

**PUBLIC WATER SUPPLIES: PROPOSED NEW
35 ILL. ADM. CODE 604
R2018-017 (RULEMAKING – WATER)**

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**SECOND HEARING, THURSDAY, NOVEMBER 16, 2017 AT 9:00 A.M.
CHICAGO AND SPRINGFIELD BY VIDEOCONFERENCE
IPCB SPRINGFIELD HEARING ROOM
CONFERENCE ROOM 1244 N, 1ST FLOOR
1021 N. GRAND AVE. E.
NORTH ENTRANCE**

PRE-FILED FOLLOWUP TESTIMONY
IN RESPONSE TO IEPA'S
RESPONSE TO CURRY'S INITIAL
PRE-FILED TESTIMONY

RESPECTFULLY SUBMITTED BY:



Capt. Michael D. Curry, PE.
As an individual
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SUBMITTAL DATE: 8 Nov. 2017

Preface

I respectfully apologize to the Board and to the Agency for not numbering my initial comments. Mea culpa.

Curry's initial pre-filed testimony was filed on 14 October 2017. The Agency's response was filed on 1 November 2017.

PART 604
DESIGN, OPERATION AND MAINTENANCE CRITERIA

Original Curry Comment 2 (604.120). *Partial.*

Curry: Respectfully recommend that use of painted labels (for piping) be permitted. Etc.

Agency Response: The Agency has no objection to the use of painted labels. The Agency proposes the following revision to proposed Section 604.120:

- a) Piping in a community water supply treatment facility shall be identified clearly by legends and color coding or the use of color coded labels. A consistent standard shall be used throughout the system.

Curry followup response:

Respectfully recommend "a)" be revised to read as follows:

- a) *Piping in a community water supply treatment facility shall be identified clearly by legends and color coding or the use of color-coded nametag labels identifying the contents of individual pipes, spaced at intervals to allow convenient identification of individual pipes. A consistent standard shall be used throughout the system.*

Reason: If the labels identify the contents, then it would not be necessary to color code the individual labels with added expense.

Original Curry Comment 16 (604.140(a)). *Partial.*

Curry: At (a) ... respectfully recommend re-phrase as follows, with addition of total ammonia (after dechlorinating samples containing chloramines) and dichloramine.

- "a) contain a plan for monitoring total Ammonia-N, free Ammonia-N, Nitrite-N, Nitrate-N, monochloramine residual, dichloramine residual, and total chlorine residual."

Agency Response: CWSs that purchase water without a free chlorine residual and distribute this water must prepare a NAP. Similar to the response for comment #3, the Agency could require monitoring for total Ammonia-N and dichloramine residual through a Special Exception Permit. However, for most CWSs the monitoring listed in the proposed language is sufficient to determine if nitrification is occurring.

Curry followup response:

Why is it important to include measurement of total NH₃-N as an indicator, along with other parameters, that nitrification is occurring?

It is Curry's opinion that measuring total Ammonia-N concentration is a responsive procedure to determine whether or not nitrification bacteria are present in the distribution system. If the Ammonia-N concentration is decreasing in the distribution system, it indicates that nitrification is likely occurring.

At water treatment plants using monochloramine as a secondary disinfectant in the distribution system, the only total $\text{NH}_3\text{-N}$ present in the water should be the amount added in the treatment process to form monochloramine. (*As a check ... the plant should test for free $\text{NH}_3\text{-N}$ at the point of entry, and the value should ideally be "zero".*) Water treatment plants normally deliver water to the distribution system with a fairly constant monochloramine residual (may vary seasonally), so the amount of total $\text{NH}_3\text{-N}$ in the system should remain fairly constant ... EXCEPT IF NITRIFICATION IS OCCURRING, WHEN AMMONIA-OXIDIZING BACTERIA OXIDIZE $\text{NH}_3\text{-N}$ TO $\text{NO}_2^- \text{-N}$ (NITRITE-N), AND NITRITE OXIDIZING BACTERIA OXIDIZE $\text{NO}_2^- \text{-N}$ TO $\text{NO}_3^- \text{-N}$ (NITRATE-N). THEREFORE, IF A REDUCTION IN $\text{NH}_3\text{-N}$ IS NOTED, IT IS EVIDENCE THAT NITRIFICATION MAY BE OCCURRING. **If nitrification is occurring, the total Ammonia-N concentration is decreasing. If "complete nitrification" is occurring the total Ammonia-N concentration will be "zero".**

Additional notes:

Presence of free Ammonia-Nitrogen in the distribution system signifies degradation of the monochloramine residual (Ref. Wahman). It does not signify that nitrification is occurring. Curry concurs with the Agency's decision to include measurement of free Ammonia-N with the NAP, but Curry believes that measurement of total Ammonia-N is important and should be included in the NAP.

Wahman, David G., Ph.D., P.E. (May 2015) "Drinking Water Chloramine Chemistry 101", 2015 Illinois Section AWWA Webinar (May 20, 2015) [USEPA Office of Research & Development, National Risk Management Research Lab].

Presence of free Ammonia-N alerts the Operator that "food" is available for the autotrophic nitrification bacteria, and this information along with other considerations may trigger a flushing event and/or other corrective action.

Nitrification is not an "instantaneous" biological process. For example, a USEPA pilot study in Iowa required (1) 55 days for *initiation* of biological nitrification and (2) addition of supplemental phosphorus to promote and sustain viable nitrification biomass for oxidation of Ammonia-N.

Absent the phosphorus, it was nearly impossible to accomplish oxidation of Ammonia-N. "The

progression of bacterial acclimation and nitrification within the contactor was incomplete, and unexpectedly and unacceptably slow.” (Ref. Lytle et al.)

Summary Report: Pilot Study of an Innovative Biological Treatment Process for the Removal of Ammonia from a Small Drinking Water System; EPA/600/R-12/655, September 2012; www.epa.gov/gateway/science; Darren A. Lytle, Colin White, Dan Williams, Lauren Koch, Emily Nauman

**Excerpt from
Hach Company TNTplus™ Ammonia – Spectrophotometric Measurement of (Total) Ammonia Nitrogen and Total Kjeldahl Nitrogen in Water and Wastewater; Hach Method 10205; Revision 2.0, August 2008.**

Equivalent to EPA 350.1 (NH₃-N), 351.1 (TKN), and 351.2 (TKN) for the purpose of regulatory reporting of Ammonia (as Nitrogen) and Total Kjeldahl Nitrogen.

	<u>Limit</u>
Method detection limit	0.004 mg/L NH ₃ -N
Method limit	0.02 mg/L NH ₃ -N
Initial accuracy	97%
Initial precision	2.7%
On-going accuracy	100%

Acceptable accuracy ... 90% to 110% of true value, or $\pm 10\%$ (can be refined)

The Ammonia-Nitrogen concentration expected to be present in chloraminated water is estimated as follows:

Ratio 5.06 mg/L Cl₂ : 1 mg/L NH₃-N

The basis for the chlorine:ammonia ratio is:

“Measurable free available chlorine should not be present in solution at chlorine to ammonia molar ratios less than 1:1. On a weight basis, this ratio is approximately 5.06 mg Cl₂ to 1 mg NH₃-N, (*emphasis added*) and this unit convention is typically used in water treatment practices (Snoeyink and Jenkins).” Ref: 2003 Ammonia from Chloramine Decay: Effects on Distribution System Nitrification; Gregory W. Harrington, Daniel R. Noguera, Christopher C. Bone, Alicia I. Kandou, Patrick S. Oldenburg, John M. Regan, and David Van Hoven – Dept. of Civil and Environmental Engineering, University of Wisconsin-Madison; published by AWWA Research Foundation and American Water Works Association.

