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PUBLIC SERVICE  
COMMISSION

February 16, 2016

Chairman James W. Gardner, Acting Executive Director  
Public Service Commission  
P.O. Box 615  
Frankfort, Kentucky 40602-0615

Re: Case No 2016-0074  
RURAL COMMUNITY ASSISTANCE PARTNERSHIP  
Commissioner Continuing Education Credits

Dear Chairman Gardner,

In this packet please find one original and five copies of the written materials that will be given to Commissioners who attend our training. With this letter and enclosures, RCAP respectfully requests that this training be approved for continuing education credit for commissioners as referenced in regulation 807 KAR 5:070.

Should you require additional information, please advise me at [khpadgett@capky.org](mailto:khpadgett@capky.org) or 502.875.5863. Thank you for your assistance.

Sincerely,

A handwritten signature in blue ink that reads "Kimberly Padgett".

Kimberly Padgett  
RCAP State Director - Kentucky

Enclosures





# Pre-Test

Required by all USEPA Training Events

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## RCAP Partners



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## Best Practices for Water Quality



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## Objectives



- Identify water system issues that may impact public health.
- Describe the importance of water system as a barrier for protecting public health.
- Identify Best Management Practices to Maintaining Water Quality.

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## Water System as a Barrier to Protect Public Health



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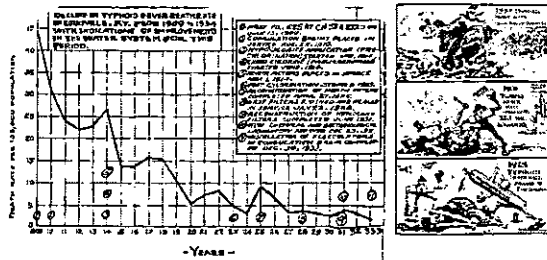
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## Typhoid Fever in Louisville, KY



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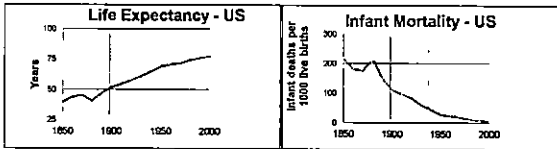
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## National Bureau of Economic Research



*"between 1900 and 1936 clean water was responsible for nearly half of the total mortality reduction in major cities, three-quarters of the infant mortality reduction, and nearly two-thirds of the child mortality reduction."* (Cutler and Miller, 2004)



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## Public Health



- Cutler and Miller (2005) estimates for conventional water treatment
- Between 1900 and 1936:
  - approximately 300 deaths per 100,000 population due to all pathogens were averted through improved water supply
  - at a cost of approximately \$500 per death averted,
  - yielding a conservatively estimated benefit to cost ratio of 23:1 (2003 U.S. dollars).
- In contrast, 2006 EPA estimates for recent regulations of arsenic are:
  - approximately 0.010 deaths per 100,000 population arsenic-related deaths were averted (total of 30 per year in the entire United States)

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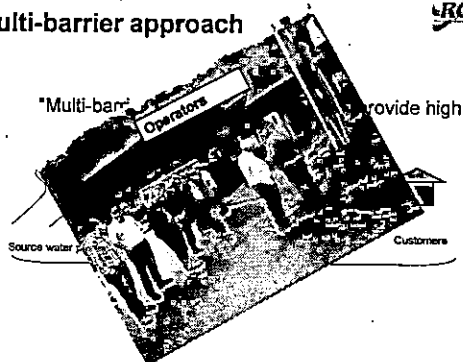
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## Multi-barrier approach



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**Operators are at the forefront of Public Health!!**



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**Participatory Activity**



- What system issues are you aware of that may have impacted public health?
- Write one issue per sticky note (5 min)
- As a table group, combine sticky notes grouping similar issues together
- Groups report out three most common issues

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**Common Problems across USA**



- Failure to maintain adequate disinfection residual
- Loss of pressure
- Failure to report/monitoring
- Uncontrolled cross connections
- Inadequately covered finished water storage
- Positive Total Coliform

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30% of all waterborne disease originates from distribution system issues

CDC, 2006

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### Distribution Barrier

- Physical Integrity
  - Main breaks
  - Leaks
  - Storage
  - Pressure
- Water Quality
  - Disinfection residual
  - Water Age
  - Monitoring
  - Prevent changes in quality
    - DBP formation
    - Biological regrowth
    - Nitrification
    - Lead and Copper

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### Discussion

- What steps should you take if you notice a component of your distribution system is not functioning properly?
- What if it is more than you can handle yourself?
- What if it is not your responsibility?

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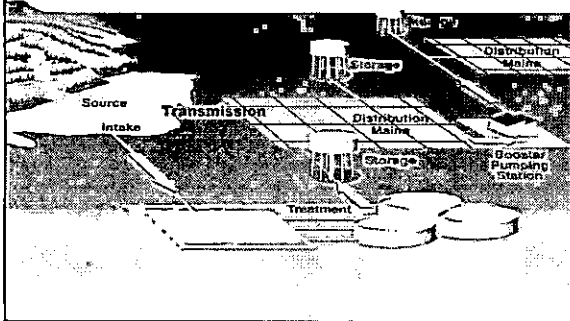
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# How do you know your water is safe?




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Pathogen	Symptoms of Illness
<i>Vibrio cholerae</i>	Vomiting, severe diarrhea, dehydration, mineral loss – often fatal
Typhoid fever	Fever, headache, weakness and fatigue, sore throat, abdominal pain, diarrhea or constipation – can be fatal
Hepatitis A	Fever, fatigue, loss of appetite, nausea, vomiting, and abdominal pain, rash – rarely fatal
<i>Salmonella spp.</i>	Diarrhea, fever, and abdominal cramps – can be fatal
<i>Shigella</i>	Bloody diarrhea, fever, and stomach cramps – rarely fatal
<i>E. coli</i>	Severe bloody diarrhea, abdominal cramps, and hemolytic uremic syndrome – can be fatal
<i>Campylobacter</i>	Diarrhea, cramping, abdominal pain, and fever – can be fatal
<i>Giardia</i>	Severe diarrhea, abdominal cramps, bloating, flatulence, weight loss, and vomiting – rarely fatal
<i>Cryptosporidium</i>	Stomach cramps, dehydration, nausea, vomiting, fever – rarely fatal
Norovirus	Vomiting, watery diarrhea, abdominal cramps, and nausea – rarely fatal

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## Health Risks



### ■ Acute

- E.coli
- Giardia
- "Blue Baby Syndrome"

### ■ Chronic

- Arsenic
- DBPs
- Lead

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**Regulations Impacting  
Distribution System Operations**



- Total Coliform Rule
- Revised Total Coliform Rule
- Surface Water Treatment Rule
- Groundwater Rule
- Stage 1 & 2 DBP Rule
- Lead and Copper Rule

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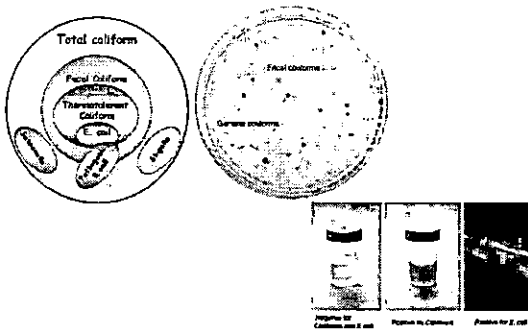
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**Total Coliform Rule**



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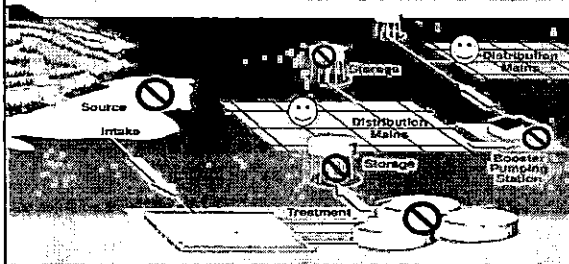
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All TCR samples are collected in the distribution system



Representative of water throughout the distribution system

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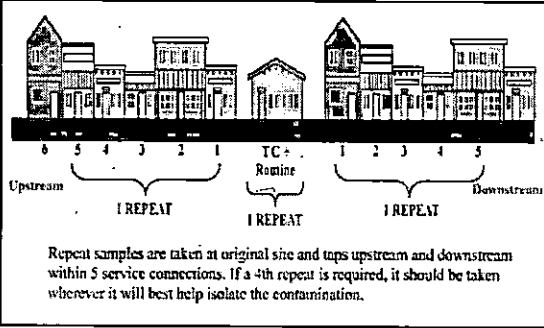
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## Where Do I Collect Repeat Samples?




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## Lead and Copper Rule



- Lead exposure to children may cause damage to the brain, red blood cells, and kidneys.



- Copper exposure can cause stomach and intestinal distress.

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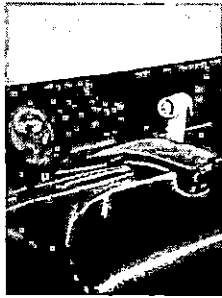
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## How do lead and copper enter our drinking water?



- 1986: Congress banned lead solder to 8%.
- January 2012: NSF reduced lead content 15µg/L to 5 µg/L.
- January 2014: SDWA defined lead free = 0.25% weighted lead content.

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### Common Errors in Lead Copper Rule



- Did not sample the correct number of sites
- Re-sampled before a request for invalidation was submitted and approved by primacy
- Calculated the 90% incorrectly
- Sample at outside tap or water fountain
- Did not collect during June, July, August, or September (if on reduced monitoring)
- Did not turn in all necessary paperwork

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### How do I calculate the 90<sup>th</sup> percentile?

Lead action level = 0.015 mg/L  
Copper action level = 1.3 mg/L

Assign numbers to the samples

No.	Copper Sample Conc.
1	0.54
2	0.77
3	0.86
4	0.87
5	0.88
6	0.92
7	0.99
8	1.10
9	1.10
10	1.50

1. Sort the samples in ascending order
  2. Multiply the total number of samples by 0.9
  3. Using that number, select the corresponding concentration
- OR
- Use Excel to calculate the 90<sup>th</sup> percentile




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### What if I take five samples?



