Partnership for Safe Water: Optimization Programs and Case Studies

Barbara Martin – AWWA
Robert Cheng, PhD, PE – Coachella Valley Water District
Hubert Lai – East Bay Municipal Utility District
Jessica Cullins – Modesto Irrigation District
Adam Fetter, PE – San Jose Water Company
Cynthia Andrews-Tate – Long Beach Water Department
Partnership for Safe Water

• Partnership for Safe Water mission:
  – *To improve the quality of drinking water delivered to customers by optimizing water system operations.*

• Two programs
  – Treatment plant optimization (1995)
  – Distribution system optimization (2011)
Partnership Subscribers

- Treatment Program
  - 251 Utilities
  - 462 Treatment plants
- Distribution Program
  - 150 Systems
- 40 States, DC, and Canada (AB, QC, NS, ON) represented
- 50% serving <100,000
  - Smallest serve populations of less than 1000
- More than 60 have joined since 2012

Partnership Treatment utilities serve a combined population of more than 85 million
Partnership Distribution utilities serve a combined population of more than 38 million
Treatment Program

- Open to surface water filtration plants of all sizes and process configurations
  - Focus on turbidity reduction (<0.10NTU)
  - Optimize processes for particulate removal
  - Multiple barrier approach
  - Process optimization approach can aid with other parameters
Distribution Program Optimization Parameters

• **Disinfectant residual - Water quality integrity**
  – Free chlorine ≥0.20 and ≤4.0 mg/L
  – Total chlorine ≥0.50 and ≤4.0 mg/L
  – Both goals for 95% of samples

• **Main break frequency - Physical integrity**
  – Goal of <15 reported breaks and leaks per 100 miles of utility owned pipeline per year

• **Pressure management - Hydraulic integrity**
  – Goals for minimum pressure (20psi, 99.5% of samples), maximum pressure (utility set), and pressure fluctuation (utility set)
Distribution Program
Performance Improvement Variables

- Disinfectant Residual
- Cross-Connection Control
- Customer Complaints
- DBP Control
- Energy Management
- External Corrosion Control
- Flushing
- Hydrant and Valve Maintenance
- Internal Corrosion Control
- Main Breaks
- Nitrification
- Pipe Rehabilitation and Replacement
- Inorganic Accumulation Control
- Pressure Management
- Security and Online Monitoring
- Storage Tank O&M
- Water Age Management
- Water Loss Control
- Water Sampling and Response
Case Studies

- Robert Cheng – PSW and EUM
- **Treatment Plant Optimization Program**
  - Hubert Lai – East Bay Municipal Utility District
  - Jessica Cullins – Modesto Irrigation District
- **Distribution System Optimization Program**
  - Adam Feffer – San Jose Water Company
  - Cynthia Andrews-Tate – Long Beach Water Department
Partnership for Safe Water and Effective Utility Management

Robert Cheng, PhD, PE
Coachella Valley Water District
Program Comparisons

1995

• Created out of need to “go beyond regulations”, *cryptosporidium*
• “To improve the quality of drinking water delivered to customers of community water systems by optimizing operations”
• Program housed within AWWA
• Originally open to surface water utilities (size independent) in US & Canada
• Program serves >100 m pop

2007

• Created on heels of privatization movement?
• “To identify, encourage, and recognize excellence in water and wastewater utility management”
• Program housed within AMWA
• Open to large US municipal agencies (>100 k population)
• AMWA utilities serve > 130 m pop

Involved in both programs
Benchmarking

How did you achieve progress?

Treatment

Turbidity (NTU)

Distribution

What did you do in each area?

