pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF SAFE DRINKING WATER

Nitrification Control Plan for Chloraminated Distribution Systems
Instructions

Section 109.716(a) of the PA Safe Drinking Water Regulations requires public water systems that use chloramines or purchase water containing chloramines to develop a monitoring plan by April 29, 2019. See 25 Pa. Code § 109.716(a). This plan must conform to the guidelines provided in industry standards, such as the American Water Works Association (AWWA) Manual M56 – *Nitrification, Prevention and Control in Drinking Water*.

One of the primary challenges with the use of chloramines is the occurrence of nitrification within the distribution system. Nitrification is a process by which bacteria oxidize ammonia (ammonia-oxidizing bacteria) to nitrite and then to nitrate (nitrite-oxidizing bacteria). The presence of nitrifying bacteria and the nitrification process can cause an accelerated decay of disinfectant residuals due to an increase in the microbial population, nitrite and other chloramine-demanding substances. This accelerated decay results in the release of additional free ammonia, leading to further biological oxidation and nitrite production. In addition, decreases in pH can result in the shift of the chloramine species from monochloramine to di- and tri-chloramines, which are less stable, and can lead to the corrosion of distribution system materials.

Several controls are employed by systems to avoid nitrification events. These controls include, but are not limited to, ensuring the proper formation of monochloramine and minimizing excess free ammonia at the treatment plant through the optimization of the chlorine-to-ammonia ratio, pH control and minimizing water age within the distribution system. Water age can be minimized through distribution operational controls including, but not limited to:

- Tank turnover and mixing
- System-wide and targeted flushing
- Water flow management through looping and valving.

Nitrification Control Plan Components

The nitrification control plan must contain a system-specific ***monitoring plan***, including, at a minimum:

- The list of parameters that will be monitored; such as:
  - Monochloramine
  - Total chlorine
  - Free ammonia
  - pH
  - Heterotrophic Plate Count (HPC)
  - Nitrite
  - Nitrate
- The monitoring locations
- The monitoring frequency

In addition to the above monitoring plan components, a ***response plan*** must be developed that outlines the expected water quality ranges and action levels for the parameters selected in the monitoring plan.

The public water system shall implement the nitrification control plan in accordance with accepted practices of the water supply industry and shall review and update the plan as necessary. Revisions may be needed when, among other times, there are source water, treatment, physical or operational changes to the distribution system that impact water flow or water age (e.g. main replacements, distribution system expansion or addition of a new storage tank).

The nitrification control plan shall be retained onsite and shall be made available for inspection by DEP upon request.

Instructions for Completing PART 1 – General System Information

Please complete the general information including: water system name, 7-digit Public Water Supply Identification Number (PWSID), mailing address, contact person, telephone number and email address. In the space provided for system type, check whether your system is a community water system (CWS), non-transient non-community (NTNC) or transient non-community (TNC) water system. Please indicate the number of people served by your system.

Please check **all** boxes for the types of sources that are used by your system, not just the primary source. Please also indicate whether your system is selling water to another water system.

Please check **all** boxes for the type of treatment done by ***your*** water system. If you only purchase and distribute water that is chloraminated by the wholesale system, please indicate that you do not do any treatment.

Please indicate whether or not your system has areas where chloraminated and chlorinated water, from different sources, blend within the distribution system.

Instructions for Completing PART 2 – Monitoring Plan

The monitoring can be broken into two parts; *treatment monitoring* (if producing chloraminated water) and *distribution system monitoring*. Both components are essential in ensuring proper chloramine residual production, stability and maintenance. The parameters and frequency selected will vary among the monitoring locations, both in the treatment process and distribution system, based on the purpose of the parameters selected, industry standards and historical data.

Part 2A – Monitoring Plan for Chloramine Production (Treatment)

Note: This part is only for water systems that produce chloramines, booster chloraminate or booster chlorinate.

Please provide a short description of the sample locations in the blocks labelled ***Pre-Treatment Frequency*** (prior to ammonia addition) and ***Post-Treatment Frequency*** (after ammonia addition and prior to entry into the distribution system).

In the columns labelled ***Pre-Treatment Frequency*** and ***Post-Treatment Frequency*** columns, please provide the frequency of sampling for each of the key monitoring parameters listed. If monitoring is not conducted for the specific parameter listed, leave the block blank. If additional parameters, not listed, are utilized to monitor either pre-treatment, post-treatment or both, please add them below *Other Parameters* in the column labelled ***Parameter*** and indicate the frequency of monitoring for those parameters in the respective columns.

