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Guideline for Evaluation and Implementation of Chloramination

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This document was developed in consultation with the Technology Committee of the Ohio Section of the American Water Works Association for purposes of providing technical guidance to members of the regulated community in complying with Ohio Revised Code Section (ORC) 6109.07 (Approval of construction or installation plans) and Ohio Administrative Code (OAC) Rule 3745-81-10 (Maximum residual disinfectant levels), Rule 3745-81-24 (Organic chemical monitoring requirements), Rule 3745-81-77 (Treatment techniques for control of disinfection byproduct (DBP) precursors), Rule 3745-81-72 (Disinfection of water from surface water sources), and Rule (3745-83-01 Operational Requirements). This guidance is not intended to create any new requirement but is merely a suggested approach to complying with the above ORC section and OAC rules. Nothing herein should be interpreted as precluding other strategies to complying with those requirements.

I. PURPOSE

To establish procedures for the evaluation and implementation of a chloramine strategy for those facilities desiring to install or modify treatment and achieve agreed upon objectives for water quality or operational improvements.

It is intended that the guideline will provide utilities a framework for performing the steps necessary to successfully understand and address the various issues, concerns, decisions, implementation factors and procedures required to successfully utilize chloramine treatment.

II. OBJECTIVE

The objective of this guideline is to provide an effective guidance document that improves utilities ability to plan and implement chloramination.

III. APPLICABLE REGULATIONS

Systems considering using chloramines need to consider the following Ohio rules:

Ohio Administrative Code (OAC) Rule 3745-81-24:

OAC Rule 3745-81-24 (A)(7) (Organic chemical monitoring requirements) requires community water systems to submit and obtain approval from the director of Ohio EPA of a general plan, and where required a detailed plan, setting forth its proposed modifications and those safeguards that they will implement to ensure that the bacteriological quality of the drinking water served by such systems will not be adversely affected prior to making any significant modification to its existing treatment process for the purpose of achieving compliance with the total trihalomethanes and haloacetic acids (five) maximum contaminant levels. At a minimum the system shall:

- evaluate the water system for sanitary defects and evaluate the source water for biological quality. Evaluation for sanitary defects includes source water protection, treatment effectiveness, storage and distribution system integrity, and an effective cross connection control program. Evaluation for source water biological quality may include total coliform, fecal coliform or *E.coli*, *Cryptosporidium* and *Giardia lamblia.*

- evaluate its existing treatment practices and consider improvements that will minimize disinfectant demand while maintaining satisfactory finished water quality throughout the distribution system.

- prepare baseline water quality data of the distribution system for the previous twelve months. Systems which have had microbial monitoring and maximum contaminant level violations during the previous two years shall, in addition, conduct a two month study of the total distribution system including a study of total coliform bacteria and fecal coliform or *E.coli* bacteria.

- prepare a program to conduct additional monitoring of coliform bacteria starting at least seven days prior to and continuing for at least thirty days after any treatment or disinfection modifications.

- prepare a program to demonstrate an active disinfectant residual throughout the distribution system at all times during and after the modification.

<u>OAC Rule 3745-81-77:</u>

OAC Rule 3745-81-77 requires surface water treatment plants to meet total organic carbon (TOC) removal percentage requirements beginning January 1, 2002 for systems serving at least 10,000 persons, and beginning January 2, 2004 for systems serving less than 10,000 persons. (While not a requirement, Ohio EPA strongly recommends that TOC removal be optimized with current infrastructure capabilities.)

<u>OAC Rule 3745-81-72:</u>

(OAC) Rule 3745-81-72 (Disinfection of water from surface water sources) requires that:

- the disinfection treatment of surface water reliably achieve at least 99.9 percent

inactivation and/or removal of *Giardia lamblia* cysts and at least 99.99 percent inactivation and/or removal of viruses as determined in the appendix of the rule.

- the residual disinfectant concentration in the water entering the distribution system from a surface water treatment plant must not be less than 0.2 milligram per liter free chlorine or one milligram per liter combined chlorine for more than four consecutive hours.