$\pm 10\%$

<u>Monochloramine residual</u>	<u>Resultant NH₃-N concentration</u>	<u>Range</u>
4 mg/L	4/5.06 = 0.79 mg/L	0.71 – 0.87 mg/L
3.5 mg/L	3.5/5.06 = 0.69 mg/L	0.62 – 0.76 mg/L
3 mg/L	3/5.06 = 0.59 mg/L	0.53 – 0.65 mg/L
2.5 mg/L	2.5/5.06 = 0.49 mg/L	0.44 – 0.54 mg/L
2 mg/L	2/5.06 = 0.39 mg/L	0.35 – 0.43 mg/L

Caution: Must dechlorinate samples containing chloramines, as noted in method instructions.

Potential scenario:

If a system delivers 3 mg/L monochloramine residual at the point of entry, the Ammonia-N concentration would be 0.59 mg/L if the recommended 5.06 chlorine to Ammonia-N ratio is used. Nitrification proceeds slowly, and in this case assume that nitrification reactions are initiated and 25% of the Ammonia-N is oxidized to Nitrate-N. The remaining total Ammonia-N residual would be $0.59 - (0.25 \times 0.59) = 0.44$ mg/L, which would illustrate a loss of total Ammonia-N that would signify potential presence of nitrification bacteria.

It is Curry's opinion that total Ammonia-N measurement procedures are sufficiently accurate to accept total Ammonia-N measurements for reasonable inclusion with the NAP.

To seek enlightenment on the importance of parameters to be monitored to detect presence of nitrification in distribution systems, Curry communicated with David G. Wahman, Ph.D., P.E. [USEPA Office of Research & Development, National Risk Management Research Lab] via email on 8 November 2017.

Please see attached:

Curry Followup Attachment Ammonia-N #1
 Email communications between Curry and Dr. Wahman.
Dr. Wahman's remarks represent his technical opinion as a researcher on these matters and in no way represents EPA policy or anything of that sort.

Please note that Table 7-3 (contained in the email from Dr. Wahman) of AWWA Manual M56 (Nitrification Prevention and Control in Drinking Water, 2nd edition, 2013, American Water Works Association) lists monitoring for Total Ammonia-N in distribution systems as "useful".

Curry respectfully requests that the Agency reconsider its rejection of the proposal to include total Ammonia-N measurements in the NAP (Nitrification Action Plan).

**Excerpt from
Hach Company TNTplus 835/836 Nitrate Method 10206, Spectrophotometric Measurement of
Nitrate in Water and Wastewater; Revision 2.2, January 15, 2013**

Equivalent to Standard Method 4500-NO₃⁻N, EPA 353.2 and EPA 300.0 for the purposes of regulatory reporting of nitrate and nitrite.

	<u>Limit</u>
Method detection limit	0.05 mg/L NO ₃ ⁻ N
Method limit	0.20 mg/L
Initial recovery range	95.4% - 102%
Initial precision	1.3
Matrix recovery range	90.5 – 101%

“Results should be within 15 percent of the actual value.”

Potential scenario:

If actual raw water Nitrate-N concentration is 2 mg/L, the measured Nitrate-N range could be 1.7 to 2.3 mg/L with the \pm 15% accuracy.

If actual raw water Nitrate-N concentration is 2 mg/L, and if water leaving the treatment plant has 4 mg/L monochloramine residual ... the available Ammonia-N should have 0.79 mg/L concentration. If we assume that nitrification is commencing and 25% of the Ammonia-N is oxidized to Nitrate-N, the total Nitrate-N concentration would become 2 mg/L + (0.25 x 0.79) = 2.2 mg/L. The measured Nitrate-N range could be 1.87 to 2.53 mg/L ... which is not significantly different from the measured range absent nitrification.

It is Curry's opinion that there can be variations in raw water Nitrate-N concentration from surface water sources (rivers, lakes), in response to precipitation events. Those variations would result in Nitrate-N variation in the distribution system.

Curry did not perform an extensive study to identify Nitrate-N variations in raw water due to time and resource constraints. Curry did spot check the internet for USACE (U.S. Army Corps of Engineers) Nitrate-N data for Rend Lake and Carlyle Lake, and obtained raw water Nitrate-N data from Springfield CWLP (City Water, Light and Power).

Please see attached:

- Curry Followup Attachment Nitrate-N #1 (Rend Lake)
- Curry Followup Attachment Nitrate-N #2 (Carlyle Lake)
- Curry Followup Attachment Nitrate-N #3 (CWLP)

The information contained in Attachments Nitrate-N #1, #2, and #3 indicates that Nitrate-N concentration variability occurred in these surface water sources.

The potential for intermittent Nitrate-N variations in raw water, coupled with test sensitivity affecting accuracy of concentration measurements, may minimize the reliability of Nitrate-N as a significant indicator that nitrification is occurring in the distribution system.

Nevertheless, it is Curry's opinion that measuring Nitrate-N should be included as part of the NAP (Nitrification Action Plan), since it is needed to perform a "Nitrogen Balance" and it is a logical parameter for inclusion with the NAP. The distribution Nitrate-N measurements will be most meaningful if Nitrate-N is also measured at the point of entry, in order to denote any significant change in the distribution system.

Original Curry Comment 37 (604.715(a)). Partial.

Curry Question: Reference is made to a 0.3 baffling factor. How is the 60 minute minimum contact time to be determined. (*Curry submitted two calculation methods, repeated below.*)

Potential Method A (historically used in Illinois to evaluate compliance with this requirement)

$$\text{Hydraulic retention time} = \frac{\text{water volume in basin, gallons}}{\text{flow rate, gpm}} = \text{minutes}$$

Or,

Potential Method B (modified for use with baffle correction factor)

$$\text{Effective retention time, } T_{10}^* = \frac{\text{water volume in basin, gal.} \times 0.3}{\text{flow rate, gpm}} = \text{minutes}$$

Agency Response:

The 60 minute minimum contact time is based upon Curry's referenced "Method A".

Curry followup response:

Curry concurs with the Agency's requirement for a minimum 0.3 baffle correction factor to prevent short circuiting. If the minimum baffling factor remains as a requirement to prevent short circuiting, respectfully recommend re-phrase 604.715 a) to read as follows:

a) *Unless otherwise approved by the Agency pursuant to Section 604.145(b), a minimum chlorine contact time of 60 minutes shall be provided for all sources utilizing surface water, groundwater under the direct influence of surface water, groundwater with basins open to the atmosphere, and groundwater obtained from unconfined, fractured bedrock. The equivalent baffling factor must be greater than or equal to 0.3 to prevent short circuiting. The 60 minute contact time shall be calculated based on the following formula:*

$$\frac{\text{Actual basin operating water volume, gallons}}{\text{Maximum pumping rate out of basin, gpm}} = \text{minimum 60 minutes}$$

Original Curry Comment 41 (604.900). *Partial.*

Curry's original comments included the following recommendations:

Chloride:Sulfate Ratio and the Larson-Skold Index be initially performed once monthly for six consecutive months, and then once annually if stable conditions are demonstrated to exist.

