Nitrification Action Plan (NAP) Guidance

Purpose

The purpose of a Nitrification Action Plan, or a NAP, is to ensure that chloramine disinfection is successful by preventing and/or responding to nitrification. This document will help you develop your system's site-specific NAP and establish action levels to detect and prevent nitrification. The table below gives some information about selecting sample sites and how often you should sample to begin establishing baselines.

Sample Sites	• Routine coliform and/or disinfectant residual sites may be used for NAP sample sites. • For systems serving more than 1,000 people, NAP sampling sites should be established at entry point(s), average water age, and maximum water age locations. • Sites should be chosen to determine the impact of blending multiple sources.
Sample Frequency	• The rule lists the minimum sampling requirements. • It may be necessary for you to perform extra sampling to understand your distribution system better.

Controls: Critical Control Conditions for Chloramination

Total Chlorine	Total chlorine is the sum of all active chlorine species. It is the level that is regulated. • The **minimum** allowable total chlorine residual is 0.5 mg/L throughout distribution. • The **maximum** residual disinfectant level (MRDL) for total chlorine is 4.0 mg/L based on the running annual average of all samples collected in distribution.
Ammonia	• Ammonia reacts with chlorine to make monochloramine and other chloramines. • As monochloramine decays, **ammonia is released**.
Monochloramine	• Monochloramine is the disinfecting member of the chloramine family. • Ideally, all of the total chlorine will be present as monochloramine.
Free Chlorine	*You are not required to measure free chlorine, except during a temporary conversion to free chlorine performed as a NAP action.*
Nitrite	• Nitrite is formed by ammonia-oxidizing bacteria which 'eat' ammonia.
Nitrate	• Nitrate is formed by nitrite-oxidizing bacteria which 'eat' nitrite.
pH	*A decrease in pH can indicate nitrification. Therefore, pH measurement is recommended at systems with low alkalinity. PWSs that use pH elevation as a nitrification control strategy should also monitor pH in the distribution system.*

Goals and Baselines

- Goals and baselines are the normal, good levels at each point in the distribution system.
- **'Goals'** are set for total chlorine, monochloramine, and ammonia to make sure that disinfection treatment is operated correctly.
- **'Baselines'** are set for nitrite and nitrate, because they come from source water, and are not under a system's control. Initial results will be used to set goals and baselines.
- Ongoing, routine sampling will be used to detect potential nitrification and take appropriate action.

Total chlorine goal and Monochloramine goal

- The total chlorine and monochloramine goals can be set at the same value, because they should always be about the same.
- The entry point goal should be high enough so that the maximum water age site can achieve its goal.

Ammonia goal

- Ideally, water at entry points just after treatment would have zero ammonia because it is 'food' for the nitrifying bacteria. Having a trace of ammonia is good because it shows that the water is in the monochloramine zone.
- Ammonia naturally increases with time.
- The ammonia goals in average and high water age locations should represent good, normal operating conditions.

Nitrite baseline and Nitrate baseline

- The nitrite and nitrate baselines are the concentrations in the source water.
- The nitrite and nitrate in the distribution system should always be the same as the source water. The only thing that can change them is nitrification, cross connection, or source water changes.

For more in depth information see Controlling Nitrification

Triggers: Yellow Flag Alerts and Red Flag Alarms	
Yellow Flag "Alert" Triggers	**Yellow alert** levels are somewhat out of the norm, indicating that nitrification may have started. Some action to get back to normal is needed--but it is probably a routine type of action like flushing.
Red Flag "Alarm" Triggers	**Red alarm** levels happen when it becomes difficult to maintain a compliant total chlorine residual, and there is a strong possibility that nitrification is the culprit. If routine actions don't get the system back to normal, more intense action will be needed.

Total Chlorine	**Total chlorine is the regulated value,** so most systems have more data for total chlorine than any other constituent. Therefore, PWSs should have at least a year of historical weekly or daily data to use for setting triggers. If a nitrification event has occurred, the exact levels where nitrification took place can be used. Otherwise, yellow and red trigger levels should be estimated.
Mono-chloramine	Ideally, **all of the total chlorine should be monochloramine**. However, some systems may have characteristic ratios of mono-to-total, for example-80% or 90%.
Ammonia	**Ammonia will decrease during nitrification.** If ammonia is not detected, nitrification is likely the cause. *Note: Ammonia is measured as 'free available ammonia as nitrogen'.*
Nitrite	**Nitrite may increase or decrease during nitrification**. Therefore, any significant deviation of the nitrite level could indicate nitrification. During the initial stages of nitrification, nitrite will increase; as nitrification progresses, nitrite will drop as it is converted to nitrate.
Nitrate	**Nitrate increases when nitrification is very bad**. The only possible reasons to see nitrate increases are (1) Nitrification, (2) Cross connection with sewage or fertilizer, or (3) Source water contamination. Any of these is a major issue.

NAP Example Template

This is an **example** of a NAP form. **A PWS must determine their own site-specific sample points, goals, baselines, triggers and actions.**

Chloramine-Effectiveness Sample Suite						
Site	Chemical	Goal	Yellow Alert		Red Alarm	
			Trigger	Actions	Trigger	Actions
Entry Point	Total / Mono	___ mg/L	___mg/L		___mg/L	
	Ammonia	___ mg/L	___mg/L		___mg/L	
Average Water Age	Total / Mono	___ mg/L	___mg/L		___mg/L	
	Ammonia	___ mg/L	___mg/L		___mg/L	
Far Reaches	Total / Mono	___ mg/L	___mg/L		___mg/L	
	Ammonia	___ mg/L	___mg/L		___mg/L	
Nitrite/Nitrate						
Site	Chemical	Baseline	Yellow Alert		Red Alarm	
			Trigger	Actions	Trigger	Actions
Entry Point	Nitrite	___ mg/L	___mg/L		___mg/L	
	Nitrate	___ mg/L	___mg/L		___mg/L	
Source water(s)	Nitrite	___ mg/L	___mg/L		___mg/L	
	Nitrate	___ mg/L	___mg/L		___mg/L	
Blended water	Nitrite	___ mg/L	___mg/L		___mg/L	
	Nitrate	___ mg/L	___mg/L		___mg/L	

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