- the disinfectant residual concentration in the distribution system, measured as free chlorine, combined chlorine, or chlorine dioxide must not be less than 0.2 milligram per liter free chlorine or one milligram per liter combined chlorine in more than five percent of the samples each month for any two consecutive months that the public water system serves water to the public.

OAC Rule 3745-81-10:

OAC Rule 3745-81-10 limits maximum residual disinfectant levels (MRDLs) to:

DISINFECTANT RESIDUAL	*MRDL (mg/L)*
CHLORINE	4.0 (as Cl_2)
CHLORAMINES	4.0 (as Cl_2)
CHLORINE DIOXIDE	0.8 (as ClO_2)

OAC Rule 3783-83-01(B):

OAC Rule 3783-83-01(B) requires each community public water system and each major non-community public water system to maintain a minimum chlorine residual of at least two-tenths milligram per liter free chlorine, or one milligram per liter combined chlorine measured at representative points throughout the distribution system. The director may by order require higher residuals as necessary to compensate for pH, temperature, or other characteristics of the delivered water.

OAC Rule 3745-91-02:

OAC Rule 3745-91-02 (Application for approval of plans) requires an application for plan approval for a substantial change in a public water system. As such, a general plan submittal should be made outlining plans for conversion to a chloramine treatment strategy.

IV. OTHER APPLICABLE GUIDANCE

Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers "Recommended Standards for Water Works"

- 1997 Edition contains a policy statement on the use of chloramine disinfectant for

public water supplies.

- 1997 Edition includes the following statements in Section 4.3 - Disinfection regarding the use of chloramines and other disinfecting agents:

  - In Article 4.3, Disinfection - “Disinfection with chloramines is not recommended for primary disinfection to meet CT requirements in a surface water treatment plant or a plant treating groundwater under the direct influence of a surface water.”

  - In Article 4.3.3, Residual chlorine - “Minimum combined residuals, if appropriate, should be 1.0 to 2.0 milligrams per liter at distant points in the distribution system.”

  - In Article 4.3.7, Other disinfecting agents - “Although disinfecting agents other than (free) chlorine are available, each has usually demonstrated shortcomings when applied to a public water supply. Proposals for use of disinfecting agents other than chlorine must be approved by the reviewing authority prior to preparation of final plans and specifications.”

USEPA Guidance Documents:

- Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA 815-R-99-012, May 1999

- Disinfection Profiling and Benchmarking Guidance Manual, EPA 815-R-99-013, August 1999

- Alternative Disinfectants and Oxidants Guidance Manual, EPA 815-R-99-014, April 1999

AWWA Research Foundation Publications:

- Optimizing Chloramine Treatment
- Nitrification Occurrence and Control in Chloraminated Water Systems
- Chloramine Effects on Distribution System Materials
- Assessing and Controlling Bacterial Regrowth in Distribution Systems
- Case Studies of Modified Disinfection Practices for Trihalomethane Control
- Health Effects of Disinfectants and Disinfection By-products
- Chloramine Decomposition in Distribution System and Model Waters
- Factors Affecting Disinfection By-Product Formation During Chloramination

V. GUIDELINE

The following procedure should be followed in evaluating, receiving approval, and

implementing a chloramine treatment strategy. It is recommended that prior to the submission of the demonstration study plan, a utility meet with Ohio EPA, Division of Drinking and Ground Waters Engineering Unit to discuss the objectives and baseline documentation outlined in sections 2.1 and 2.1.2.

VI. PROCEDURES

1.0 General Criteria

1.1 Chloramination has been widely used as a disinfectant in water treatment in the United States since the early 1900s. Chloramines are currently used as a primary disinfectant at 3.1 percent of surface water systems and 0.1 percent of ground water systems, and as a secondary disinfectant at 8.1 percent of surface water and 0.3 percent of ground water systems. Most systems using chloramines serve populations greater than 10,000. Monochloramine is the preferred option for chloramination. Dichloramine and trichloramine are to be avoided.

1.2 Monochloramine disinfectant residual throughout the distribution system can result in the following benefits:

1.2.1 Monochloramines are not as reactive with organics as free chlorine in forming total trihalomethanes (TTHMs) and most other disinfection byproducts.

