BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

AQUA ILLINOIS, INC.,)
)
Petitioner,)
)
v.) PCB 2023-012
) (Permit Appeal - Public Water Supply)
ILLINOIS ENVIRONMENTAL PROTECTION)
AGENCY,)
)
Respondent.)

NOTICE OF ELECTRONIC FILING

To: *See Attached Service List*

PLEASE TAKE NOTICE that on the 23rd day of September, 2022, I caused to be filed with the Office of the Clerk of the Illinois Pollution Control Board by electronic filing the attached Certificate of Record on Appeal Filed on 9.23.22 and Record on Appeal Filed on 9.23.22, a true and correct copy of which is attached hereto and hereby served upon you.

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

/s/ *Kathryn A. Pamenter*
Christopher J. Grant
Kathryn A. Pamenter
Senior Assistant Attorneys General
Ann Marie A. Hanohano
Assistant Attorney General
Environmental Bureau
Office of the Illinois Attorney General
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Counsel for Aqua Illinois, Inc.
(via e-mail)

CERTIFICATE OF SERVICE

I, Kathryn A. Pamenter, a Senior Assistant Attorney General, hereby certify that on the 23rd day of September, 2022, I caused to be served the foregoing Notice of Electronic Filing, Certificate of Record on Appeal Filed on 9.23.22 and Record on Appeal Filed on 9.23.22 upon the parties named on the attached Service List, via e-mail or electronic filing as indicated.

/s/ *Kathryn A. Pamenter*
Christopher J. Grant
Kathryn A. Pamenter
Senior Assistant Attorneys General
Ann Marie A. Hanohano
Assistant Attorney General
Environmental Bureau
Office of the Illinois Attorney General
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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

AQUA ILLINOIS, INC.,

Petitioner,

v.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,

Respondent.

PCB 2023-012
(Permit Appeal-Public Water Supply)

CERTIFICATE OF RECORD ON APPEAL FILED ON 9.23.22

Pursuant to 35 Ill. Adm. Code 105.116 and 105.212, the following constitutes an index of documents comprising the Record on Appeal Filed on 9.23.22:

Category I: Any permit application or other request that resulted in the Agency's final decision:

PAGES	**DOCUMENT**	**DATE**
R 000001-000007	Aqua request for Supplemental Permit	Mar. 24, 2022
R 000008-000013	Aqua request for Special Exception Permit	Mar. 28, 2022

Category II: Correspondence with the petitioner and any documents or materials submitted by the petitioner to the Agency related to the permit application:

None.

Category III: The permit denial letter that conforms to the requirements of Section 39(a) of the Act or the issued permit or other Agency final decision:

PAGES	**DOCUMENT**	**DATE**
R 000014-000016	IEPA Special Exception Permit to modify IEPA Permit No. 0071-FY2021	June 29, 2022

Category IV: The hearing file of any hearing that may have been held before the Agency, including any transcripts and exhibits:

None.

Category V: Any other information the Agency relied upon in making its final decision:

A. Miscellaneous

PAGES	DOCUMENT	DATE
R 000017-000156	USEPA Guidance Document - Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems	March 2016
R 000157-000321	Aqua Corrosion Control Study Report (Parts 1 and 2)**	Nov. 2019
R 000322-000341	Aqua (Dr. Crockett) Presentation	Mar. 24, 2020
R 000342-000350	Aqua (Dr. Crockett) Presentation**	July 1, 2021
R 000351-000362	Aqua (Dr. Crockett) Presentation**	July 14, 2021
R 000363-000372	Dr. Edwards Presentation*, **	July 14, 2021
R 000373-000382	Aqua Chemical Change Description**	July 15, 2021
R 000383-000434	IEPA Construction Permit No. 0071-FY2021*, **	July 30, 2021
R 00435-000442	IEPA Operating Permit No. 0071-FY2021	Aug. 3, 2021
R 000443-000451	Aqua (Dr. Crockett) Presentation*	Oct. 29, 2021
R 000452-000470	Dr. Edwards Presentation*, **	Oct. 29, 2021
R 000471-000487	Aqua Final Optimal Corrosion Control Treatment Report**	Jan. 27, 2022
R 000488-000493	Aqua OCCT Evaluation of Treatment Alternatives Form	Feb. 14, 2022
R 000494	Aqua OCCT Recommendation Form	Feb. 14, 2022
R 000495-000500	Draft IEPA Special Exception Permit to modify IEPA Permit No. 0071-FY2021	June 2022
R 000501-000521	Summary Spreadsheet of University Park water quality data	Aug. 2021 - June 2022
R 000522-000580	Summary Spreadsheet of University Park lead compliance sampling results**	July 1, 2019 – June 29, 2022

R 000581-000600	Email from David Cook dated November 5, 2021 with Kankakee and Iroquois River nitrate data and related emails	Various
R 000601	Kankakee WTP TP01 Nitrate	Apr. 2000 – Apr. 2021

B. Court Order

PAGES	DOCUMENT	DATE
R 000602-000621	Agreed Interim Order	Nov. 1, 2019

C. Regulations

PAGES	DOCUMENT	DATE
--	35 Ill. Adm. Code Part 611, Subpart G***	--
--	35 Ill. Adm. Code 601.101***	

* Petitioner previously requested that such presentations be kept confidential. On September 19 and 20, 2022, respectively, Petitioner gave its written authorization to make such presentations public.

**Addresses have been redacted.

***Respondent has not included a copy of these regulations, as they may be found on the Illinois Pollution Control Board's website.