Sample No.  
Sample Conc.

1	0.85
2	0.90
3	0.92
4	1.10
5	1.50

CALCULATE BASED ON SAMPLE #

1. 5 samples x 0.9 = 4.5
2. Average the 4<sup>th</sup> and 5<sup>th</sup> sample
3. Average = (1.10 + 1.50)/2 = 1.3



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### Sample Problem



Refer to Handout.

- What is the 90<sup>th</sup> percentile?
- Does this meet or exceed the regulations?

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### Problem: Lead and Copper Rule



Samples	Lead (mg/L)
1	0.004
2	0.005
3	0.008
4	0.011
5	0.017

- What is the 90<sup>th</sup> percentile?
- Does this meet or exceed the regulations?

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### Solution to Lead and Copper Rule



Samples	Lead (mg/L)
1	0.004
2	0.005
3	0.008
4	0.011
5	0.017

- Total of 5 Samples
- Need 0.9 x 5 samples = 4.5<sup>th</sup> sample
- 90<sup>th</sup> percentile = (sample #4 + sample #5) / 2 = 0.014mg/L
- Low, but very close to action level of 0.015 mg/L

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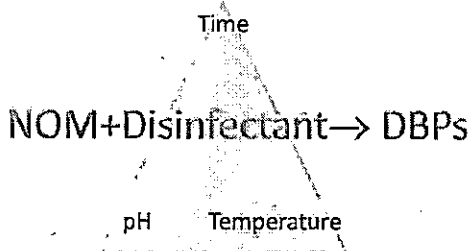
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## Disinfectants and Disinfection Byproduct Rule (Stage 1 & 2)



What can you control as an operator?

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## Disinfection Byproducts



Disinfection Byproduct	MCL (mg/L)
Total Trihalomethanes (TTHM)	0.080
Haloacetic Acids (HAA5)	0.060

DBPs have been shown to cause cancer and reproductive health effects in animals and humans

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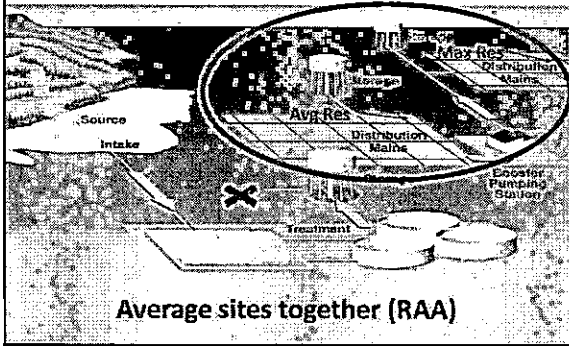
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## Sampling for TTHM & HAA5 (Stage 1)




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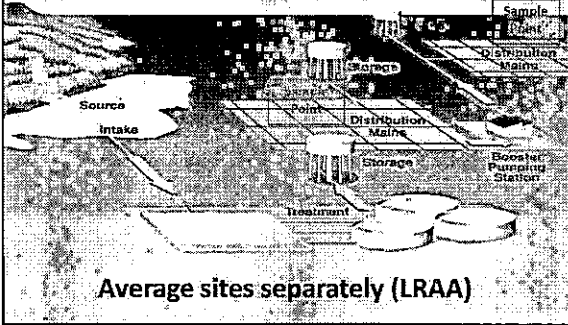
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## Sampling for TTHM & HAA5 (Stage 2)



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Be proactive – avoid violations through best practices!



- Protect your source
- Maintain disinfection
- Maintain distribution system



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## Points of Discussion



- How do you protect your source?
- How do you maintain your distribution system?
  - Pipes
  - Valves
  - Cross Connections
  - Storage Tanks
  - Hydrants

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Pipes

RCAR

Pipe networks can have impacts on water quality.

- Dead ends
- Cross connections
- Main breaks



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Pipe - dead ends

RCAR

Effect on water quality: Extended water age

- Decay of chlorine residual
- Increased DBPs
- Increased microorganisms



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Solutions to dead ends

RCAR

- Pipe loops
- Flushing valves
- Flushing program



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### Dead end solutions - loops



- Pipe loops make the distribution system more robust
- Allow more than 1 way for water to get to different points of distribution system
- Effect on water quality
  - Decrease water age
  - Help maintain disinfectant residual
  - Potentially reduce DBP and microbiological concentrations

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### Dead end solutions – flushing



- Flushing valves
- Flushing programs



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### Valves



#### Types of valves

- Flushing
- Pressure regulating
- Flow control
- Isolation
- Backflow prevention
- Air release
- Buried-under-the-pavement valves



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## Valves - Solutions



What can be done to limit water quality impacts?

- Survey valves to be sure they are open
- Exercise valves
- Open and close valves slowly



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## Cross Connections



Any point in a water distribution system where chemical, biological, or other contaminants may come into contact with potable water



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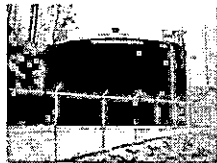
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## Storage Tanks



Purpose

- Improve system hydraulics
- Peak flow/fire flow
- Balance treatment needs



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### Factors that Impact Water Quality in Storage



- Stratification vs mixing
- Inlet/outlet configuration
- External contamination
- Increased water age
- Loss of chlorine residual
- Formation of DBPs
- Microscopic critters in the water
- BIG critters in the water



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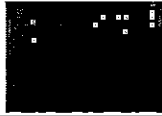
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### Common storage tank issues



- Finished water storage not properly covered
- Cracks in the walls or storage cover
- Accesses and vents not protected with proper screen or other approved devices
- Storage facility not structurally sound
- Lack of normal maintenance and inspection schedule for storage tanks



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### Hydrants



- Flushing
- Caution – *water hammer*
- Fire Protection



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### Hydrant Impacts on Water Quality



- Flushing, scouring and cleaning (planned/unplanned)
- Cross connection potential
- Poor sampling points

Water can be trapped in the barrel of the hydrant when closed, resulting in unrepresentative samples

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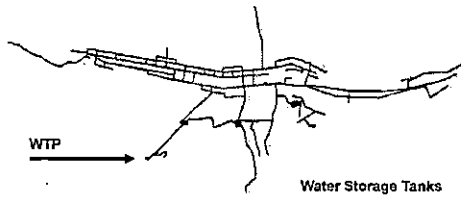
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**Activity:** Where would you expect to find water with the greatest age?



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Where would you expect to find water with the greatest age?



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**Future??**



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Kentucky Office: 101 Burch Court, Frankfort, Kentucky 40601  
502.875.5863  
[www.rcap.org](http://www.rcap.org)

Kimberly Padgett, State Director  
[khpadgett@capky.org](mailto:khpadgett@capky.org)

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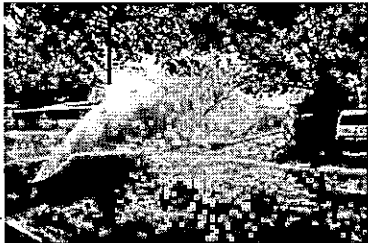
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**Break!**



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## **Participatory Activity**

- What system issues are you aware of that may have impacted public health?

- Write one issue per sticky note (5 min)

- As a table group, combine sticky notes grouping similar issues together

- Groups report out three most common issues

- 1.

- 2.

- 3.

**Practice Problem:**

What is the 90<sup>th</sup> Percentile of the following lead results?

0.008 mg/L

0.017 mg/L

0.004 mg/L

0.011 mg/L

0.005 mg/L


1) What is the 90<sup>th</sup> Percentile?

2) Does this meet or exceed the regulations?

**Revised Total Coliform Rule**

RTCR  
Kentucky Implementation January 1<sup>st</sup>, 2016!



To Protect and Enhance Kentucky's Environment



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**Revision to the Total Coliform Rule:**

- Increase public health by reducing potential pathways of fecal contamination in the distribution system (DS)
- RTCR uses total coliforms (TC) as indicators of the integrity of the DS
  - Indicate effectiveness of treatment
- RTCR uses E. Coli as an indicator of fecal contamination
  - Indicate possible contamination



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**Similarities to Current TCR**

- A minimum number of routine samples required per month
- Sampling at sites representative of the distribution system
  - Repeat samples are required
  - MCL Violation for E. Coli



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### Overall shift in focus for RTCR

- From: monitoring results and public notification
- To: monitoring results and assessment/corrective actions (Find and Fix)



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### Benefits of the shift in focus

- More proactive approach to public health protection
- Reduction in confusion associated with PN actions for TC violations



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### Core Elements

1. MCL / MCLG for TC and EC
2. Assessments
3. Sample Site Plans
4. Monitoring requirements
5. Seasonal systems



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### Core Elements

#### 1. MCL / MCLG for TC and EC

- No MCL/MCLG for TC:
  - TC threshold exceedance triggers assessment and corrective action
  - TC used as part of an overall TT
- Keeps *E. coli* with an MCLG of zero and the MCL the same as the TCR




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### Core Elements

#### 2. Assessments:

- Investigate and correct any sanitary defects found
  - Sanitary defect: "a defect that could provide a pathway of entry for microbial contamination into the distribution system or that is indicative of a failure or imminent failure in a barrier that is already in place"
- Two levels of assessment depending on the severity and frequency of contamination




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### Core Elements

#### 3. Sample Site Plans:

- Sample Site Plans need to be redone (by Dec. 2015)
  - Identify Routine, Repeat, and GWR locations
  - Identify sample schedule (# routine /month)




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### Core Elements

3. Sample Site Plans (Continued):

- Provides flexibility in the location of sites for repeat samples
  - Within 5 service connections (same as TCR)
  - Outside 5 service connections:
    - Fixed Locations (Identified in Site Plan)
    - Situational Basis (Identified by SOP)
- Allows the use of dedicated sampling stations.