1.2.2 Monochloramine provides a more stable and longer lasting residual.

1.2.3 Monochloramine may be more effective in controlling existing biofilms; however, free chlorine may be more effective in minimizing their initial establishment.

1.2.4 Monochloramine can be more effective in minimizing many tastes and odors.

1.3 Free chlorine disinfection residual throughout the distribution system can result in the following benefits:

1.3.1 Provide more effective protection from post-treatment contamination of the distribution system.

1.3.2 Provide a more rapid and effective indicator of a breach of the distribution system.

1.3.3 Provide a more effective barrier against opportunistic and endemic pathogens in distribution and plumbing systems.

1.3.4 Inhibit regrowth and biofilm formation.

1.4 It is Ohio EPA's position, that where possible, each water system maintain a significant strong oxidant (i.e., free chlorine or chlorine dioxide) disinfectant residual throughout the distribution system. Ohio EPA supports the use of chloramination where it is necessary to maintain compliance with disinfection byproducts, and disinfectant residual rules, address serious taste and odor issues, or other improvements to water quality. Chloramination may also be considered for controlling documented biological regrowth problems which interfere with monitoring the bacterial quality of the water.

2.0 Demonstration Study Criteria

2.1 Prior to the demonstration study and as an initial step in planning for a chloramination treatment strategy, the water system should provide baseline data and submit for preliminary approval a protocol for the evaluation of the treatment strategy including information regarding the treatment objective for which chloramination will be used and the criteria by which success will be judged. This will establish the basis for approval of the treatment strategy.

2.1.1 Establish, justify and commit to specific chloramine treatment objectives, which may include the items listed below.

2.1.1.1 Meeting drinking water standards

2.1.1.2 Meeting drinking water quality goals

2.1.1.3 Improving aesthetic properties of drinking water

2.1.1.4 Improving treatment plant operations

2.1.1.5 Improving distribution system operation

The water supplier will be expected to justify why the stated objectives cannot be achieved using either a free chlorine residual or chlorine dioxide after optimization of treatment and distribution system operation.

2.1.2 Provide the following baseline documentation. Baseline data may be used in justification for the need for chloramination, development of approval criteria for the demonstration study plan and for evaluation of the implementation plan:

2.1.2.1 HPC baseline monitoring results for a one year period. These may be collected at any time prior to the

implementation of chloramination, but should be done as soon as possible.

2.1.2.2 Existing total coliform monitoring results for previous year.

2.1.2.3 Disinfectant residual monitoring results for the previous year.

2.1.2.4 TTHM/HAA5 monitoring data for the previous year.

2.1.2.5 Disinfection profile information. If not collected as part of the Interim Enhanced Surface Water Treatment Rule, alternative information may be negotiated with Ohio EPA.

2.1.2.6 Evaluation of source, treatment, and distribution system for sanitary defects.

2.1.2.7 Evaluation of source water biological, TOC and SUVA quality.

2.1.2.8 Evaluation of treatment performance for TOC removal meeting regulatory requirements. Plant optimization for microbial removal and minimization of disinfection byproducts is recommended.

2.1.2.9 Evaluation of the distribution system for minimization of residence time and disinfectant residual levels**,** and maximization of circulation.

2.2 Prepare and submit a demonstration study plan, plan to include:

2.2.1 Information on the treatment strategy using chloramines and the method of providing primary disinfection.

2.2.2 Testing method(s) to evaluate performance of chloramine treatment under anticipated full scale system conditions; options may include the following listed below. Not all of the below steps will be required for all proposals. At a minimum, bench scale studies of treatment optimization and distribution system simulation will be expected. Specific study requirements will be determined at or following the initial meeting with Ohio EPA.

