NEACE & KOENIG

ATTORNEYS AT LAW

Robert D. Neace
David A. Koenig

223 Main Street
P.O. Box 6205
Florence, KY 41022-6205
PHONE: (859) 525-6161
FAX: (859) 525-6194

March 19, 2008

Ms. Beth O'Donnell
Executive Director
Public Service Commission
P.O. Box 615
211 Sower Blvd.
Frankfort, KY 40601

Re: ***Boone County Water District***
Case No. 2008-0058

Dear Ms. O'Donnell:

Enclosed please find original and five (5) copies of second supplementation to application of the Boone County Water District for approval of commissioner training. We believe that this completes our application.

Thanking you for your consideration, and with kindest regards, I remain,

Very truly yours,

DAVID A. KOENIG

DAK:as
enclosures

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

BOONE COUNTY WATER DISTRICT TRAINING OR CERTIFICATION	))	**CASE NO. 2008-00058**

SECOND SUPPLEMENTATION TO APPLICATION

* *

COMES NOW the Boone County Water District, through counsel, and hereby supplements its second supplementation to its application for certification of a proposed water district commissioner training program and hereby submits the course materials in support of the application of the Boone County Water District.

DAVID A. KOENIG, KBA #39530
Attorney at Law
P.O. Box 6205, 223 Main Street
Florence, KY 41022-6205
(859) 525-6161

5

RECEIVED
MAR 2 4 2008
PUBLIC SERVICE
COMMISSION

Gateway
Community & Technical College
HIGHER EDUCATION BEGINS HERE

Drinking Water Continuing Education

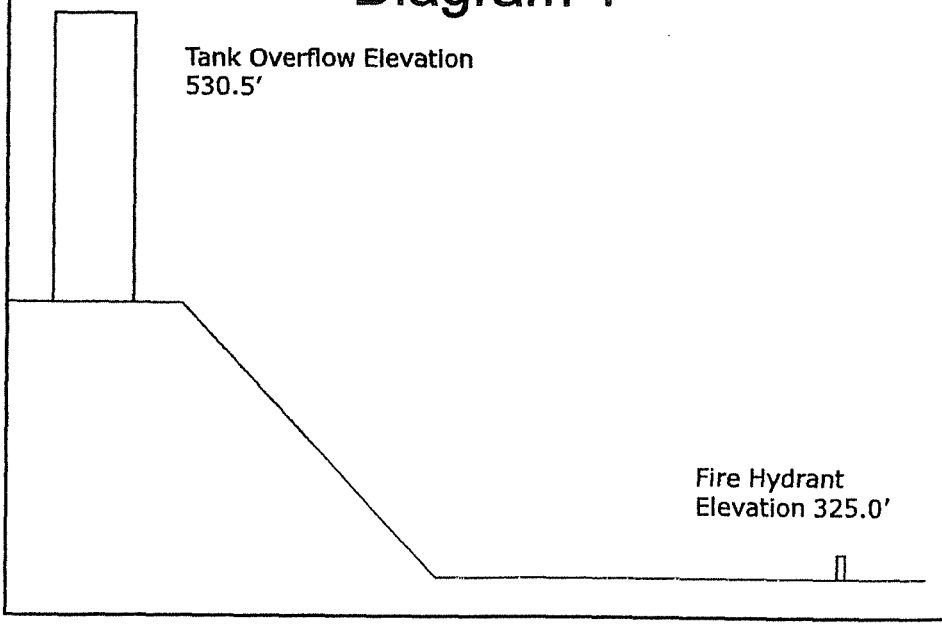
March 11 and 12, 2008

Agenda

March 11		March 12	
7:45-8:00	Registration	7:45-8:00	Registration
8:00-9:45	Flushing	8:00-9:45	Jar Testing
9:45-10:00	Break	9:45-10:00	Break
10:00-11:30	Flow Test	10:00-11:30	C12 Safety
11:30-12:30	Lunch	11:30-12:30	Lunch
12:30-2:00	Boil Water Advisory	12:30-2:00	Basic Hydraulics
2:00-2:15	Break	2:00-2:15	Break
2:15-3:30	Corrosion Control	2:15-3:30	Math

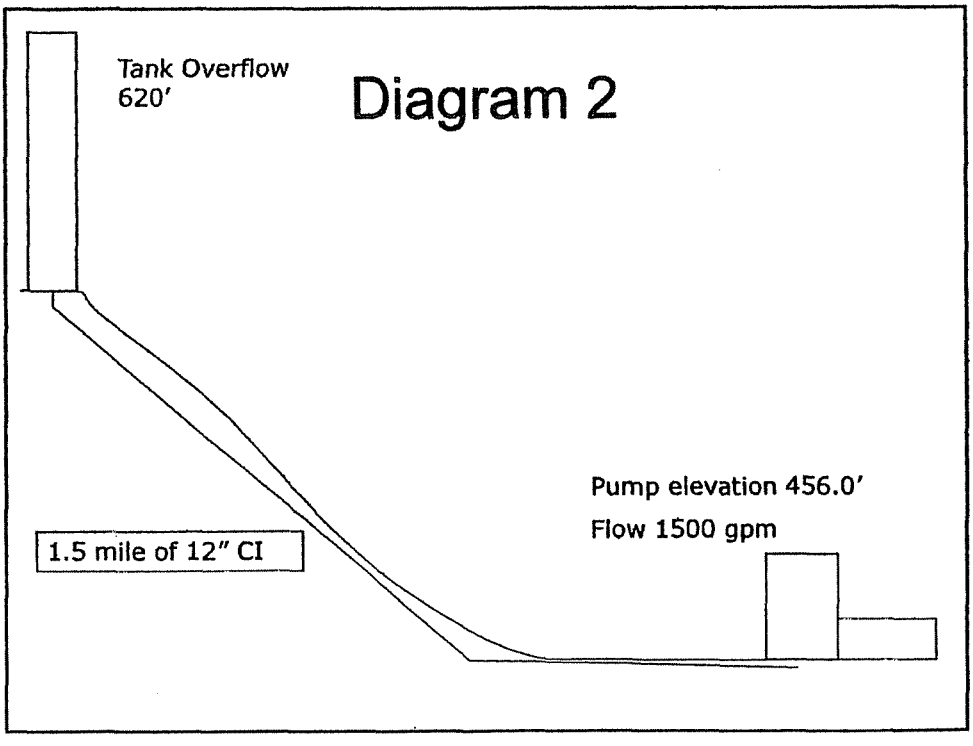
BASIC HYDRAULICS

Diagram 1



From diagram 1 find the pressure in psi at the fire hydrant.

- Tank overflow elevation 530.5′
- Fire hydrant elevation 325.0′
- Head pressure = Tank overflow elevation – Fire hydrant elevation
- Head pressure = 530.5′ – 325.0′
- Head pressure = 205.5′
- One foot of head = .433 psi
- Pressure = 205.5′ * .433 = 88.98 psi



From diagram 2 find the water horsepower needed to pump water to the tank.

- WHp = Total Head * flow(gpm)/3960
- Head loss from the pipe = 1.5 miles * 5280′ / 100 = 79.2 (100′ sections)
- Head loss for each 100′ section = .89
- Head loss for the pipe = 79.2 * .89 = 70.5′
- Elevation head = 620′ – 456′ = 164′
- WHp = (164′ +70.5′) * 1500 / 3960
- WHp = 88.8

2A. From diagram 2 find the water horsepower using the same numbers except there is an inch of calcium or corrosion on the interior of the 12" main thus making the main equal to 10 inches.

- $\text{WHp} = \frac{\text{Total Head X Flow (gpm)}}{3960}$
- Head loss from pipe = 1.5 miles X 5280′ / 100 = 79.2 (100′ sections)
- Head loss for each 100′ sections = 2.13′
- Head loss for pipe = 2.13′ X 79.2 = 168.7
- Elevation head = 620′ – 456′ = 164′
- $\text{WHp} = \frac{(168.7' + 164') \text{ X } 1500}{3960}$
- WHp = 126

Assuming that 1 kw hour cost $0.05, the cost to operate the pump from problem # 2 is:

- 1 Hp = 0.746 kw hrs.
- 88.8 Hp X 0.746 kw hrs. = 66.2 kw hrs.
- 66.2 kw hrs. X $0.05 = 3.31 per hour

The cost to operate the pump in problem # 2a is:

- 126 Hp X 0.746 kw hrs. = 94.0 kw hrs.
- 94.0 kw hrs. X $0.05 = 4.70 per hour

Assuming the pump runs 12 hours a day, 7 days a week the cost for operating the pump in problem # 2 for a 30 day period is:

- $3.31 / hr X 12 hrs./day X 30 days = $1,191.60

The cost for operating the pump in problem # 2a is:

- $4.70 / hr X 12 hrs/day X 30 days = $1,692.00
- 1,692.00 – 1,191.60
- Difference 0f $500.40

FORMULA & CONVERSION SHEET for DRINKING WATER TREATMENT & DISTRIBUTION

CONVERSIONS

1 psi	= 2.31 ft. of head
1 ft. of head	= .433 psi
1 cuft of water	= 7.48 gallons
1 cuft of water	= 62.4 lbs.
1 gallon	= 8.34 lbs.
1 gallon	= 3,785 ml
1 Liter	= 1,000 ml
1 Liter	= 1,000 grams
1 mg/L	= 8.34 lbs/MG
1 ppm	= 1 mg/L
1 ml	= 1 gram
1 pound	= 453.6 grams
1 pound	= 7,000 grains
1 kilogram	= 1,000 grams
1 cuft/sec	= 448.8 gpm
1 MGD	= 1.55 cuft/sec
1 MGD	= 694.5 gpm
1 HP	= 33,000 ft.lbs./min
1 HP	= .746 kilowatt
1 mile	= 5,280 feet

FLOW AND VELOCITY

"Q" = FLOW expressed in cubic feet per second (cfs)

"V" = VELOCITY expressed in feet per second (fps)