For systems that rely on adjustment of pH and other water quality parameters for corrosion control, test for CCPP (Calcium Carbonate Precipitation Potential) once weekly, and control the treatment process to prevent excessive calcium carbonate scale deposition by assuring that the CCPP does not exceed + 4 mg/L.

For systems that feed orthophosphate corrosion inhibitor, monitor calcium carbonate scale forming tendency using the Marble Test.

Agency Response:

None.

Curry followup response:

It is implied that 604.900 is intended to establish "General Stabilization Requirements", but the methodology for evaluating water stability is absent. In Curry's opinion, it is not sufficient to describe the "parameters" and exclude necessary procedures and information about how the parameters are to be evaluated to assure delivery of stable water.

In addition to water stability evaluations to minimize *corrosion*, water stability evaluations should be made to prevent damaging *deposition of excess calcium carbonate scale* in water mains and household plumbing systems.

At the 2016 AWWA WQTC (American Water Works Association Water Quality Technology Conference) at Indianapolis,(attended by Curry) Michael Schock with USEPA commented that the Flint, Michigan lead problems were a result of the Michigan regulatory and engineering communities ignoring the available body of knowledge pertaining to corrosion control. This "body of knowledge" should be applied in Illinois, in Curry's opinion.

Curry respectfully recommends that 604.900 be modified to include known methods for monitoring water stability ... for both the tendency to be corrosive and the tendency to deposit excessive calcium carbonate scale.

Additional comment with regard to the "Marble Test" (Calcium Carbonate Saturation Index) for evaluating the tendency to deposit excess calcium carbonate scale in water containing phosphates:

If the alkalinity has increased, it indicates that the water was not saturated with calcium carbonate and could not deposit any protective scale. In fact, it might dissolve any previously deposited scale and would then be corrosive. If the alkalinity has decreased, the water is supersaturated with calcium carbonate and may deposit protective scale or maintain a coating already deposited. Recommend that alkalinity decrease be less than 4 mg/L (as CaCO₃), similar to the CCPP.

The procedures for "Calcium Carbonate Saturation" are similar to the *marble test* described by T.E. "Doc" Larson, and are described at Simplified Procedures for Water Examination, Manual of Water Supply Practices M12. (AWWA, 2002)

Original Curry Comment 50 (604.1115 (c)(11)). Partial.

Curry Original Question: Is there a certain distance between the chlorine gas storage area and residential or developed areas that the Board and Agency feel should trigger installation of equipment to chemically neutralize chlorine gas?

Agency Response:
No response.

Curry followup response:

The original proposal states ...

11) provisions must be made to chemically neutralize chlorine gas where feed and/or storage is located near (emphasis added) residential or developed areas in the event of any measured chlorine release. The equipment must be sized to treat the entire contents of the largest storage container on site.

Respectfully request a response to Curry's original question. Since this is a mandatory provision, a minimum clearance distance should be stated in order to guide and determine applicability of the regulation. Otherwise, will the Agency accept the judgement decision of the CWS?

Followup Attachments

Curry Followup Attachment Ammonia-N #1

Curry Followup Attachment Nitrate-N #1 (Rend Lake)

Curry Followup Attachment Nitrate-N #2 (Carlyle Lake)

Curry Followup Attachment Nitrate-N #3 (CWLP)

- end -

Curry Followup Attachment Ammonia-N #1

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SUBMITTAL DATE: 8 Nov. 2017

8 November 2701 email communications between Curry and David G. Wahman, Ph.D., P.E.,
Research Environmental Engineer, Drinking Water Treatment and Distribution Branch, Water
Systems Division, National Risk Management Laboratory, U.S. Environmental Protection
Agency

*Dr. Wahman's remarks represent his technical opinion as a researcher on these matters and in
no way represents EPA policy or anything of that sort.*

Mike Curry

From: Wahman, David <Wahman.David@epa.gov>
Sent: Wednesday, November 08, 2017 1:25 PM
To: Mike Curry
Subject: RE: Illinois EPA Proposed Regulation ... Nitrification Action Plan

Hello Mike,

You can share the technical information in my email, but please make certain to note that this is my technical opinion as a researcher on these matters and in no way represents EPA policy or anything of that sort. I have provided some additional responses directly to where you ask your questions in the below email in green.

Regards,
Dave

David G. Wahman, Ph.D., P.E.
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From: Mike Curry [mailto:mcurry@curryassociates.com]
Sent: Wednesday, November 08, 2017 1:22 PM
To: Wahman, David <Wahman.David@epa.gov>
Subject: RE: Illinois EPA Proposed Regulation ... Nitrification Action Plan

Dear David,

Tremendous!!!

Thank you very much for responding to our inquiry and for further enlightenment on this subject. I greatly appreciate this input and would like to share it with my friends at IEPA and the Illinois Pollution Control Board if it is okay with you? Your additional information is invaluable.

In your item 1 ... yes, I acknowledge the potential for loss of N gas, but would expect it to be a low concentration amount, but nevertheless we need to keep this in mind. Am I interpreting your comment correctly that it is worthwhile to monitor total Ammonia-N ... since it "adds another piece of data ..."? Yes, I believe it would be beneficial to monitor total ammonia-N as it should only require a calculation from other measured parameters that should be taken as part of the NAP. If you are recommending that another measurement specifically be taken to measure total ammonia-N, I would need to understand what that method entails to better provide a response.

Electronic Filing: Received, Clerk's Office 11/8/2017

In your item 2 ... in calculating total ammonia, we have for many years used a calculation formulation similar to what you show ... except we have expressed it as [(monochloramine/5.07) + free Ammonia-N] which is numerically the same result. Please, should we be concerned about accounting for Ammonia-N in presence of **dichloramine** if we are calculating total Ammonia-N? If we test for Ammonia-N, the results can be compared as a backup with the calculated value. We know of many Operators that use the Hach method for measuring monochloramine and free Ammonia-N. That method will be very adaptable for Operators at "consecutive systems" (that do not operate a treatment plant and presently do not have any laboratory items other than for testing chlorine residual). As a matter of practice, we typically "recommend" that Plant Operators use amperometric titration to speciate the chlorine residual concentrations, and also use the Hach monochloramine periodically as a back-check to validate in the residual results ... particularly since most Plants have a spectrophotometer for other parameters and purchasing the additional reagents for monochloramine and free Ammonia-N is not a burden. You are correct that dichloramine will cause issues with the calculation of total ammonia-N if present in a meaningful concentration (which should only occur if you are operating around pH 7ish or below). Even in this case, you could make some assumptions to determine the dichloramine concentration (or get it directly from your amperometric titration) and then also include dichloramine in your total ammonia-N calculation.