2.2.2.1 Bench scale demonstration studies.

2.2.2.2 Pilot scale demonstration studies.

2.2.2.3 Computer simulations of the distribution system.

2.2.2.4 Full scale demonstration studies.

2.2.3 Establish testing protocol and acceptance criteria for evaluating performance.

2.2.4 Bench and pilot testing apparatus requirements, if applicable include:

2.2.4.1 Flow rate measurement.

2.2.4.2 System process detention times.

2.2.4.3 Chemical feed strengths and feed rates.

2.2.4.4 Analytical methods for water quality parameters.

2.3 Demonstration Study

2.3.1 Testing should be performed in accordance with the developed testing program to meet the desired objective(s).

2.3.2 Once testing equipment is in place, perform quality control checks of the equipment and document testing results. Checks to include:

2.3.2.1 Initial set-up tests to establish operating parameters of test apparatus (i.e. plant capacity, actual detention times, flow meter accuracy, calibration of chemical feed pumps).

2.3.2.2 Check of analytical equipment and procedures.

2.3.3 Testing should be conducted during the period of historical worse case treatment conditions (i.e., period of highest disinfection byproduct formation; period of most difficult residual maintenance). Systems are encouraged to do additional seasonal or monthly testing to develop a thorough understanding of treatment characteristics in preparation for implementation of chloramination.

2.3.4 The following test data should be compiled and submitted:

2.3.4.1 Free and combined chlorine residuals at agreed locations and frequency before and after the point of ammonia application.

2.3.4.2 pH before and after the point of ammonia application.

2.3.4.3 Dosages for chlorine and ammonia feeds.

2.3.4.4 Calculated ratio of chlorine to ammonia feed.

2.3.4.5 Treatment objective results (e.g., disinfection byproduct formations; residual profile for maximum residence time) as defined in the approved study plan.

3.0 Approval Criteria

3.1 The applicant shall submit a final general plan report following the demonstration study with the proposal for implementation of a chloramine treatment strategy. The report should include previous submittal information, testing results and a summary of the planned facility design. The following should be included:

3.1.1 Baseline documentation data and information on the chloramine usage objective.

3.1.2 Schematic diagram and process information for the plant facilities showing the treatment scheme for providing primary disinfection followed by chloramines for use as a secondary disinfectant; include information on points of chemical addition, chemical mixing provisions, and residual monitoring provisions

3.1.2.1 Provide a schematic diagram of the present plant showing where primary disinfection is accomplished, chemical(s) used for primary disinfection and sampling points for disinfectant residual monitoring.

3.1.2.2 Provide a schematic diagram of the present plant showing where primary disinfection with either free chlorine, chlorine dioxide , or ozone will be accomplished, where water will be sampled for primary disinfection control, and to establish CT data for primary disinfection compliance; where ammoniation and addition of additional chlorine (if needed) will occur; where water will be sampled for chloramination control; and where water will be sampled to measure chloramine residual before water is delivered to the first customer in the distribution system.

3.1.2.3 Provide calculations for primary CT disinfection value considering the primary disinfectant utilized and the maximum plant flow condition under the modified plant

layout in which chloramination will be practiced.

3.1.2.4 Based on past experience with chlorine demand, calculate chlorine dosage that might be required at a condition involving peak flow and peak chlorine demand, after plant modifications have been made, and check to determine if present chlorine feed capacity is adequate to provide this. Based on chloramine testing done consider whether additional chlorine dosing will be needed for chloramination, to meet the residual requirements for chloramine. Check to determine whether chlorine feeding capacity is adequate to meet the needs of free chlorine dosing plus the additional chlorination (if needed) during chloramination.

3.1.3 Information on testing program conducted by the utility in evaluating chloramine treatment to meet the defined objective(s); include the following:

3.1.3.1 Testing program description.

3.1.3.2 Established acceptance criteria for evaluation of performance.

3.1.3.3 Testing quality control procedures results.

3.1.3.4 Testing results.

3.1.3.5 Analysis of testing results to confirm chloramine usage objective.

3.1.4 Planned process operating conditions covering range of chloramine residual leaving the plant, chlorine to ammonia-nitrogen ratio, and pH conditions at chemical application point(s).

3.1.5 Chemical feed facilities design parameters, include:

3.1.5.1 Type of chemical to be utilized for ammonia addition.

3.1.5.2 Planned feed equipment additions or modifications for application of both chlorine and ammonia at various feed points.

3.1.5.3 Chemical storage and feed equipment sizing criteria.

3.1.5.4 Planned safety provisions.

3.1.6 Planned implementation strategy covering such items as the implementation schedule and planned notification and education programs.

