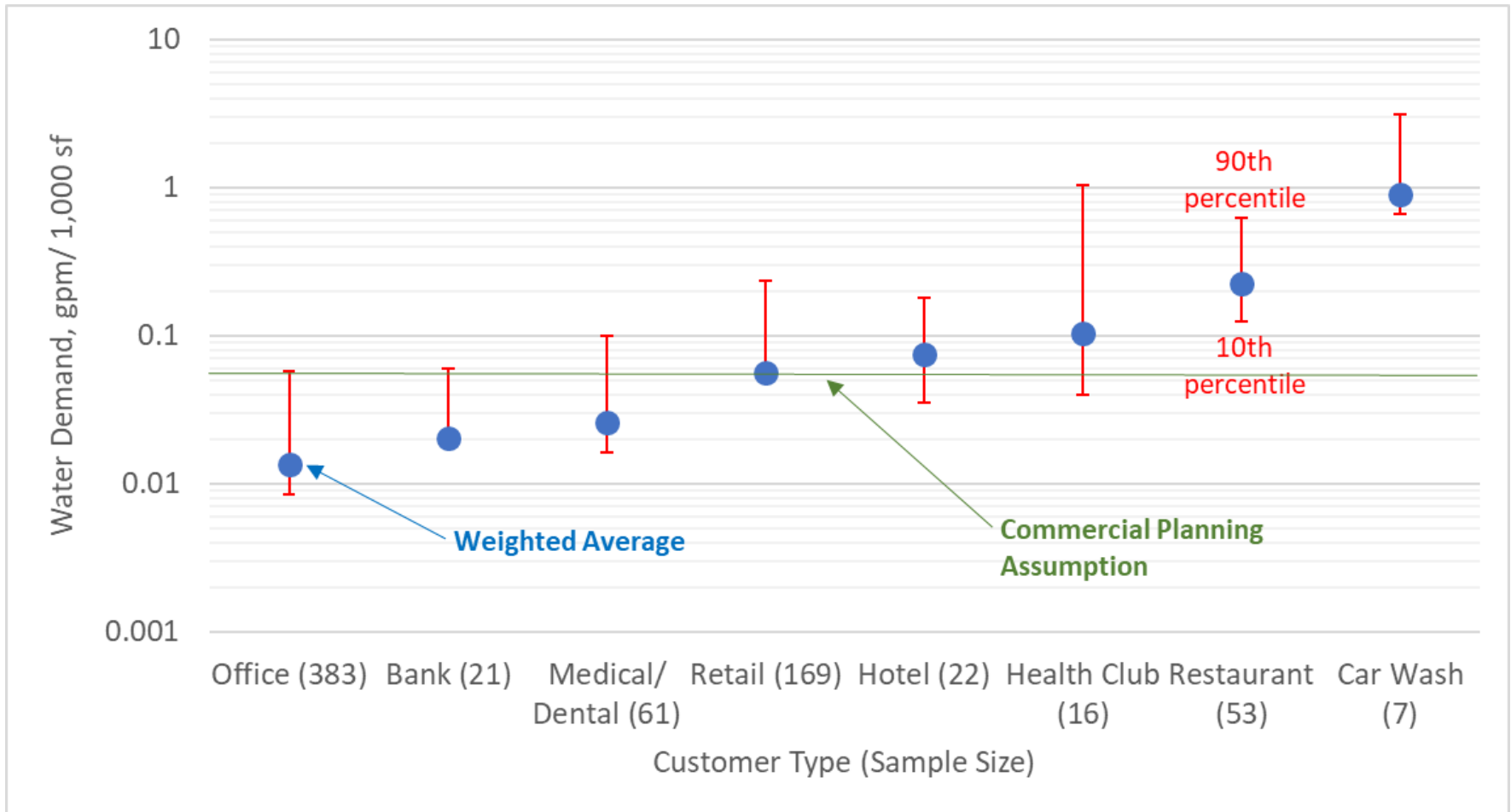
Land Use

Tax Assessor

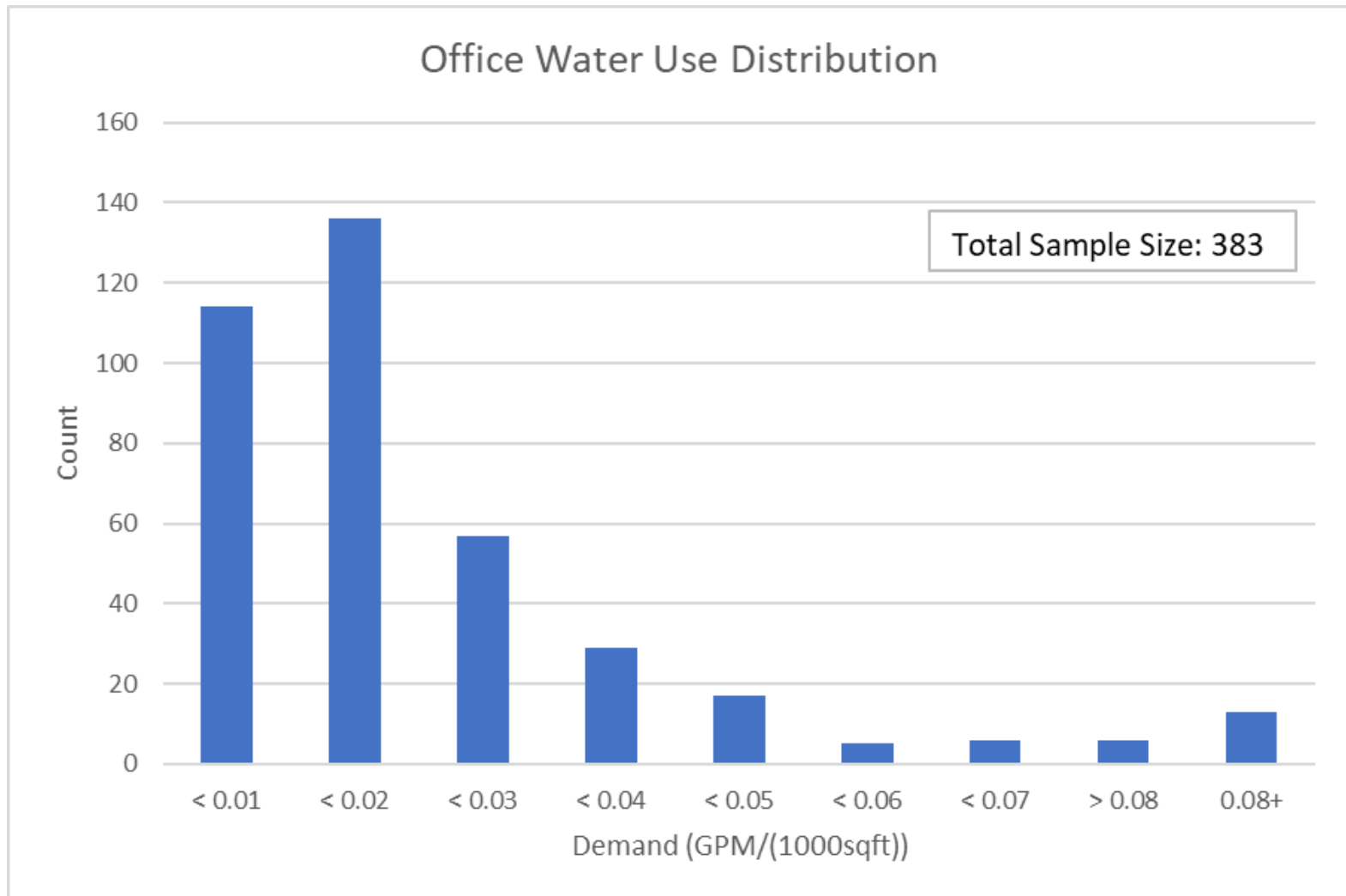


Customer
Demands
w/Business
Sector and
Building Size

Sector-Specific Water Use



Sector-Specific Water Use



Lead Concerns

- Bellevue School District mistakenly announces non-existent lead issue (during Flint crisis)
- Opportunity to inform City Council about the City's excellent water quality



CBS Seattle SPORTS NEWS CBSN LIVE BEST OF CW 11 MORE

Bellevue Schools Retesting Water For Lead

May 11, 2016 at 12:56 pm Filed Under: Bellevue, LEAD, Water



A school bus takes students to Newtown High School December 18, 2012 in Newtown, Connecticut. Students in Newtown, excluding Sandy Hook Elementary School, return to school for the first time since last Friday's shooting at Sandy Hook which took the lives of 20 students and 6 adults. AFP PHOTO/Brendan SMIALOWSKI (Photo credit: BRENDAN SMIALOWSKI/AFP/Getty Images) (Photo credit: BRENDAN SMIALOWSKI/AFP/Getty Images)



SEATTLE (DONNA GORDON BLANKINSHIP, Associated Press) — The Bellevue School District is retesting the water in all its [schools](#) more than a decade after finding lead in 13 out of its 16 elementary schools.