Refer to industry guidelines, such as the American Water Works Association (AWWA) Manual M56 – *Nitrification, Prevention and Control in Drinking Water*, to assist with determining the appropriate and industry accepted treatment monitoring parameters and frequencies.

Note: *The locations, parameters, concentrations or values, and frequencies discussed below do not supersede permit or regulatory requirements, concentrations or values, or frequencies.*

General Information

When monitoring to ensure the proper formation of monochloramine, evaluation of only one parameter (e.g. Total Chlorine) provides an incomplete picture and hinders optimal control and management of the distribution system. Therefore, it is important to have paired data, for all critical parameters, at multiple monitoring points to best determine if the desired concentration of monochloramine is being formed.

There are several key parameters that can be monitored during treatment to ensure the proper formation of monochloramine. At a minimum, prior to the point of formation (application point for ammonia), a water system should monitor free chlorine, pH and source water free ammonia. After formation, a water system should, at a minimum, monitor monochloramine, total chlorine, free ammonia and pH. In addition, a water system may consider measuring other parameters, such as finished water nitrite and nitrate, as a baseline to assess differences relative to samples collected in the distribution system (e.g., an increase in nitrate in the distribution system is indicative of nitrification) and to determine if background concentrations of these compounds exist or are being formed within the treatment plant.

Parameters

Free Chlorine

In order to dose the proper amount of ammonia to ensure the formation of monochloramine without the presence of excess free ammonia, the concentration of free chlorine must be monitored. This monitoring should be done immediately upstream of the point of ammonia addition. Free chlorine may also be monitored after ammonia addition to ensure that all the free chlorine has reacted. It is important to note that accurate evaluation of free chlorine, following ammonia addition, is generally not feasible via standard colorimetric testing methods. Therefore, it is important to ensure that the method used can accurately quantify the concentration of free chlorine, without interference from monochloramine.

Total Chlorine

Total chlorine includes all species of chloramine and free chlorine. During treatment, total chlorine is most useful when used in conjunction with monochloramine analyses, since this is the chloramine species that should be targeted. If the monochloramine concentration is significantly less than the total chlorine concentration, this can indicate a significant dichloramine and/or trichloramine formation issue during treatment. As previously mentioned, under desired conditions, total chlorine and monochloramine residual should be relatively similar. Monitoring total chlorine alone does not provide adequate information to optimize chloramination processes.

Monochloramine

Monochloramine is the target chloramine species for secondary disinfection within the distribution system. Monitoring directly for this species, at some point after the reaction to form monochloramine, will help determine whether or not the target concentration was generated or if there are production issues. Production issues can be more easily identified when monochloramine concentrations are compared to the total chlorine concentration and when used in conjunction with the free ammonia analysis. Significant differences between the monochloramine and total chlorine concentrations (i.e. when total chlorine is considerably greater than monochloramine) can indicate an improper ratio of free chlorine to free ammonia during the chloramine generation process. The overall goal is to maintain the greatest percentage of total chlorine, in the form of monochloramine, as possible throughout the distribution system.

Free Ammonia

The presence of background free ammonia (e.g. from source water) can unintentionally contribute to the formation of chloramines when free chlorine is introduced. Additionally, background ammonia, if not identified and adjusted for, can result in the overfeeding of ammonia at plants that intentionally form chloramines. Therefore, it is important to monitor background free ammonia concentrations and to take it into consideration when determining the proper ammonia doses for the formation of monochloramine. Free ammonia should also be monitored at the entry point to ensure that excess free ammonia, which is a food source for ammonia-oxidizing bacteria, is not being sent into the distribution system. The presence of elevated free ammonia at the entry point is typically the result of overfeeding ammonia or of failure to identify and adjust for elevated source water ammonia levels. Alternatively, if ammonia is underfed, it can result in the undesired formation of dichloramine and trichloramine. A small, but measurable free ammonia residual at the entry point ensures that a water system is feeding the optimal ratio of chlorine to ammonia. Ultimately, each water system should adopt an optimal entry point free ammonia concentration goal, consistently monitor for free ammonia and adjust feed rates as needed to meet the goal; thereby insuring optimal downstream chloramine performance.

pH

pH is a significant factor affecting the rate of reaction during monochloramine formation. Studies have shown that monochloramine formation is best at a pH between 7.5 and 9.0, with 8.3 being optimal. Therefore, it is important to ensure that pH is monitored prior to the addition of free ammonia to ensure a sufficient target pH is consistently maintained for the reaction to occur efficiently. In addition, pH at the treatment plant entry point should be monitored since pH affects the chloramine decay rate within the distribution system. Studies have shown that chloramine residuals decayed more slowly at pH values above 8.5. Therefore, it is important to ensure that a target pH is being maintained leaving the treatment plant to minimize the impacts of pH on the decay rate. pH fluctuations outside of optimal ranges are likely to impact chloramination performance, even if chlorine and ammonia feed rates are maintained at an optimal level.