3.2 Approval of the chloramine treatment strategy will be based on justification of the need for chloramination**,** meeting treatment requirements for TOC/disinfectant byproduct precursor removal, an acceptable written distribution system(s) operation plan for the source system and all targeted consecutive public water systems, meeting the agreed upon demonstration study approval criteria and submission and approval of the information showing that the necessary planning and testing has been performed to successfully implement chloramination for the purpose intended as initially established. Any consecutive system not optimizing distribution system operation shall be informed of their responsibility for maintaining compliance with disinfection/disinfection byproduct rules and all other drinking water standards. Targeted consecutive public water systems are those used to justify chloramination.

3.2.1 Applicant should submit documentation stating that notification and education programs will be completed prior to implementation of the chloramine treatment strategy.

3.2.2 Applicant shall submit regulatory compliance information in accordance with Ohio Administrative Code 3745-81-24, Paragraph (A)(7)(a) through (e).

3.3 Applicant shall meet treatment requirements and distribution system operation criteria as listed below:

3.3.1 Treatment Requirements:

3.3.1.1 OAC Rule 3745-81-77 requirements for total organic carbon (TOC) removal percentage;

3.3.1.2 OAC Rule 3745-81-71 requirements for microbial removal and inactivation;

3.3.1.3 minimization of disinfectant demand and disinfection byproducts formation; and

3.3.1.4 acceptable process control monitoring (see Appendix B).

3.3.2 Implementation of an acceptable distribution system operation plan

should:

3.3.2.1 minimize residence time;

3.3.2.2 maximize water circulation;

3.3.2.3 minimize disinfectant residuals consistent with regulations;

3.3.2.4 identify deficiencies in the distribution system and discuss options for improvements and corrections; normally capital improvements will not be required for approval of chloramination;

3.3.2.5 provide a strategy to monitor for and control nitrification should it occur; and

3.3.2.6 provide acceptable distribution system monitoring (see Appendix B).

4.0 Conflict Resolution

4.1 Conflicts will be resolved following procedures as specified in the document "Action Plan", Drinking Water Plan Review Work Group Final Report, draft July 15, 2003.

VII. HISTORY

The Division of Drinking and Ground Waters first issued this policy on September 16, 2003.

Appendix A

The following information is provided as a general guide for consideration when implementing a chloramine treatment strategy.

1.0 Develop implementation plan; address the following:

1.1 Evaluate funds, facilities, technical expertise, staff time and administrative oversight necessary to accomplish work, given available resources.

1.2 Obtain commitment from senior management or elected officials.

1.3 Assign project responsibilities and establish lines of communication.

1.4 Establish schedule for the work.

1.5 Identify public notification needs. Include early notification of customers with capital investment needs.

1.6 Consider use of outside technical resources/review groups and advisory committees to review information and provide input.

1.7 Inclusion of all consecutive public water systems in the planning, evaluation, and implementation of the project.

2.0 Evaluate benefits and drawbacks concerning the use of chloramines:

2.1 Review available information and understand issues associated with use of chloramine treatment. Important issues to review include:

2.1.1 Water quality factors:

2.1.1.1 Compliance with regulatory requirements (disinfection/disinfection byproducts requirement).

2.1.1.2 Compatibility with other treatment.

2.1.1.3 Nitrification susceptibility.

2.1.1.4 Corrosion and material deterioration.

2.1.1.5 Consumer acceptance (aesthetic acceptance).

2.1.1.6 Environmental concerns.

2.1.2 Design and implementation factors:

2.1.2.1 Capital and operating costs.

2.2.2.2 Safety.

2.1.2.3 Treatment flexibility.

2.1.2.4 Ease of implementation.

3.0 Establish process and facility design parameters**:**

3.1 Establish point of ammonia application following primary disinfection; consider potential impacts on disinfection profile.

3.2 Establish pH control range for chloramination, normally pH range is 7.0 to 9.0; optimum pH for Monochloramine formation is 8.3.