VI. Privileged Material. Any inadvertent disclosure of any information or documents that are protected by the attorney-client privilege, the work product doctrine, or any other privilege, doctrine or legal theory protecting information from discovery is not to be deemed a waiver of any such privilege or protection.

[THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK]

I, David Cook, of the Illinois Environmental Protection Agency hereby certify that the documents contained in the Record on Appeal filed on 9.23.22 in the above-referenced matter and summarized in the above index, is complete to the best of my knowledge, information, and belief.

BY: ______________________________

David Cook
Manager, Permit Section
Division of Public Water Supplies
Illinois Environmental Protection Agency

Signature Page to Certificate of Record on Appeal Filed on 9.23.22
in Permit Appeal PCB 2023-012

AQUA
An Essential Utilities Company

March 24, 2022

Mr. David Cook
Manager
Division of Public Water Supplies, Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

RE: Aqua Illinois-University Park-Facility ID: IL 1975030
County: Will
Permit 0071-FY2022
Request for Supplemental Permit

Dear Mr Cook:

On July 30, 2021, the Illinois Environmental Protection Agency ("Illinois EPA" or "Agency") issued to Aqua Illinois Construction Permit No. 0071-FY2022 ("Construction Permit") authorizing the switch of corrosion control treatment to zinc orthophosphate for the University Park Water System ("UP Water System"). On that same day, Illinois EPA authorized the operation of the new treatment pursuant to Operating Permit 0071-FY2022 ("Operating Permit" and collectively with the Construction Permit as "Construction/Operating Permit"). In addition to the Standard Conditions, Illinois EPA also included 7 additional Special Conditions in the Construction Permit as part of the Agency's approval of the project to switch the treatment. Circumstances have changed and the UP Water System now meets the lead action level as of the July-December, 2021 compliance monitoring period. Further, on February 15, 2022, Aqua Illinois submitted its Final Optimal Corrosion Control Treatment identifying zinc orthophosphate as the optimal treatment.

Please find enclosed a written request for issuance of a Supplemental Permit to alter the sampling plan contained within the Construction/Operating Permit or in the alternative, issuance of a modification to the Construction/Operating Permit. Issuance of a Supplemental Permit (or modification to the Construction/Operating Permit) is appropriate and consistent with Section 39

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Illinois EPA

of the Illinois Environmental Protection Act, 415 ILCS 5/1 *et seq* ("Act") and applicable Illinois Pollution Control Board regulations promulgated thereunder.

We look forward to working with the Agency on this written request as quickly as possible. As always, we remain available at any time to discuss any aspect of our sampling and work in University Park.

Sincerely,

Melissa Kah

Melissa Kahoun
Environmental Compliance Manager

Aqua Illinois: Permit Application for a Supplemental Permit or, In the Alternative, to Modify Certain Conditions of Construction and Operating Permit 0071-FY2022

On July 30, 2021, the Illinois Environmental Protection Agency ("Illinois EPA") issued to Aqua Illinois Construction Permit No. 0071-FY2022 ("Construction Permit") authorizing the switch of corrosion control treatment to zinc orthophosphate for the University Park Water System ("UP Water System"). On that same day, Illinois EPA authorized the operation of the new treatment pursuant to Operating Permit 0071-FY2022 ("Operating Permit"). In addition to the Standard Conditions, Illinois EPA also included 7 additional Special Conditions in the Construction Permit as part of the Agency's approval of the project to switch the treatment. Circumstances have changed and the UP Water System now meets the lead action level as of the July-December, 2021 compliance monitoring period. Further, on February 15, 2022, Aqua Illinois has submitted its Final Optimal Corrosion Control Treatment Recommendation ("Final OCCT Recommendation") identifying zinc orthophosphate as the optimal treatment. The Final OCCT Recommendation is provided as Attachment A to this permit application and is incorporated by reference herein. Aqua Illinois is requesting a Supplemental Permit to modify the project, more specifically, to modify the compliance sampling plan contained within the Construction/Operating Permit No. 0071-FY2022, or in the alternative, a permit modification to Construction/Operating Permit.[1]

Aqua Illinois is seeking to alter the compliance sampling plan contained in Special Condition 6 of the Construction/Operating Permit by replacing the existing Special Condition 6 in full with the following:

> ***Collect between 40 and 60 lead compliance samples from the kitchen tap of compliance pool approved individual sample site locations for the month of March, 2022, as the final month of monthly compliance sampling. Thereafter, the supplier shall be required to collect no fewer than 40 lead compliance samples from compliance pool sample site locations only once in each subsequent six-month compliance sampling period and may then reduce monitoring consistent with Section 35 Ill. Adm. Code 611.356(d)(4). Aerators shall not be cleaned within 96-hours of sample collection.***

Aqua Illinois is also seeking the addition of a new Special Condition 7:

During calendar year 2022 and during each month in which the supplier is not collecting compliance samples pursuant to Special Condition 6 and 35 Ill. Adm. Code 611.356, the supplier shall collect no fewer than 10 tap water samples from the kitchen tap in 500 ML bottles, after a six-hour stagnation period, testing for lead only, at compliance sampling pool sample site locations. Aerators shall not be cleaned within 96-hours of sample collection

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Since July 30, 2021, Aqua Illinois has been performing compliance sampling pursuant to the Illinois LCR and the special conditions included in the Construction Permit authorizing the zinc orthophosphate treatment change project. At the time of permit issuance, the UP Water System did not meet the LCR lead action level and a treatment change was needed to address the subset of homes with lead plumbing not responding to the previously approved treatment. Circumstances have changed since permit issuance and the UP Water System now meets the lead action level. Since Aqua Illinois switched to zinc orthophosphate, Aqua has collected 289 samples, observing a 90% percentile of 5.6 ppb. Additionally, 76% of the compliance samples were non-detect for lead since the treatment switch. Further, Aqua

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[1] Since the Agency's rules regarding the modification of public water supply permits are unclear as to the precise procedures, Aqua Illinois is applying for a Supplemental Permit, Construction/Operating Permit Modification and, by separate submittal, a Special Exception Permit to modify its compliance sampling plan.