Nitrite

Nitrite is the first by-product generated during nitrification. Although source water concentrations of nitrite are typically low to non-existent, monitoring for background concentrations of nitrite at the entry point is useful in establishing a baseline. If there are background levels of nitrite, those levels need to be factored in when interpreting distribution system nitrite results.

Nitrate

Nitrate is a by-product of complete nitrification (free ammonia → nitrite → nitrate). When using nitrate as an indicator for nitrification within the distribution system, it is important to incorporate nitrate monitoring at the entry point, especially during summer months when the presence of nitrate is more prominent in source waters. Establishment of a thorough baseline is important due to the presence of nitrate in source waters and the stability and persistence of nitrate within the distribution system.

Other parameters

A water system may have system-specific indicators, such as water temperature or entry point alkalinity, which are not included in this guidance document. When selecting additional parameters, it is important to have a full understanding of why the chosen parameter is useful in determining whether monochloramine was formed properly and to know how to properly interpret the data being collected.

Other parameters may also include parameters needed to ensure simultaneous compliance with other regulatory requirements, such as the Lead and Copper Rule, that can be impacted by changes in disinfection practices.

Frequency

It is important to thoroughly monitor treatment plant water chemistry to ensure that only monochloramine is being generated and that excess free ammonia is not being sent into the distribution system, which may lead to accelerated nitrification. Monitoring should occur at a frequency that not only allows for the establishment of a comprehensive baseline, but allows for the detection and immediate remediation of generation issues.

The table below provides example monitoring frequencies for the parameters listed in the Treatment Plant Monitoring Parameters section of this guidance document. ***It is important to note that these are only examples. If there are specific regulatory monitoring requirements or site-specific permit conditions, those requirements and conditions must be followed.*** Frequencies will be system-specific, based on the sample collection and analyses capabilities of the individual utility. A system may choose to increase the monitoring frequencies for specific parameters, or include additional, non-routine parameters, if the monitoring indicates the possible onset of nitrification, there are treatment or source changes or if there is an "Action Level" exceedance (see part 3A). Systems may also consider the potential benefits of continuous monitoring for as many parameters as feasible. Continuous monitoring can provide real time data that can be used to optimize chemical feed rates.

Example Treatment Monitoring Frequencies

Parameter	**Frequency**	
	Pre-Treatment	**Post-Treatment**
Free Chlorine	Continuous*	NA
pH	Every 2 hours*	Every 2 hours
Free Ammonia	Daily raw water samples until baseline is established	Every 2 hours
Monochloramine	NA	Every 2 hours
Total Chlorine	NA	Continuous
Nitrite	NA	Daily until baseline is established
Nitrate	NA	Daily until baseline is established
Other Parameters	Parameter specific, as determined by the utility	

* At a location after free chlorine addition, but as close as possible prior to the point of ammonia addition.

Part 2B – Monitoring Plan for Chloraminated Distribution Systems

Please provide a short description of the sample locations in the blocks below the row labelled ***Monitoring Locations***.

In the columns below each sample location, please provide the frequency of sampling for each of the key monitoring parameters listed. If monitoring is not conducted for the specific parameter listed, leave the block blank. If additional parameters, not listed, are utilized to monitor any of the sites listed, please add them below *Other Parameters* in the column labelled ***Parameter*** and indicate the frequency of monitoring for those parameters in the respective columns.

Refer to industry guidelines, such as the American Water Works Association (AWWA) Manual M56 – *Nitrification, Prevention and Control in Drinking Water*, to assist with determining the appropriate and industry accepted distribution monitoring parameters, locations and frequencies.

Note: *The locations, parameters, concentrations or values, and frequencies discussed below do not supersede permit or regulatory requirements, concentrations or values, or frequencies.*

General Information

Locations

It is essential to assess water quality at individual locations in the distribution system for proper data interpretation under a nitrification prevention and control program. In addition to distribution system monitoring, it is also recommended that all distribution system entry points be monitored for comparison and determination of background levels for each monitoring parameter.