In your item 3 ... should the second line refer to "nitrite" increase? We definitely concur that Nitrite-N should be included with the NAP and should be monitored in remote parts of the distribution system ... to ensure that the 1 mg/L MCL is not approached. Yes, it should be nitrite. Let me try to state it another way that I hope is clearer. The point I was making is that you can have nitrification occurring and actually not measure a nitrite concentration as the ammonia might be completely oxidized to nitrate (e.g., during a really bad nitrification episode). In this case, your other monitoring parameters should hint that something is going on (e.g., the residual and ammonia are low or non-existent). But, if you can measure a nitrite concentration (as there is typically no nitrite entering systems), you definitely know nitrification is occurring.

(Not related to this topic ... but we were involved with a groundwater system that had 5 mg/L Ammonia-N in their raw water ... the water quality degradation culminated in nitrification/denitrification and release of Nitrogen gas into the water delivered to the customers ... an extreme circumstance! The problem initially came to our attention when we inadvertently discovered presence of Nitrite-N concentrations far above the MCL ... and "wondered about the cloudy water". The education continues.) Increases in nitrite-N in the distribution system are an area I wish that current regulations would better address (i.e., the MCL requirement is based on the entry point to the distribution system and therefore misses nitrite production in the distribution system). If there was a way for you to publish this data in a peer-reviewed paper (e.g., JAWWA) and show nitrite concentrations above the MCL in the distribution system as a result of nitrification, it would be very valuable. Whenever I bring this issue up, I lack enough published evidence to illustrate that this does occur at levels of concern (i.e., above the MCL).

In your item 4 ... we have collected additional data from USACE for Carlyle Lake and Rend Lake, and City of Springfield City Water, Light and Power (CWLP) that documents Nitrate-N variations in surface water sources. The field nitrate methods, if "followed to the T" are cumbersome and "might" be beyond the capability of small systems Operators that purchase treated water from another source.

Thanks for including the table from AWWA M56. I am still going through M56 and missed this table. I do note that the table lists Total Ammonia-N as a useful parameter. The two tables I sent were from the proof of the 2nd edition of M56 and can be found on page 132 of the 1st edition of M56. If you have the 2nd edition, they should be in Chapter 7. Chapter 7 provides a good discussion on monitoring parameters. If you read the text, M56 is not a fan of total ammonia-N, but I think the discussion centers around using total ammonia-N as an operational parameter.

IEPA and the Illinois Pollution Control Board will make the final decision on parameters to be included with the NAPs at Illinois community water systems distributing chloraminated water. I remain hopeful that Total Ammonia-N will be included in those parameters because ... as you suggest ... it adds another piece of data ... to arrive at a holistic view. Tracking Total Ammonia-N with both lab tests and the calculation method is prudent. If all else fails, is there an option to make it a "recommended" vs "required" parameter?

Thank you again for sharing your expertise in this area. I am hopeful that you will grant permission to share your email with IEPA and the Illinois Pollution Control Board, to share our improve our understanding.

Best ...

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From: Wahman, David [<mailto:Wahman.David@epa.gov>]
Sent: Wednesday, November 08, 2017 10:53 AM
To: Mike Curry
Subject: RE: Illinois EPA Proposed Regulation ... Nitrification Action Plan

Hello Mike,

Things are well here.

I have a couple of thoughts I can share on the use of total ammonia-N with regards to chloramine use (I hope these make sense).

1. One complicating factor with total ammonia-N tracking is that a decrease in total ammonia-N is not necessarily a result of nitrification. If monochloramine is decaying as a result of its abiotic chemistry (i.e., not as a result of nitrification), you will see a total ammonia-N loss as a portion of the nitrogen is lost as nitrogen gas. With that said, I think tracking total ammonia-N (which can simply be calculated, see #2) adds another piece of data to view what is occurring in a system along with direct measurements of monochloramine, free ammonia-N, nitrite, pH, and temperature. A holistic view is required to see what is going on in a system.
2. If I was operating a system, I would always be measuring monochloramine and free ammonia-N in any sample and therefore could always calculate the total ammonia-N (monochloramine * 14/71 + free ammonia-N). Not that I am advocating HACH, but they make a nice method that accomplishes both monochloramine and free ammonia-N measurement.
3. The only chemical parameter I consider as a direct measure that nitrification is definitely occurring without regard to what is going on with other water quality parameters is an increase in nitrite. You can have nitrification occurring and not measure a nitrite increase, but if you see a nitrite increase, you have nitrification occurring to some extent.
4. I agree that nitrate can be of limited use, especially if the nitrate concentration varies or is relatively high in the influent water. Honestly, if you are seeing nitrate increases in a chloramine system from nitrification, you have a severe nitrification problem that has likely been occurring for a decent amount of time. I am not a fan of any of

the field nitrate methods; therefore, I typically don't measure nitrate unless I am getting into some deeper troubleshooting.

You have likely seen this before, but here is another source to judge the usefulness of various parameters (Table from AWWA M56).

Table 7-2 Usefulness of water quality parameters at a treatment plant for nitrification monitoring

Parameter/Usefulness		
Very Useful	Useful	Limited Usefulness
Free chlorine	TOC	Hardness
Total chlorine	Chloramine decay	Alkalinity
Free ammonia-N		Nitrate-N ¹
pH		Nitrite-N ²
Temperature		Total ammonia-N

NOTE: TOC, total organic carbon.
¹Very useful as background or baseline.

Table 7-3 Usefulness of water quality parameters for distribution system nitrification monitoring

Parameter/Usefulness		
Very Useful	Useful	Limited Usefulness
Total chlorine	Nitrate-N ²	Dissolved oxygen
Nitrite-N	Total ammonia-N	TOC
Free ammonia-N	HPC-R2A	Hardness
Temperature	pH	Alkalinity
Free chlorine ³		AOB ⁴

NOTE: AOB, ammonia-oxidizing bacteria; TOC, total organic carbon.
¹Very useful if background nitrate-N level is consistent.
²Very useful during breakpoint chlorination (not for routine monitoring).
³Limited usefulness until rapid inexpensive enumeration methods are available.

Boiling down all the above, I guess my opinion would generally be the following: you are going to have the information to calculate and track total ammonia-N, why not do it as it adds another piece of the puzzle?

I hope this provides the input you were looking for on this matter.

If you would like to discuss further, please give me a call.

Regards,
 Dave

David G. Wahman, Ph.D., P.E.
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From: Mike Curry [<mailto:mcurry@curryassociates.com>]
 Sent: Wednesday, November 08, 2017 10:26 AM

Electronic Filing: Received, Clerk's Office 11/8/2017

To: Wahman, David <Wahman.David@epa.gov>

Subject: Illinois EPA Proposed Regulation ... Nitrification Action Plan

Greetings David,

Trust all is well as weather is changing along our shared latitude.

IEPA has a proposal before the Illinois Pollution Control Board that would require all community systems using chloramines to develop and implement their own NAP (Nitrification Action Plan). We concur, and acknowledge that widespread occurrence of nitrification has not been document in Illinois ... and our course the proactive measure of having systems implement the NAP is a good move to minimize potential for nitrification problems. We were involved with a consecutive system last year about this time that experienced a SEVERE nitrification problem. There was a systemwide boil order for 2 months ... and it required extreme free chlorine residuals coupled with hard flushing to get it cleared up.