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### Core Elements

4. Monitoring requirements:

- Minimum number of samples based on the same population chart:
  - Additional samples
    - Eliminates additional routines for PWSs taking fewer than 5 routine samples that are on a monthly schedule.
- Read 40 C.F.R. 141 Subpart Y.



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### Core Elements

5. Defines "seasonal systems"; requires start-up procedures:

- Seasonal PWS is defined as: "a non-community PWS that is not operated on a year-round basis and starts up and shuts down at the beginning and end of each operating season."
- must demonstrate completion of a State-approved start-up procedure



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### Assessments (Find)

- Level 1 vs. Level 2
- Elements of Assessments
- Corrective Actions



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### Level 1 Assessments

- Assessment:
  - Conducted by the PWS
  - A basic examination of the source water, treatment, distribution system and relevant operational practices (find)



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### Level 1 Assessments

- Triggers:
  - If collect at least 40 samples per month, more than 5% of samples collected are TC (P)
  - If collect fewer than 40 samples per month, more than one sample is TC (P)
  - If the PWS fails to take every required repeat sample after any single routine TC (P)



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### Level 2 Assessments

- Assessment:
  - Conducted by the State or a party approved by the State
  - A more in-depth examination of the system and its monitoring and operational practices



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### Level 2 Assessments

- Triggers:
  - Violation of the RTCR MGL for *E. coli*.
    - EC (P) RP following a TC (P) RT
    - TC (P) RP following a EC (P) RT
    - Fail to take all required RRs following an EC (P) RT
    - Fail to test for EC when any RP is TC (P)
  - Two Level 1 triggers in a rolling 12 month period



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### Elements of Assessments

- Atypical events that may affect distributed water quality or indicate that distributed water quality was impaired
- Changes in distribution system maintenance and operation that may affect distributed water quality, including water storage



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### Elements of Assessments

- Source and treatment considerations that bear on distributed water quality
- Existing water quality monitoring data
- Inadequacies in sample sites, sampling protocol, and sample processing



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### Corrective Action (Fix)

- PWS must correct all sanitary defects found during the assessment
- Sanitary defects and corrective actions must be described in the assessment form
  - the PWS must submit to the State within 30 days of the assessment trigger



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### Corrective Action (Fix)

- A timetable for any corrective actions not already completed must also be in the form; the State will determine a schedule after consulting with the PWS
- The form may also indicate that no sanitary defects were found
- The State determines if the assessment is sufficient



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### Violations, PN, CCR

- Violation of the RTCR MCL for *E. coli* – Tier 1 PN
  - Failure to take RRs following EC (P) RTs
  - Fail to take all required RPs following an EC (P) RT
  - Fail to test for EC when any RP is TC (P)
  - EC (P) RP following a TC (P) RT
  - TC (P) RP following a EC (P) RT



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### Violations, PN, CCR

- T1 violation occurs when a PWS fails to conduct a required Assessment or Corrective Action – Tier 2 PN
- M&R violations – Tier 3 PN
  - Fails to take all required TC samples
  - Fails to analyze for EC following TC (P) RT sample
  - Fails to submit monitoring reports
  - Fails to submit a completed assessment form



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### Violations, PN, CCR

- PN/CCR Language – TC health effects language changed to reflect failure to conduct assessment or corrective action



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### Analytical Methods

- Changes to the methods in the RTCR are consistent with the lab cert manual
  - Change in holding time definition
  - Requiring de-chlorinating agent
  - Requiring autoclaving of MF equipment
- Analytical methods table changes



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### Case Study #1

- UTILITY PROFILE
  - Eagle Cliff is a community PWS that receives its water from a spring source and serves 5,500 people. It collects 6 routine samples per month.
- DESCRIPTION OF THE PROBLEM
  - In July, a routine sample and one of its associated repeat samples both come back total coliform positive.



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### Triggers a Level 1 Assessment



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**HEALTHY DRINKING WATER**  
**REGULAR TAP WATER QUALITY**  
**Annual Assessment Form** (Rev. 02/09/09)

Water Utility Name: \_\_\_\_\_  
 County: \_\_\_\_\_  
 City: \_\_\_\_\_

**Service Area Information**

Is this assessment being performed?  Yes  No

Is this assessment being performed in accordance with 403 KAR 1:027?

Assessment Date: \_\_\_\_\_  
 Assessment Time: \_\_\_\_\_  
 Assessor: \_\_\_\_\_

**System Description**

Is the water supply derived from a surface water source (river, lake, pond, stream, etc.)?  Yes  No

**Water Quality**

No taste or odor  Taste or odor  No color  Color  
 No turbidity  Turbidity  No suspended solids  Suspended solids  
 No iron  Iron  No manganese  Manganese  
 No lead  Lead  No copper  Copper  
 No nitrate  Nitrate  No nitrite  Nitrite  
 No fluoride  Fluoride  No disinfection byproducts  Disinfection byproducts  
 No other  Other

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**Water Quality**

Is the water quality being monitored in accordance with 403 KAR 1:027?  Yes  No

**Water Quality Monitoring**

Is the water quality being monitored in accordance with 403 KAR 1:027?  
 Yes  No

**Water Quality Monitoring Results**

Is the water quality being monitored in accordance with 403 KAR 1:027?  
 Yes  No

**Water Quality Monitoring Results**

Is the water quality being monitored in accordance with 403 KAR 1:027?  
 Yes  No

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## Case Study #1

- ASSESSMENT AND CORRECTIVE ACTION

  - Upon inspection of the distribution system piping, small fractures were found in the water main leading from the spring source to a water tank.
  - The piping was replaced and additional samples were taken to determine whether coliforms were still present in the system. The results came back negative.



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Case Study #2

- UTILITY PROFILE
  - Eggleston Glen is a large municipal PWS that is supplied by a ground water source. The system treats its water before serving it to its 52,000 customers. It collects 60 routine samples per month.



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Case Study #2

- DESCRIPTION OF THE PROBLEM
  - In August, more than 5% of the monthly total coliform samples came back positive. Two of the repeats were TC+ and one of the two was also EC+. The positive samples were in the same general location in the distribution system and in proximity to a large ground storage tank.



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Triggers a Level 2 Assessment.



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### Case Study #2

- **ASSESSMENT AND CORRECTIVE ACTION**
  - Several days prior to the collection of the positive samples, the system experienced pressure loss for a period of 4 hours while the media in the GAC filters at one of the plants was being changed out. During this time the tank levels dropped to near empty.



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### Case Study #2

- **ASSESSMENT AND CORRECTIVE ACTION**
  - Normally stagnant water from the tank entered the distribution system during the pressure loss event causing the total coliform positive results. The tank was taken off-line, cleaned and shock chlorinated in accordance with State guidelines before putting it back in service. The distribution system near the tank was also flushed to improve water turnover.



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### Available Guidance

- 40 C.F.R. 141.851 through 141.861 (Revised Total Coliform Rule)
- 401 K.A.R. 8:200 (Microbiological Monitoring)
- RTR Assessments and Corrective Actions Guidance
- Small Systems Guidance (Systems  $\leq$  1,000)
- RTR: A Quick Reference Guide.
- Fact sheets, placards, laboratory quick reference guide



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## RTCR Website

- [http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/regulation\\_revisions.cfm](http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/regulation_revisions.cfm)
- Please read it in its entirety !!



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## Labs, Lab Accountability & PWSs



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## DOW, Labs & PWSs

- PWSs are regulated by the DOW
- Labs are regulated by the DOW
- The DOW does not regulated agreements or contracts between Labs and PWSs
- PWSs are responsible for compliance results even if they contract a third party



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### DOW, Labs & PWSs



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### DOW, Labs & PWSs

- Lab reporting errors and incorrect analytical practices that can result in violations:
  - Late report submission
    - Incomplete report
    - Incorrect information (e.g. PWSID #)
    - Missed and/or incorrect holding times used
    - Incorrect dates
    - Incorrect method/analyte reference codes



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### Lab Accountability

- Labs can held accountability for causing a violation for a PWS
- Not automatic: PWS must contact the compliance officer at DOW if they believe the lab caused the violation
- Violation is reviewed by compliance officer and Lab Certification



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### Lab Accountability

- If the violation is determined to the fault of the lab:
  - Notice of Deficiency (NOD) letter issued to the laboratory
    - PWSs are notified of the lab's NOD
  - If a lab receives three (3) NOD letters with similar errors within the same compliance period or a single NOD that affects at least 10 PWS an on-site audit will be conducted
    - Fee is charged to lab




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### Lab Accountability

- Lab audit could be announced or unannounced
- If lab audit determines deficiencies, lab's certification is downgraded to provisional
- If a lab downgraded to provisional certification has 3 lab errors resulting in any PWSs noncompliance or any single lab error resulting in 10 PWSs in noncompliance or not meeting all required remedial recommendations from the on site audit, their lab certification is revoked for 6 months




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### RTCR Contact

Rodney Ripberger

Division of Water

200 Fair Oaks Lane, 4<sup>th</sup> Floor

Frankfort, KY 40601

Phone: (502) 564-3410 ext. 4579

Fax: (502) 564-2741

Email: [rodney.ripberger@ky.gov](mailto:rodney.ripberger@ky.gov)




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Rural Community Assistance Partnership  
Practical solutions for improving rural communities



## Improving System Operations & Water Quality

Bud Mason & Jared Schmal  
Technical Assistance Providers



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### Goals

To improve your system operations and water quality by:

1. Learning how to gather system information,
2. Analyze this data by using available tools,
3. Make positive changes based on the results



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### What is our Mission?

To provide safe drinking water and wastewater at the most reasonable cost.

What do our customers expect?



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**How can we improve system operations & water quality?**

Results-Based Detailed Tracking!



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**System Language**

How do our systems talk to us?



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**System Language**

**What are the numbers saying?**

- Treatment Processes
- Daily Operations
- Repairs & Maintenance
- Test Results
- Financial



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## System Language

What are the numbers saying?