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Illinois EPA

Illinois has submitted its Final OCCT Recommendation identifying zinc orthophosphate as the optimal treatment for the UP Water System. In support of the request for issuance of a Supplemental Permit (or, in the alternative, a modification to the Construction/Operating Permit) authorizing the compliance sampling plan presented in the special conditions detailed above, Aqua Illinois submits the following:

1. **The compliance sampling plan contained in Special Condition 6 should be altered now that the UP Water System has met the lead action level.**

    - The alterations to the compliance sampling plan Aqua Illinois seeks are those contained in the special conditions detailed above. The requested compliance sampling plan meets and is consistent with the requirements of the Act and Board regulations specifically those found in the State LCR.

2. **The compliance sampling regime mandated by 35 Ill Adm. Code 611.356 has as its most aggressive sampling frequency, the collection of samples once during each six month compliance monitoring period.**

    - The sampling regime requires sampling once in every six month monitoring period as the most frequent sampling frequency with the regulations allowing for a reduction of monitoring frequency based on achieving certain milestones.

    - The federal LCR, its regulatory history, and the Illinois LCR, do not mandate the imposition of a monthly compliance sampling regime. In promulgating the LCR, USEPA, after considering many factors and comments provided during the LCR rulemaking process, specifically contemplated ***and rejected*** other sampling frequencies, including quarterly sampling. In fact, in promulgating the final LCR in 1991, EPA specifically stated: "EPA's approach is fully consistent with the letter and intent of the SWDA." See 56 Fed. Reg. at 26513 (June 7, 1991). USEPA also considered both customer inconvenience and exhaustion and cost to the supplier when promulgating its approach to compliance sampling frequency. When deciding on the regulatory approach to compliance sampling (with the highest frequency being once every six months), USEPA already considered variability in results and confirmed its approach of not requiring more frequent sampling. Further, in so mandating the number of samples, USEPA specifically found that "the number of samples required in the final rule sufficiently accounts for variability in lead and copper levels..." See 56 Fed. Reg. at 26523.

    - Although 35 Ill Adm. Code 611.356(e) requires that all sampling meeting the compliance sampling requirements be considered in calculating the 90th percentile, this regulatory provision is not a source of authority to mandate additional monitoring much less monthly compliance sampling. Further, Section 19 of the Illinois Environmental Protection Act, 415 ILCS 4/19 is also not a source of authority for imposition of monthly LCR-driven compliance sampling.

3. **Section 611.Table D lists the number and frequency of samples that are required. Table D is identical in substance to Table 18 promulgated by USEPA in 1991.**

- **Section 611.TABLE D Number of Lead and Copper Monitoring Sites**

System Size (Persons Served)	Number of Sites (Standard Monitoring)	Number of Sites (Reduced Monitoring)
More than 100,000	100	50
10,001-100,000	60	30
3,301 to 10,000	40	20
501 to 3,300	20	10
101 to 500	10	5
100 or fewer	5	5

BOARD NOTE: Derived from 40 CFR 141.86(c).

- According to the size and status of the UP Water System, Aqua Illinois is required to obtain 40 samples during each six month monitoring period. Under the compliance sampling plan in the Construction/Operating Permit, Aqua Illinois is required to obtain a minimum 40-60 compliance samples each month equating to 240-360 compliance samples during each compliance monitoring period.

4. **The regulatory compliance sampling framework is already designed to include highest risk sampling sites through the site selection requirements of 35 Ill. Adm. Code 611.356.**

- To account for the sites with the highest risk of lead, 35 Ill. Adm. Code 611.356 requires suppliers to select sites based on a tiering. Aqua Illinois has roughly 80 sampling sites on its approved list.

- In addition to mandating monthly compliance sampling, Illinois EPA is also requiring Aqua Illinois to return to homes with the highest results each month ***within the same compliance monitoring period***. Such an approach (if customer cooperation is obtained) theoretically and practically results in the ***same high result home*** being counted four times in a compliance monitoring period instead of once.

- Such a sample consequence was considered and specifically rejected by USEPA in developing the regulatory sampling frequency and number of samples to be required. To be sure, EPA determined that its final rule requires a ***sufficient number*** of samples and "will catch "high levels" in the System by requiring sampling at high risk sites." See 56 Fed. Reg. at 26524. Quadrupling high sample results during a single compliance monitoring period to "catch high results" is inconsistent with the overall sampling approach crafted by USEPA and is not necessary to carry out the purposes of the Act or Illinois LCR.