I am contacting you to ask you to share your view about my recommendation to IEPA and the Board to include monitoring for total Ammonia-N as part of the NAP. If free Ammonia-N is present in the distribution system and assuming the water at the point of entry does not have free Ammonia-N (i.e., using correct chemical feed procedures to produce monochloramine), the **presence of free Ammonia-N signifies that chloramine residual is decaying, but it does not indicate that nitrification is present.** Eventually, nitrification will develop if presence of free Ammonia-N persists ... but development of an autotrophic nitrifying biomass is not a rapid process. (I am sure you are aware of Darren's well documented Iowa pilot study to determine design criteria for biological oxidation of Ammonia-N that lasted over 500 days ... requiring over 50 days just to get the biological process initiated.)

My view is that monitoring to detect a reduction of total Ammonia-N in the distribution system is needed to determine whether or not nitrification is occurring. For example, if a point of entry monochloramine residual is 3 mg/L ... the total available Ammonia-N would be $3/5.06 = 0.59$ mg/L. When monitoring in the distribution system would detect a total Ammonia-N concentration less than 0.59 mg/L ... it would suggest that nitrification is occurring (the Ammonia-N is being oxidized to Nitrite-N, Nitrate-N). Depending on how well the monochloramine residual is holding up, Nitrite-N monitoring results, and the monitoring to indicate the amount of total Ammonia-N "loss" (oxidized to Nitrite-N ... to Nitrate-N) ... the Operator should have information to decide on corrective action. By tracking/recording total Ammonia-N in the distribution system, compared to the point of entry, monitoring for total Ammonia-N is, in my opinion, a necessary step. IEPA has rejected my recommendation to include monitoring for total Ammonia-N. I do not mind having my recommendation rejected ... but for successful implementation of a NAP I still contend that monitoring total Ammonia-N is needed. My interest is solely to promote "good NAPs".

Monitoring for Nitrate-N in surface waters should be included with the NAP, but due to potential raw water Nitrate-N concentration variations in streams and lakes, monitoring for Nitrate-N will not necessarily provide evidence that nitrification is occurring or not. I just checked some USACE data from Carlyle Lake in Illinois, and the Nitrate-N concentration varied considerably between barely detectible to 0.9 mg/L (as N). Surface water source Nitrate-N concentration likely varies in response to precipitation events and seasonal conditions where agricultural land is in the tributary watershed. I agree that Nitrate-N should be monitored, but I do not believe that it is necessarily an indicator that nitrification is present unless viewed as a component in the overall monitoring plan ... which would include Nitrite-N and total Ammonia-N.

Please would you mind commenting on my recommendation to include total Ammonia-N as a parameter to be monitored in the NAP. Please do not hesitate to contact me if you have any questions. Thanks.

Best ...

Capt. Michael D. Curry, P.E.
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Curry Followup Attachment Nitrate-N #1

**PUBLIC WATER SUPPLIES: PROPOSED NEW
35 ILL. ADM. CODE 604
R2018-017 (RULEMAKING – WATER)**

www.ipcb.state.il.us/

**SECOND HEARING, THURSDAY, NOVEMBER 16, 2017 AT 9:00 A.M.
CHICAGO AND SPRINGFIELD BY VIDEOCONFERENCE
IPCB SPRINGFIELD HEARING ROOM
CONFERENCE ROOM 1244 N, 1ST FLOOR
1021 N. GRAND AVE. E.
NORTH ENTRANCE**

PRE-FILED FOLLOWUP TESTIMONY
IN RESPONSE TO IEPA'S
RESPONSE TO CURRY'S INITIAL
PRE-FILED TESTIMONY

RESPECTFULLY SUBMITTED BY:



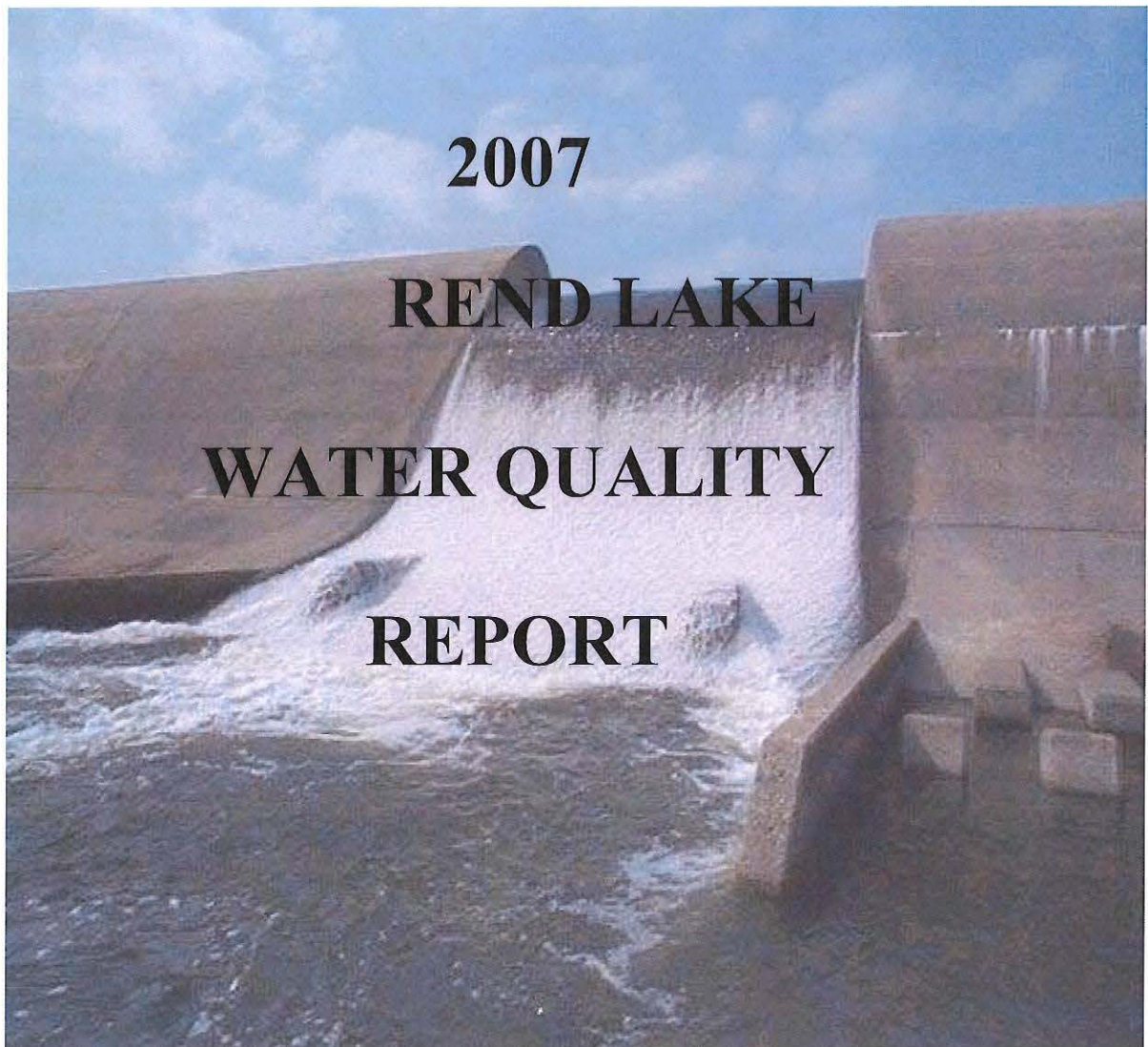
Capt. Michael D. Curry, PE.
As an individual
803 South Paul Street
Nashville, IL 62263
Work Ph. 618-327-8841
mcurry@curryassociates.com