Chloramine degradation and nitrification typically starts in areas with high water age, therefore these areas within the distribution system should be targeted for sampling. These locations include, but are not limited to:

- Tanks (during ***both*** fill and draw cycles)
- Dead ends
- Other low flow areas (e.g. business parks, housing developments, etc.).

In addition to water age, other considerations for site selection are:

- Pipe material (e.g. older, unlined cast iron pipes may have greater disinfectant demand and higher biological activity due to tuberculation)
- System pressure (e.g. lower pressure areas may have decreased flow)
- Areas influenced by more than one source, especially when blending free chlorine and monochloramine.
- Areas immediately following booster chlorination.

These sampling locations may include some distribution system regulatory sampling locations (i.e. Disinfection Requirement Rule, Total Coliform Rule, Disinfectant / Disinfection By-Product Rule, Lead and Copper Rule), as well as additional critical locations.

These locations can be identified using many tools available to a water system, including, but not limited to:

- Hydraulic model
- System distribution map
- Historical distribution disinfectant data
- Complaint logs
- Comprehensive distribution water quality sampling, beyond regulatory sampling (e.g. sampling at the beginning and end of hydrant flushes during a routine flushing program).

Each distribution system is unique, therefore there is not a set number of sample locations to be identified. Using the criteria listed above, a water system should identify a sufficient, and reasonable, number of locations to accurately characterize its system and identify disinfectant degradation and nitrification issues.

Parameters

No one parameter alone can be used to make a determination concerning nitrification. Therefore, it is important to determine which parameters can be used in conjunction to best characterize a system and identify and correct nitrification issues before they become difficult to remedy.

There are several key parameters that can be monitored within a distribution system serving chloraminated water. These parameters are listed in priority order. At a minimum, a water system should monitor monochloramine, total chlorine, free ammonia and nitrite. In addition, a water system may find pH, nitrate, heterotrophic plate counts (HPCs) and temperature as useful indicators within its system. If conducting chlorine burns, a system should incorporate free chlorine monitoring during those times to ensure that breakpoint chlorination has occurred and that free chlorine has become the primary disinfectant throughout the entire distribution system.

Total Chlorine

Total chlorine includes all species of chloramines and free chlorine. Alone, total chlorine will only provide an indication of the total amount of all chlorine species, but can be useful if it indicates that there is a low amount of total disinfectant. Total chlorine is most useful when used in conjunction with monochloramine analyses, since this is the chloramine species that should be targeted. If the monochloramine concentration is significantly less than the total chlorine concentration, this can indicate a dichloramine formation issue during treatment or as a result of booster chlorination, if booster chlorination is employed within the distribution system. Under desired conditions, total chlorine and monochloramine residual should be approximately the same, although the measured total chlorine residual may be slightly higher due to interferences from other chemicals.

Monochloramine

Monochloramine is the target chloramine species for secondary disinfection within the distribution system. Monitoring directly for this species may help identify production issues, when compared to total chlorine results, and is useful in identifying disinfectant degradation within the distribution system. Low concentrations or downward trends at a specific monitoring location can indicate the onset of nitrification or, at a minimum, a chlorine demand or water age issue.

Free Ammonia

Free ammonia will be present within a chloraminated distribution system as a result of three factors; source water ammonia, excess ammonia added during the formation of the chloramines and liberated free ammonia from the decomposition of chloramine. Therefore, the presence (> 0.05 mg/L) of free ammonia at the distribution system entry point can indicate a source issue, treatment issue or the occurrence of nitrification. Typically, increases in distribution system ammonia concentrations indicate chloramine decay and the possible onset of nitrification. In addition, a decrease in free ammonia, along with a decrease in monochloramine concentrations, may indicate the presence of elevated ammonia-oxidizing bacteria.

Nitrite

Nitrite is the first by-product generated during nitrification. Since source water concentrations of nitrite are typically low to non-existent, as verified through entry point sampling, elevated levels of nitrite within the distribution system can indicate that nitrification is occurring. Although not typically monitored at the same frequency as monochloramine, total chlorine, free ammonia and pH, it is necessary to monitor for nitrite on a consistent basis to establish a reliable baseline. Outside of the routine monitoring, it is also useful when other monitoring parameters, specifically monochloramine, total chlorine and free ammonia, indicate the possible occurrence of nitrification (e.g. when the monochloramine residual is below 1.50 mg/L).

pH

pH is a significant factor affecting the chloramine decay rate. Studies have shown that chloramine residuals decayed more slowly at pH values above 8.5. Therefore, it is important to ensure that a target pH is being maintained within the distribution system to minimize the impacts of pH on the decay rate. In addition, nitrifiers can decrease the pH of poorly buffered water, making decreasing or low pH a possible indicator of nitrification. If chloramines are decaying system-wide and pHs are below the system-specific target value, this can either be attributed to system-wide nitrification issues, if associated with other indicator parameters, or treatment issues. In addition, changes in pH can lead to simultaneous compliance issues for regulated parameters that may be impacted by changes in pH (e.g. lead and copper).