➤ Treatment Processes



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## System Language

Parameter	Value	Unit	Limit
Flow	100	m <sup>3</sup> /d	
Temperature	15	°C	
pH	7.5		
Dissolved Oxygen	2.0	mg/L	
BOD	100	mg/L	
SS	100	mg/L	
Ammonia	1.0	mg/L	
Nitrite	0.5	mg/L	
Nitrate	10	mg/L	
Chlorophyll a	10	µg/L	
Alkalinity	100	mg/L	
Hardness	100	mg/L	
Calcium	100	mg/L	
Magnesium	100	mg/L	
Sulfate	100	mg/L	
Chloride	100	mg/L	
Total Solids	100	mg/L	
Total Suspended Solids	100	mg/L	
Total Dissolved Solids	100	mg/L	
Calcium Hardness	100	mg/L	
Magnesium Hardness	100	mg/L	
Sulfate Hardness	100	mg/L	
Chloride Hardness	100	mg/L	
Total Hardness	100	mg/L	



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## System Language

Parameter	Value	Unit	Limit
Flow	100	m <sup>3</sup> /d	
Temperature	15	°C	
pH	7.5		
Dissolved Oxygen	2.0	mg/L	
BOD	100	mg/L	
SS	100	mg/L	
Ammonia	1.0	mg/L	
Nitrite	0.5	mg/L	
Nitrate	10	mg/L	
Chlorophyll a	10	µg/L	
Alkalinity	100	mg/L	
Hardness	100	mg/L	
Calcium	100	mg/L	
Magnesium	100	mg/L	
Sulfate	100	mg/L	
Chloride	100	mg/L	
Total Solids	100	mg/L	
Total Suspended Solids	100	mg/L	
Total Dissolved Solids	100	mg/L	
Calcium Hardness	100	mg/L	
Magnesium Hardness	100	mg/L	
Sulfate Hardness	100	mg/L	
Chloride Hardness	100	mg/L	
Total Hardness	100	mg/L	



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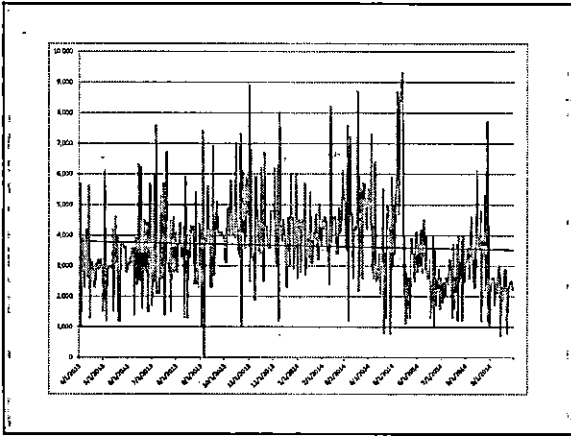
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**System Language**

**What are the numbers saying?**

> Daily Operations

*RCAR*

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**System Language**

**What are the numbers saying?**

Code	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Each Year
100													
200													
300													
400													
500													
600													
700													
800													
900													
1000													
1100													
1200													
1300													
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9500													
9600													
9700													
9800													
9900													
10000													

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**System Language**

What are the numbers saying?

➤ Repairs & Maintenance




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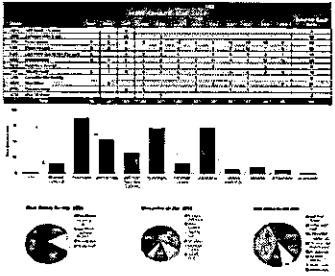

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**System Language**


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**System Language**

What are the numbers saying?

➤ Test Results




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### System Language

**PMC Laboratory**  
 2000 University Drive  
 Fort Lauderdale, FL 33304  
 Phone: (954) 344-1111  
 Fax: (954) 344-1112  
 Email: info@pmclab.com

**Client Information**  
 Client Name: City of Fort Lauderdale  
 Project Name: Water Treatment Plant  
 Project No: 10000000000000000000  
 Date: 10/1/2000

**Test Results**

Test Name	Result	Unit	Remarks
PH	7.2		
Alkalinity	120	mg/L	
Hardness	150	mg/L	
Calcium	80	mg/L	
Magnesium	70	mg/L	
Total Solids	1000	mg/L	
Dissolved Solids	500	mg/L	
Suspended Solids	500	mg/L	




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### System Language

**Water Audit**

Area	Flow (MGD)	Loss (%)	Notes
Raw Water	10.0	0	
Water Treatment	9.5	5	Leakage
Water Distribution	8.0	15	Leakage, Theft
Water Consumption	7.0	10	Industrial, Residential
Water Return	0.5	7	Recycling
<b>Total</b>	<b>10.0</b>	<b>100</b>	




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### System Language

**What are the numbers saying?**

➤ **Financial**

- Cost of Service
  - O&M Costs
    - Energy Bills
    - Repair Costs
    - Chemical Costs
    - Many More!
  - Debt Service
  - Reserve Accounts
- Billing Reports
- Profit & Loss Statement
- Balance Sheets
- Yearly Audits




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## Expense Trends

Comparative Expense Trend Analysis - Rev 2

Dept Name	FY 2013		FY 2014		FY 2015		Budget FY 2016		2016 Budget	
	Amount	Year Over	Amount	Year Over	Amount	Year Over	Amount	Year Over	Amount	Year Over
Personnel	\$ 143,829		\$ 214,564		\$ 215,518		\$ 214,564		\$ 202,796	
Materials	37,728		12,841		14,466		14,266		13,772	
Professional Fees	174,263	0 13.8%	146,203	15.3%	145,528	16.1%	145,528	16.1%	146,500	15.9%
Contracted Services	115,331	0 23.4%	87,863	0 17.0%	89,411	0 1.6%	89,700	0 0.3%	84,300	0 6.1%
Office O&M	54,390	0 8.8%	52,618	0 3.1%	50,024	0 4.9%	54,200	0 7.2%	57,000	0 5.0%
Multimedia/IT	10,138		9,200		9,200		9,200		9,200	
<b>TOTAL</b>	<b>\$ 440,679</b>	<b>0 12.1%</b>	<b>\$ 426,246</b>	<b>0 17.0%</b>	<b>\$ 424,741</b>	<b>0 0.4%</b>	<b>\$ 424,252</b>	<b>0 0.1%</b>	<b>\$ 429,796</b>	<b>0 13.1%</b>

## Billing Analysis

Monthly Billing Analysis Schedule

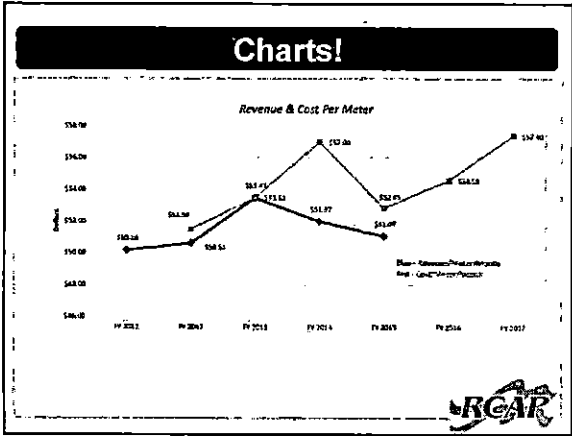
Month	Revenue	Expenses	Net Income	Profit Margin
Jan-13	1,000,000	700,000	300,000	30.0%
Feb-13	1,100,000	750,000	350,000	31.8%
Mar-13	1,200,000	800,000	400,000	33.3%
Apr-13	1,300,000	850,000	450,000	34.6%
May-13	1,400,000	900,000	500,000	35.7%
Jun-13	1,500,000	950,000	550,000	36.7%
Jul-13	1,600,000	1,000,000	600,000	37.5%
Aug-13	1,700,000	1,050,000	650,000	38.2%
Sep-13	1,800,000	1,100,000	700,000	38.9%
Oct-13	1,900,000	1,150,000	750,000	39.5%
Nov-13	2,000,000	1,200,000	800,000	40.0%
Dec-13	2,100,000	1,250,000	850,000	40.5%
<b>Annual Total</b>	<b>18,000,000</b>	<b>12,000,000</b>	<b>6,000,000</b>	<b>33.3%</b>

## Budget Projections

Budget Schedule

Year Ending June 30, 2016

Account	Approved Budget	Current FY 2015	Actual Yr. End	Actual vs. Budget	Percentage Difference	Projected Budget FY 2016
<b>Income</b>						
4000 Water Rates - Retail	\$ 521,000	\$ 508,477	\$ (12,523)	-2.4%	\$ 517,800	
4010 Loan Adjustments	-	0	0	0.0%	(1,000)	
4100 Tap Out Existing Lines (\$1,500)	12,425	10,089	\$ (2,336)	-18.8%	8,000	
4150 Late Fees	4,650	3,840	\$ (810)	-17.4%	8,000	
4200 Service & Transfer Fees	1,710	793	\$ (917)	-53.6%	800	
4400 ISO Gross Income	6,437	63,780	\$ 57,343	891.0%	241	
4800 Interest Income	-	1,578	\$ 1,578	15.8%	241	
4900 Miscellaneous Income	-	-	-	-	-	-
<b>TOTAL INCOME</b>	<b>545,222</b>	<b>596,777</b>	<b>\$ 51,555</b>	<b>9.3%</b>	<b>\$ 538,041</b>	
<b>Expenses</b>						
8100 Bad Debt	-	2,004	\$ (2,004)	-100.0%	1,000	
8125 Bank & Credit Card Fees	1,492	3,271	\$ (1,779)	-119.2%	3,300	
8300 Dues & Subscriptions	-	878	\$ 878	100.0%	200	
8350 Jani Care	847	843	\$ (4)	-0.5%	800	
8600 Utilities Expense	144,530	142,848	\$ (1,682)	-1.2%	142,000	
8600 Legal & Accounting Fees	1,720	1,823	\$ 103	6.0%	1,700	
8700 Engineering Fees	2,125	-	\$ 2,125	100.0%	2,000	
8800 Office Supplies	2,270	173	\$ (2,097)	-92.4%	1,000	
8810 Internet Fees	478	754	\$ 276	57.7%	800	
8825 Postage	3,678	2,428	\$ (1,250)	-33.9%	3,000	
8850 Printing & Publications	451	451	\$ 0	0.0%	450	
8900 Contract Services - Other	27,200	26,348	\$ (852)	-3.1%	26,200	
8940 Contract Services - Meter Reading	21,200	17,254	\$ (3,946)	-18.6%	19,500	
8990 Contract Services - Maintenance	54,400	47,510	\$ (6,890)	-12.7%	54,000	




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### System Language

How is all this information linked together?