SUBMITTAL DATE:

8 Nov 2017

Excerpt from 2007 Rend Lake Water Quality Report
U.S. Army Corps of Engineers, St. Louis District

Cover page
Location of sample sites
Nitrogen variation ... note Nitrate-N varied from 0.2 to 2.4 mg/L spike



U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
ENVIRONMENTAL QUALITY SECTION – WATER QUALITY

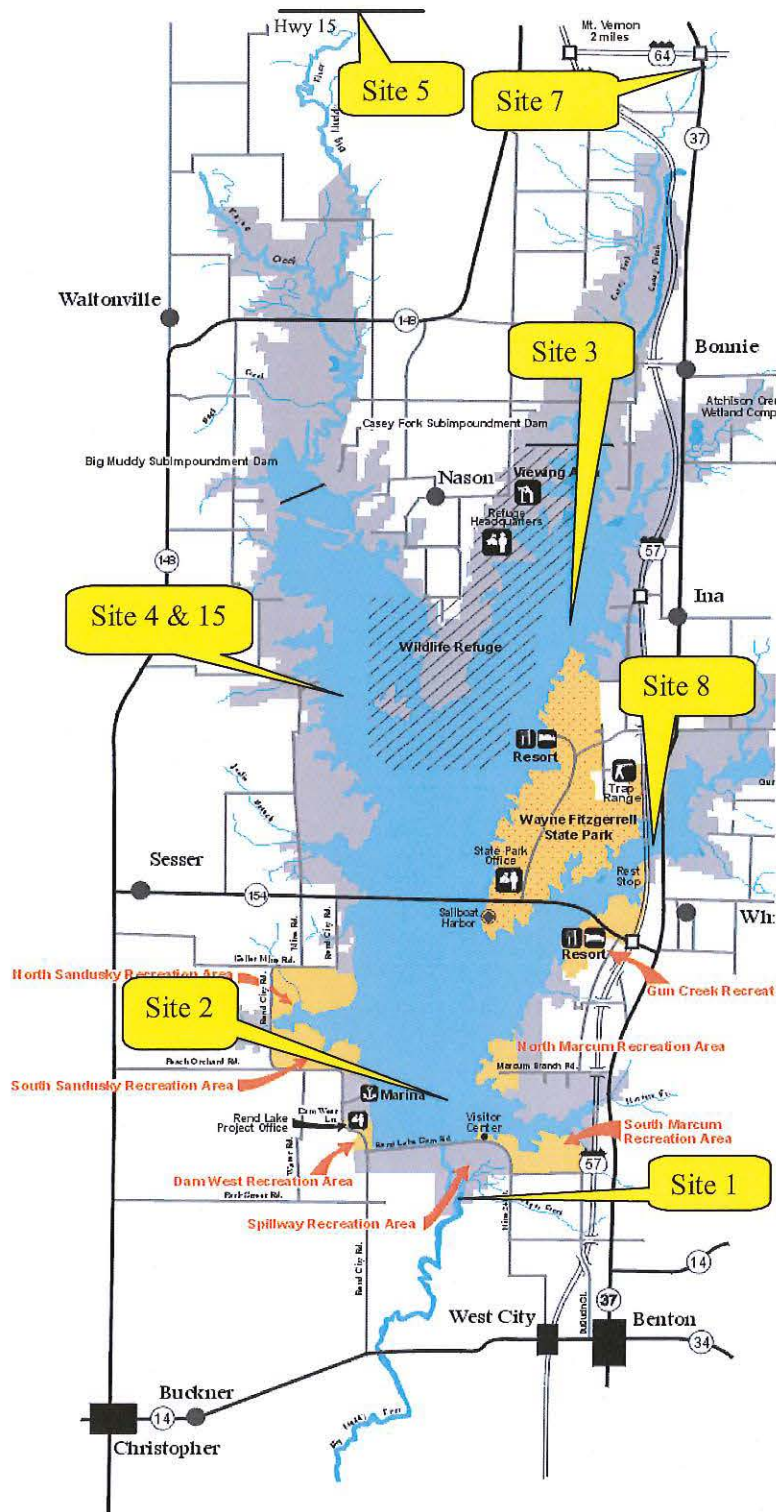
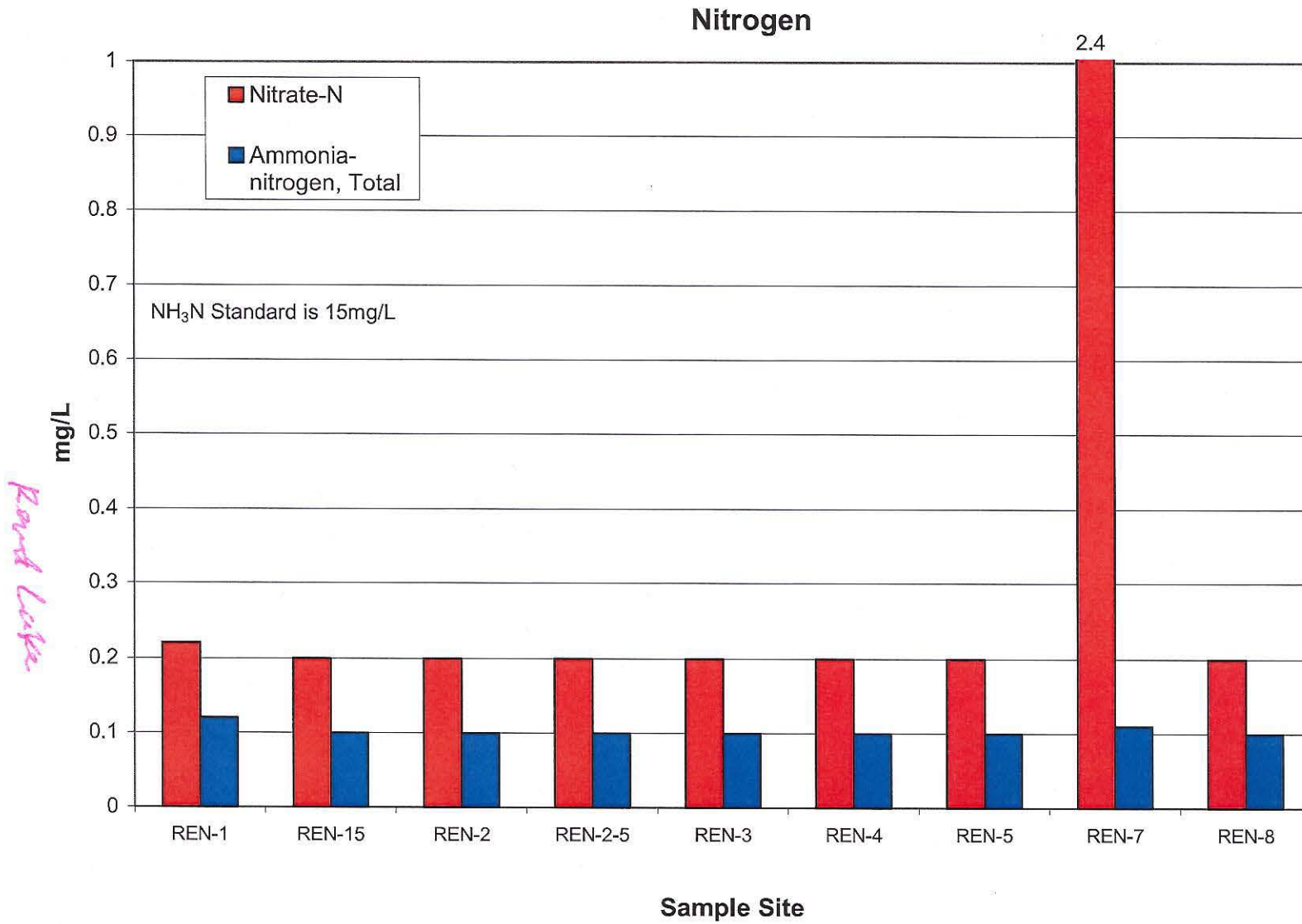