"A" = AREA expressed in square feet (sqft)

$$Q = A \times V$$

$$V = Q \div A$$

$$A = Q \div V$$

WATER-BRAKE-MOTOR HORSEPOWER

$$WHP = \frac{GPM \times Total\ Head\ (ft)}{3960}$$

$$BHP = \frac{GPM \times Total\ Head\ (ft)}{3960 \times E_p}$$

$$MHP = \frac{GPM \times Total\ Head\ (ft)}{3960 \times E_p \times E_m}$$

E_p = Pump Efficiency (%)

E_m = Motor Efficiency (%)

CONVERSION OF TEMPERATURES

$$°F = (°C \times 1.8) + 32$$

$$°C = \frac{(°F - 32)}{1.8}$$

Check your work: water freezes at 32° F and 0° C
water boils at 212° F and 100° C

OBJECT	AREA(ft^2)	VOLUME (ft^3)
Rectangle	Length' × Width'	Length' × Width' × Height'
Circle	.785 × D' × D'	
Triangle	½ (Base' × Altitude')	
Cylinder		.785 × D' × D' × Length'
Sphere		.5236 × D' × D' × D'

Diameter (D) = 2 × radius Circumference = 3.14 × D Perimeter = Sum of the Sides

FILTRATION RATE = Flow (gpm) ÷ Surface Area (sqft)
BACKWASH RATE = Flow (gpm) ÷ Surface Area (sqft)
SURFACE OVERFLOW RATE = Flow (gpm) ÷ Area(sqft)
DETENTION TIME = Volume (gals) ÷ Flow (gpm)
WEIR OVERFLOW RATE = Flow (gpm) ÷ Feet of weir
SPECIFIC CAPACITY = Well yield (gpm) / Drawdown (feet)
FILTRATION RATE : for every 1.6 in./min of rise or fall = 1 gpm/ft

Lbs. of chemical = ppm × 8.34 × MG

$$ppm = \frac{lbs.\ of\ chemical}{8.34 \times MG}$$

Cl_2 Dosage = Demand + Residual

$$Specific\ Gravity = \frac{wt.\ of\ a\ particular\ liquid}{equivalent\ wt.\ of\ water}$$

$$Strength\ of\ Solution = \frac{wt.\ of\ chemical}{wt.\ of\ solution}$$

Opflow
ISSN 0149-8029 Vol. 17 No. 5 May 1991
A monthly publication of the American Water Works Association

Causes and Cures of Distribution System Corrosion

Kevin M. Ripp
Marketing Manager
Kjell Water Consultants
Beloit, Wis.

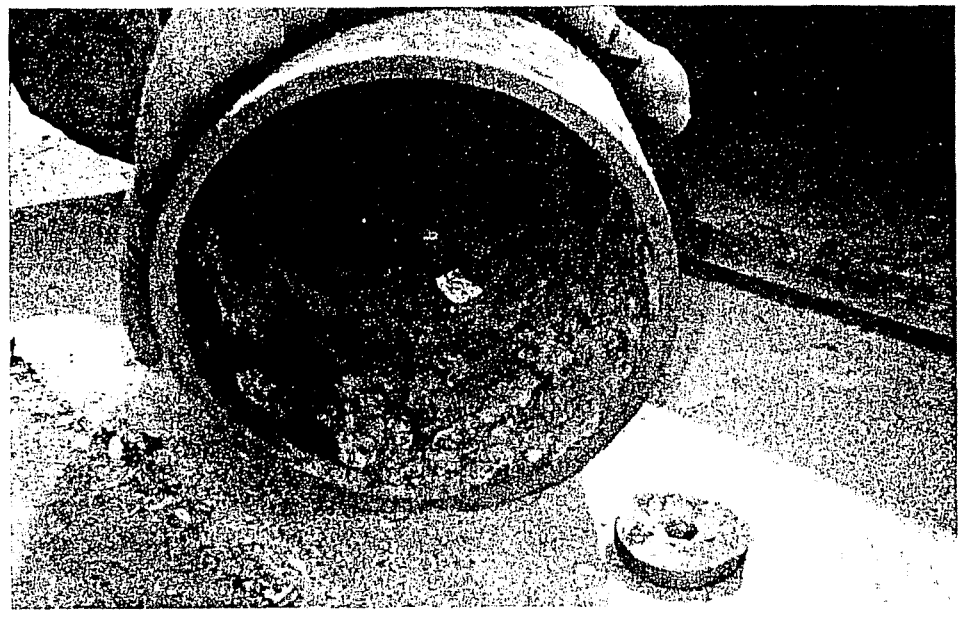


Figure 1 Corrosion in a cast-iron pipe: Corrosion is always a result of a combination of factors including physical, chemical, and biological.

As marketing manager for a water treatment chemicals company, I occasionally receive calls from concerned water users. For example, one morning I received a call from a distressed mother of two. She said the children's naturally blonde hair was stained green and she had been trying to solve this problem all summer. Now, with school approaching, and green hair really not all that popular in the Midwest, she desperately needed to fix the problem.

After consulting the water supplier and evaluating the situation, we determined the green stains were the result of a low-alkalinity, corrosive water supply, and copper plumbing. We decided to add a corrosion inhibitor to form a protective film over the copper. To do this, we installed continuous feed equipment at the wellhouse prior to chlorination.

Testing revealed that the corrosion inhibitor, in addition to solving the green-hair dilemma, also lowered first-draw lead levels from 50 ppb (50 µg/L) down to 10 ppb (10 µg/L).

Corrosion and the Senses

A good operator can see, taste, and smell changes in water quality and has the "sixth sense" to detect differences in quality before they become problems. It is this sixth sense that makes the science of corrosion control an art in an effective treatment program.

Color. Iron corrosion stains bathroom vanities and white laundry with a familiar rust color. In homes, copper corrosion results in blue-green stains that show up in sinks, baths, and blonde hair.

Taste and odor. Corrosion can cause a metallic taste and sometimes a musty odor. *At times this odor can be attributed to bacterial problems.*

Costs of Corrosion

Economic costs. Corrosion can increase the operating expenses of a water distribution system (Figure 1). For example, when iron mains build up with tuberculation, flow rates and efficiency are reduced. This could lead to the premature replacement of mains. Fortunately, this kind of corrosion is easily seen and identified.

Health costs. Corrosive water can cause the leaching of lead and copper into a water supply. Unfortunately, lead leaching problems are not as visible as other types of corrosion problems; to determine lead leaching, the water must be tested for the presence of lead.

Classifying Water

Before you start solving corrosion problems, you need to determine the type of water you are dealing with. Generally speaking, water can be classified into three categories: scaling, neutral, and corrosive.

Scaling typically indicates hard waters that are over-saturated with calcium carbonate. Scaling tendencies are easily noticed in hot water heaters.

Neutral water is in equilibrium. By adjusting the water to "slightly scaling," a protective eggshell crust forms in the water system. Forming this perfect eggshell coating is easier said than done.

Corrosive water tends to dissolve piping. Deposits of tuberculation in a cast-iron system are typical by-products.

Although it's easy to classify water qualities, it is important to remember that for every rule there is an exception.

For example, in one water system an operator had a problem because of cast-iron corrosion. However, once the

are equal, the Langelier index is zero and, theoretically, the water is stable.

Measuring Corrosion Rates

Corrosion rates can be measured using corrosion coupons or by testing the water.

Coupons. A coupon is a piece of metal, the same type of metal that is used in the water system. The coupons are set up in test racks, and the racks are inserted in the pipes or tanks at various points in the distribution system. After a certain period of time, they are removed and tested or examined for types and amounts of corrosion.

While coupons provide a useful way to judge and compare rates of corrosion, they really don't measure what is actually happening inside a 45-year-old main that doesn't at all resemble the coupon.

Testing. Analyzing water samples from the distribution system provides an accurate and practical way to monitor actual corrosion rates. By sampling and analyzing the water regularly, the metal content of the water can be monitored. The metal content indicates the rate of corrosion.

When lead leaching is the concern, obtaining first-draw, customer-service, and distribution samples is the best way to monitor.

What Inhibitor Is Right?

Basically, there are two ways to inhibit, or slow down, corrosion. They are adjusting the pH or adding a corrosion inhibitor. Sometimes, both are used.

Adjusting pH. If the water is corrosive and lead leaching is a problem, consider raising the pH to make the water more likely to form scale. Table 1 lists several chemicals that can be used to raise pH. Using this chart in combination with the Baylis curve or the Langelier saturation index, an operator can see how to change the water quality.

While each chemical listed raises the pH, each provides different sources of hydroxide (OH) or carbonate (CO_3) alkalinity. For example, only lime provides calcium, and it is the least expensive chemical per pound. However, it is also the most troublesome to feed. Liquid caustic soda can be fed easily and safely. However, long-term shortages of caustic soda will make it expensive.

Before adjusting the pH, other factors may need to be considered, such as trihalomethane (THM) formation at higher pH levels and the fact that disinfection by chlorination is most efficient between pH 7.2 and pH 7.5.

Chemical inhibitors. Chemical inhibitors may be used alone or with a pH adjustment program. Besides forming a film on the inside of distribution piping, some inhibitors also sequester minerals and buffer the water to help stabilize pH changes.

The costs of a corrosion control program are easily offset by the savings . . . . Remember, when dealing with corrosion, the cleaner the water system—the better the corrosion control.

Sodium phosphates have been used for film formation, sequestration, and dispersion for more than 100 years. They can also be used to stabilize and buffer a pH-adjusted water. These phosphates generally work over a wide range of pH and under a variety of conditions.

Products such as sodium hexametaphosphate and sodium tripoly phosphate have been two traditional mainstays. Other powders and powdered blends are also available. Recently, many liquid-blended phosphates have shown the best performance and ease of application.

For waters below pH 8.0, zinc phosphates can be added for film formation. Zinc phosphates can be made of zinc orthophosphate or zinc polyphosphate; they come in liquid and powder forms. Maximum contaminant levels (MCLs) for heavy metals, such as for zinc in treatment sludge, have limited the use of zinc phosphates in some applications.

Silicates, more commonly known as "water glass," are known for the glass-like coatings they form in distribution systems. They can be blended with phosphates for corrosion reduction.

You Get What You Pay For

In general, with generic or proprietary compounds, you get what you pay for. Be sure to choose products that have a good history and are approved by the National Sanitation Foundation (NSF). This ensures that what you are buying is a quality product.