5. **By mandating both monthly compliance sampling and compliance sampling with a repeated focus on the sites with the highest prior results, the existing compliance sampling plan is causing a bias in the calculation of the 90th percentile used to determine whether a lead action level exceedance exists for the water system.**

- USEPA itself identified the bias that occurs when repeat samples are taken from homes within the same compliance monitoring period in its discussion of the promulgation of its 2021 revisions to the LCR "find and fix" follow up sampling requirements. Although the final rule revising the LCR requires multiple home sampling, EPA cautions: "[t]he results of these "find-and-fix" follow up samples would be submitted to the state but would not be included in the system's 90th percentile calculation **because multiple investigatory samples at locations with high lead levels would bias results**." 86 Fed. Reg. 4198, 4235 (January 15, 2021) (Emphasis Added)

- The formula for calculating the 90th percentile under the Illinois LCR is skewed when a supplier is required to take repeat compliance samples at high result homes during a compliance monitoring period. This is especially exaggerated when the sampling site locations as a whole have already been selected based on the highest risk of lead due to the age of the home (since here, the UP Water System itself does not contain lead nor are there lead service lines).

- Such bias in selection and exclusion, with an exaggerated focus on high lead results does not benefit the purpose of the sampling, does not provide System customers with an accurate picture of the meaning of the 90th percentile calculation as it relates to their water supply and is inconsistent with the regulations.[2]

6. **The LCR does not require water suppliers to collect compliance samples only when water quality parameters (like CSMR or nitrate) present at worst case conditions.**

    - Aqua Illinois is not currently seeking alteration to the water quality parameter monitoring conditions included in the Construction/Operating Permit.

7. **The Agency has never mandated the following compliance sampling plan elements on any other water supplier in its regulatory history: monthly compliance sampling; repeated collection of compliance samples from the same high result homes within the same compliance sampling period; and/or compliance samples to be collected specifically during worst case water quality conditions of the compliance sampling period.**

    - The Illinois LCR, as promulgated by the Board is an identical in substance rule and USEPA has specifically considered and promulgated the compliance sampling framework it deemed necessary and protective of human health. If the Agency wishes to have in place in Illinois a more stringent compliance sampling regime, it should go through a rulemaking process before the Illinois Pollution Control Board so the "more stringent than federal requirements" can be vetted through notice and comment for all interested stakeholders impacted in Illinois.

During the 30 years since the LCR was promulgated, the frequency of compliance sampling during a compliance monitoring period and the number of compliance samples required to be taken during a compliance monitoring period have both remained unchanged. Aqua Illinois' requested alteration to the compliance sampling plan presented herein conforms fully with (and goes beyond) the applicable regulatory sampling framework developed by USEPA and

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[2] We note that very recently USEPA has not imposed monthly compliance sampling at its most recent LCR lead action level exceedance case involving Benton Harbor, MI.

promulgated by identical in substance rulemaking by the Board and as specifically imposed by the Illinois PWS regulations.

AQUA
An Essential Utilities Company

March 28, 2022

Mr. David Cook
Manager
Division of Public Water Supplies, Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

RE: Aqua Illinois-University Park-Facility ID: IL 1975030
County: Will
Permit 0071-FY2022
Request for Special Exception Permit

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Div. of Public Water Supplies
Illinois EPA

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Aqua is submitting this request for a Special Exception Permit ("SEP") pursuant to 35 Ill. Adm. Code 602.600(d) and because: the precise procedure for alteration of permits under the Illinois Pollution Control Board Public Water Supply regulations is unclear; and in past practice, the Agency has used the SEP approach to alter sampling plans, among other permit conditions. By separate submittal, Aqua has also applied to Illinois EPA for a Supplemental Permit, or in the alternative, for a modification of the Construction/Operating Permit.

Specific Requests Regarding Compliance Sampling Plan

Aqua Illinois is seeking to alter the compliance sampling plan contained in Special Condition 6 of the Construction/Operating Permit by replacing the existing Special Condition 6 in full with the following:

Collect between 40 and 60 lead compliance samples from the kitchen tap of compliance pool approved individual sample site locations for the month of March, 2022, as the final month of monthly compliance sampling. Thereafter, the supplier shall be required to collect no fewer than 40 lead compliance samples from compliance pool sample site locations only once in each subsequent six-month compliance sampling period and may then reduce monitoring consistent with Section 35 Ill. Adm. Code 611.356(d)(4). Aerators shall not be cleaned within 96-hours of sample collection.

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Background and Justification for Issuance

Since July 30, 2021, Aqua Illinois has been performing compliance sampling pursuant to the Illinois LCR and the special conditions included in the Construction Permit authorizing the zinc orthophosphate treatment change project. At the time of permit issuance, the UP Water System did not meet the LCR lead action level and a treatment change was needed to address the subset of homes with lead plumbing not responding to the previously approved treatment. Circumstances have changed since permit issuance and the UP Water System now meets the lead action level. Since Aqua Illinois switched to zinc orthophosphate, Aqua has collected 289 samples, observing a 90th percentile of 5.6 ppb. Additionally, 76% of the compliance samples were non-detect for lead since the treatment switch. Further, Aqua Illinois has submitted its Final OCCT Recommendation identifying zinc orthophosphate as the optimal treatment for the UP Water System. In support of the request for issuance of a SEP authorizing the compliance sampling plan presented in the special conditions detailed above, Aqua Illinois submits the following:

1. **The compliance sampling plan contained in Special Condition 6 should be altered now that the UP Water System has met the lead action level.**
    - The alterations to the compliance sampling plan Aqua Illinois seeks are those contained in the special conditions detailed above. The requested compliance sampling plan meets and is consistent with the requirements of the Act and Board regulations specifically those found in the State LCR.
2. **The compliance sampling regime mandated by 35 Ill Adm. Code 611.356 has as its most aggressive sampling frequency, the collection of samples once during each six-month compliance monitoring period.**
    - The sampling regime requires sampling once in every six-month monitoring period as the most frequent sampling frequency with the regulations allowing for a reduction of monitoring frequency based on achieving certain milestones.
    - The federal LCR, its regulatory history, and the Illinois LCR, do not mandate the imposition of a monthly compliance sampling regime. In promulgating the LCR, USEPA, after considering many factors and comments provided during the LCR rulemaking process, specifically contemplated and rejected other sampling frequencies, including quarterly sampling. In fact, in promulgating the final LCR in 1991, EPA specifically stated: "EPA's approach is fully consistent with the letter and intent of the SWDA." See 56 Fed. Reg. at 26513 (June 7, 1991). USEPA also considered both customer inconvenience and exhaustion, and cost to the supplier when promulgating its approach to compliance sampling frequency. When deciding on the regulatory approach to compliance sampling (with the highest frequency being once every six months), USEPA already considered variability in results and confirmed its approach of not requiring more frequent sampling. Further, in so mandating the number of samples, USEPA specifically found that "the number of samples required in the final rule sufficiently accounts for variability in lead and copper levels…" See 56 Fed. Reg. at 26523.

    - Although 35 Ill Adm. Code 611.356(e) requires that all sampling meeting the compliance sampling requirements be considered in calculating the 90th percentile, this regulatory provision is not a source of authority to mandate additional monitoring much less monthly compliance sampling. Further, Section 19 of the Illinois Environmental Protection Act, 415 ILCS 4/19 is also not a source of authority for imposition of monthly LCR-driven compliance sampling.
3. **Section 611.Table D lists the number and frequency of samples that are required. Table D is identical in substance to Table 18 promulgated by USEPA in 1991.**

- **Section 611.TABLE D Number of Lead and Copper Monitoring Sites**

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BOARD NOTE: Derived from 40 CFR 141.86(c).

- According to the size and status of the UP Water System, Aqua Illinois is required to obtain 40 samples during each six-month monitoring period. Under the compliance sampling plan in the Construction/Operating Permit, Aqua Illinois is required to obtain a minimum 40-60 compliance samples each month equating to 240-360 compliance samples during each compliance monitoring period.

4. **The regulatory compliance sampling framework is already designed to include highest risk sampling sites through the site selection requirements of 35 Ill. Adm. Code 611.356.**
   - To account for the sites with the highest risk of lead, 35 Ill. Adm. Code 611.356 requires suppliers to select sites based on a tiering. Aqua Illinois has roughly 80 sampling sites on its approved list.
   - In addition to mandating monthly compliance sampling, Illinois EPA is also requiring Aqua Illinois to return to homes with the highest results each month ***within the same compliance monitoring period***. Such an approach (if customer cooperation is obtained) theoretically and practically results in the ***same high result home*** being counted four times in a compliance monitoring period instead of once.
   - Such a sample consequence was considered and specifically rejected by USEPA in developing the regulatory sampling frequency and number of samples to be required. To be sure, EPA determined that its final rule requires a ***sufficient number*** of samples and "will catch "high levels" in the System by requiring

sampling at high risk sites." *See* 56 Fed. Reg. at 26524. Quadrupling high sample results during a single compliance monitoring period to "catch high results" is inconsistent with the overall sampling approach crafted by USEPA and is not necessary to carry out the purposes of the Act or Illinois LCR.

5. **By mandating both monthly compliance sampling and compliance sampling with a repeated focus on the sites with the highest prior results, the existing compliance sampling plan is causing a bias in the calculation of the 90th percentile used to determine whether a lead action level exceedance exists for the water system.**
    - USEPA itself identified the bias that occurs when repeat samples are taken from homes within the same compliance monitoring period in its discussion of the promulgation of its 2021 revisions to the LCR "find and fix" follow up sampling requirements. Although the final rule revising the LCR requires multiple home sampling, EPA cautions: "[t]he results of these "find-and-fix" follow up samples would be submitted to the state but would not be included in the system's 90th percentile calculation **because multiple investigatory samples at locations with high lead levels would bias results**." 86 Fed. Reg. 4198, 4235 (January 15, 2021) (Emphasis Added)
    - The formula for calculating the 90th percentile under the Illinois LCR is skewed when a supplier is required to take repeat compliance samples at high result homes during a compliance monitoring period. This is especially exaggerated when the sampling site locations as a whole have already been selected based on the highest risk of lead due to the age of the home (since here, the UP Water System itself does not contain lead nor are there lead service lines).
    - Such bias in selection and exclusion, with an exaggerated focus on high lead results does not benefit the purpose of the sampling, does not provide System customers with an accurate picture of the meaning of the 90th percentile calculation as it relates to their water supply and is inconsistent with the regulations.[1]
6. **The LCR does not require water suppliers to collect compliance samples only when water quality parameters (like CSMR or nitrate) present at worst case conditions.**
    - Aqua Illinois is not currently seeking alteration to the water quality parameter monitoring conditions included in the Construction/Operating Permit.
7. **The Agency has never mandated the following compliance sampling plan elements on any other water supplier in its regulatory history: monthly compliance sampling; repeated collection of compliance samples from the same**

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[1] We note that USEPA has not imposed monthly compliance sampling at its most recent LCR lead action level exceedance case involving Benton Harbor, MI.

high result homes within the same compliance sampling period; and/or compliance samples to be collected specifically during worst case water quality conditions of the compliance sampling period.