## ACTIVITY

How well do we know our system?

**RCAR**

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## Spreadsheets

**RCAR**

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**Spreadsheets**



Spreadsheets are too difficult to use!



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**Spreadsheets**

Spreadsheet software:

- Microsoft Excel
- Apple Numbers
- Google Drive
- Many, many others



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**Overview**

- Spreadsheets use a grid made from columns and rows to track and manipulate numbers.
- A great benefit with spreadsheets is that you can experiment with numbers without having to RE-DO all the calculations.
- The abilities of spreadsheets are only impeded by the skills required to create them!



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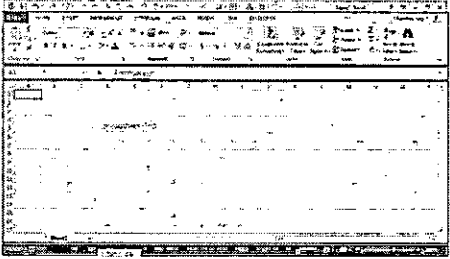
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## Spreadsheets



**RCAR**

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## Columns

➤ In a spreadsheet the **COLUMN** is defined as the vertical space that is going up and down the window. **Letters** are used to designate each **COLUMN'S** location.

The **COLUMN** labeled **D** is highlighted.



**RCAR**

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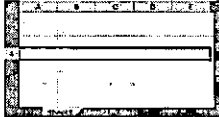
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## Rows

➤ In a spreadsheet the **ROW** is defined as the horizontal space that is going across the window. **Numbers** are used to designate each **ROW'S** location.

**ROW** labeled **4** is highlighted.



**RCAR**

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## Cells

➤ A **CELL** is the space where a row and column intersect. Each **CELL** is assigned a name according to its **COLUMN letter** and **ROW number**.

In the above diagram the **CELL** labeled **C2** is highlighted.




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## Labels

➤ Labels are text entries

- Labels help identify what we are talking about
- Labels do not have a value associated with them
- Sometimes called 'headers'

First Name	Last Name	Company Name	Address 1	City	State	Zip	Phone
Gregg	Smith	Lucky Ltd. (Chicago)	12121 W. 95th	Franklin	Illinois	60770	707-273-0779
Marcus	Adams	Rosemount Industrial Supply	7500 Dunlap	Hennepin	Minnesota	55425	652-828-4112
Warren	Boony	Vanitas Global	8534 Larch	Spring	Wisconsin	53576	478-876-0545
Phyllis	Chou	Dexter Enterprises	5528 Oak	Atlanta	Massachusetts	01348	617-234-9412
Cyrille	Cost	Henry Enterprises	1275 Lytle	Abingdon	California	91024	951-349-7198
Michael	Cook	Dunbar Manufacturing	2620 Hickory	Everett	Wisconsin	53126	270-729-8562
James	Cotton	Boys Club	584 South	Des Moines	Wisconsin	52741	541-944-4757
Alan	Johnson	East Coast Health	1121 Peachtree	Rockledge	Florida	32955	407-815-4752
Robert	Mitchell	Law Offices	361 Cranston	Orange	Florida	32703	352-286-4779
Eric	Chang	Psychology Inc.	2425 Hawthorne	Tampa	Minnesota	55425	612-856-5358
Andrew	Calahan	Parsons Electric	5844 Holly	Cleveland	Texas	75242	214-462-3275
Thomas	Young	Psychology Inc.	1402 Hawthorne	Chicago	Florida	32916	904-827-7832
Charles	Yates	Deer Weapons Works	3203 Hickory	Proctor	Virginia	24614	541-977-4832




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## Constants

➤ Constants are **FIXED** number data

➤ Constants may refer to dollars, percentages, or number of items (in this case number of hours worked within a certain pay period).

Pay date	Hours	Rate
15-Jul	16.00	10.00
29-Jul	16.00	10.00
15-Aug	16.00	10.00
29-Aug	16.00	10.00
15-Sep	16.00	10.00
29-Sep	16.00	10.00
15-Oct	16.00	10.00
29-Oct	16.00	10.00
15-Nov	16.00	10.00
29-Nov	16.00	10.00
15-Dec	16.00	10.00
29-Dec	16.00	10.00
15-Jan	16.00	10.00
29-Jan	16.00	10.00
15-Feb	16.00	10.00
29-Feb	16.00	10.00
15-Mar	16.00	10.00
29-Mar	16.00	10.00
15-Apr	16.00	10.00
29-Apr	16.00	10.00
15-May	16.00	10.00
29-May	16.00	10.00
15-Jun	16.00	10.00
30-Jun	16.00	10.00
Totals	344.00	3440.00




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## Formulas

- Formulas are math equations that CALCULATE a value to be displayed.
- DO NOT type in the numbers; type in the equation.
- It is BEST to Reference as much data as possible as opposed to typing data into equations. That way when OTHER information changes, we DO-NOT have to change the equations or type in information again.

Pay date	HOURS	Pay Rate
15-Jul	8.00	3.13
15-Jul	12.00	3.13
15-Aug	7.00	3.13
15-Aug	8.00	3.13
15-Sep	9.00	3.13
15-Sep	9.00	3.13
15-Oct	10.00	3.13
15-Oct	14.00	3.13
15-Nov	14.00	3.13
15-Nov	14.00	3.13
15-Dec	12.00	3.13
15-Dec	12.00	3.13
15-Jan	12.00	3.13
15-Jan	12.00	3.13
15-Feb	14.00	3.13
15-Feb	14.00	3.13
15-Mar	14.00	3.13
15-Mar	14.00	3.13
15-Apr	14.00	3.13
15-Apr	14.00	3.13
15-May	14.00	3.13
15-May	14.00	3.13
15-Jun	12.00	3.13
15-Jun	12.00	3.13
15-Jul	12.00	3.13
15-Jul	12.00	3.13




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## Basic Math Functions

- Math functions built into them. Of the most basic operations are the standard multiply, divide, add and subtract.

Operation	Symbol	Reference Data	Answer
Multiply	*	= A1 * B1	25
Divide	/	= A1 / B1	1
Add	+	= A1 + B1	10
Subtract	-	= A1 - B1	0




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## SUM Function

### Definition:

- Probably the most popular function in any spreadsheet is the SUM function. The Sum function takes all of the values in each of the specified cells and totals their values.
- The syntax is: =SUM(first value, second value, etc)

### Tips:

- Blank cells will return a value of zero to be added to the total.
- Text cells can not be added to a number and will produce an error.




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## Sum Function

**RCAR**

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## Average Function

➤ The average function finds the average of the specified data. (Simplifies adding all of the indicated cells together and dividing by the total number of cells.)

**RCAR**

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## Max & Min Functions

➤ The **Max** function will return the largest (max) value in the selected range of cells. The **Min** function will display the smallest value in a selected set of cells.

**RCAR**

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## Count Function

- The **Count** function will return the number of entries (actually counts each cell that contains **NUMBER DATA**) in the selected range of cells.
- Remember: cells that are blank or contain text will not be counted.

COUNTA (List)			
Using the Value Function		Using the Average Function	
Value 1:	25	Value 2:	25
Value 2:	30	Value 3:	20
Value 3:	75	Value 4:	75
Sum of values 1, 2, and 3:	122	Average of values 1, 2, and 3:	75
Using the Max Function		Using the Min Function	
Value 1:	20	Value 1:	75
Value 2:	30	Value 2:	20
Value 3:	75	Value 3:	75
Max value from values 1, 2, and 3:	75	Min value from values 1, 2, and 3:	20
Count of non-blank cells: 11			

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## IF Function

**Definition:**

- The IF function will check the logical condition of a statement and return one value if true and a different value if false.
- The syntax is:  
=IF (condition, value-if-true, value-if-false)

**Tips:**

- Until you are used to writing them, test them out on multiple cells.
- There are multiple ways to write an IF statement to get the same result

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## IF Function

➤ IF Functions are like programming - they provide multiple answers based on certain conditions.

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graph TD
    A[Condition] -- true --> B[True Statements]
    A -- false --> C[False Statements]
    B --> D[ ]
    C --> D
    D --> E[ ]
    