Conclusion

The costs of a corrosion control program are easily offset by the savings.

A corrosion control program allows a distribution system to last longer and operate more efficiently. This efficiency allows water operators to save time because of fewer customer complaints; less need to flush hydrants; and more efficient valve, water main, and meter performances.

In unlined ductile, galvanized, or cast-iron pipe, certain products can remove existing corrosion by-products. This cleaning can often result in lower electrical pumping costs and improved chlorine residuals. Remember, when dealing with corrosion, the cleaner the water system—the better the corrosion control. ♦

Table 1 Proper Use of pH Adjustment Chemicals

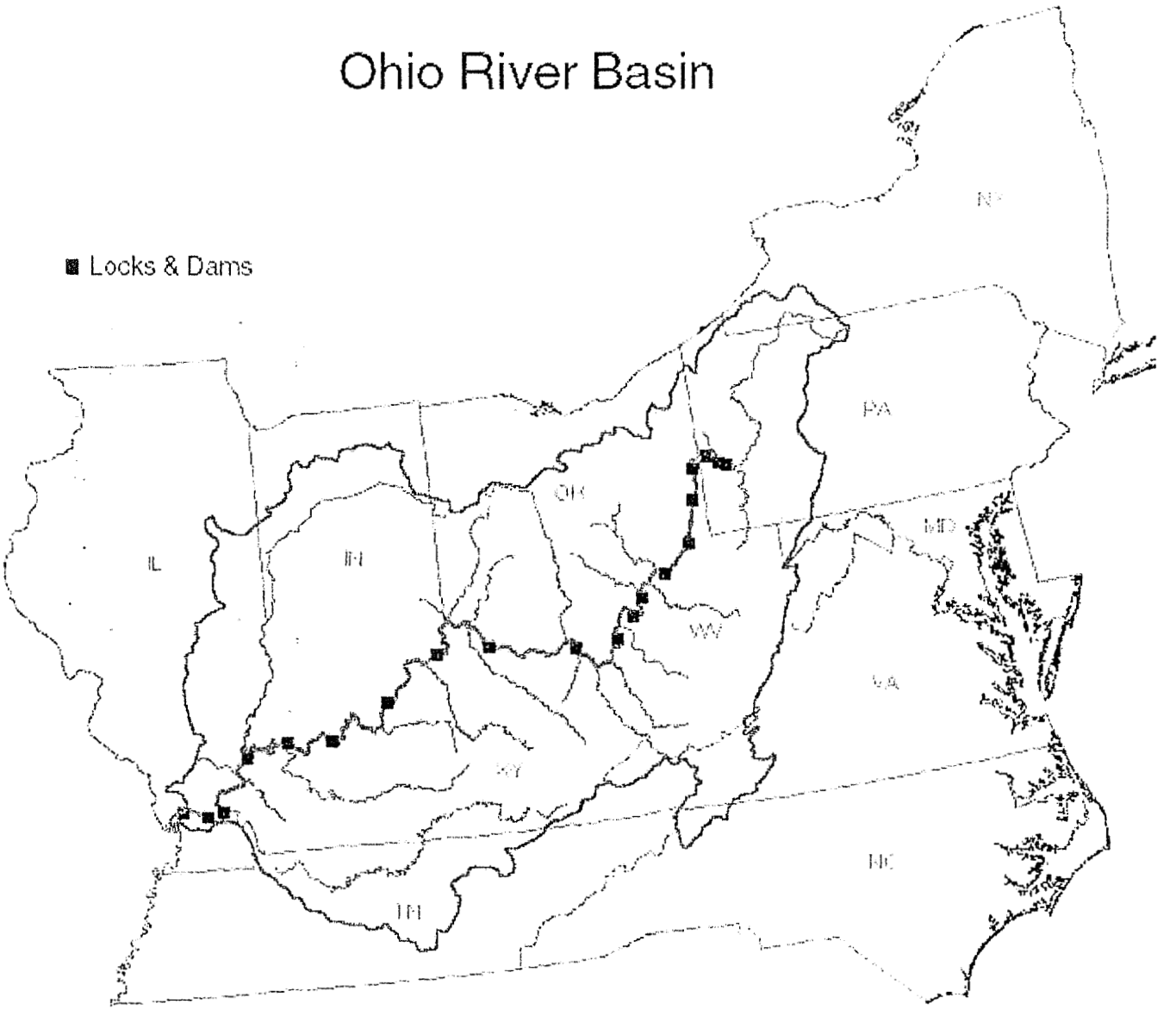
Chemical	Feed Rates	Alkalinity Increase per Added 1 ppm*	Equipment
Caustic soda (NaOH) —50% solution	1–29 ppm	1.25	Chemical feed pump
Soda ash (NaCO)	1–40 ppm	0.94	Feed pump, solution tank
Lime (CaOH)	1–20 ppm	1.35	Lime slaker
Sodium bicarbonate ($NaHCO_3$)	5–30 ppm	0.59	Feed pump, solution tank

*1 part per million (ppm) = 1 mg/L

Ohio River Basin

The Ohio River Basin is a region of 204,000 square miles covering parts of 14 states and including a population of nearly 25 million people, many in such major cities as Pittsburgh, Columbus, Cincinnati, Louisville, Indianapolis, and Nashville. The Consortium involves researchers and educators from throughout this basin, not just those concerned with the mainstem of the Ohio River. The Ohio River itself flows 981 miles from Pittsburgh to Cairo, Illinois, where it joins with the Mississippi. The navigation in the river and its tributaries relies upon the 19 locks and dams the mainstem of the river as shown in the following.

Water-related problems in the Ohio River Basin include effluent from municipal wastewater treatment plants, combined sewage and storm water overflows, urban storm water, acid mine drainage, agricultural and forest lands runoff, sedimentation, toxic pollutants, problems from oil and gas recovery brines, reservoir sedimentation, ground water pollution, and drinking water contamination, emerging pathogens, and exotic aquatic species. The region has been cited as a major contributor of acid precipitation for areas to the northeast and has a number of hazardous waste disposal sites.



Nineteen locks and dams in the Ohio River for navigation (ORSANCO, Corporate Member)

[Return]

Division Of Water

Flushing

Last Modified: 3/13/2007

Technical Documents

General Design Criteria

Emergency Alternate Water Source

Flushing

Five-Mile Policy

EPA Technical Guides

GWUDI

Grandfathering Cryptosporidium Data

Continuous-Recording Turbidimeter Protocol

Radionuclides Memo

Emergency Disinfection of Drinking Water

Required Sampling for New System

LT1 Enhanced Surface Water Treatment

In 2001, the Drinking Water Branch sent a memorandum to all public water systems in Kentucky regarding the regulations and standards for the "Design of Water Distribution Systems with Respect to Flushing Velocities." Those regulations and standards still apply.

The Drinking Water Branch is charged with the responsibility of ensuring that water systems are designed with the capability of providing an adequate quantity and acceptable quality of drinking water to all customers. With the emphasis on providing potable water to all citizens of the commonwealth by 2020, it is critical that proposed projects take into consideration existing infrastructure limitations that (1) prohibit provision of safe, reliable service to proposed customers and (2) compromise service to existing customers.

As lines are extended farther out into service areas, the core infrastructure may reach a point at which additional projects cannot be supported without upgrading that core system. Water pressure and velocity dissipates. The minimum required pressure of 20 psi cannot be maintained. With this in mind, we are emphasizing the need for adequate hydraulic design in proposed projects.

Because of inadequate pressure and velocity, many water systems do not have the capability of providing adequate flushing of new lines. Without the ability to provide sufficient velocities, a flushing program will essentially be of little benefit.

Water utilities flush distribution mains for a variety of reasons: corrosion control, sediment removal, taste and odor control, control of color, high turbidity, low chlorine residuals, bacteriological growths or as a response to customer complaints. The main objective of flushing is to improve water quality and service for customers. Benefits of flushing programs include preservation and improvement of water quality and control of bacterial growth.

Flushing is important to maintain good water quality. Flushing is

best effective when the minimum recommended velocity of at least 2.5 feet per second can be maintained.

Although the basic procedures of a routine flushing program are well defined, flushing program design remains a problem. An effective flushing program should anticipate and prevent water quality problems and customer complaints.

The ability of systems to meet the requirements of the Disinfection Byproducts Rule will be affected by an inability to flush lines to this standard.

The following regulations and standards apply to flushing and flushing velocities:

- 401 KAR 8:100 Section 1(10): Modifications and extension of service. The cabinet may refuse to approve modifications of a public water system or an extension of service to one or more customers if the modification or extension of service may result in the water system's inability to supply consistent water service in compliance with 401 KAR 8:010 through 8:600 inclusive.
- 401 KAR 8:020 Section 2(14): Flushing recommended. (a) To protect public health, a distribution system may be thoroughly flushed at least twice a year, usually in the spring and fall. The purpose of systematic flushing is to reduce turbidity created from the scouring of accumulated sediment within the water lines. Flushing shall start at the hydrants nearest the source of supply and proceed in an outward direction to the end of each main. Flushing shall continue at each hydrant until all traces of turbidity and color are gone. Hydrants shall be opened and shut slowly to prevent damage from water hammer. (b) In addition to the regularly scheduled flushing, the following conditions shall indicate a need to flush the entire system: 1. Turbidity within the distribution system greater than five or one nephelometric turbidity units, or NTU, as applicable to the system; 2. An inability to maintain an adequate residual of a disinfection agent in any part of the system; or 3. A heterotrophic plate count, or HPC, in excess of 500. (c) Other indicators that flushing may be necessary shall be taste and odor complaints, color of water, contaminated water samples or line repairs.
- Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers "Recommended Standards for Water Works 1992" (Ten State Standards):
  - Part 8.1.1 "The system shall be designed to maintain a minimum pressure of 20 psi (140kPa) at ground level at all points in the distribution system under all conditions of flow."
  - Part 8.1.6 "Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed."