- The Illinois LCR, as promulgated by the Board is an identical in substance rule and USEPA has specifically considered and promulgated the compliance sampling framework it deemed necessary and protective of human health. If the Agency wishes to have in place in Illinois a more stringent compliance sampling regime, it should go through a rulemaking process before the Illinois Pollution Control Board so the "more stringent than federal requirements" can be vetted through notice and comment for all interested stakeholders impacted in Illinois.

During the 30 years since the LCR was promulgated, the frequency of compliance sampling during a compliance monitoring period and the number of compliance samples required to be taken during a compliance monitoring period have both remained unchanged. Aqua Illinois' requested alteration to the compliance sampling plan presented herein conforms fully with (and goes beyond) the applicable regulatory sampling framework developed by USEPA and promulgated by identical in substance rulemaking by the Board and as specifically imposed by the Illinois PWS regulations.

We look forward to working with the Agency on this SEP request as quickly as possible. As always, we remain available at any time to discuss any aspect of our sampling and work in University Park.

Sincerely,

Melissa Kah

Melissa Kahoun
Environmental Compliance Manager

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR
JOHN J. KIM, DIRECTOR

217/782-1724

SPECIAL EXCEPTION PERMIT

June 29, 2022

Ms. Melissa Kahoun
Environmental Compliance Manager
Aqua Illinois Water Company
1000 South Schuyler Avenue
Kankakee, IL 60901

Re: Aqua IL University Park (IL1975030)
Request to Modify Permit Conditions for 0071-FY2022

Dear Ms. Kahoun:

The Illinois Environmental Protection Agency (Agency) has reviewed Aqua's two letters. The request in both letters was to modify additional condition #6 on Construction Permit 0071-FY2022 and to add a new additional condition #7. The March 24, 2022 letter was a request for supplemental permit and was received on March 31, 2022. The March 28, 2022 letter was a request for a special exception permit and was received on April 1, 2022. Both letters were reviewed together and logged into Permit Tracking using log number 2022-1072.

The letters were reviewed along with the data received from the additional conditions in construction permit 0071-FY2022. Pursuant to 35 Ill. Adm. Code 602.600 the Agency has decided to replace all the permit conditions to construction permit 0071-FY2022 for clarity and based upon the Lead and Copper Rule steps in the Part 611 regulations.

The conditions below supersede and replace the additional conditions in Construction Permit 0071-FY2022. The conditions are in the same order as the construction permit for clarity. Significant additions from the language in the construction permit are underlined.

ADDITIONAL CONDITIONS:

1. An operating permit was required prior to feeding zinc orthophospate. The operating permit for permit number 0071-FY2022 was issued on August 3, 2021. This Special Exception Permit replaces the additional conditions in construction permit 0071-FY2022.

2. The zinc orthophosphate product must be NSF/ANSI 60 approved and contain a 1:10 Zn to PO_4 ratio. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 604.105(g) and Chemical Change Description dated July 15, 2021.)

3. Optimal Water Quality Parameter (OWQP) ranges will be set after Optimal Corrosion Control Treatment (OCCT) is designated and the community water supply meets the lead action level in two consecutive six-month monitoring periods.The orthophosphate dose and residual shall be a minimum of 3 mg/L as PO_4. The pH range shall be 7.4 to 8.0 at the Central Avenue Booster Station. The zinc range shall be 0.3 - 0.5 mg/L. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 611.351(e) and the Chemical Change Description dated July 15, 2021)

4. Water quality monitoring must be conducted for the Aqua Illinois - University Park community water supply as described below and results submitted for each month to david.cook@illinois.gov within 10 days after the last day of the month. The submissions must include all water quality parameter monitoring done during the month including any monitoring not mentioned here.

The revised water quality monitoring requirements include daily monitoring for flow and orthophosphate at the Central Avenue Booster Pump Station, weekly monitoring for pH and nitrate at the Central Avenue Booster Pump Station, and quarterly monitoring at three locations for free chlorine, total chlorine, monochloramine, free ammonia, orthophosphate, pH, and alkalinity. In addition, quarterly monitoring at three locations is required for chloride, sulfate, CSMR (calculated value), nitrite, nitrate, iron, manganese, and zinc. Quarterly monitoring at one location is required for Total Organic Carbon (TOC).

Any water quality parameter monitoring conducted must be reported in a spreadsheet. The data are needed to set Optimal Water Quality Parameter (OWQP) ranges. This additional condition expires after the Agency sets OWQP ranges. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 604.140, 611.352(a), 611.352(f), the Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Supplies, USEPA March 2016 (Updated), and the Chemical Change Description dated July 15, 2021)

5. Nitrate water quality monitoring must be conducted for the Aqua Illinois - Kankakee entry point to the distribution system on a weekly basis and results submitted to david.cook@illinois.gov within 10 days after the last day of the month. The nitrate water quality results must be reported in a spreadsheet. This additional condition expires after the Agency sets OWQP ranges. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, and 611.352(f))

6. Additional condition #6 of construction permit 0071-FY2022 is terminated by this Special Exception Permit as it is duplicative to the lead compliance monitoring requirement in the Agreed Interim Order. The elimination of this condition does not eliminate the monthly lead compliance monitoring that is required pursuant to the Agreed Interim Order. (People of the State of Illinois, No. 19 CH 1208, November 1, 2019)

As the Agreed Interim Order requires monthly monitoring, Aqua's request to modify additional condition #6 is denied. The request to add a new additional condition #7 is denied, since it is moot based upon Agreed Interim Order that continues to require monthly lead compliance monitoring.