1. Product Quality
2. Customer Satisfaction
3. Employee and Leadership Development
4. Operational Optimization
5. Financial Viability
6. Infrastructure Stability
7. Operational Resiliency
8. Community Sustainability
10. Stakeholder Understanding and Support

Effective Utility Management
Award Process

• I – Commitment
• II – Baseline data reporting
• III (Directors Award) – Self-Assessment completion
• IV(a) (Presidents award)
• IV (Excellence award) – Demonstrated optimization

• Gold – exceptional utility performance
  ✓ meet all 10 EUM attributes

• Platinum – utility excellence
  ✓ demonstrated progress in all 10 EUM attributes
  ✓ 3 yrs after Gold award

• Sustainability
  ✓ progress in economic, social, env.
  ✓ 3 yrs after Platinum award

Peer review of application common to both programs
Common Themes

Performance
- Product Quality

Capacity
- Water Resource Adequacy

Design
- Infrastructure Stability

Operations
- Operational Optimization
- Operational Resiliency
- Customer Satisfaction
- Community Sustainability

Administration
- Financial Viability
- Employee Leadership & Development
- Stakeholder Understanding
Notable improvement in daily maximum turbidity AND consistency over many years.
Program Approach

• Team approach
• Involvement at all levels across all areas of organization
• Promotes system-specific learning and comprehensive assessment
Benchmarking

• Action planning is critical
• Address factors limiting performance
  – SMART goals
  – All aspects of plant/system operation:
    • Operational
    • Training
    • Staffing
    • Funding
    • Capital improvements
Accountability

- Annual reporting process:
  - Data submission
  - Report documenting progress against Action Plan and identifying any new actions
- All data summarized in program’s annual data report to quantify program impact
- Continuous improvement
Transferrable Information

• Self-assessment is system-specific learning opportunity covering all aspects of treatment plant and/or distribution system operation.

Partnership Self-Assessment ➔ EUM Award Package, Funding Applications, Etc.
Recognition

• Recognition for optimization accomplishments builds credibility and stakeholder support

EUM Stakeholder Understanding:
Has your governing Board or Council recognized your work or indicated its awareness of your work in adopting more effective management practices?
Aurora Water (CO) recognized for receiving the Excellence in Water Treatment Award at a board meeting and in the City’s Annual Report.
PSW-EUM are Complementary

• It’s about much more than water quality!
  – Connection to other award programs
  – Cost savings
  – Recognition
  – Stakeholder engagement
  – Operational optimization
  – Funding
EBMUD Overview

- A water and wastewater utility
- Located on East side of the San Francisco Bay
- Serves 1.4 million people
- Raw water supply:
  - Three aqueducts from Sierra Nevada Mountains
  - Two local reservoirs
  - Sacramento River supplemental drought supply
- Six water treatment plants (3 seasonal, 1 backup)
EBMUD Service Area, WTPs
EBMUD: Optimize Treatment

• Involves O&M Staff, Managers, Board of Directors
• Committed to reliably providing high-quality water
  – Regularly review plant performance
  – Identify process control improvements
  – Plan and implement WTP improvements
• EBMUD’s Filter Effluent Operating Target:
  – Maintain $\leq 0.10$ NTU
  – All WTPs, at all times
EBMUD & Partnership for Safe Water

• EBMUD Turbidity WQ Goals:
  – Based on Partnership’s Phase IV goals

• Partnership participation:
  – Demonstrates commitment to WQ optimization
  – Encourages routine review of plant performance
  – PSW awards publicized in Annual Water Quality Report and other publications
  – Annual report documents treatment history
EBMUD’s Partnership Timeline

- **1995**: Board committed Partnership Participation
- **1997,99**: Submitted Self-Assessment Reports (Phase III)
  - **In-Line WTPs**: Orinda, Walnut Creek (WC), Lafayette
  - **Conventional WTPs**: USL, Sobrante
- **2000**: Orinda WTP: *Directors Award*
  - 2005/2010/2015  5-Year/10-Year/15-Year Directors Award
- **2001**: WC, Lafayette, USL, Sobrante WTPs: *Director’s Award*
  - 2006/2011  5-Year/10-Year Directors Award
Excellence in Water Treatment Awards (Phase IV)

- **2005**: Submitted Orinda WTP Phase IV Application
- **2006**: Orinda WTP: *Excellence in Water Treatment Award*
- **2011**: Orinda WTP: 5-Year *Excellence Award*
- **2016**: 10-Year *Excellence Award*
Orinda WTP
Phase IV Excellence Award

- Orinda WTP is the largest of six water treatment plants, with design capacity of 175 MGD
- Operate as an in-line filtration plant (without flocculation & sedimentation process)