- Part 8.5.6 "All new, cleaned or repaired water mains shall be disinfected in accordance with American Water Works Association (AWWA) Standard C651."
- AWWA Standard C651 Sec. 5.2.2 for disinfection states: "... the flushing velocity in the main shall not be less than 2.5 feet per second...." for slug and continuous feed disinfection methods.
- "General Design Criteria for Surface and Ground Water Supplies," July 1990, referenced in 401 KAR 8:100, states: "A minimal pressure of 30 psi must be available on the discharge side of all meters."

Proposed projects submitted to the Division of Water for review must include supportive documentation that shows water lines can be adequately flushed while maintaining the minimum required pressures. Each submittal must be accompanied by a hydraulic analysis that evaluates, or data that can be used to evaluate, the proposed extension at average design flows and peak flows, including flushing requirements. This analysis needs to include existing lines back to the nearest storage tank or booster pump station.

Proposed projects need to submit the following:

1) Calculate whether 30 psi can be maintained at the discharge side of each proposed meter under peak domestic demand using D.R. Raylor curves or the formula: 10 gpm x square root of number of customers.
2) Simulate maximum flow velocity while maintaining 20 psi throughout the distribution system.

If the 2.5 feet per second flushing velocity cannot be met while maintaining 20 psi, the area shall be considered underserved. This information may be used by Area Water Management Planning Councils for use in prioritizing 2020 fund projects.

For assistance, refer to this Web page about computer programs that simulate hydraulic and water-quality behavior within pressurized pipe networks.

Regarding operation and maintenance, refer to statement of policy on water quality control in distribution systems and area-wide optimization performance criteria for distribution system.

For more information about flushing water lines, contact:

Mike Riley, supervisor
Permits and Plans Review
Drinking Water Branch
Division of Water
14 Reilly Road
Frankfort,KY 40601
Phone: 502-564-2225 ext 592

Fax: 502-564-9899
Email: jmike.riley@ky.gov

Division of Water
14 Reilly Road
Frankfort, KY 40601
Phone: 502-564-3410
Fax: 502-564-0111
E-mail: water@ky.gov

Water Treatment Plant
Jar Test

Date: _____ Time: _____ Operator: _____

Raw Water Data

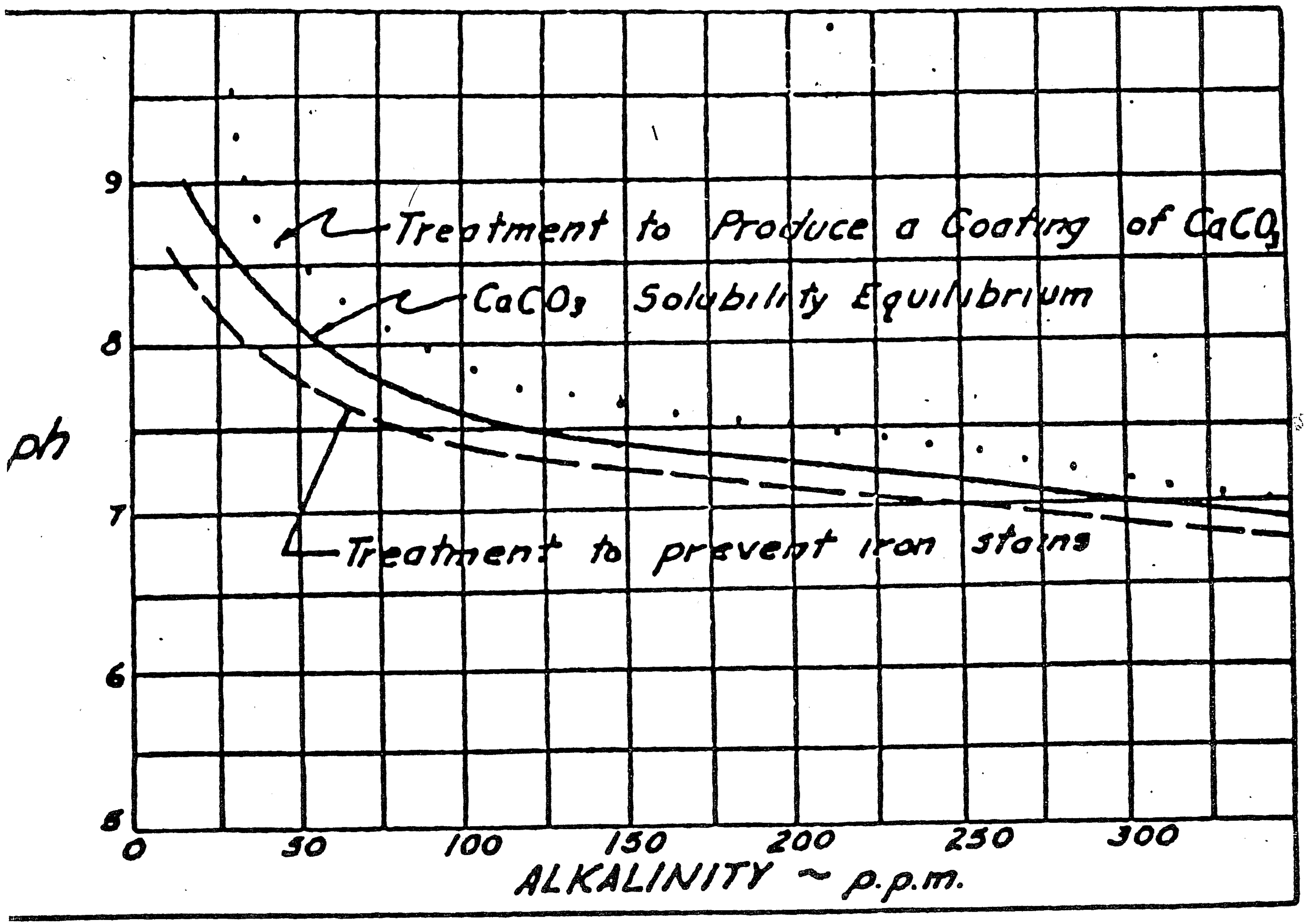
Turb. _____ Fe _____
pH _____ Mn _____
Alk _____ Temp _____
Hard. _____ _____

Mixing Sequence

	RPM	Time
1	_____	_____
2	_____	_____
3	_____	_____
Settling	_____	_____

Chemicals PPM		1	2	3	4	5	6
Floc Quality	First Appearance						
	5 Min						
	10Mins						
	20 Mins						
Settled Water Quality	Turb.						
	pH						
	Filtered						
	Clarity						

Comments: _____


Treatment to Produce a Coating of CaCO3
CaCO3 Solubility Equilibrium
Treatment to prevent iron stains
ph
9
8
7
6
5
0
50
100
150
200
250
300
ALKALINITY ~ p.p.m.

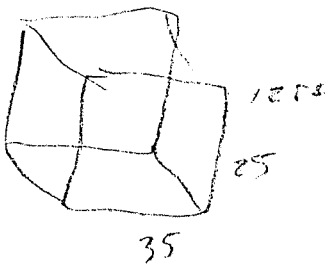
11.41 x 3785 = 43186

11.41 ÷ .88 ~~12.965~~ 10.04

43186

PPM $\frac{11.41}{8.34 \times MG}$ $\frac{11.41}{8.34 \times .0063}$ $\frac{11.41}{.025}$

1440 . 075 . 018



L x W x H

35 x 25 x 12 10,500 FT3

10,500 x 7.48 78,540 GAL

50 x 8.34 x .0785 = 32.52

50.0 GPH

-Gal - 10.4 LBS

38 ml/m

How many LBS of chemical

Flow Rate 1650 gpm How much ppm

r = Q ÷ A 1650

= W x L

38 x 1440/3785 = 14.45 GAL

14.45 x 10.4 = 150.28

PPM = $\frac{\#}{\text{Flow} \times 8.34}$ $\frac{150.28}{13761}$

Agency Name Image

Chlorine or Chloramine Residual

Last Modified: 5/24/2007

Rules

Consumer Confidence Report

Public Notification

Fees

Chlorine or Chloramine Residual

Volatile Organic Chemicals

Ozone

Turbidity

Monthly Operating Report

TTHMs and HAA5s

Chlorine Dioxide

Inorganic Chemicals

Secondary Contaminants

Cross-Connections

Asbestos

Corrosivity

Chlorine and Chloramine

Chlorite

Radionuclides

Synthetic Organic Chemicals

Bacteriological

Water systems that use chlorine for disinfection must report daily free chlorine residual readings on their Monthly Operating Report (MOR) and maintain a minimum **free chlorine residual** level of 0.2 mg/L (401 KAR 8:150).

Water systems using chloramine must report **total chlorine residuals** and maintain a minimum residual level of 0.5 mg/L throughout the distribution system (401 KAR 8:150).

Reporting daily includes **reporting weekends** on the MOR.

The regulation (401 KAR 8:150) requires collecting residuals at the plant tap (EPTDS) and representative points in the distribution system. The minimum free chlorine residual level of 0.2 mg/L must be maintained and the residual level entering the distribution system cannot be less than 0.2 mg/L for more than four hours (401 KAR 8:150, Section 1[2]). Water systems using chloramine must report total chlorine residuals and maintain a minimum residual level of 0.5 mg/L throughout the distribution system (401 KAR 8:150 Section 1[1][b]).

If a water system fails to report daily free or total chlorine residuals, a violation of "failure to report" will result. Be sure to report on the MOR the daily free chlorine residuals from the distribution system, including weekends, to avoid a violation. The representative points in the distribution system need to be reported on the distribution page. The plant tap residual information needs to be recorded daily on the water quality page of the MOR and is to be the lowest chlorine (or chloramine) residual of the day.

If the minimum free chlorine residual entering the distribution system is not restored to at least 0.2 mg/L within four hours after a value of less than 0.2 mg/L is observed, the water system is in violation of a treatment technique requirement (401 KAR 8:150). The system must restore the minimum concentration to return to compliance.

The monitoring requirements in 401 KAR 8:150, Section 3(2)(b) state that the residual disinfectant concentration of the water entering the distribution system (EPTDS) must be monitored by public water systems continuously. The lowest value must be recorded each day; this includes weekends. In order to find the lowest chlorine value of the day, the continuous analyzer must have a continuous recording device (chart, computer or SCADA).