On Friday morning, [school](#) officials told The Associated Press the testing that found unsafe levels of lead in water was from early May. Later Friday, they said that upon further review, they learned the elementary school results were from 2005.

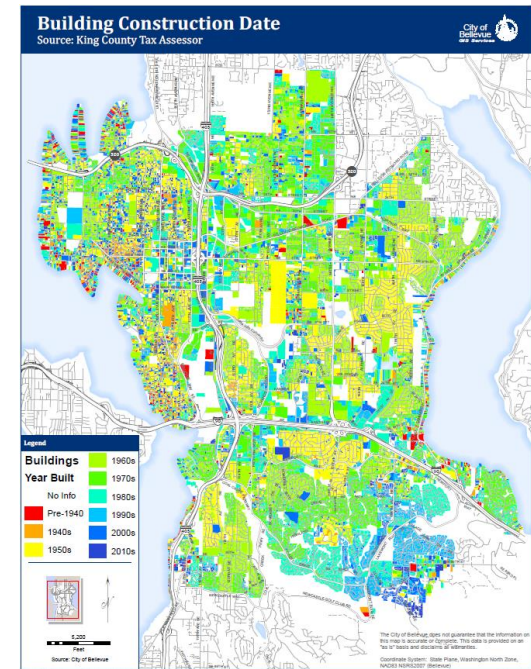
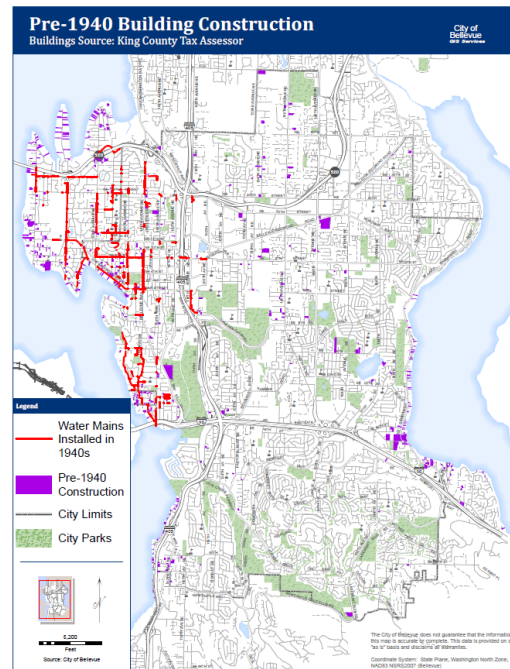
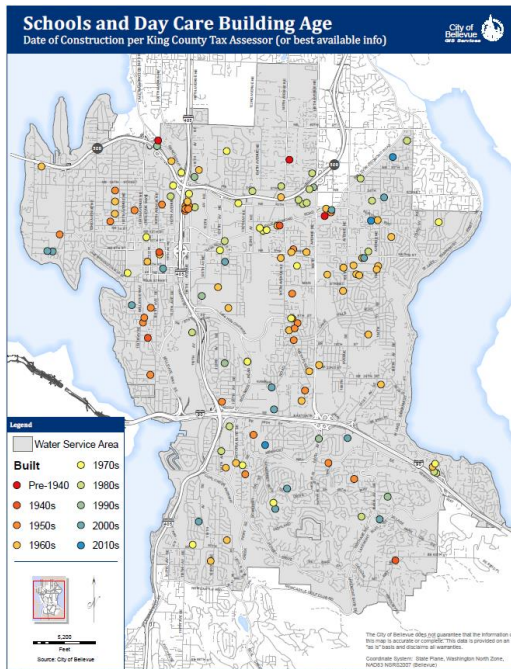
A district spokeswoman says she does not know when tests that found lead in the water at middle and [high schools](#) were done.

[School](#) officials have replaced or repaired the troubled fixtures which tested positive for lead above the actionable level set by the Environmental Protection Agency, the district said.

Lead Concerns Response



- GIS informed analysis, plus great maps
- Join date of construction, map with pipe age
- Positive reception, issue resolved



GIS



Non-intuitive...

...because it does so many things

Slow...

...because it's powerful

Lack of Support...

...you bet



Questions?