Temperature

Biological activity typically increases with increasing temperatures. Although temperature alone cannot be used as an indicator, it can be used as a supplemental parameter, especially when monitoring at tanks, where the majority of temperature fluctuations occur. Historical temperature data may be used to establish a trigger, indicating when a more aggressive distribution system monitoring program is needed.

Heterotrophic Plate Counts (HPCs)

HPCs can be used to gauge the biological activity that is occurring within the distribution system. Increasing HPCs within the distribution system can indicate the onset of nitrification and, at a minimum, increasing biological activity, which can result in an increase in disinfectant demand.

Nitrate

Nitrate is a by-product of complete nitrification (free ammonia → nitrite → nitrate). When using nitrate as an indicator for nitrification, it is important to incorporate entry point monitoring as well as a comprehensive baseline within the distribution system, especially during summer months when the presence of nitrate is more prominent in source waters. Establishment of a thorough baseline is important due to the potential presence of nitrate in source waters and the stability and persistence of nitrate within the distribution system. When compared to the baseline data, increases in nitrate can be a useful parameter when confirming the occurrence of nitrification.

Free Chlorine

Free chlorine is ***only*** useful for distribution monitoring during free chlorine conversions, during seasonal chlorination, when trying to boost chloraminated water with free chlorine past breakpoint and when free chlorine and chloraminated waters are blended. Caution must be used when using N,N-diethyl-p-phenylenediamine (DPD) methods, due to the positive interference from monochloramine, other oxidants or oxidized manganese. Please refer to the DPD method being utilized for additional information on specific interferences that may occur.

Other parameters

A water system may have system-specific indicators, such as dissolved oxygen or alkalinity, which are not included in this guidance document. When selecting additional parameters, it is important to have a full understanding of why the chosen parameter is useful in determining whether nitrification is occurring and to know how to properly interpret the data being collected.

Other parameters may also include parameters needed to ensure simultaneous compliance with other regulatory requirements, such as the Lead and Copper Rule, that can be impacted by changes in disinfection practices.

Frequency

It is important to thoroughly characterize the distribution system and monitor at a frequency that, not only allows for the establishment of a comprehensive baseline, but allows for the detection and immediate remediation of nitrification events before they become difficult to correct.

The table below provides example entry point and distribution system monitoring frequencies for the parameters listed. ***It is important to note that these are only examples. If there are specific regulatory monitoring requirements or site-specific permit conditions, those requirements and conditions must be followed.*** Frequencies will be system-specific, based on the sample collection and analyses capabilities of the individual utility. A system may choose to increase the monitoring frequencies for specific parameters, or include additional, non-routine parameters, if the monitoring indicates the possible onset of nitrification, if the monitoring indicates the possible onset of nitrification, there are treatment or source changes or if there is an “Alert Level” or “Action Level” exceedance (see part 3B).

Example Distribution Monitoring Frequencies

Parameter	Frequency
Monochloramine	Daily*
Total Chlorine	Daily*
Free Ammonia	Same time and frequency as monochloramine and total chlorine
Nitrite	Weekly or if triggered by an alert level of other parameters (e.g., monochloramine <1.50 mg/L)
pH	Same time and frequency as monochloramine and total chlorine
Nitrate	Weekly or if triggered by an alert level of other parameters (e.g. when nitrite is monitored)
HPCs	Monthly
Temperature	Same time and frequency as monochloramine and total chlorine
Free Chlorine	Daily during chlorine burn, when blending chlorinated and chloraminated water or when attempting to booster chlorinate past breakpoint
Other Parameters	Parameter specific, as determined by the utility

* If the overall number of system-wide sample locations does not allow for daily monitoring, the monitoring locations may be put on a monitoring schedule where each monitoring location is sampled at least weekly.

Instructions for Completing Part 3 – Response Plan

The response plan can be broken into two parts; *treatment response plan* (if producing chloraminated water) and *distribution system response plan*. Both components are essential in ensuring proper chloramine residual production, stability and maintenance. The action levels and responses selected will vary among the monitoring locations, both in the treatment process and distribution system, based on the purpose of the parameters selected, industry standards and historical data.