If there is a failure in the continuous monitoring equipment, grab sampling every four hours may be conducted in lieu of continuous monitoring, but for no more than five working days following the failure of the equipment. Systems serving 3,300 or fewer persons may take grab samples in lieu of continuous monitoring on an ongoing basis at the frequencies each day prescribed in 401 KAR 8:150 (number of samples per day based on population size).

The system shall take a grab sample every four hours until the residual disinfectant concentration meets the requirements of Section 1(1) of the administrative regulation. The grab samples must not be taken the same time each day (401 KAR 8:150, Section 3[2][b]), but can be taken at the same points in the distribution system. The residual disinfectant concentration shall be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled (401 KAR 8:150, Section 3[2][c] and see 401 KAR 8:200 regarding microbiological monitoring). The sampling interval shall be subject to cabinet review and approval.

If distribution residual disinfectant levels are below the minimum, then heterotrophic plate counts (HPC) should be run to show there is adequate residual in the system to prohibit microbial growth. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/mL, measured as HPC, is deemed to have an adequate disinfectant residual for purposes of determining compliance (401 KAR 8:150, Section 1[2][c]).

As stated in the public water supply regulations concerning disinfection and filtration (401 KAR 8:150, Section 1), a public water system using groundwater or surface water as a source and uses chlorine for disinfection must provide the following (401 KAR 8:150, Section 1[1][a] 1-5):

1. A public water system shall use continuous automatic disinfection by chlorination.
2. Provide a minimum free chlorine residual of two-tenths (0.2) milligrams per liter, or ppm, throughout the distribution system measured as described in subsection (2) of 401 KAR 8:150 Section 1.
3. Provide a contact period of at least 30 minutes between the chlorine and the water to allow adequate time for disinfection.
4. Check free chlorine residuals **daily** at representative points throughout the system.
5. Report the free chlorine residuals monthly pursuant to 401

KAR 8:020, Section 2(7)(a).

The Surface Water Treatment Rule (SWTR) establishes two requirements concerning the maintenance of a residual (Guidance Manual for Compliance 1989). First, the SWTR requires a detectable residual be maintained throughout the distribution system. Second, a minimum free chlorine residual level of 0.2 mg/L must be maintained as stated in public water supply regulations, 401 KAR 8:150, Section 1(1)(a)2.

For water systems using chlorine, the minimum requirement in the regulations is to report free chlorine residual; however, for operation and maintenance, the system could, periodically, report total chlorine for comparison of total to free chlorine. Water systems using chloramine must report total chlorine residual and maintain a minimum residual level of 0.5 mg/L throughout the distribution system (401 KAR 8:150 Section 1[1][b]).

Maintaining a minimum disinfectant residual prevents microbial growth in the distribution system. Referred to as "biological stability," this provides a condition wherein the treated water quality does not enhance biological growth in the distribution system (Alternative Disinfectants Manual 1999).

In addition, recording daily free chlorine residual helps the water system with operation and maintenance to detect potential problems. The absence of a detectable disinfectant residual may be caused by a number of factors, including:

1. Insufficient chlorine applied at the treatment plant.
2. Interruption of chlorination.
3. A change in chlorine demand in either the source water or the distribution system.
4. Long standing times and/or long transmission distances.

Furthermore, in the absence of a detectable disinfectant residual in the distribution system, the water system may opt through operation and maintenance to correct the problem through one of the following techniques:

1. Routine flushing.
2. Increasing disinfectant doses at the water system.
3. Cleaning of the pipes (either mechanically by pigging or by the addition of chemicals to dissolve the deposits) in the distribution system and/or storage tanks to remove accumulated debris, which may be exerting a disinfectant demand.
4. Flushing and disinfection of the portions of the distribution system in which a residual is not maintained.
5. Installation of booster disinfection feed facilities within the distribution system.
6. Looking for potential cross-connections.
7. Eliminating dead-end lines.
8. Improving coagulation/flocculation/sedimentation process to

reduce total organic carbon (TOC) that can continue to exert a chlorine demand in the distribution system.

In conclusion, make sure your water system is reporting chlorine or chloramine residuals daily, including weekends. The minimum free chlorine residual level of 0.2 mg/L must be maintained and the residual level at the plant tap cannot be less than 0.2 mg/L for more than four hours (401 KAR 8:150, Section 1[2]). Failure to report chlorine or chloramine residuals on a weekend will result in a violation. If the chlorine residual concentration is not restored to at least 0.2 mg/L within four hours after a value of less than 0.2 mg/L is observed, the water system is in violation of a treatment technique requirement. Water systems using chloramine must report total chlorine residual and maintain a minimum residual level of 0.5 mg/L.

For questions regarding chlorine residuals in the distribution system, contact Frank Hall, supervisor of the Facility Planning and Compliance Section, or a compliance officer in the Drinking Water Branch at 502-564-3410.

There are many publications on disinfectant residuals; three are mentioned below.

- The public water supply regulations (401 KAR Chapter 8) incorporate by reference the "Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources," October 1989, as published by the U.S. Environmental Protection Agency, Science and Technology Branch, Criteria and Standards Division, Office of Drinking Water, Washington, D.C. Available through the American Water Works Association (AWWA).
- Information on maintaining a residual is available in the AWWA's "Manual of Water Supply Practices and Water Chlorination Principles and Practices."
- U.S. EPA's manual titled "Alternative Disinfectants and Oxidants Guidance Manual" (EPA-815-R-99-014) contains technical information on chlorine residuals. This is a 346-page PDF document requiring Adobe Acrobat Reader. A free Adobe Acrobat Reader may be downloaded here.

REFERENCES:

1. Alternative Disinfectants and Oxidants Guidance Manual (EPA-815-R-99-014), U.S. EPA, April 1999.
2. Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources, U.S. EPA, October 1989 (not available online).
3. Environmental and Public Protection Cabinet, Kentucky Administrative Regulations, Title 401, Chapter 8, Public Water Supply Regulations.

Division of Water
14 Reilly Road
Frankfort, KY 40601
Phone: 502-564-3410
Fax: 502-564-0111
E-mail: water@ky.gov

401 KAR 8:100. Design, construction and approval of facilities.

RELATES TO: KRS Chapter 224, 40 C.F.R. Part 141 (1995)

STATUTORY AUTHORITY: KRS 224.10-100, 224.10-110, 40 C.F.R. Part 141 (1995), 42 U.S.C. A 300f, 300g, 300j

NECESSITY, FUNCTION, AND CONFORMITY: KRS 224.10-110 directs the cabinet to enforce administrative regulations adopted by the secretary for the regulation and control of the purification of water for public and semipublic use. The Safe Drinking Water Act, as amended by the Safe Drinking Water Act Amendments of 1986, provides for primary enforcement responsibility by states that have adopted regulations "no less stringent than the national primary drinking water regulations", as well as meeting other criteria stipulated by the Act. The Commonwealth of Kentucky has accepted and is currently exercising this primary enforcement responsibility. This administrative regulation sets out design plan requirements for the construction of new and expanded facilities that deliver pure water for public or semipublic use, as well as stipulating certain reporting requirements and requiring modifications to existing facilities for certain line replacements, and feeding activated carbon. There is no federal regulation that deals with this subject matter, therefore, this administrative regulation is no more stringent than the federal regulation. The plans review process specified in this administrative regulation allows plans to be reviewed and certain judgments to be made about water systems to ensure that other state and federal requirements are being met.

Section 1. Plans and Specifications. (1) Plans to be submitted. Before a supplier or potential supplier of water may enter into a financial commitment for or initiate construction of a new public water system, or increase the capacity of an existing public water system, he shall submit the preliminary plans to the cabinet. An applicant shall demonstrate to the cabinet evidence of efforts to avoid locating part or all of the new or expanded facility at a site which is subject to a significant risk from earthquakes, floods, fires or other disasters which could cause a breakdown of the public water system or a portion thereof. Except for the intake structure, the facility shall be out of the 100-year flood plain.

(2) Preliminary information. The following information shall be submitted to the cabinet by a professional engineer on behalf of the applicant along with the fee required by 401 KAR 8:050, Section 1(1):

(a) The names of the applicant and the owner of the plant;

(b) A United States Geological Survey quadrangle map which shows the location of the proposed facility;

(c) The proposed source of water and quantity available, with the location of the intake or wellhead identified by latitude and longitude in degrees, minutes and seconds;

(d) An analysis of the water from the proposed source, which covers all regulated parameters, performed by a laboratory certified by the cabinet or its authorized agent;

(e) A description of the proposed facility, including size, flow rate through filters, settling basin size, and other general criteria; and

(f) An operation plan, including anticipated load, hours of operation, area served and the name of the plant operator.

(3) Preliminary plans approval. Upon receipt and review of the preliminary plans, as set forth in subsection (1) of this section, the cabinet shall either approve the preliminary plans or return them to the supplier of water for revision. Approval of the preliminary plans signifies approval only of the concept described in the preliminary plans and does not alter in any way the responsibility of the supplier of water to submit complete plans and specifications to the cabinet for final approval. The facility shall comply with the approved preliminary plans. Any change in the final design from the concept set forth in the preliminary plans shall be approved prior to its incorporation in the final plans and specifications.

(4) Preliminary plans for semipublic treatment facilities or distribution systems. Preliminary plans are not required by the cabinet for semipublic treatment facilities or for distribution system construction, extensions or improvements.

(5) Final plans and specifications for water treatment plants and distribution facilities.

(a) Plans for the construction or modification of public water systems shall be submitted by the water system or shall be accompanied by a letter from the water system confirming that it has reviewed the plans, accepts the design and can and will provide water service to the project. Public water systems which purchase water from another public water system, shall also submit a letter from the seller of water for all construction or modification projects if: the project will result in exceeding eighty-five (85) percent of the purchasers current purchase contract; or the project could result in a pressure reduction below thirty-five (35) pounds per square inch in either the purchaser's or the seller's system; or, the project will result in a demand for water by the purchaser in excess of a 10,000 gallon per day increase. This requirement may be waived by the cabinet if the purchaser shows that a reasonable attempt to obtain the letter has been made and the seller of water fails to provide the required letter. This provision shall not be the sole justification for rejection of the proposed project. The intent is to alert the seller and the purchaser that they are approaching their water purchase contract limitations and the state standards on minimum water pressure.