3.3 Establish chloramine residual level leaving the plant, consider the following:

3.3.1 Typical range of total chlorine residual leaving the plant is 1.0 to 3.0 mg/l.

3.3.2 Residual level for the utility must be sufficient to comply with the regulatory requirements of the Ohio Administrative Code 3745-81-72 and 3745-83-05.

3.3.3 Inadvertent water releases to natural waterways can adversely affect aquatic organisms.

3.3.4 Upcoming regulation may limit range of chloramine residual.

3.3.5 Higher residual levels may be required to account for/control nitrification conditions in the distribution system.

3.4 Establish chlorine to ammonia-nitrogen ratios, target range is from 3:1 to 5:1; each utility must consider site specific factors to select the optimum ratio and it may vary over time.

3.5 Establish basis of design parameters for the necessary chemical feed facilities, the following requirements should be addressed:

3.5.1 Type of chemical to utilize and the required feed range of equipment necessary to cover the range of plant flows at the range of chemical dosages anticipated.

3.5.2 Location of application points, method of mixing, and type of chemical feed equipment to utilize.

3.5.3 Monitoring and control provisions for process and chemical feed system operation.

3.5.4 Chemical storage and feed system provisions covering such factors as unloading provisions, standby provisions and safety considerations.

3.5.5 Rechlorination requirements and options within the distribution system.

3.6 Monitoring and control of disinfection:

3.6.1 Provide a schematic diagram of the present plant showing where primary disinfection is accomplished, chemical(s) used for primary disinfection and sampling points for disinfectant residual monitoring.

3.6.2 Provide a schematic diagram of the present plant showing where primary disinfection with either free chlorine, chlorine dioxide, or ozone will be accomplished, where water will be sampled for primary disinfection control, and to establish CT data for primary disinfection compliance; where ammoniation and addition of additional chlorine (if needed) will occur; where water will be sampled for chloramination control; and where water will be sampled to measure chloramine residual before water is delivered to the first customer in the distribution system.

3.6.3 Provide calculations for primary CT disinfection value considering the primary disinfectant utilized and the maximum plant flow condition under the modified plant layout in which chloramination will be practiced,

3.6.4 Based on past experience with chlorine demand, calculate chlorine dosage that might be required at a condition involving peak flow and peak chlorine demand, after plant modifications have been made, and check to determine if present chlorine feed capacity is adequate to provide this. Based on chloramine

testing done consider whether additional chlorine dosing will be needed for chloramination, to meet the residual requirements for chloramine. Check to determine whether chlorine feeding capacity is adequate to meet the needs of free chlorine dosing plus the additional chlorination (if needed) during chloramination.

4.0 Develop public notification and education program:

4.1 Prior to implementing chloramination it is necessary to inform customers of the change in the treatment process and its potential impacts on their water use. Of particular concern is the potential chloramine hazard to dialysis patients and aquarium fish. Both groups are potentially susceptible to getting large quantities of chloramines in their blood streams where it interfers with hemoglobin function. Planning for the notification and education program should begin early in the process when the decision to switch to chloramination has been finalized. The notification and education program will need to address various customers with differing needs as are listed in the following paragraphs. Certain customers may have capital investment needs (dechloramination equipment) and they will need sufficient time to plan and budget for these expenses.

4.2 Review available information materials and prepare notification brochure and fact sheets as appropriate:

4.2.1 General information brochure should include information on:

4.2.1.1 Upcoming change in water treatment concerning the use of chloramination.

4.2.1.2 Reason(s) for change.

4.2.1.3 How they may be affected.

4.2.1.4 Answers on anticipated common questions customers may ask and information concerning appropriate contacts (individuals or agencies) where they can obtain additional information.

4.2.2 Detailed fact sheets describing impacts on customers with specialized water needs or interests such as kidney dialysis patients and aquiculture interests.

4.3 Develop list of contacts who have special needs or who may provide assistance with/in the notification campaign:

4.3.1 Potential contacts may include:

4.3.1.1 State and local health departments.

4.3.1.2 Kidney dialysis treatment centers.

4.3.1.3 Pet and aquarium supply centers.

4.1.3.4 Aquiculture organizations (i.e., clubs of fish breeders, commercial fish rearing businesses).

4.3.1.4 Restaurants or stores with live fish and/or aquatic organisms.

4.3.1.5 Schools and universities.

4.3.1.6 Specialized manufacturing plants.

4.3.1.7 Academic and commercial laboratories.

4.3.1.8 Consecutive public water systems.

4.4 Provide notification to customers with capital investment needs as soon as a decision on the use of chloramines is made.