Solids settling basins (filter BW), Supernatant to creek, Trucked sludge
EBMUD Filter Performance Goals

**EBMUD Water Quality Goals: Exceed PSW (99% vs. 95%)**

<table>
<thead>
<tr>
<th>Treatment Techniques</th>
<th>Units</th>
<th>Other Standard</th>
<th>Basis for WQG</th>
<th>EBMUD Water Quality Goal</th>
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</thead>
<tbody>
<tr>
<td>Individual Filter Effluent (IFE) Turbidity</td>
<td>NTU</td>
<td>PSW: &lt; 0.10 NTU more than 95% of the time.</td>
<td>Exceed Partnership for Safe Water</td>
<td>&lt; 0.10 NTU more than 99% of the time.</td>
</tr>
<tr>
<td>Filter Startup Turbidity</td>
<td>NTU</td>
<td>PSW: Max individual backwash recovery period(^1) of 15 minutes.</td>
<td>Partnership for Safe Water</td>
<td>Max individual backwash recovery period(^1) of 15 minutes.</td>
</tr>
<tr>
<td>Combined Filter Effluent (CFE) Turbidity</td>
<td>NTU</td>
<td>CaSWTR(^2)</td>
<td>Exceed Partnership for Safe Water(^3)</td>
<td>&lt; 0.10 NTU more than 99% of the time.</td>
</tr>
</tbody>
</table>

1. Backwash recovery period is the time the turbidity is ≥ 0.10 NTU after a filter is placed in operation following a backwash or filtering to waste.
2. California Surface Water Treatment Rule (SWTR); combined filter effluent turbidity < 0.3 NTU 95% for conventional plants and 0.2 NTU for in-line filtration plants more than 95% of the time.
3. < 0.10 NTU 95 percent of the time.
PSW Phase III Data Report

- Data from 4-hour grab samples:

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<td>RSD</td>
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<td>11.9%</td>
<td>11.5%</td>
<td>13.0%</td>
<td>21.2%</td>
<td>16.2%</td>
<td>8.9%</td>
<td>9.7%</td>
<td>7.6%</td>
<td>4.4%</td>
<td>12.7%</td>
<td>14.1%</td>
<td></td>
</tr>
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</table>
EBMUD Turbidity Data Management

- **1-Minute Turbidity Data**
  - Individual Filter & Combined Plant Effluents
  - Continuous online instrumentation

- **Automatic filter Start/Stop times**

- **Operators edit data status if not representative of effluent water quality**
  - Example: calibration spikes
  - Report summarizes all edits, before and after, info not lost

- **Statistics analyze only real in-service data**
## Monthly Filter Turbidity Report

### ORINDA WATER TREATMENT PLANT

**July 1, 2011 12:00 AM to August 1, 2011 12:00 AM**

### Individual Filter Effluent Turbidity Statistics

<table>
<thead>
<tr>
<th>Filter</th>
<th>1-Minute Turbidity Data</th>
<th>Date/Time</th>
<th># of 1-Minute Turbidity Readings ≥ 0.10 NTU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95% 96% 97% 98% 99% Max</td>
<td>Maximum</td>
<td>Turbidity Range</td>
</tr>
<tr>
<td>1</td>
<td>0.029 0.03 0.034 0.036 0.047 0.082</td>
<td>7/4/2011 3:19</td>
<td>0.10 - 0.15 0.151 - &gt;0.20 Total</td>
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<td>2</td>
<td>0.035 0.037 0.041 0.046 0.055 0.247</td>
<td>7/13/2011 13:48</td>
<td>0 0 2 3</td>
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<tr>
<td>3</td>
<td>0.032 0.034 0.036 0.042 0.051 0.083</td>
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<td>4</td>
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<td>7/24/2011 23:06</td>
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<td>6</td>
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<tr>
<td>7</td>
<td>0.043 0.046 0.049 0.054 0.061 0.092</td>
<td>7/17/2011 4:20</td>
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<td>8</td>
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<td>7/27/2011 10:13</td>
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<td>15</td>
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<td>7/28/2011 10:44</td>
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</tr>
</tbody>
</table>

### Notes:

1. In-service filter data only. Maximum turbidity readings removed and updated if maximum occurs as part of a spike that operations has determined to be non-representative of actual filter effluent turbidity (operations only X's out turbidity readings ≥ 0.10 NTU).