Part 3A – Response Plan for Chloramine Production (Treatment)

Note: This part is only for water systems that produce chloramines, booster chloraminate or booster chlorinate.

In the tables labelled ***Pre-Treatment Goals, Action Levels and Responses*** and ***Post-Treatment Goals, Action Levels and Responses***, please provide the system-specific goal, action level and response, if the action level is exceeded, for each of the key monitoring parameters listed. If monitoring is not conducted for the specific parameter listed, leave the blocks blank. If additional parameters, not listed, are utilized to monitor either pre-treatment, post-treatment or both, please add them below *Other Parameters* in the column labelled ***Parameter*** and provide the goal, action level and response for those parameters in the respective columns. Refer to industry guidelines, such as the American Water Works Association (AWWA) Manual M56 – *Nitrification, Prevention and Control in Drinking Water*, to assist with determining the appropriate and industry accepted goals, action levels and responses for chloramine treatment.

General Information

It is important to establish system-specific treatment goals and action levels. The following example is a table of goals and action levels for *some* of the parameters listed. **Action Levels** trigger operational responses, such as treatment chemical dose adjustments. ***It is important to note that these are only examples. If there are specific regulatory monitoring requirements or site-specific permit conditions, those requirements and conditions must be followed.***

Example Treatment Goals and Action Levels

Parameter	Goal	Action Level
pH	8.0	< 7.5, > 9.0
Monochloramine	2.00 mg/L	≤ 1.50 mg/L
Total Chlorine	2.00 mg/L	≤ 1.50 mg/L
*Free Chlorine (Entry Point)**	0.00 mg/L	> 0.00 mg/L
Free Ammonia (Entry Point)	< 0.10 mg/L	≥ 0.10 mg/L

* The method being used must be able to accurately quantify the concentration of free chlorine, without interference from monochloramine.

Outside of applicable regulatory and permit requirements, it is ultimately the responsibility of the utility to determine suitable goals and action levels for the individual utility, which may be different than the levels shown in the example, for ***all*** parameters being monitored. The water system should have a complete understanding of how to interpret all of the data collected and utilize the established action levels in order to make sound, data-based decisions.

Part 3B – Response Plan for Chloramine Distribution

In the table labelled ***Distribution System Goals and Trigger Levels***, please provide the system-specific goal, alert level and action level for each of the key monitoring parameters listed. If monitoring is not conducted for the specific parameter listed, leave the blocks blank. If additional parameters, not listed, are utilized to monitor the distribution system, please add them below *Other Parameters* in the column labelled ***Parameter*** and provide the goal, alert level and action level for those parameters in the respective columns.

In the table labelled ***Distribution System Response Plan***, please provide the system response to an *action level* exceedance for each of the monitoring locations identified in Part 2B. Refer to industry guidelines, such as the American Water Works Association (AWWA) Manual M56 – *Nitrification, Prevention and Control in Drinking Water*, to assist with determining the appropriate and industry accepted responses to nitrification occurring within the distribution system.

General Information

It is important to establish system-specific distribution system water quality related goals and triggers. The following table is an example of goals, alert levels and action levels for *some* of the parameters listed. **Alert Levels** will trigger increased monitoring, such as increasing sampling frequency or adding additional parameters, and **Action Levels** will trigger operational responses, such as increasing tank turnover or flushing. If an **Action Level** trigger occurs, sampling should be continued to monitor the effectiveness of the operational response. ***It is important to note that these are only examples. If there are specific regulatory monitoring requirements or site-specific permit conditions, those requirements and conditions must be followed.***

Example Distribution System Goals and Trigger Levels

Parameter	Goal	Alert Level	Action Level
Monochloramine	2.00 mg/L	1.50 mg/L	< 1.00 mg/L
Total Chlorine	2.00 mg/L	1.50 mg/L	< 1.00 mg/L
Nitrite	0.00 mg/L	0.010 mg/L	≥ 0.015 mg/L
Free Ammonia	0.00 mg/L	0.05 mg/L	≥ 0.10 mg/L
Nitrate	≤ background	Increase above background	Increase above background

It is ultimately the responsibility of the utility to determine suitable goals, alert levels and action levels for the individual utility, which may be different than the levels provided, for ***all*** parameters being monitored. The water system should have a complete understanding of how to interpret all of the data collected and utilize the established alert and action levels in order to make sound, data-based decisions.