(b) Plans and specifications for all public water systems shall be prepared and submitted to the cabinet by a professional engineer

registered in Kentucky, and shall bear the engineer's seal. The seal of a professional engineer is not required on plans and specifications for semipublic water supplies, or for public water supply projects in which the expenditure for the completed project does not exceed $2,000. The construction or installation of any new facilities or works or the alteration or reconstruction of any existing facilities or works, in any public or semipublic water system, shall not begin until four (4) copies of the plans and specifications, or any changes thereto, together with design data as may be required for proper review of the plans, have been submitted to the cabinet and have been approved by the cabinet in writing. A complete package, including plans, specifications, necessary fees, letters and other information, shall be submitted in the form and content as may be specified by the cabinet, and shall be submitted at least thirty (30) days prior to the date on which action is requested of the cabinet. The front page of the plans shall contain the name of the water supply, its ownership, location by city and county, and the name of the person preparing the plans.

(c) The cabinet's review of plans shall be limited to sanitary features of design and other features of public health significance and shall not include an examination of structural, mechanical or electrical design or economic factors.

(d) The plans shall be drawn to scale and accompanied by proper specifications, so as to permit a comprehensive engineering review, and shall include, but not be limited to, the following:

1. If treatment facilities are involved, chemical analyses of the proposed raw water source or sources shall be performed and evaluated before final approval is granted;

2. A plan and sectional view with all necessary dimensions of the water treatment facilities;

3. A piping diagram showing all appurtenances, including treatment facilities, in sufficient detail, as well as pertinent elevation data, to permit a hydraulic analysis of the system; and

4. Specifications containing details on all treatment equipment, including catalog identification of pumps, chlorinators, chemical feeders and related equipment.

5. A capacity to feed activated carbon shall be a part of the design for a new community or nontransient noncommunity surface water system.

6. A plan for a water line that would propose a section of line be laid within a 200 foot radius of an underground storage tank as defined in KRS 224.60-100 or a petroleum storage tank as defined in KRS 224.60-115, shall provide that all water lines within the 200 foot radius shall be ductile iron pipe or other nonpermeable pipe approved by the cabinet. Any future replacement of an existing water line within a 200 foot radius of a storage tank, whether or not plans are submitted to the cabinet, shall also meet this requirement. The requirements of this subparagraph may be waived, in writing, if the public water system shows to the satisfaction of the cabinet, that the protection afforded by nonpermeable material is unnecessary due to hydrological, geological, or other physical conditions at a particular site.

(6) Approval of final plans. If approved, one (1) set of plans and specifications stamped "approved" will be returned to the engineer or person who prepared them and one (1) set will be returned to the water supply.

(7) Construction.

(a) During construction, a set of approved plans and specifications shall be available at the job site at all times. All work shall be performed in accordance with the approved plans and specifications.

(b) If the cabinet's representative observes work being performed in a manner which does not conform to the approved plans and specifications, the cabinet shall notify the owner in writing.

(8) Final approval of facility. Upon completion of construction, the person who presented the plans shall certify in writing that the project has been completed in accordance with the "approved" plans and specifications. The public water supply shall operate the facility consistent with the approved plans and specifications. Any proposed change to the approved plan shall be submitted to the cabinet for approval. The public water supply shall not implement any change to the approved plan without the prior written approval of the cabinet.

(9) Expiration of approval. Unless construction is begun within one (1) year from date of approval, the approval shall expire. Extension of approval may be granted upon written request to the cabinet.

(10) Modifications and extension of service. The cabinet may refuse to approve modifications of a public water system or an extension of service to one (1) or more customers if the modification or extension of service may result in the water system's inability to supply consistent water service in compliance with 401 KAR 8:010 through 8:600 inclusive.

(11) All plans and specifications submitted pursuant to this administrative regulation shall be consistent with "Recommended Standards for Water Works", "General Design Criteria for Surface and Groundwater Supplies", and "Water Policy Memorandum Number 84-02, General Guidelines for Conducting Stream Studies for Wastewater Discharges Proposed Within Five Miles Upstream from Public Water Supply Sources, or for the Location of Public Water Supply Intakes Within Five Miles Downstream from Wastewater Discharges", which are incorporated by reference in Section 4 of this administrative regulation.

Section 2. Treatment Techniques for New and Existing Systems. (1) General requirements. The requirements of this section constitute primary drinking water regulations. These administrative regulations establish treatment techniques in lieu of maximum contaminant levels for specified contaminants.

(2) Treatment techniques for acrylamide and epichlorohydrin. Each public water system shall certify annually in writing to the cabinet, using third party or manufacturer's certification, that when acrylamide and epichlorohydrin are used in drinking water systems, the combination or product of dose and monomer level does not exceed the levels specified as follows:

Acrylamide = 0.05% dosed at one (1) ppm (or equivalent);

Epichlorohydrin = 0.01% dosed at twenty (20) ppm (or equivalent).

Certifications may rely on manufacturers or third parties, as approved by the cabinet.

Section 3. All existing community and nontransient noncommunity water systems using surface water as a source shall, by January 1, 1995, submit to the cabinet for approval plans to establish the capacity to feed activated carbon to the treatment system. Within twelve (12) months of the approval of the plans, the water system shall certify in writing to the cabinet that the approved plan has been implemented.

Section 4. The following documents are hereby incorporated by reference and are available for public inspection and copying, subject to copyright laws, between 8 a.m. and 4:30 p.m., Monday through Friday, except for state holidays, at the Division of Water, 14 Reilly Road, Frankfort Office Park, Frankfort, Kentucky 40601:

(1) Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers "Recommended Standards for Water Works," 1992, published by and available from Health Research Inc., Health Education Services Division, P.O. Box 7126, Albany, New York 12224.

(2) "General Design Criteria for Surface and Ground Water Supplies", July 1990, which is published by and may be obtained from the Division of Water; and

(3) "Water Policy Memorandum number 84-02, General Guidelines for Conducting Stream Studies for Wastewater Discharges Proposed within Five Miles Upstream from Public Water Supply Sources, or for the Location of Public Water Supply Intakes within Five Miles Downstream from Wastewater Discharges", 1984, which is published by and may be obtained from the Division of Water. (17 Ky.R. 609; Am. 1437; 1715; 1977; eff. 11-15-90; 20 Ky.R. 3037; 21 Ky.R. 316; eff. 7-27-94; 23 Ky.R. 2560; eff. 5-14-97.)

Kentucky Division of Water
Consumer and Boil Water Advisory Guidance

Issued March 2005

Background

Consumer advisories provide pertinent, important information to the public regarding their drinking water. Such advisories cover microbiological as well as chemical contamination in addition to other information of concern. In practice, the majority of consumer advisories are "boil water advisories."

The term "coliform bacteria" refers to a large group of facultative aerobic bacteria common in the environment and generally not harmful. The presence of coliform bacteria, as measured by the total coliform test, is simply an indicator that a problem with the water treatment plant or distribution system exists and that the water may be contaminated. There are three (3) groups of coliform used as measures of water quality:

- Fecal coliform
- *Escherichia coli (E. coli)*: a sub-group of fecal coliform bacteria
- *E. coli 0157:H7*: a specific species of *E. coli*, which has been responsible for waterborne and food-borne disease outbreaks. Most outbreaks caused by this strain have been related to food contamination.

Positive coliform tests must go through a confirmation stage to determine if the coliform bacteria found are of fecal origin. Further investigation is necessary, including the collection of additional samples. If fecal coliforms or *E. coli* are confirmed found in drinking water, then it is likely that disease-causing microorganisms are present. "Results from a single sample or set of samples are typically not cause for issuing a BWA... Detection or sudden increase of any microbial indicators in a single sample or set of samples is not sufficient grounds to issue a BWA [boil water advisory]." (AWWA M48)

"Boil water advisories require a considerable amount of thought if they are to be carried out in timely fashion. One of the most important aspects of BWAs is determining what circumstances trigger the event ... Customer confidence may be eroded or elevated depending on the timeliness and accuracy of the information they receive. Professional judgment and discretion are necessary in making decisions on the issuance of an advisory ... In situations where microbial results are available and system failures are documented, the decision to issue an advisory should be straightforward." (AWWA M48) A system wide boil water advisory may not be warranted. If the problem is isolated to a specific zone or tap, then the advisory should be issued only for that area.

Boil Water advisories are a safeguard to protect the public. When reasonable doubt exists, the protective decision is to issue the advisory.

Regulatory Language

Definitions: 401 KAR 8:010

Consumer Advisory. A notice to the consuming public through radio, television, direct mail, electronic mail, posting, newspaper or other media and that conveys the quickest and most effective manner:

a) Information that the water provided by a system may cause adverse human health effects if consumed and what action the public is advised to take; or
b) Other information that the public needs to know about its water.

Boil Water Advisory (BWA). A type of consumer advisory that provides notice to the consuming public through radio, television, direct mail, electronic mail, posting, newspaper or other media and that conveys the quickest and most effective manner:

a) Information that water provided by a system may cause adverse human health effects due to possible biological contamination if consumed, unless it is first boiled for three (3) minutes at a rolling boil; and
b) What action to take.

Advisory Regulatory Requirements: 401 KAR 8:020

Public water systems (PWSs) and semipublic water systems **may** issue boil water advisories if the system believes an advisory is warranted.

The Environmental and Public Protection Cabinet **may** direct that a boil water advisory be issued when confirmed positive bacteriological sample results have been received (including E. coli or fecal coliform) or conditions exist within a water system that indicate a possible adverse health effect from the consumption of the water distributed by the system.

The cabinet **may** issue a consumer advisory if conditions exist within a water system that indicate a possible adverse health effect from the consumption of water by the public or when other information of interest to the consumer needs to be communicated.

Line Break Reporting Requirements: 401 KAR 8:150

1. A PWS shall notify the cabinet immediately if it experiences a loss of pressure below twenty (20) pounds per square inch (psi) in the area surrounding the break or if line breaks require more than eight (8) hours to repair. These reports are not required if the loss of pressure or line break occurs in a service line serving a single family residence. The issuance of a BWA is NOT mandated by regulations.