Figure 1
Location of sample sites
Rend Lake



Curry Followup Attachment Nitrate-N #2


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R2018-017 (RULEMAKING – WATER)**

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SUBMITTAL DATE:



Excerpt from 2012 Carlyle Lake Water Quality Report
U.S. Army Corps of Engineers, St. Louis District

Cover page
Location of sample sites
Nitrogen variation ... Nitrate-N varied from barely detectible to 0.9 mg/L



U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
ENVIRONMENTAL ENGINEERING SECTION – WATER QUALITY

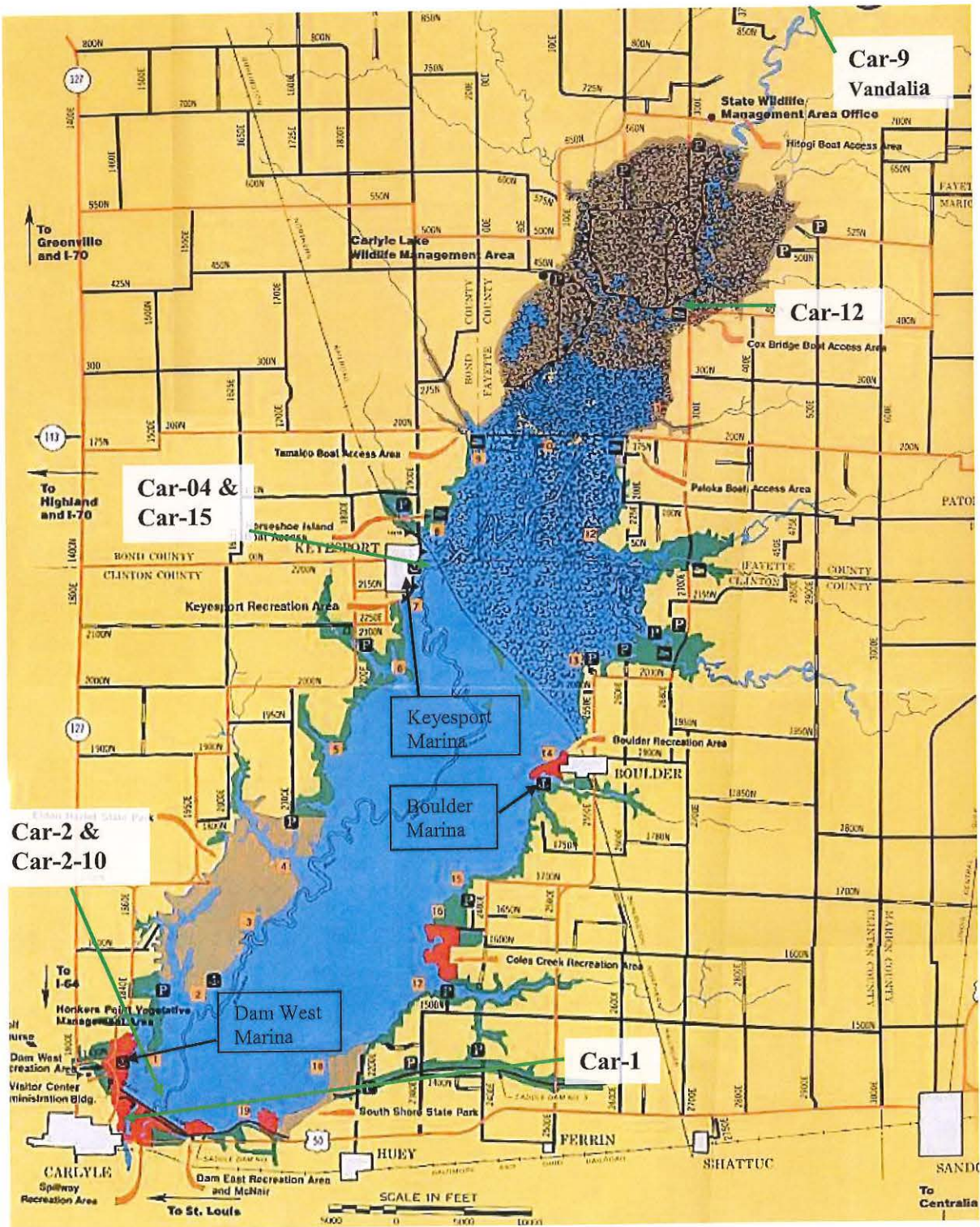
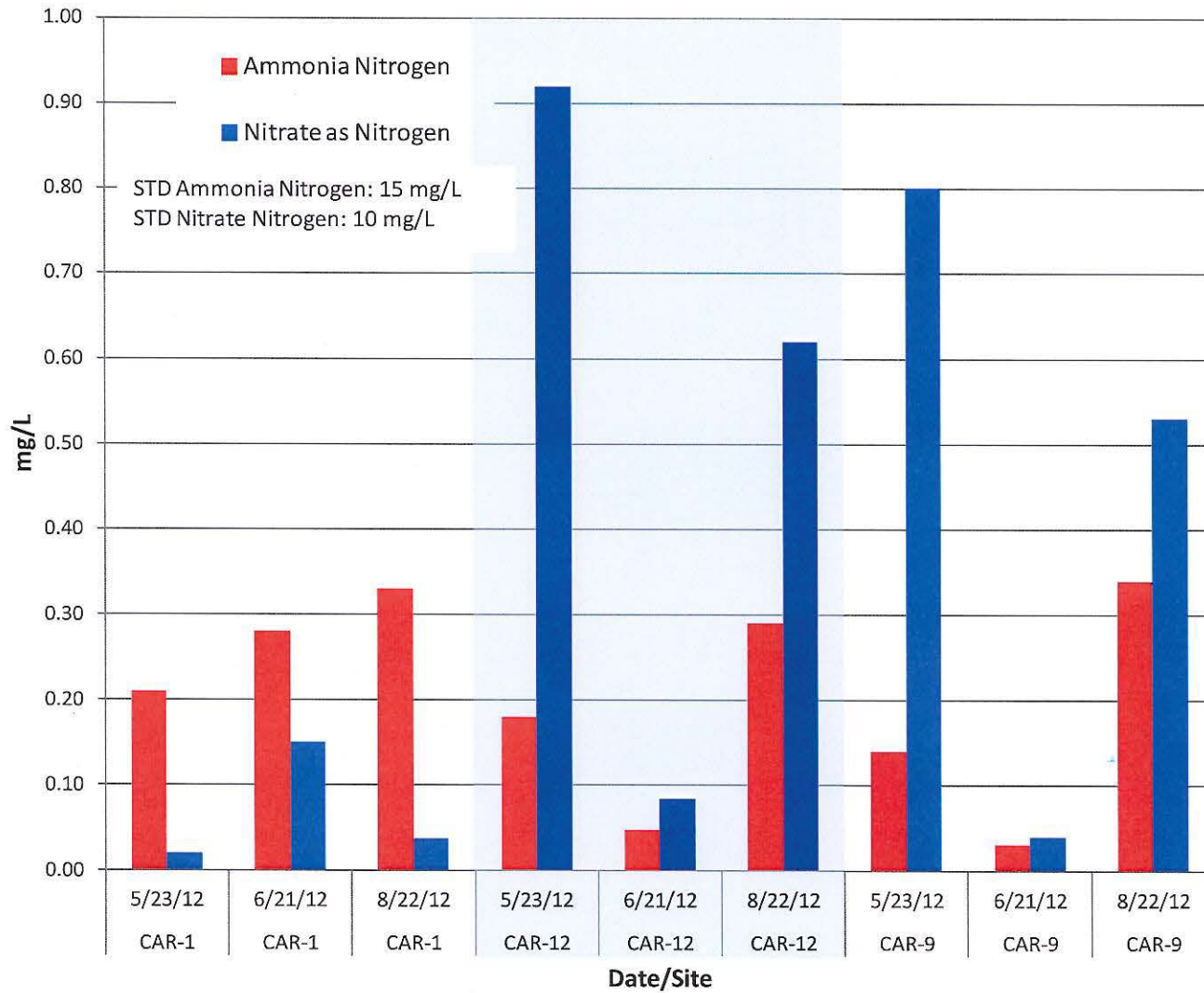