2. Explanations for turbidity spikes:

   - Filter #2 on 7/13/11 13:48 experienced a short but abrupt flow spike from 6 to 12 MGD, leading to a 3 minute turbidity spike with a maximum of 0.247 NTU. The flow was immediately reduced and the filter was taken out of service within 7 minutes. Mechanical maintenance had just been completed on the Filter #2 effluent valve versus valve. The versus valve malfunctioned when placed back into service. A new Standard Operating Procedure has been developed to prevent similar incidents from happening in the future.
## Phase IV Filter Annual Summary

### 2011 - 2012 Annual Summary Table

**Individual Filter Effluent Turbidity Monthly Statistics**

Orinda WTP, Partnership Phase IV Annual Report

<table>
<thead>
<tr>
<th>Treatment Goal</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
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<tbody>
<tr>
<td>Individual Filter Effluent Turbidity</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>95% Maximum Turbidity, NTU</strong></td>
<td>0.048</td>
<td>0.043</td>
<td>0.041</td>
<td>0.036</td>
<td>0.031</td>
<td>0.034</td>
<td>0.031</td>
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<td>0.036</td>
<td>0.039</td>
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<tr>
<td>Worst Filter - 95%</td>
<td>#15</td>
<td>#7</td>
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<td>#7, 17</td>
<td>#17</td>
<td>#17</td>
<td>#15</td>
<td>#15</td>
<td>#15</td>
<td>#5</td>
<td>#7</td>
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<tr>
<td><strong>Maximum Turbidity, NTU</strong></td>
<td>0.087</td>
<td>0.247</td>
<td>0.085</td>
<td>0.073</td>
<td>0.062</td>
<td>0.068</td>
<td>0.068</td>
<td>0.092</td>
<td>0.076</td>
<td>0.106</td>
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<td>Worst Filter, Max Turbidity</td>
<td>#4, 15</td>
<td>#2</td>
<td>#6</td>
<td>#5, 8</td>
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<td>#17</td>
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<td>#20</td>
<td>#15</td>
<td>#10</td>
<td>#7</td>
<td>#2</td>
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<tr>
<td><strong>When Max Turbidity Occurred</strong></td>
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<tr>
<td>Start of Run</td>
<td>Equip</td>
<td>Maintenance</td>
<td>Start of Run</td>
<td>Equip</td>
<td>Maintenance</td>
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<td>Start of Run</td>
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</table>

**NOTES:**

1. Filter #2 on 7/13/11 13:48 experienced a short but abrupt flow spike from 6 to 12 MGD, leading to a 3 minute turbidity spike with a maximum of 0.247 NTU. The flow was immediately reduced and the filter was taken out of service within 7 minutes. The spike was caused by equipment malfunction. Mechanical maintenance had just been completed on the filter #2 effluent valve versa valve (hydraulic control system). The versa valve malfunctioned when placed back into service. A new Standard Operating Procedure has been developed to prevent similar incidents from happening in the future. The SOP requires that the filter effluent valve be hydraulically locked in place during the work. Just prior to the component being placed back into service, the operator manually adjusts the controller setpoint to match the actual flowrates.

2. Filter #10 on 3/28/12 10:03 experienced a 0.106 NTU turbidity spike, with seven minutes over 0.1 NTU. Operators closed the filter effluent valve for 15 minutes and filtered to waste, then resumed the filter run. The spike occurred approximately 20 hours into the filter run (normal runs at that time were approximately 2 days). The turbidity spike was caused when the plant cationic polymer system was shut down for maintenance (9:10 am - 9:48 am). This was a planned maintenance activity. The primary coagulant dose was increased and a coagulant was used to manually feed polymer. Four filters experienced spikes and were shut down. The combined plant effluent turbidity reached a maximum of 0.07 NTU. The filter #19 particle log removal dropped to a minimum of 2.74. The combined effluent #2 dropped to 2.59 log for one minute.
EBMUD SCADA Trends