Sincerely,

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

cc: Donald Denault, Certified Operator
Elgin Regional Office
DPWS/CAS

United States
Environmental Protection
Agency

Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems

Office of Water (4606M)
EPA 816-B-16-003
March 2016 (Updated)

Disclaimer

This document provides technical recommendations to primacy agencies and public water systems (PWSs) in determining the most appropriate treatment for controlling lead and copper and complying with the corrosion control treatment (CCT) requirements of the Lead and Copper Rule (LCR) that are in place at the time of document publication.

The statutory provisions and EPA regulations described in this document contain legally binding requirements. This document is not a regulation itself, nor does it change or substitute for those provisions and regulations. Thus, it does not impose legally binding requirements on EPA, states or the regulated community. This document does not confer legal rights or impose legal obligations upon any member of the public.

While EPA has made every effort to ensure the accuracy of the discussion in this document, the obligations of the regulated community are determined by statutes, regulations or other legally binding requirements. In the event of a conflict between the discussion in this document and any statute or regulation, this document would not be controlling.

The general descriptions provided here may not apply to a particular situation based upon the circumstances. Interested parties are free to raise questions and objections about the substance of these technical recommendations and the appropriateness of the application of these technical recommendations to a particular situation. EPA and other decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those described in this document, where appropriate.

Mention of trade names or commercial products does not constitute endorsement or recommendation for their use.

This is a living document and may be revised periodically without public notice. EPA welcomes public input on this document at any time.

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Table of Contents

Exhibits

Flowcharts

Acronyms

AL	Action Level
ANSI	American National Standards Institute
AWWA	American Water Works Association
CCPP	Calcium Carbonate Precipitation Potential
CCT	Corrosion Control Treatment
COC	Chain of Custody
CSMR	Chloride-to-Sulfate Mass Ratio
CWS	Community Water System
DBP	Disinfection Byproduct
DBPR	Disinfection Byproducts Rule
DIC	Dissolved Inorganic Carbon
DO	Dissolved Oxygen
EDS	Energy Dispersive Spectroscopy
EMF	Electromotive Force
EPA	Environmental Protection Agency
HAA5	Haloacetic Acids
ICP-MS	Inductively Coupled Plasma Mass Spectroscopy
LCR	Lead and Copper Rule
LSI	Langelier Saturation Index
LSL	Lead Service Line
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCLG	Maximum Contaminant Level Goal
MDBPR	Microbial and Disinfection Byproducts Rules
NDWAC	National Drinking Water Advisory Council
NOM	Natural Organic Matter

NPDWR	National Primary Drinking Water Regulations
NSF	NSF International
NTNCWS	Non-transient, Non-Community Water System
OCCT	Optimal Corrosion Control Treatment
ORP	Oxidation-Reduction Potential
OWQP	Optimal Water Quality Parameter
POU	Point-of-use
PWS	Public Water System
RLDWA	The Reduction of Lead in Drinking Water Act of 2011
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
TDS	Total Dissolved Solids
TTHM	Total Trihalomethanes
VOC	Volatile Organic Compound
WQP	Water Quality Parameter
WRF	Water Research Foundation
WWTP	Wastewater Treatment Plant

Chapter 1: Introduction

1.1 Purpose and Audience

The purpose of this document is to provide technical recommendations to help primacy agencies and systems comply with corrosion control treatment (CCT) requirements of the Lead and Copper Rule (LCR), including designation of optimal corrosion control treatment (OCCT).[1] This document summarizes the regulatory requirements, and provides technical recommendations that can assist systems in complying with CCT steps and assist primacy agencies with evaluation of technical information from systems. It also includes background information on corrosion and CCT techniques. This document provides Excel-based ***OCCT Evaluation Templates*** that can be used to organize data and document decisions.

The technical recommendations provided in this document are consistent with previously published corrosion control guidance (USEPA, 1992a; USEPA, 1997; and USEPA, 2003). It is not intended to supersede prior guidance; those resources continue to provide technical information that may be relevant to, and further inform, decision-making. Instead, this document is intended to serve as an added resource, offering supplemental information gleaned from recent developments in the drinking water industry's understanding of lead and copper release and control. This includes:

- Influence of oxidation-reduction potential (ORP) on lead and copper release, and importance of Pb(IV) compounds for systems with lead service lines (LSLs).
- Importance of aluminum, manganese, and other metals on formation of lead scales and lead release.
- Impact of physical disturbances on lead release.
- Mechanisms and limitations of using blended phosphates for corrosion control.
- Target water quality parameters (WQPs) for controlling copper corrosion.
- Impacts of treatment changes, particularly disinfectant changes, on corrosion and corrosion control.

EPA recognizes that research is ongoing, and that the water industry's understanding of corrosion, metals release, and treatment strategies will continue to evolve. EPA will update this document periodically as new information becomes available and as time and resources allow.

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[1] Note that for the purposes of this document, "optimal corrosion control treatment" or "OCCT" is only used when referring to the requirement in section 141.80(d) of the existing LCR for primacy agencies to designate optimal corrosion control treatment. Section 141.2 defines optimal corrosion control treatment as "the corrosion control treatment that minimizes the lead and copper concentrations at users' taps while insuring that the treatment does not cause the water system to violate any national primary drinking water regulations." The terms "optimal" or "optimized" may also be used in the manual to indicate the best conditions for preventing lead and copper from leaching into water.