   NOTE: The eight hours begin when the system becomes aware of the break.

2. Community and nontransient noncommunity public water systems shall maintain a log of all breaks or ruptures which includes:

   - Location of the break or rupture,
   - Date and time it was discovered,
   - Population affected,
   - Length of time required to repair,
   - Date and time disinfectant residuals are detected,
   - Date and time bacteriological samples are taken, and
   - Results of bacteriological tests.

The log shall be available for inspection by the cabinet. The PWS is NOT required to report all line breaks and ruptures to the cabinet, only those that meet the criteria in #1 above.

Emergency Repairs: 401 KAR 8:150

For line repairs due to breaks or ruptures, the system shall thoroughly flush the break area and maintain at least a minimum detectable disinfectant residual (depending upon type of disinfectant used).

Public water systems may leave the line in service before bacteriological sampling and may forgo a boil water advisory if:

- The line can be repaired under pressure (i.e. maintain a minimum of 20 psi in the line under repair);
- The break area is thoroughly flushed; and
- At least the minimum disinfectant residual (depending upon type of disinfectant) is maintained.

The system shall take at least two (2) bacteriological tests, one (1) located before or just upstream of the break or rupture and one (1) located behind or just downstream of the break or rupture, as close to the break or rupture as practical. If necessary, additional samples may be required to be representative of the area affected by the break. The sample bottles shall be clearly labeled as "special" tests and the results submitted to the cabinet clearly identified as "special" samples.

Records of the bacteriological results shall be submitted to the cabinet with the routine monthly compliance bacteriological samples unless the "special" samples are required to lift a boil water advisory. Samples needed to lift boil water advisories shall be submitted to the cabinet as soon as results are known. The results of "special" bacteriological samples shall be maintained for one (1) year.

Boil Water Advisory Guidance (other than a main break situation):

Issuance of a BWA.

A BWA should generally be issued if:

1. High turbidity levels in filtered surface water indicate the potential for pathogen breakthrough and interference with disinfection efficiency. Sustained combined filter effluent turbidity readings greater than 1 NTU for 6 or more hours, OR a confirmed turbidity level greater than 5 NTU shall trigger a boil water advisory unless the turbidity is attributable to other circumstances unrelated to filter malfunction (i.e., iron or manganese particles). A BWA is NOT warranted for iron and manganese problems.

2. The occurrence of a key water treatment plant process malfunction, not immediately repaired, which results in unfiltered surface water OR non-chlorinated water being discharged into the distribution system.

3. There is free chlorine disinfectant residual at the entry point to the distribution system less than 0.2 mg/L or total chlorine disinfectant residual less than 0.5 mg/L for chloraminated systems for more than 4 hours **or** in situations in which the system has difficulty restoring a chlorine residual after measures to do so have not succeeded;

4. A water main break, pump failure or other water distribution system malfunction results in portions of the system having zero ("0") pressure or with negative pressure zones.

5. There is the occurrence of a cross connection or known back siphon episode with an unapproved water supply in which the microbiological quality of the water may be compromised. Examples: flooded wellhead or treatment plant, water main break in a stream crossing.

6. A Groundwater source is confirmed under the direct influence of surface water (GWUDI) and the water systems associated with that source has not installed filtration.

7. The presence of other pathogens such as *Giardia* and *Cryptosporidium* is confirmed at a level and under circumstances that the Division of Water and the state epidemiologist deem a risk.

Strong consideration should be given to issuing a BWA in the following cases:

A. Breaks impacting a school (some utilities make this a policy, but prior consultation with the Board of Education involved is recommended);
B. Breaks in remote part of system which cause delay and difficulty finding or isolating the break;
C. Breaks in a low elevation segment of a high relief (hilly) area where some residents will have pressure loss/water outage;

D. Breaks adjacent to older or damaged sewer lines; and
E. Breaks in very low flow/demand areas that may have lower disinfectant residuals.

Strong consideration should be given to issuing a BWA in the following situations:

1. An acute bacteriological violation has occurred (confirmed presence of fecal coliforms or E. coli bacteria). Best professional judgment must be used with regard to the scope or severity of the problem, based on the number and location of positive samples in relation to the size of the system. If chlorine/chloramine residuals in the distribution system are greater than the minimums required, the option exists to wait for complete speciation to issue the BWA.

2. State or local health department officials have confirmed a waterborne disease outbreak directly associated with the public water supply.

Customer Notification Content

PWS shall carefully determine the appropriate area to which it issues the advisory. The area should include only those customers potentially at risk. The PWS should clearly define the boundary of the affected area using local landmarks or roadways (e.g. "James Bickford Road") to provide clear information to customers. Do not place a system wide BWA when the affected area may be isolated. For example, if only three houses on a dead end spur main lack water pressure after a break on that line, then a system-wide BWA is not appropriate.

Affected customers should be notified that:

- A line break has occurred;
- Repairs have been made;
- Customers should flush household pipes/faucets, home automatic icemakers, water fountains, etc.

The notification should state that customers with infants, elderly or immuno-compromised individuals in the household, should seek advice about drinking water from their health care providers. This is a standard notification required to be included in each PWS's annual Consumer Confidence Report (Water Quality Report).

The BWA notification is similar to that given customers when a PWS conducts its annual or semi-annual flushing program. The flushing notification, however, does not trigger notification of Health Departments or the requirement of DOW authorization to end the incident (as required of BWAs). The PWS should carefully label notifications to minimize confusion between BWAs, Consumer Advisories and routine flushing. For example, "Water Line Break Notification".

Distribution of Notification

1. If a BWA is issued by the water system, then the system shall immediately notify the Division of Water and the local health department via a protocol established between the system and the health department. The Division of Water may check to ensure appropriate local health departments have been contacted by the system and may

contact the Division of Local Health, Sanitation Branch for major incidents such as those of system wide impact.

2. If the Division of Water issues a BWA, the same distribution protocol should be followed as if the system had issued the BWA.

3. The water system shall notify the public via doorknob hangers, newspapers, TV, radio or any other media having an immediate public impact. When feasible, door-to-door public notification of an advisory should be conducted.

4. The public water system shall notify hospitals, nursing homes and other sensitive populations about the event, if appropriate.

Bacteriological Sampling to Lift the Boil Water Advisory

An adequate number of samples shall be collected and analyzed for total coliform bacteria as follows:

a) With regard to an acute bacteriological violation, the minimum number of bacteriological samples to be collected shall follow the normal protocol for repeat sampling pursuant to the Total Coliform Rule.

b) With regard to a **system-wide BWA**, it is recommended that the minimum number of samples to be collected should be:

Population Served:	Minimum # of Samples
25-1000	3
1001-2000	4
2001-3000	5
3001-4000	6
4001-7000	7
7001-10,000	8
10,001-25,000	9
25,001-50,000	10
> 50,000	10 or 10% of required monthly samples (whichever is greater)

If 10 samples or fewer are collected, all sample results must be negative to remove the BWA. If a system serving a population less than or equal to 50,000 elects to take more than 10 samples, no more than one sample may be positive for total coliform, but it **must** be *E. coli* negative. NOTE: If any samples are positive, the appropriate resampling must occur.

If a BWA is restricted to a smaller portion of the distribution system, then the required number of bacteriological samples should be proportionally lower.

A consecutive system (purchaser) affected by a BWA from their producing system shall also issue a BWA for the area in their system that receives water from that producer. Sampling to lift the BWA in the consecutive system should occur once the BWA in the

producing system has been lifted. The number of samples from the consecutive system would be based only upon the population of the area affected.

Lifting a Boil Water Advisory

BWAs remain in effect until DOW determines or approves that the advisory may be lifted.

A laboratory certified by the cabinet to perform drinking water analyses shall perform microbiological, chemical and radiological testing.

Analytical results shall be forwarded by the laboratory to the cabinet prior to the cabinet's authorizing the lifting of a BWA issued for public health reasons. Outside of routine working hours, the cabinet will cooperate to authorize lifting a BWA when the laboratory verbally informs the cabinet's designated representative of the results. The representative can be reached through the cabinet's 24-hour reporting line (800/928-2380).

Should the Environmental Response Team (ERT) lift a BWA during off-hours, weekends and holidays, the information used to lift the BWA should be forwarded to the appropriate Regional Office on the next business day.

The following criteria must be met:

1. Satisfactory analytical results (bacteriological and/or turbidity) coupled with free chlorine residuals of 0.2 mg/L or greater, or total chlorine residuals of 0.5 mg/L for chloraminated systems, throughout the distribution system.

2. Sufficient flushing has occurred in the distribution system to eliminate water that was or might have been contaminated.

3. Treatment deficiency has been corrected

4. For a waterborne disease outbreak, the state epidemiologist, local health department and DOW must confirm that the health risk is now minimal.

Consumer Advisories

Consumer advisories (CA) are for those situations that necessitate public notification regarding drinking water contamination events that are not bacteriological in origin. Consumer advisories are typically related to chronic exposure (bacteria present an acute hazard) to a contaminant and can be more restrictive as to water use. A lesser use of a CA would be to provide other information that may affect customer health. Common examples include:

Drinking Water Contamination

1. Elevated turbidity due to the presence of iron or manganese. These chemicals create "color" in the water, not particulates. By boiling water that contains

manganese, one could concentrate the metal, resulting in a taste or staining of clothes or plumbing fixtures.

2. Detection of a chemical-based cross-connection.

3. Elevated levels of regulated contaminants (such as arsenic, lead) or non-regulated contaminants such as gasoline or crude oil

4. Terrorism event

5. Gasoline or crude oil detected in the distribution system

Other Information Pertinent to the Consuming Public

1. Notification of a chemical change at the water plant that would affect how the public would perceive the water or how the water would impact customer health (change in taste, hardness, disinfectant).

2. Distribution infrastructure improvements that could result in the shutting off of water for a period of time (new lines, replacing lines/meters, slip-lining)

Consumer advisory notifications can follow the same guidelines as those for boil water advisories. The advisories should be tailored for each event, providing easy-to-understand information through the quickest and most effective means of communication. Sufficient information should be given to explain the event and its duration, its consequences to the consuming public, actions to be taken during the event and a water system phone number.