• SCADA Instrumentation data stored in OSCII
• Data By Exception (set criteria, ± amount, time)
  – Allow rapid data retrieval, flexible trends
• Filter run trends:
  – Turbidity
  – Filter flow
  – Filter effluent valve position
  – Head loss
  – Particle counts & particle counter flow
Example – Filter Run Optimization
Example: Detect Filter Underdrain Failure
Modesto Regional Water Treatment Plant
Presidents Award Onward
Jessica Cullins
Modesto Irrigation District
Water Treatment Laboratory Technician
Overview

• History with the Partnership and Presidents Award
• Settling Aid Study
  – Plant overview
  – Jar & pilot testing
  – Full Scale testing
• Future Steps
History with Partnership and Presidents Award

- Member since 1995
- Received Directors Award in 2001
- Received Presidents Award 2013

<table>
<thead>
<tr>
<th>Filter ID</th>
<th>95th Percentile</th>
<th>Average ntu</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.046</td>
<td>0.028</td>
</tr>
<tr>
<td>2</td>
<td>0.049</td>
<td>0.029</td>
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<tr>
<td>3</td>
<td>0.052</td>
<td>0.033</td>
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<tr>
<td>4</td>
<td>0.051</td>
<td>0.031</td>
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<tr>
<td>5</td>
<td>0.050</td>
<td>0.029</td>
</tr>
<tr>
<td>6</td>
<td>0.049</td>
<td>0.029</td>
</tr>
</tbody>
</table>
But What About the Rest of the Plant Processes?

- Filters are great!
  - No filter to waste capability
- Recycle water system is getting help
- Sedimentation basins need help
Excellence in Water Treatment
Award

Can we do it?
Plant Overview

CONVENTIONAL WATER TREATMENT PLANT SCHEMATIC

MODIFICATIONS TO EXISTING INSTRUMENTATION

<table>
<thead>
<tr>
<th>SAMPLE POINT</th>
<th>MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIT 453</td>
<td>DAF INFLUENT FLOW RATE</td>
</tr>
</tbody>
</table>
Jar & Pilot Testing

• Jar Testing
  – Nalco Optimer 7128 and Coreshell 71325
  – Dose & Timing

• Pilot Testing
Pilot Testing Results

Pilot Plant Results - Coreshell

Pilot Plant Results - Optimer
Now What?

• Further refine coagulant doses
  – Zeta Potential Analyzer?
• Expand on initial full scale trial
• Try more settling aids
• Membrane Plant Data
• Apply for Excellence in Water Treatment Award
Presentation Overview

- For Distribution System Residual
  - Partnership Criteria
  - Current performance
  - Optimization efforts
  - Current and Planned
  - Lessons learned
Partnership Criteria - 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
Current Performance - Residual

- 69.0% of all measurements meeting criteria
  - 87.2% of TCR samples, (2014 - 88.3%)
  - 47.8% of tank/reservoir samples (2014 - 53.1%)
- Average System Min daily value: ND
- Average Entry point: 0.72 ppm
Optimization Efforts

Where to start?

Step 1- Get Better Data
- SL1000’s deployed for nitrification monitoring
- Free chlorine, monochloramine, free ammonia, and nitrite, weekly at every tank

• Migration to Locus EIM
  - Better data accessibility/reporting
  - More complete data tracking
  - GIS functionality with shared maps
  - Accommodates mobile data entry
Optimization Efforts

Step 2: Figure out what to do with it

• Short term: Weekly Ops/WQ meeting for residual, GIS, and
  – Map tools
  – Flow chart protocol
Optimization Efforts

Step 3: Figure out what to do with it—Long term Capital Projects:
- Residual boosting
- Reduction in water age
- Facilitate corrective action
- Avoid residual blending

Operational Changes:
- New or revised SOPs
- New skills or personnel
Optimization Efforts

Automated Chloramine Boosting System
Alum-Rock Pilot
Residual Trends for Monochlor Pilot Project

- Start of pilot - 1.5 ppm target
- Dose boost - 2.5 ppm target
- After Breakpoint
- Power Outage

