Water Storage Tank Monitoring, Sampling, and Fluctuation: Improving Water Quality and Reducing Disinfectant By-products (DBP's)

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BIRMINGHAM WATER WORKS BOARD

600,000 People Served

BWWB Service Area

www.baselogistics.net

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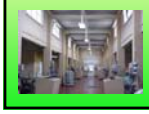
Shades Mountain (80 mgd peak)
Original construction 1890's
Provides approx. 50% of system demand

Western (60 mgd peak)
Original construction 1960's
Provides approx 30% of system demand

H.Y. Carson (25.9 mgd peak)
Original construction 1970's
Provides approx 10% of system demand



Putnam (24 mgd peak)
Original construction 1930's
Provides approx 10% of system demand

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Water Sources

- No large rivers
- Drought susceptible
- Water quality varies widely
- Four sources
- Finished water from different plants/sources mix in distribution system

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Disinfectant By-products (DBP's)

- Stage 2 regulation begins 2012
- Reaction of chlorine and organic compounds measured as total organic carbon (TOC)
- Some DBP's suspected carcinogens
- Affected by water age

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Regulated DBPs

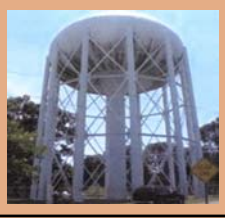
- Total Trihalomethanes (TTHM) – 80 ppb is the Maximum Contaminant Level (MCL)
- Haloacedic Acids (HAA) – 60 ppb is the Maximum Contaminant Level (MCL)
- Stage 2 – Monitoring locations with locational running annual average (LRAA)

BWWB LRAA Goal

- Total Trihalomethanes
  - 80% of MCL or 64 ppb
- Haloacedic Acids
  - 80% of MCL or 48 ppb

BWWB DBP reduction strategy

- Chloramine flow through project
- Chlorine dioxide pilot study
- Investigation of alternate coagulants
- Algae identification and control
- Source water TOC reduction
- Granulated activated carbon (GAC) Demo
- Source Water Monitoring
- Tank Mixing, Fluctuation



Tank Types

Storage Tanks

- 51 total drinking water storage tanks
- All geometric types represented
- Tanks vary widely in age

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Storage Tanks

- Improve water quality by reducing water age
- Reliable monitoring data

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BWWB Tank Mixing

- Applied to 16 Tanks ranging in design styles (Reservoir, Elevated, Standpipe)
- Passive Systems
- One tank (Sulphur Springs I) is fitted with temperature sensors

Mixing Device

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Mixing Device

Nozzles / Check Valves

Temperature Study

- Initial Data was collected in 2006
- The temperature data reflects temperature fluctuations, relative to height, in the Sulphur Springs I Tank

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Tank Sampling

- Tanks throughout the distribution system that utilize mixing devices are sampled
- The tanks were sampled for residual chlorine, HAA's, and TTHM's at varying heights

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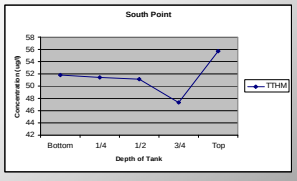

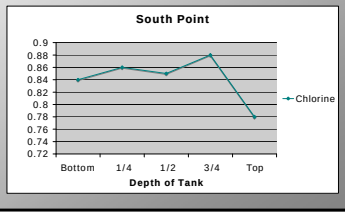

Current Work

- Sulphur Springs I and II fitted with temperature sensors and sampling ports
- Bi-weekly sampling of all tanks with mixing devices

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Simple Ways To Improve Water Quality in Tanks

- Bacteriological Monitoring
- Tank Fluctuation

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Bacteriological Sampling

- Anticipate water quality problems
- Identify problem tanks

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False Positives

- In some cases make up more than 10 percent of positive bacteriological samples
- Can be reduced significantly with proper training of field technicians

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Results of false positives

- Costly re-sampling
- Negative attention from regulators, press
- Unnecessary addition of chlorine (DBP's)

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Sample Container

- 100 ml plastic bottle undamaged
- Must contain powdered preservative
- Seal broken only immediately before sampling

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Typical 100 ml Sample Bottle

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Sampler Error

- Bringing bottle into contact with possible contaminants
- Careless handling
- Storage above 40 deg. F

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Possible Sources of False Positives

- Contaminated sample collecting device
- Sampler not wearing protective equipment
- Dangerous or awkward sampling locations

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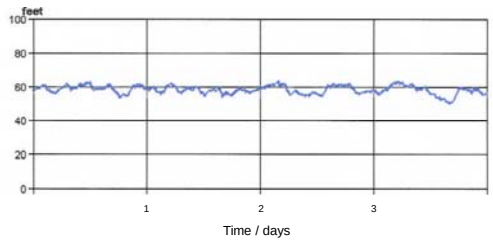
Tank Fluctuation

- Operators fluctuate tank levels
- Goal of 20 % volume reduction in tanks daily
- 50 % reduction achieved in several tanks

Tank Fluctuation

- Avoid stagnation / stratification
- Reduce the need for adding chemicals by maintaining chlorine residuals
- Reduce the possibility of freezing
- Potential energy cost reduction

Tank with no significant fluctuation



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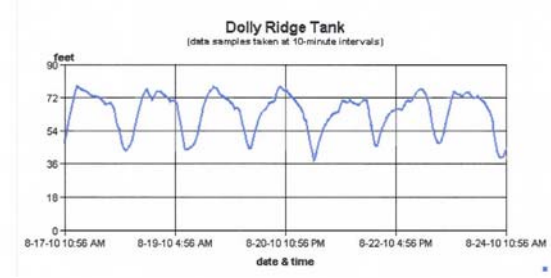

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Tank Fluctuation

- Tank Fluctuation and Flushing program suspended during drought in May 2007
- Resumed in later in 2007
- 20% reduction of DBP's

Questions?

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