Consumer advisories (for those incidents other than boil water advisories) can be issued by the Division or by the water system. If the event involves elevated levels of a contaminant or a terrorism event, the applicable DOW Regional Office shall be notified immediately. The Regional Offices do not need to be notified of those public information advisories that do not involve public health.

Consumer Advisories remain in effect until the DOW determines or approves that the advisory be lifted. Lifting a consumer advisory will be dependent upon the event but will require resolution of the situation that led to the advisory. This may require additional sampling if related to a chemical cross-connection or elevated source water contaminants such as manganese or may simply involve notification that the event has ended (main replacement, new meters).

APPENDIX A

EXAMPLES

BOIL WATER AND CONSUMER ADVISORIES

Situation	Resolution	BWA? Yes or No
High filtered water turbidity; high filtered water manganese	Turbidity reading is false due to color from the manganese; not true particulate turbidity; optimize treatment; consider flushing system	No
High filtered water turbidity; overdose of permanganate confirmed	Turbidity reading is false due to color from the permanganate; not true particulate turbidity optimize treatment; consider flushing system	No
CFE turbidity at 1.6 NTU for 4 hours	Optimize treatment; consider flushing system	No, not over 6 hours in duration
CFE turbidity spiked at 6.1 NTU for 15 minutes	Optimize treatment; consider flushing system	Yes, greater than 5 NTU regardless of duration
Chlorine cylinder empties and is not caught until operator returns from rounds	Immediately change chlorine cylinder; consider flushing system	Depends on how long residual in plant tap below 0.2 free or 0.5 total –if longer than 4 hours, yes (this is a judgment call on the part of the field)
Upgrades on filters under way Settled water inadvertently sent through an empty filter bed	Immediately valve off the empty filter bed; Consider flushing the system	Yes, as unfiltered water entered the system
On-line chlorine analyzer records a free chlorine residual of 0.15 mg/L for 20 minutes; confirmed that not analyzer/recorder malfunction	Raise chlorine residual; investigate cause of residual loss	No, as entry point chlorine residual was less than 0.2 mg/L for less than 4 hours Refer to 8:150 Section 1(2)(b). This is also a judgment call on the part of the field.
Ice storm knocks off power to the water plant for 1 day Despite conservation efforts, portions of the town are without water	Call power company; investigate backup power sources; when power restored, consider slow flushing to refill pipes	Yes, as portions of the system had no pressure or possible negative pressure
Main break that requires 6 hours to repair	Repair main, conduct bacteriological sampling Report results of sampling Maintain main break log	No, but customers affected should be notified that a break has occurred and to flush water before using. Sensitive populations should seek medical advise
Break on a small line that is repaired under pressure	Repair main; conduct bacteriological sampling; report results of sampling; maintain main break log	No

Situation	Resolution	BWA? Yes or No
Main break that lowers pressure in the area to 13 psi; repaired in 2 hours	Repair main,; conduct bacteriological sampling,; notify cabinet; report results of sampling; maintain main break log	No, but customers affected should be notified that a break has occurred and to flush water before using. Sensitive populations should seek medical advise
Booster pump in remote area burns up; pressure drops from 52 psi to 30 psi	Repair pump to restore pressure	No
Riverbank well for a true GW system is flooded during a record flood event; wellhead protection questionable for this event	Once flooding recedes, inspect wellhead and make necessary repairs	Yes, as this is considered a cross-connection with a non-potable source
Utility receives reports of sewer odors coming from faucets in a subdivision hair-like particles in water	Investigate immediately; check storage tanks (this really happened—dead body in tank)	YES (this would most likely become a Consumer Advisory)
During routine bacteriological sampling, notice a hard-piped cross-connection between water supply and fertilizer	Immediately notify company and utility of cross-connection; disconnect cross-connection; monitor until install approved backflow protection devices	No, as not microbiological contamination; flush system
During a routine inspection, field finds documentation that GW system is considered "under the influence of surface water" and has not yet installed treatment	Enforcement?	Yes, as unfiltered surface water is entering the distribution system
A customer has their water tested for Giardia and the test comes back positive; lab is not certified to test for Giardia; no confirmation was done; mo reports of giardiasis in area and no treatment upsets	Consult with medical community; consult with DOW	No, as the Giardia result is suspect and not supported by water plant malfunctions or by disease occurrence
Main break in the middle of a stream crossing during a flood event	Repair main; conduct bacteriological sampling; report results of sampling; maintain main break log	Yes, as the potential is high for contamination from the turbid water

Situation	Resolution	BWA? Yes or No
Laboratory confirms presence of E.coli in a distribution sample	Consider flushing area. If chlorine residual is low, raise residual in area	Yes—this could become a Consumer Advisory
Laboratory reports a positive total coliform sample; confirmation not done yet; free chlorine residual was 1.7 mg/L		No, as this is not a confirmed sample positive for E.coli or fecal coliform and the free chlorine residual was greater than 0.2 mg/L. Wait for confirmation
Water main break in contaminated soil (i.e. sewage lateral lines, sewer line in same ditch) regardless of repair mechanism or if under pressure	Repair main; conduct bacteriological sampling; report results of sampling; maintain main break log	Yes, as sewage is contaminated. Could issue BWA for localized area.
Contractor breaks water line while excavating petroleum UST with significant free product around line and pressures drop to 13 psi	Repair main; conduct bacteriological sampling; report results of sampling; maintain main break log. Depending upon water main material, may need to replace entire line; hazardous waste cleanup issues	No, as boiling the water would release the petroleum products into the air. This could cause explosions as well as illness. This would be a Consumer Advisory with specific instructions.
System (or inspector) discovers that entire system has no chlorine residual; flushing did not resolve the situation	Check residual at master meters, investigate any sources of chlorine demand, etc. Determine if a chemical issue (i.e. high Mn)	Yes, as no chlorine residual could be an indication of bacteriological contamination; rule out any chemical contamination first Situation may also warrant an NOV
Pressure routinely below 20 psi in the distribution system or below 30 psi on the discharge side of customer meters	Contact DWB for sanction documentation	If the potential for backflow exists, Yes. Base decision on experience with system
Low to no chlorine residual in one area of the distribution system; system is doing HPCs in lieu of chlorine residuals with results less than 500 cfu/ml	Investigate cause of low or no chlorine residual and resolve	No, as water in the distribution system with an HPC count less than 500 cfu/ml is deemed as having "adequate disinfection residual"
Water system will be doing an extensive main relocation in a subdivision	Customers could experience low pressure/see and hear construction work	No, issue a Consumer Advisory

Situation	Resolution	BWA? Yes or No
Water system decides to use booster chlorination in one area of the distribution system	Customers notice slight chlorine smell	No, issue a consumer advisory for that area explaining the situation
Contamination detected in a suburban area not traceable to a cross-connection—possible terrorist event	Work with federal authorities and other responders to determine contaminant then decontaminate the system.	No, as most likely not bacteriological. May need to issue a "Do not drink" notification

Corrosion Control

What is Corrosion?

The deterioration of a substance due to reaction with its environment.

Types of Corrosion

- Chemical – Oxidation/ Rusting. Deterioration of a metal returning to its original state.
- Physical – Erosion Corrosion. High velocities in Tee's, Elbows. and Valves where actual wearing away of the pipe wall is occurring.
- Biological – Microorganisms, which thrive on the pipe wall, creating a living colony resulting in inadequate disinfecting, Taste/Odor problems, Discolored water, and TTHM potential.

Contributing factors that cause corrosion

- Temperature
- D O
- pH
- Inadequate flows
- Dead ends

Recognizing the types of Corrosion

- Galvanic – Dissimilar metals
- Pitting – Biological mutations in molding process
- Erosion – Physical wearing away of pipe wall
- Passivation – Scale build up, not achieving Calcium equilibrium
- Biological – Customer complaints, T/O, discolored water, high Cl2 demands, tuberculation
- Water Discoloration – ferrous corrosion, sedimentation

Lead & Copper Samples

- Corrosive water leaches lead & copper into the water.

Treatment

- pH adjustment
- Calcium coating
- Inhibitors

Energy

- Operational cost

Bacteriological

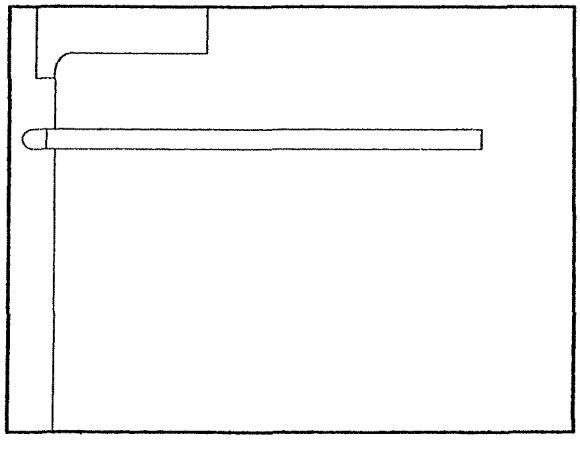
- Tuberculation caused by corrosion can provide a safe environment for bacteria inside of the distribution mains.
- High velocities from flushing or main breaks can shear the tubercles , thus releasing bacteria into the water supply.

Pretreatment

- Corrosion can cause problems with industries trying to meet Pretreatment standards.

Monitoring

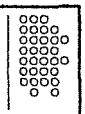
- pH curve
- Langelier Index
- Aggressive Index
- Phosphate monitoring



pH Testing

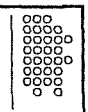
Calibration
Buffers
Records
Storage
Maintenance

Calibration



- pH meter must be calibrated once a day, and checked several time throughout the day.
- Fresh buffers must be used.

Buffers



- Fresh
- Do not contaminate buffers
- Expiration dates

Records

- Calibration log
  - Without a log, pH readings are not recordable.

Storage

- pH probes should be stored in storage solution or 4 buffer.
- pH probes should never be stored in distilled water.

Maintenance

- pH probes do not last for ever!
- When a probe become slow or sluggish it may need to be replaced.