- Bottom of lift
- Tank of install
- Top of lift
- End of Pilot

Lines:
- Purple: Miguelito
- Orange: Alum Rock 3 Grab
- Yellow: Alum Rock Online
- Red: Crothers

Dates:
- Mar-14
- Apr-14
- May-14
- Jun-14

ppm Total Chlorine
Optimization Efforts

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
- Automated off target set point
- Liquid ammonium sulfate - comparatively safe
- Full SCADA integration
- Full Secondary containment
Miguelito Disinfectant Boosting System

- Start of pilot - 2.0 ppm FC target
- Switch to 2.5 ppm target
- Monochloramine
- Adjusted to 3 ppm target

Graph details:
- ppm residual
- 10/31/15 to 2/28/16
- FC-Miguelito
- FC-Alum Rock 3
- FC-Crothers
- Mono-Miguelito
- Mono-Alum Rock 3
- Mono-Crothers
Optimization Efforts
Optimization Efforts

Chlorinated Well Fields

Chlorinated Treatment Plants
Optimization Efforts

Chloraminated Imported Water Turnouts
Optimization Efforts
Optimization Efforts
Optimization Efforts

Capital Improvements
- SCADA controlled valves (3 in progress)
- Four residual boosting systems approved in years 2015-2017
- Mixing systems with venturi-style dosing ports at ten key sites in 2016. All tanks and reservoirs by 2019
- Two key well fields and one plant chloraminated

Operational Improvements
- Improved SOPs for tank inspection and cleaning
- Hydraulic model to incorporate water age and disinfectant residual
Lessons Learned

• Residual less that 2 ppm cannot be sustained
  – EPA’s DS Optimization program for Comprehensive Performance Evaluation considers 2 ppm minimum in chloraminated systems to be “optimized”

• Bromide interference makes residual targets more elusive
  – Bromide + Chlorine = Hypobromous acid
  – Hypobromous acid + ammonia = bromamine
  – Bromamine registers as total residual oxidant in DPD, but is not effective or persistent

• Nitrification makes your DBPs worse
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
Focus: Residual- Lessons Learned

- Nitrification makes your DBPs worse
  – Stanford Study with Teng Zeng and Bill Mitch
AWWA Partnership for Safe Water

LBWD Distribution Optimization Approach

Cynthia Andrews-Tate

Long Beach Water Department

March 22nd, 2016
Outline

• Goals
• LBWD Distribution System
• LBWD Approach
• LBWD Assessment, Limiting Factors and Improvements
• Benefits
PSW and LBWD Goals

**PSW**
- Goal: offer utilities optimization tools to improve beyond regulatory requirements
- Programs
  - Treatment
    - SW: 1995
    - GW: Pilot 2015
  - Distribution: 2011

**LBWD**
- Goal: provide a reliable high quality water at the lowest cost
- Programs
  - Treatment
    - GW: Pilot 2015
  - Distribution: 2011
LBWD Distribution System

- Two storage reservoirs
- One treatment plant pump station and one booster pump station
- ~900 miles mains
- ~20,500 valves, ?? - blowoffs
LBWD\PSW Approach

• Team Approach
  ▪ Administration
  ▪ Engineering
  ▪ GIS
  ▪ Treatment Plant
  ▪ Water \ Valves \ Field Operations
  ▪ Water Quality
## LBWD Performance Assessment

<table>
<thead>
<tr>
<th>Indicators</th>
<th>PSW-Goal</th>
<th>LBWD - 2012 Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine Residual (95% measurements)</td>
<td>0.50 to 4.00 mg/L</td>
<td>1.48 to 2.98 mg/L</td>
</tr>
<tr>
<td>Pressure</td>
<td>System: 20 to 80 psi; Single site range: ≤15 psi</td>
<td>25 to 80 psi in &gt;95% measurements; &gt;99% sites range &lt;15 psi</td>
</tr>
<tr>
<td>Main Breaks</td>
<td>≤15 annual breaks/100 miles</td>
<td>&lt;10 since 2001</td>
</tr>
</tbody>
</table>
Performance Assessment and Limiting Factors

Disinfectant Residual

- DBP Compliance
- Nitrification
- Micro Compliance/Sampling
- Security Emergency Mgmt
- Post Precipitation Inorg Accum
- Internal Corrosion Control
- Storage