```

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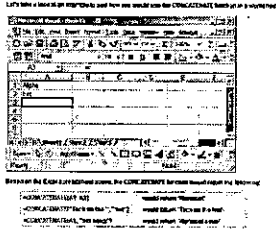
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## Concatenate function

➤ **Concatenate function** - join several strings into one text string

- **Note:** The concatenate function does not automatically leave a blank space between words or other data.



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## Tables

➤ To make managing and analyzing a group of related data easier, you can turn a range of cells into a Microsoft Office Excel table (previously known as an Excel list). A table typically contains related data in a series of worksheet rows and columns that have been formatted as a table. By using the table features, you can then manage the data in the table rows and columns independently from the data in other rows and columns on the worksheet.



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## Elements of an Excel Table

➤ **Header row** By default, a table has a header row. Every table column has filtering enabled in the header row so that you can filter or sort your table data quickly.

Product	Price	Quantity
Chocobon	\$ 907.16	6,328.80
GummyBears	\$ 2,300.00	2,174.00
ScottishT	\$ 9,279.92	2,283.49
Sir Robin	\$ 2,174.00	
TasteBou	\$ 2,174.00	
Chocolate	\$ 2,174.00	
<b>Totals:</b>		\$ 22,809,070



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## Elements of an Excel Table

- **Banded rows** By default, alternate shading or banding has been applied to the rows in a table to better distinguish the data.

Product	Qtr 1	Qtr 2	Grand Total
Chocolate	\$ 744.60	\$ 162.56	\$ 907.16
Gummibärchen	\$ 5,079.60	\$ 1,249.20	\$ 6,328.80
Scottish Longbreads	\$ 1,267.50	\$ 1,062.50	\$ 2,330.00
Sir Rodney's Scones	\$ 1,418.00	\$ 756.00	\$ 2,174.00
Tarte au sucre	\$ 4,728.00	\$ 4,547.92	\$ 9,275.92
Chocolate Biscuits	\$ 943.89	\$ 349.60	\$ 1,293.49
<b>Total</b>	<b>\$14,193.59</b>	<b>\$8,177.78</b>	<b>\$ 22,371.37</b>



## Elements of an Excel Table

- **Total row** You can add a total row to your table that provides access to summary functions (such as the **AVERAGE**, **COUNT**, or **SUM** function). A drop-down list appears in each total row cell so that you can quickly calculate the totals that you want.

Product	Qtr 1	Qtr 2	Grand Total
Chocolate	\$ 744.60	\$ 162.56	\$ 907.16
Gummibärchen	\$ 5,079.60	\$ 1,249.20	\$ 6,328.80
Scottish Longbreads	\$ 1,267.50	\$ 1,062.50	\$ 2,330.00
Sir Rodney's Scones	\$ 1,418.00	\$ 756.00	\$ 2,174.00
Tarte au sucre	\$ 4,728.00	\$ 4,547.92	\$ 9,275.92
Chocolate Biscuits	\$ 943.89	\$ 349.60	\$ 1,293.49
<b>Total</b>	<b>\$14,193.59</b>	<b>\$8,177.78</b>	<b>\$ 22,371.37</b>



## Creating Tables

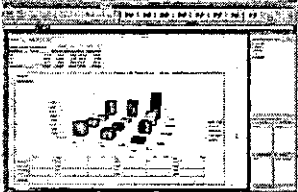
1. Highlight a set of cells



### Pivot Table


➤ A Pivot table lets you arrange, sort, and filter a set of data on the fly so you can analyze it from different perspectives with minimum effort.

- Start with a data list with a few columns
- Make sure each of the rows have a value of each one of the columns



The screenshot shows a PivotTable in Microsoft Excel. The PivotTable is set to show data by 'Region' (rows) and 'Sales' (columns). The data is summarized in a compact grid. The background of the slide is a grid of horizontal lines.

### Tips & Tricks

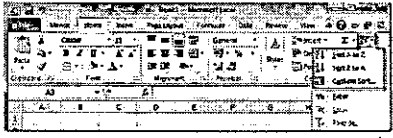


The slide features a large white area with a black header bar at the top. The text 'Tips & Tricks' is centered. In the bottom right corner, there is a logo for 'RCAR'.

### Sorting

➤ Arranging data so it's easy to analyze

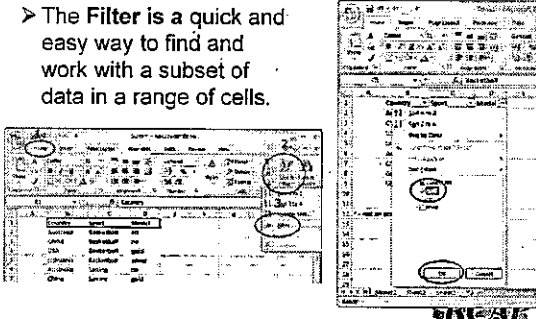
➤ You can sort the data alphabetically, from highest to lowest, or by a number of additional criteria (such as cell color)



The screenshot shows the 'Sort' menu in Microsoft Excel. The menu options include 'Sort A to Z', 'Sort Z to A', 'Sort by Color', and 'Custom Sort...'. The background of the slide is a grid of horizontal lines.

## Filters

➤ The Filter is a quick and easy way to find and work with a subset of data in a range of cells.



The screenshot shows the 'Filter' menu with options like 'Filter By Color', 'Filter By Text Color', 'Filter By Font Color', 'Filter By Cell Value', 'Filter By Cell Color', 'Filter By Cell Contents', 'Filter By Cell Font Color', 'Filter By Cell Font Size', 'Filter By Cell Text Color', and 'Filter By Cell Text Color'. Below the menu is a table with columns 'Name', 'Address', 'City', 'State', 'Zip', and 'Phone'. The 'City' column is filtered to show only 'Dallas'.

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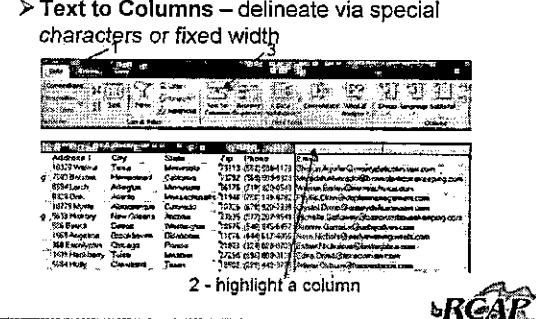
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## Text to Columns

➤ Text to Columns – delineate via special characters or fixed width



The screenshot shows the 'Text to Columns' wizard. Step 1: 'Delimited' is selected. Step 2: 'Comma' is selected as the delimiter. Below the wizard is a table with columns 'Address 1', 'City', 'State', 'Zip', and 'Phone'. The 'Address 1' column is highlighted.

2 - highlight a column

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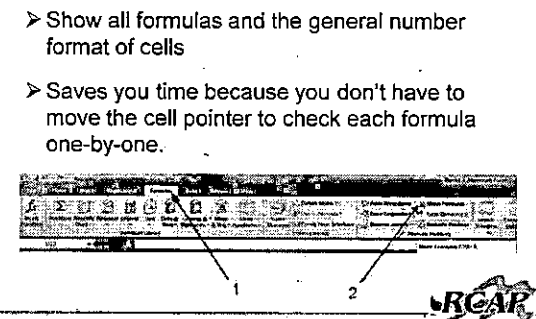
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## Show All Formulas

➤ Show all formulas and the general number format of cells

➤ Saves you time because you don't have to move the cell pointer to check each formula one-by-one.



The screenshot shows the 'Formulas' ribbon with the 'Show All Formulas' button highlighted. A red box is drawn around the button, and a red arrow points to it from the number '1'. Another red arrow points to the 'Show All Formulas' button from the number '2'.

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## Removing duplicate values

> Removing duplicate values – check for and delete specific cells with duplicate values

1 - click to highlight all content

2 - click Unselect All

3 - check this box

4 - select 1 attribute to remove duplicates on

## Freeze Headers

> To freeze a row in your worksheet, highlight the row where you wish all rows before the highlighted row to be frozen or locked, go to **Window>Freeze Panes** and you will see a line appear across your worksheet. Everything above the line is frozen and will remain in view when you scroll down your worksheet.

1

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## Set Print Area

1 - select an area you want to print

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### Narrow Margins

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### Shrink to Fit

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Not sure if spreadsheet makes sense.

Or

i have gone insane

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**Closing Notes**

Real World Applications!

Does all this information benefit us?

Is it achievable?



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**Wrap-up**



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**RCAR** Rural Community Assistance Partnership  
Practical solutions for improving rural communities



## Sample Collection

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### Objectives

- Understand general procedures and challenges for sample collection.
- Recognize sample type, container type, preservation method, and maximum holding time for various sampling parameters.



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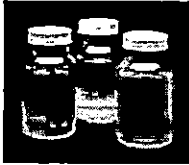
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### Coliform Sampling – Why?

- Indicator of pathogen contamination
- Total Coliform (TC)
  - Not necessarily a health threat in itself; used to indicate other potentially harmful bacteria
  - A very common microbe
  - Should be absent if chlorine residual is adequate.
- *E. coli*
  - A subset of total coliform which indicates fecal waste contamination from mammals (humans, cows, etc)
  - *Found only in mammal feces*



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**Coliform Sampling – Best Practices**

- Collecting total coliform samples correctly and properly is absolutely critical in protecting public health
- Improper sampling is the most common reason for positive results (false positive)
  - Repeated sampling requires extra effort, time, and money
  - May lead to unnecessary MCL violation and subsequent corrective measures



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**Coliform Sampling Procedures**

1. Assemble sampling supplies
2. Go to sampling location(s) specified in the sampling plan
3. Remove any aerators, strainers, or hoses from the tap
4. Open the cold water tap for about 2 to 3 minutes before collecting the sample
5. Fill out label, tag, and lab form in waterproof ink
6. Adjust the flow to about the width of a pencil
7. Remove the bottle cap



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**Coliform Sampling Procedures, cont.**

8. Fill the bottle to the shoulder or about ¼ inch from the top
9. Place the cap on the bottle and screw it down tightly
10. Turn the tap off and replace the aerator, strainer, or hose
11. Check the information on the label
12. Complete any additional lab forms that come with the sample bottle
13. Refrigerate or ice the samples; sample must reach the lab for processing within 30 hours of sample collection



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### 1. Assemble Supplies

- 125 ml sterilized plastic bottle
- Dechlorination agent (do not rinse out bottle)
- Label and lab form (chain of custody form)



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### Wash Your Hands!



**THINK STERILE!**  
Assume your hands are dirty even after you wash them...



Preparation and Handling



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### Preparation & Handling

- Wear clean clothing, wash your hands and try to keep them bacteria free for the collection process
- Watch for contamination sources  
nearby activities – soil disturbances- sewer lift stations – animals/manure
- Avoid talking and disturbing the air while collecting (sneezing/coughing)
