San Jose Water Company

Distribution System Optimization- San Jose Water’s Pursuit of Distribution System Water Quality Excellence
Presentation Overview

- What is the Partnership?
- Foci of Optimization
- Response to Performance
- Operational Methods for improvement
- Capital Tools for improvement
- SJWC Optimization efforts
  - Current and Planned
- Lessons learned
What is the Partnership?

AWWA Partnership for Safe Water-Distribution System Optimization Program

- Came out of 2007 WRF project
- Provides framework for improvement
- Includes utility benchmarks
- Commitment to quality and organizational improvement
What is the Partnership?

- **Four Phase Process**
  - **Phase I: Commitment**
    Utilities commit to engage staff, collect and assess data, and pursue improvement
  - **Phase II: Data Collection**
    Annual Data submission focusing on disinfectant residuals, pressure data, and main break statistics
  - **Phase III: Self-Assessment**
    Narrative report analyzing data, and identifying “performance limiting factors”
  - **Phase IV: Optimized Performance**
    Achieve highest level of optimization
Foci of Optimization

Focus 1: Main Break Frequency

- \( \leq 15 \) breaks per 100 miles  ✔️ 8.9
- Declining five year average  ✔️

http://www.theengineer.co.uk/Pictures/web/d/y/r/33_water_image.jpg
Foci of Optimization

Foci of Optimization 2: Pressure Monitoring

- 20 psi minimum in 99.5% daily minimum measurements
- Utility specified (150 psi) maximum in 95% of measurements
- Daily pressure fluctuations do not exceed utility specified goal (50% of the average) in 95% of measurements
- Pressure collected at a minimum of two critical sites in each pressure zone

Pilot cover 10 zones. Full scale install complete December 2016
Foci of Optimization

Focus of Optimization 3: Disinfectant Residual

- 95% of monthly routine residual measurements above target levels
  - Free Chlorine Residuals $\geq 0.20$ mg/L
  - Total Chlorine Residuals $\geq 0.50$ mg/L

61% of all SJWC measurements meeting criteria

SJWC Background

- Privately owned public utility
  - 150 years old
  - Over one million customers
  - 2400 miles of pipe
  - 23 well fields with almost 100 wells
  - Two Water Treatment plants
  - 14 Imported Water Turnouts
  - 98 storage tanks and reservoirs
  - 140 Distribution system sample taps
SJWC Background

- **Built for reliability**
  - As much extra storage as possible
  - High residence times in storage

- **Built for economy**
  - Highly optimized to minimize cost by automating selection of most affordable source water regardless of disinfectant
  - Source of water for an area could change day to day
  - Lots of residual blending
SJWC Background
SJWC Background
SJWC Background
SJWC Response

Where to start?

Step 1- Get Better Data

- Jan 2014- SL1000’s deployed for nitrification monitoring
- Total chlorine, monochloramine, free ammonia, nitrite weekly at every tank
SJWC Response

Step 2- Make your data useful

- Migration to Locus EIM cloud database
  - Better data accessibility/reporting/tracking
  - Accommodates mobile data entry with real time alerts

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<th>Sampling Program</th>
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<th>Sample Date</th>
<th>Location ID</th>
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SJWC Response

Step 2- Make your data useful (cont’d)

- Live online WQ GIS maps
SJWC Response

Step 3: Figure out what to do with it short term

- Weekly Ops/WQ meeting for residual, GIS, and project review
  - Map tools
  - Flow chart protocol
SJWC Response

- Step 3: Figure out what to do with it short term (cont’d)

% Compliance with Partnership Goals
SJWC Response

Step 4: Figure out what to do with it—Long term

- Possibilities for operational improvements
- Tools for Capital Projects
SJWC Response

Step 4: Figure out what to do with it—Long term

Operational Methods for Improvement:

- New or revised SOPs
- New skills or personnel
  - Training—conceptual or technical
  - Hire staff if needed
- Modified Treatment processes
  - Check for unexerted biological or chemical demand
SJWC Response