Figure 1
Location of sample sites

Carlyle Lake

Carlyle Tributary Ammonia Nitrogen & Nitrate Nitrogen



Carlyle Lake

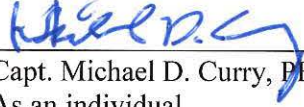
Curry Followup Attachment Nitrate-N #3

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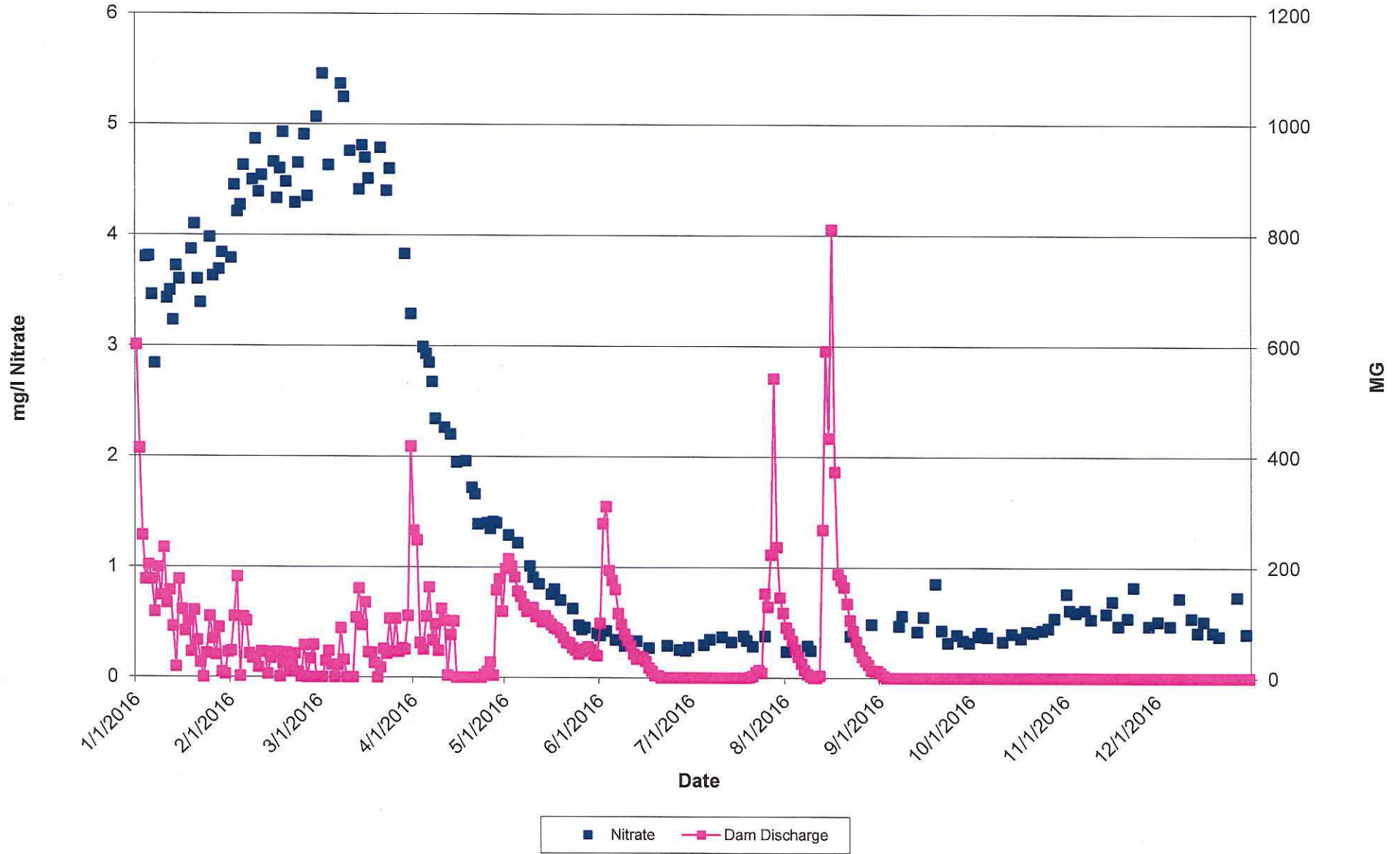
SUBMITTAL DATE: 8 Nov 2017

City of Springfield, IL
City Water, Light and Power

Nitrate Levels and Dam Discharge, Lake Springfield
(please note Nitrate variation)

Lake Springfield Nitrate Concentration
Maximum Level at Intake
(2005 – 2016, inclusive)
(please note Nitrate variation)

City Water, Light and Power Nitrate Levels and Dam Discharge



City Water, Light and Power
Lake Springfield Nitrate Concentration
Maximum Level At Intake