- Smoking during sample collection is not advised. If it is TC+ it will be you who has to recollect



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**2. Use Location(s) in Sampling Plan**

**Sample Tap – Do's**

- > Tap should be clean, in good repair, and free of attachments
- > Sample cold water only
  - Valves that control hot and cold independently
  - Water heaters can be laden with bacteria
- > Use a line directly connected to the main
- > Sample indoors, when possible



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**Question**

*Where can coliforms be found?*



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**Sampling Tap – Don'ts**

- > Sample tap should NOT be:
  - Outdoors
  - To close to the bottom of the sink
  - Swivel type with a single valve for both hot & cold water
  - Leaking or on a leaky pipe
  - Threaded in the interior



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### Sampling Tap – Don'ts

- Sample tap should NOT be:
  - Upward flowing
  - Located in a room of questionable sanitary conditions
  - Attached to any household point-of-entry or point-of-use devices (e.g. aerators)
  - Drinking fountains



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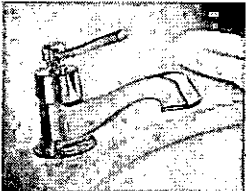
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### What to Avoid

- Faucets to avoid:
  - Swivel-type faucets that have a single valve for hot and cold water



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### What to Avoid

- Outdoor faucets
- Faucets close to or below ground level



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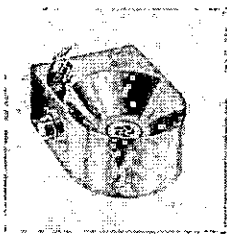
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**What to Avoid**

- Faucets that point upward



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**What to Avoid**

- Faucets in places highly prone to contaminations (e.g. janitor's closet, public rest rooms)



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**3. Remove Aerator, Strainer, or Hose**

- Can trap sediment or particulates
- Biofilms can form in a hose



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**4. Open Cold Water for 2-3 Minutes**

- > Want to get water representative of conditions in the water main
- > When temperature stabilizes is a good guide



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**5. Fill out Label, Tag & Lab Form**

- > In waterproof ink
- > Write clearly



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**6. Adjust Flow to Width of a Pencil**

- > You want a steady, controlled flow
- > Don't change the flow once you start sampling (could dislodge microbial growth)



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**7. Remove the Bottle Cap**

- > Be careful not to touch the inside of the bottle or bottle cap
- > Do not lay the cap down or put it in your pocket
- > **STERILE, STERILE, STERILE!!!!**



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**8. Fill Bottle to the Shoulder**

- > ¼ inch from the top
- > **DO NOT** rinse the bottle



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**9. Place Cap on Bottle**

- > Screw down tightly (but not too tight)
- > Think **STERILE**



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**10. Turn Tap Off & Replace the Aerator, Strainer, or Hose**

If items are not reconnected or replaced appropriately, it may lead to future contamination



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**11. Check the Information on the Label**

- Sample ID
- Sample Location
- Sample Date
- Sample time



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**12. Complete Additional Lab Forms**

- Chain of custody
- Make sure to write clearly in waterproof ink



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**Chain of Custody**

- Sample Sign in Sheet
- Who Transported Sample
- Date and Time of Delivery/drop off
- Number of Samples dropped off



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**13. Ice & Send to Lab for Processing**

- **WITHIN 30 HOURS!**
- Refrigeration recommended; Cooler with blue ice
- The quicker it gets to the lab the better
- Use a certified laboratory for analysis



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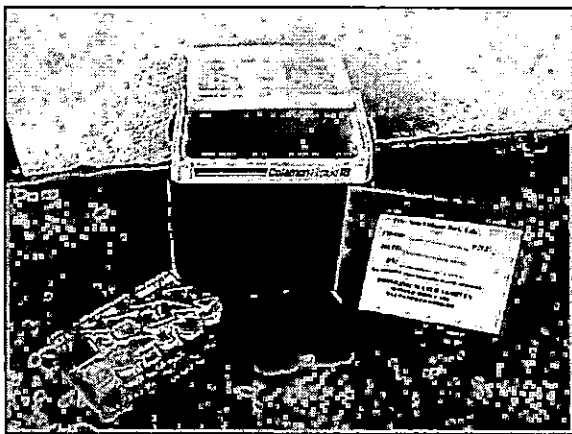
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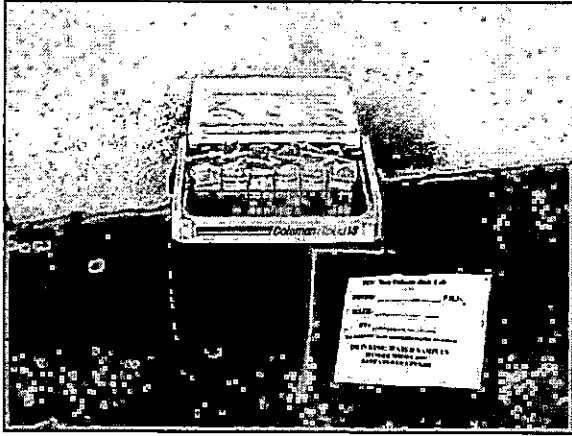
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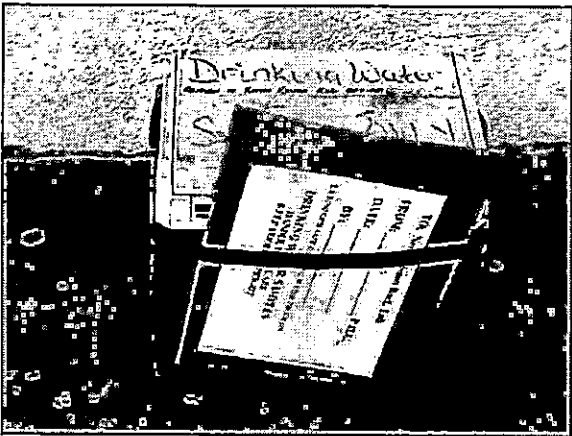
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**Helpful Hints**

- Sample early in the week or month
- If you feel something went wrong, resample
  - Bottles are cheap, but false positive samples are not



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### Improper Sampling Techniques

- Not Flushing the Tap
- Improper Handling of Bags/Containers
- Exceed 30 Hour Holding Time



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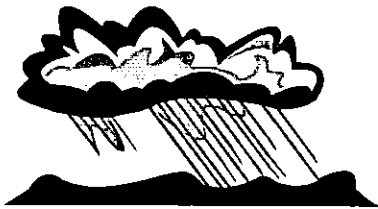
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### Avoid Sampling in the Rain



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### Keep your faucets maintained – no spray



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**Who's Responsible??**

The WATER/WW SYSTEM PERSONNEL are responsible for insuring that all water/ww samples are collected during the correct compliance period



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**Failure to Monitor**

- > Utility responsible that the results go to the regulatory agency
- > Violation occurs if no sample taken or reported
  - Includes Public Notice and other measures



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**Laboratory Results**

- > You will be notified by your Lab if you have a TC+ sample
- > Collect Repeats and Triggered Source samples within 24 hours or as scheduled
- > May require corrective action be taken to resolve contamination



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**Colilert® Test**

1. Collect proper sample
2. Add one sample pack
3. Cap and shake
4. Incubate at 35°C for 24 hours
5. Read results
  - Negative: Less yellow than comparator
  - Positive total coliform: Yellow equal or greater
  - Positive E. coli: Yellow and fluorescence



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**Coliform Sampling Procedures for Wastewater**

1. Assemble sampling supplies
2. Fill out label, tag, and lab form in waterproof ink
3. Remove the bottle cap
4. Fill the bottle to the shoulder or about ¼ inch from the top
5. Place the cap on the bottle and screw it down tightly
6. Check the information on the label



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**Coliform Sampling Procedures for Wastewater**

7. Complete any additional lab forms that come with the sample bottle
8. Refrigerate or ice the samples; sample must reach the lab for processing within 6 hours of sample collection



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**Volatile Organic Compounds (VOCs)**

- Can occur in both treated and untreated drinking water
- Generally found at higher concentrations in ground water than in surface water
- Because these organic chemicals are volatile, they require special sampling procedures



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**VOC Sampling Supplies**

Before you begin sampling, it is important to have all of your supplies on hand



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**VOC Sample Preparation Instructions**

Although different sizes and types of sampling containers may be used for collecting VOC samples, most laboratories supply 40ml to 120ml glass vials. The laboratory will normally add the proper preservative in advance.



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**VOC Sample Preparation Instructions**

For chlorinated waters, a powdered dechlorinating agent (ascorbic acid) will be added, and the sampler must subsequently add hydrochloric acid to the filled vials. Therefore, a small vial of 1:1 hydrochloric acid, disposable pipets, and small eye-dropper bulbs will be included for chlorinated systems.

For unchlorinated waters, the laboratory will add the acid to the empty vials.



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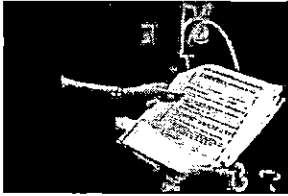
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**VOC Sampling Preparation Instructions**

Samplers should obtain specific instructions from the laboratory at the time the empty vials are received.



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**Trip Blanks**

- Consist of sample containers filled at the laboratory that must remain sealed and must be shipped back to the lab
- A check to see if samples were contaminated during shipment



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**Trip Blanks**

If the laboratory has not included trip blanks, contact them before taking any samples.



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**VOC Sampling Preparation Instructions**

Food, drink and even 2<sup>nd</sup> hand cigarette smoke should never come into contact with the sample or its containers. These foreign objects have been suspected of causing false results in samples so be sure to practice good, clean sample collection procedures.



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**Important Safety Precaution**

**Caution – Hazard**

Sample containers may contain liquid preservatives that will cause burns. If it comes into contact with the skin or eyes, flush with liberal amounts of water and seek immediate medical attention.



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**VOC Sampling Procedure**

Use a non-swivel faucet and remove all attachments including any aerators, strainers and hoses.



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**VOC Sampling Procedure**

Turn on the water tap and run the water for 2-3 minutes then reduce the flow so that the stream is approximately 1/4 inch in diameter. Do NOT change the flow rate until after sampling is completed.



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**VOC Sampling Procedure**