Main Breaks

- Customer Complaints
- Maintenance: hydrant/valve
- Pipeline Rehab/Replace
- Storage

Pressure Control

- Water Loss Control
- Cross Connection Control
- Flushing
- Pipeline Rehab/Replace
- Storage/Tank Maintenance

Energy Management

- Main Breaks

Copyright: AWWA PSW
Performance Limiting Factors: Disinfectant Residual

- DBP Compliance
- Nitrification
- Micro Compliance/Sampling
- Security Emergency Mgmt
- Post Precipitation Inorg Accum
- Internal Corrosion Control
- Storage
- Water Age
- Disinfection: Mains, Repairs
- Flushing
- Customer Complaints
- Disinfectant Residual

Performance Limiting Factors:
- Disinfectant Residual
- DBP Compliance
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Performance Limiting Factors: Disinfectant Residual

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- Internal Corrosion Control
- Storage
- Water Age
- Disinfection: Mains, Repairs
- Flushing
- Customer Complaints

Not Optimized
Performance Limiting Factors: Disinfectant Residual

- **Post Precipitation Control**
  - Monitored inorganic components at flushing sites
  - Correlation not found
Performance Limiting Factors: Pressure Management
Performance Limiting Factors: Pressure Management
Performance Limiting Factors: Pressure Management

- Customer Complaints
- Main Breaks
- Energy Management
- Pressure Control
- Cross Connection Control
- Water Loss Control
- Pipeline Rehab/Replace
- Storage/Tank Maintenance
- Flushing

Not Fully Optimized
Performance Limiting Factors: Main Breaks

- Pressure Control
- Water Loss Control
- Customer Complaints
- Maintenance: hydrant/valve
- Pipeline Rehab/Replace
- Storage
- Internal/External Corrosion Control
Performance Assessment-Main Breaks

- Annual average
- Rolling 5 year average

PSW Max Goal
Performance Limiting Factors:

Main Breaks

- Not Fully Optimized
- Pressure Control
- Water Loss Control
- Internal/External Corrosion Control
- Storage
- Pipeline Rehab/Replace
- Maintenance: hydrant/valve
- Customer Complaints
PSW Goals Benefit LBWD

Confidence

• Emergency Response Plan (J100) – Improved from <4 (2012) to 7 (scale 1-10) in preparedness

• New Administration – recognized improvements and confidence

• Newsletters – Attributed LBWD’s confidence to our continued improvements and optimization to protect public health

• Directors Award Since 2012

• Presidents Award – 2015
Feedback: PSW-LBWD Team

- **Eng:** reiterates we need to stay on top of optimizing our work, reminds us what we are here for
- **Administrator:** means being vigilant on what we need to do to stay optimized and move towards more optimization on other things; reminds the staff to implement and adopt PSW goals
- **Field Ops:** PSW a great tool to measure ourselves against industry standards, where our strengths and weaknesses are and how we can work together to get better
- **GIS:** utilizing every group and put everyone’s strength together, use technology
- **Analyst:** water quality doesn’t end at TP, it’s up to DS to maintain WQ;
- **Field Ops:** working with all divisions together to get safe and reliable drinking water to customers and keep the cost down and reliable water
- **Field Ops:** it’s a continuous process to instill PSW goals into employees and the hardest part is to get the buy ins from top to bottom; team helps to implement and remind staff they are the frontline of the goals
- **TP Supt:** PSW involves all the groups ensures you always efficiently run your system and ensure WQ, and get the buy ins from the group
- **Field Ops Supt:** PSW brings everyone together with common goals, to make ourselves better, there is always ways to improve, using other people’s experience to help us improve. Hard part is to get everyone to understand how their work fit into the big picture and why we are doing it
- **Eng:** each section is equally good and important and PSW is how we can learn from each other
- **TP:** PSW brings us together and we learn from each other and have a better understanding of what is involved in delivering high quality water to our customers
- **WQ:** PSW’s assessment tools exposed our weaknesses and our strength comes from how we came together and fix the problems
Acknowledgement
Questions?

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