Step 4: Figure out what to do with it—Long term

Tools for Capital Projects:

1. Residual boosting systems
2. SCADA controlled operational zone valves to reduce water age
3. Tank mixing systems (manual venturi boosting) to preserve residual and facilitate corrective action
Tools for Optimization

Automated Chloramine Boosting System
Tools for Optimization

Boosting System Installation at Miguelito

- Two mixers in each of two 1.5 MG reservoirs
- One dosing point in each reservoir
- Motive force from higher zone pressure
- Onsite hypochlorite generation
- Fully automated chemical feed to achieve target set point
- Liquid ammonium sulfate- comparatively safe
- Full SCADA integration
- Full Secondary containment
Tools for Optimization

Miguelito Lift Disinfectant Residuals

- Increase Target to 3.0 ppm
- Switch to chloramines
- Bottom of lift
- Start up with free chlorine
- Top of lift
- Analyzer Clog
- Ion Exchange Saturation

Legend:
- Green: Miguelito 1
- Orange: Miguelito 3
- Blue: Alum Rock 3
- Gray: Crothers

San Jose Water Company

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Tools for Optimization

Operational Zone Valve

- Large Zone (~20k services)- multiple reservoirs
  - One Reservoir site sits 20’ higher than the other
  - One zone input on south side (can’t split zone)
  - One main connects zone across a creek

One month trend- 3” movement
Tools for Optimization

Mixer/Analyzer/Venturi boosting
Tools for Optimization

Mixer/Analyzer/Venturi boosting
SJWC Optimization Efforts

- Revision of main break response SOP to incorporate risk-based “triage” strategy (per AWWA C651-14 and WRF Project 4307 Effective Microbial Control Strategies for Main Breaks and Depressurization)

- Improved SOPs for tank inspection and cleaning in draft

- Hydraulic model improvements to incorporate water age and disinfectant residual
SJWC Optimization Efforts

Planned Outcomes: CIP

- SCADA controlled valves (3 in progress)
- Four residual boosting systems approved in years 2015-2017- two are complete
- Mixing systems with venturi-style dosing ports at 7 key sites in 2016. All tanks and reservoirs by 2019
- Two key well fields chloraminated to reduce disinfectant blending
Lessons Learned

- Residual less that 2 ppm cannot be sustained
  - EPA’s Distribution System Optimization program for Comprehensive Performance Evaluation requires 2 ppm minimum in chloraminated systems to be considered “optimized”
- Beware of cometabolism of residual by Ammonia Oxidizing Bacteria
  - Can cause rapid residual loss without the occurrence of nitrification
  - May account for upwards of 40% of residual loss
Lessons Learned

- Residual less that 2 ppm cannot be sustained
  - EPA’s Distribution System Optimization program for Comprehensive Performance Evaluation requires 2 ppm minimum in chloraminated systems to be considered “optimized”
- Beware lingering demand
Lessons Learned

- Make good use of decay curves

- Characterizing residence time and entry point residual compared to normalized decay curve for influent water can help determine the need for boosting
Lessons Learned

- Nitrification makes your DBPs worse
  - Stanford Study with Teng Zeng and Bill Mitch

**DBP Impact of Nitrification**

- **Influent (Santa Teresa)**
- **Midpoint (Hydrant on fill cycle)**
- **Endpoint (mixed nitrified tank sample)**

- THM Avg
- SDS THM Avg
- HAA Avg
- SDS HAA Avg
Focus: Residual- Lessons Learned

- Focusing on the worst residuals will not solve most of your residual problems
  - Must pinpoint and understand causes of degradation
- Mixers facilitate operational response
  - Will not sustain residual or reverse nitrification in progress
  - Will assist boosting, breakover, or help sustain non-nitrifying waters
- Operations-Water Quality partnership is essential
Distribution System Optimization

Questions?

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