Remove the cap from the vial, keeping the vial upright to prevent spilling any preservatives. Do NOT put the cap face down or put it in your pocket. Do NOT allow the inside of the cap or bottle threads to be touched by any object.



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**VOC Sampling Procedure**

Hold the vial at an angle pointing away from your face and carefully fill it until it is full. Be careful not to rinse out the preservatives.



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**VOC Sampling Procedure**

**For Chlorinated Water:**

If the water has been chlorinated, use the vials with the 1:1 (one part acid to one part water) hydrochloric acid (HCL) for each 20ml of sample volume. This should have been supplied by the lab for you.



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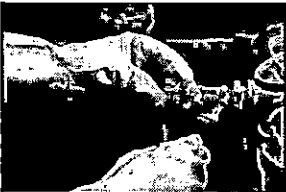
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**VOC Sampling Procedure**

Carefully complete filling the vial by putting water inside the cap and transferring it one drop at a time to the vial.



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**VOC Sampling Procedure**

Screw the cap on the vial being sure not to overtighten the cap.



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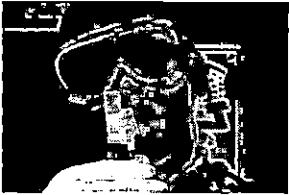
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**VOC Sampling Procedure**

Invert the vial, tap against your other hand, and check for air bubbles. If any are present, add additional water (just a drop or two), seal and check again.



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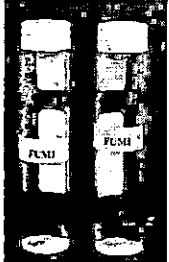
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**VOC Sample Preparation Instructions**

Remember that each "sample" consists of 2 to 3 filled vials. Repeat the sampling procedures to fill additional vials for each sample.



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**VOC Sampling Procedure**

Complete all necessary forms supplied by the laboratory with the appropriate information.



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**VOC Sampling Procedure**

Place the samples in the cooler (the trip blanks should still be in the cooler). Keep the samples at 2 degrees to 6 degrees Celsius (36 degrees to 46 degrees Fahrenheit) and keep them away from direct light or gasoline and solvent vapors.

**Tip:** Bag up the samples and the ice separately in the cooler to help prevent leakage or possible contamination of the sample from the ice.



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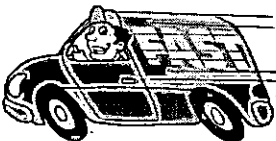
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**VOC Sampling Procedure**

Deliver the samples to the laboratory or ship the samples by an overnight courier to ensure prompt testing for the most accurate results. It is recommended that all samples be received by the laboratory within 7 days.



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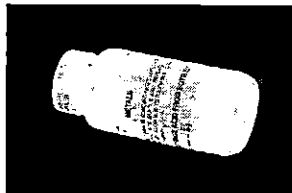
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**IOC-Metals Sample Preparation Instructions**

For IOC-Metals sampling, most laboratories supply 8 oz. plastic sampling containers using an acid added as a preservative. Caution and safety in use of these containers must be taken.



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**IOC-Metals Sample Procedures**

Hold bottle at an angle and carefully fill it to its shoulder. Do NOT touch the interior of the bottle or the underside of the cap. Do NOT allow the bottle to touch the faucet or allow water to splash up onto the faucet.



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**IOC-Cyanide Sample Preparation Instructions**

For cyanide sampling, a one liter glass or plastic container is often used. The lab usually adds sodium hydroxide (NaOH) to the container for preservation of the sample.



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**IOC-Cyanide Sample Procedures**

Hold container at an angle pointing away from your face and carefully fill it to its shoulder. The acid in the container will mix rapidly with the water and may splatter a bit. Leave enough room in the bottle so the sample can be shaken to mix the preservative. Put the cap on the container, tighten it, and shake the bottle vigorously for one minute.



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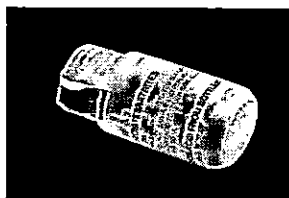
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**Nitrate-Nitrite Sample Preparation Instructions**

For Nitrate-Nitrite sampling, laboratories may supply 200ml or one liter plastic or glass sample containers with concentrated Sulfuric Acid as a preservative.



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**Nitrate-Nitrite Sample Procedures**

Hold bottle at an angle and carefully fill it to its shoulder. Do NOT touch the interior of the bottle or the underside of the cap. Do NOT allow the bottle to touch the faucet or allow water to splash up onto the faucet.



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**For Your Information**

Many environmental laboratories have Sample Collection lists available on their websites that entail sample type, container type/size, preservation method and holding time.

It is to your benefit to print this information off and utilize it as a reference.



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**Activity**



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**Acknowledgements**

American Water Works Association  
COMMITTED TO THE UTILITY'S LONG INTEREST AND SUCCESS



Quality First



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**Wrap-up**

Questions



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**Post – Test**

Required by all USEPA Training Events



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Kentucky Office: 101 Burch Court, Frankfort, KY 40601  
502.875.5863

Chris Wells, Technical Assistance Provider  
[cwells@capky.org](mailto:cwells@capky.org)



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## Sample Type

## Container

## Preservation

## Holding Time

Sample Type	Container	Preservation	Holding Time
Acidity	P / Liter	Cool to 4°C	14 Days
ADMI Color	P / Liter	Cool to 4°C	48 Hours
Alkalinity	P / Liter	Cool to 4°C	14 Days
Ammonia, Nitrogen	P / 8 oz.	Cool to 4°C, Sodium thiosulfate, pH <2 with Sulfuric acid	28 Days
BOD	P / Liter	Cool to 4°C	48 Hours
Chloride	P / Liter	Cool to 4°C	28 Days
Chlorine	P / Liter	Analyze immediately	
Chromium, Hexavalent	P / Liter	Cool to 4°C	24 Hours
COD	P / Liter	Cool to 4°C, Sulfuric acid	28 Days
Coliform, Fecal	G or P sterile / 100 mL	Cool to 4°C, Sodium thiosulfate	6 Hours
Coliform, Total	G or P sterile / 100 mL	Cool to 4°C, Sodium thiosulfate	30 Hours
Color	G / Liter	Cool to 4°C	48 Hours
Cyanide, Total and Amenable	P / Liter	Cool to 4°C, pH > 12 with NaOH, 0.6 g Ascorbic acid	14 Days
Fluoride	P / 60 mL	None required	28 Days
HAAs	3 - 60mL amber vials	Cool to 4°C, Ammonium chloride	14 Days
Hardness	P / 8 oz.	Cool to 4°C, pH <2 with Nitric acid	6 Months
Hydrocarbons, Purgeable Aromatic	2G / 40mL vials	Cool to 4°C, Sodium thiosulfate	14 Days
Hydrocarbons, Petroleum Total	2G / 40mL vials. P / Liter	Cool to 4°C	7 Days
Mercury	P / 8 oz.	Cool to 4°C, pH <2 with Nitric acid	28 Days
Metals, Dissolved	P / 8 oz. or 50ml vial	Filtered then, Cool to 4°C, pH <2 with Nitric acid	6 Months
Metals, Total	P / 8 oz. or 50 ml vial	Cool to 4°C, pH <2 with Nitric acid	6 Months
MTBE	3G / 40mL vials	Cool to 4°C, Hydrochloric acid	14 Days
Nitrate	P / Liter	Cool to 4°C	48 Hours
Nitrate-Nitrite	P / Liter	Cool to 4°C, Sulfuric acid	28 Days
Nitrite	P / Liter	Cool to 4°C	48 Hours
Nitrogen, Organic	P / 8 oz.	Cool to 4°C, Sodium thiosulfate, pH <2 with Sulfuric acid	28 Days
Odor	P / Liter	Cool to 4°C	24 Hours
Oil and Grease	G / Liter	Cool to 4°C, Sulfuric acid	28 Days
Orthophosphate	P / Liter	Cool to 4°C	48 Hours
PCBs	2A, G / Liter	Cool to 4°C	7 Days
pH	P/G minimum 25 mL	Analyze immediately	
Phenolics	G / Liter	Cool to 4°C, Sulfuric acid	28 Days
Phosphorous/Phosphate	P / Liter	Cool to 4°C, Sulfuric acid	28 Days
Specific Conductance	P / Liter	Cool to 4°C	28 Days
Solids, Dissolved	P / Liter	Cool to 4°C	7 Days
Solids, Settleable	P / Liter	Cool to 4°C	48 Hours

Sample Type	Container	Preservation	Holding Time
Solids, Suspended	P / Liter	Cool to 4°C	7 Days
Solids, Total	P / Liter	Cool to 4°C	7 Days
Solids, Volatile	P / Liter	Cool to 4°C	7 Days
Sulfate	P / Liter	Cool to 4°C	28 Days
Sulfide	P / Liter	Cool to 4°C, Zinc acetate, pH >9 NaOH	7 Days
Sulfite	P / Liter	Analyze immediately	
Surfactants (MBAS)	G / Liter	Cool to 4°C	48 Hours
Temperature	P / Liter	Analyze immediately	
THMs	3 - 40mL clear vials	Cool to 4°C, Ascorbic acid, Hydrochloric acid	14 Days
TKN	P / 8 oz.	Cool to 4°C, Sodium thiosulfate, pH <2 with Sulfuric acid	28 Days
TOC	2 - 40mL amber vials	Cool to 4°C, pH <2 with Sulfuric acid	28 Days
Total Organic Halogens (TOX)	A, G / Liter	Cool to 4°C, pH <2 with Sulfuric acid	7 Days
Turbidity	P / Liter	Cool to 4°C	24 Hours
UVA-254	G / Liter or 40 mL vial	Cool to 4°C	24 Hours
VOCs	3 - 40mL clear vials	Cool to 4°C, Ascorbic acid, Hydrochloric acid	14 Days

P = Plastic    G = Glass    A = Amber

Please note these holding times for analysis completion. Deliver all samples to laboratory as soon as possible after collection to insure sample integrity.

Please call the lab for sampling instructions for parameters not listed above.

# **SAMPLING ACTIVITY**

- Your instructor will tell you to collect a drinking water sample for either total coliform or volatile organic compounds.
- Once that has been determined, you will select the proper sampling container from those provided to you.
- You will then determine which sampling site to use to collect your sample (water fountain, bathroom sink, kitchen sink, outdoor spigot, etc.).
- Once the appropriate site has been selected, you will collect the sample by utilizing the best management practices per each approved sampling method from the training.