4.5 Within a two to eight week period before implementing chloramine treatment, run notification campaign to inform customers of the treatment change and its impact. The appropriate district office of Ohio EPA Division of Drinking and Ground Waters should be notified of the start-up date at least two weeks in advance.

4.5.1 For customers at large:

4.5.1.1 Send general information brochure with monthly utility bill or in a separate mailing.

4.5.1.2 Provide news article in local newspaper.

4.5.1.3 Make press release on local radio/TV stations.

4.5.2 For kidney dialysis treatment center/patients:

4.5.2.1 Contact state and/or local county health department to assist in meetings/correspondence with these customers.

4.5.2.2 Provide direct contact with every dialysis treatment center and provide notification literature.

4.5.2.3 Utilities should be proactive in confirming that equipment for dechloramination is in place without relieving the customer of ultimate responsibility.

4.5.3 For customers with live fish, provide specific information concerning chloramine impacts to fish, groups include:

4.5.3.1 Pet shops and aquarium supply centers; these businesses with direct contact with fish owners can help notify customers, provide technical advise, and furnish dechlorination supplies and test kits.

4.5.3.2 Aquiculture organizations; these groups can assist by contacting members through newsletters, at meetings, by direct phone campaign and by mail.

4.5.3.3 Schools and universities; these institutions can provide educational opportunities concerning chloramine use as a disinfectant and method of residual removal.

4.5.3.4 Restaurants and stores handling live fish and aquatic organism.

4.5.4 For specialized manufacturing plants and academic/commercial laboratories, contact directly and provide literature to assist them in making the transition

5.0 Recommended minimum sampling for systems using Chloramines:

When chloramines are implemented by a utility, sampling should be in accordance with Appendix B.

Appendix B
RECOMMENDED MINIMUM MONITORING FOR SYSTEMS USING CHLORAMINES

Parameter	Raw Water	Prior to Ammonia Addition	Plant Tap	Distribution System *
pH	daily	continuous	continuous	weekly >18°C monthly ≤ 18°C
Total Alkalinity			daily	weekly >18°C monthly ≤ 18°C
Temperature	daily	daily	per rules	weekly >18°C monthly ≤ 18°C
Free Chlorine Residual		continuous	per rules	per rules
Combined Chlorine Residual			per rules	per rules
Free Ammonia	seasonal to daily		daily	weekly >18°C quarterly ≤ 18°C
Total Ammonia**			weekly > 18°C quarterly ≤ 18°C	weekly >18°C quarterly ≤ 18°C
Nitrate			weekly >18°C quarterly ≤ 18°C	weekly >18°C quarterly ≤ 18°C
Nitrite			weekly >18°C quarterly ≤ 18°C	weekly >18°C quarterly ≤ 18°C
Monochloramine			weekly	weekly >18°C monthly ≤ 18°C
Combined dichloramine plus trichloramine ***			weekly	weekly >18°C monthly ≤ 18°C
Total Coliform (TC)			weekly for one year, then monthly	per rules (twice frequency in rules for first year when > 18°C)
Heterotrophic Plate Count (HPC) (R2A agar)			weekly for one year, then monthly	same as TC for one year, then monthly
Taste and Odor Disinfection Byproducts			according to objectives quarterly for one year	according to objectives per rules
Dissolved Oxygen				as needed to confirm other indicators

*Initially at same locations as required total coliform monitoring. After one year, at critical locations determined during first year monitoring.

**Total ammonia is the free ammonia (NH3-N and NH+4-N) plus the ammonia-N that combines with chlorine to form Monochloramine (NH2Cl).

***As difference between combined chlorine and Monochloramine.

All parameters with approved methodologies must be done in an Ohio EPA approved laboratory.

All other parameters must be done according to standard methods.

Appendix C

Steps in Obtaining an Ohio EPA Decision on Chloramination Proposals