1.2 Document Organization

The remainder of this document is organized as follows:

Chapter 2: Background Information provides a history of regulatory actions to reduce lead and copper exposure from drinking water, including efforts since the 1986 Safe Drinking Water Act (SDWA) Amendments to limit the amount of lead in plumbing materials. It also describes the sources of lead in water, including an overview of lead and copper corrosion and release mechanisms, and relative contribution of lead- and copper-containing materials. Lastly, this chapter provides an updated description of water quality and physical factors that influence lead and copper levels in drinking water.

Chapter 3: Corrosion Control Treatment for Lead and Copper describes the available CCT methods and provides approaches that can be used to identify CCT alternatives. The chapter also provides technical recommendations on setting treatment dose and water quality conditions.

Chapter 4: Corrosion Control Treatment Steps under the LCR reviews the CCT requirements under the LCR and provides additional technical recommendations for primacy agencies and systems to consider when meeting these requirements.

Chapter 5: OCCT Start-Up and Monitoring provides technical recommendations on CCT start-up, reviews requirements under the LCR and technical recommendations for follow-up monitoring during the first year of CCT implementation, reviews requirements for establishing optimal water quality parameters (OWQPs) under the LCR, and reviews LCR-required WQP and technical recommendations for additional corrosion control monitoring.

Chapter 6: Impacts of Source Water and Treatment Changes on Lead and Copper in Drinking Water reviews the requirements in the LCR for notification and approval of a source or treatment change. The chapter also provides technical information on how source and treatment changes can affect lead and copper release.

Chapter 7: References provides a full list of references that were used in the development of this document.

These chapters are supported by several appendices:

Appendix A provides a glossary of corrosion terms.

Appendix B provides a lookup table for systems to determine dissolved inorganic carbon (DIC) based on pH and alkalinity.

Appendix C provides technical recommendations on how to conduct investigative sampling and construct lead profiles to help identify the sources of lead and copper in a building water system.

Appendix D provides blank forms for data collection to support a system's OCCT recommendation and/or the corrosion control study.

Appendix E provides blank forms for systems to support OCCT recommendations to their primacy agencies.

Appendix F summarizes desktop and demonstration tools that can be used by systems when conducting a corrosion control study.

Appendix G provides blank forms for systems and technical recommendations for primacy agencies when reviewing system data and designating OWQPs.

1.3 How to Use this Document

Primacy agencies and systems can use the material in Chapters 2 and 3 as a technical reference to help understand corrosion and CCT and to evaluate CCT alternatives. Tools such as the flowcharts in Chapter 3 are intended for screening and are not meant to serve as substitutes for pilot studies and other site-specific investigations. Chapters 4 and 5 provide a review of the LCR regulatory requirements and provide additional technical recommendations to support primacy agencies and systems when a system serving 50,000 or fewer people exceeds the lead or copper action level (AL), or if a system increases its population to more than 50,000 and is subject to the CCT requirements of the LCR for the first time. Chapters 4 and 5 can also be useful for systems serving more than 50,000 people that previously installed CCT but have subsequent AL exceedances. Primacy agencies and systems can use the information in Chapter 6 to review the regulatory requirements related to notification and approval of a source or treatment change. They can also use the technical information in this chapter to determine how treatment changes could impact lead and copper release.

The Excel-based ***OCCT evaluation templates*** mirror the steps and tables in Chapters 4 and 5 and Appendices D through G. Primacy agencies can use the templates to document circumstances around an AL exceedance and review compliance deadlines for individual systems. They can also use the templates to support determinations of whether or not to require a CCT study, what kind of study to require, and to document their decisions. The templates provide electronic versions of the forms in Appendices D through G. Systems can use the forms to organize their data and information electronically and prepare submittals to their primacy agencies.

Chapter 2: Background Information

This chapter provides information on:

- Regulations to control lead and copper in drinking water;
- Sources of lead and copper;
- Water quality characteristics that impact corrosion of lead and copper and release of these metals into the water; and
- Physical and hydraulic characteristics of water systems that impact lead and copper release.

2.1 Regulatory Actions to Control Lead and Copper in Drinking Water

2.1.1 Lead and Copper Regulation

The national primary drinking water regulation that controls lead and copper in drinking water is the 1991 Lead and Copper Rule (LCR) (USEPA, 1991b), as amended. In the 1991 rulemaking, the Environmental Protection Agency (EPA) established maximum contaminant level goals (MCLGs) (zero for lead and 1.3 milligrams per liter (mg/L) for copper) and action levels (0.015 mg/L for lead and 1.3 mg/L for copper) in public water systems (PWSs). (See Exhibit 2.1 for a timeline of lead and copper regulations and related regulatory activities.) The lead or copper action level is exceeded if the concentration in more than 10 percent of water samples (i.e., the 90th percentile level) collected after a minimum stagnation period of 6 hours is greater than the respective action level. Samples from residences must be collected from cold water kitchen or bath taps and those collected from non-residential areas must be collected from interior taps (§141.86(b)(2)).[2] The number of samples to be collected depends on the size of the water system, as specified in the regulation. The 1991 LCR also established requirements that are triggered, in some instances, by exceedances of the action levels. These additional requirements include the installation and maintenance of corrosion control treatment (CCT) and source water monitoring/treatment, lead public education, and lead service line (LSL) replacement.

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[2] Unless otherwise stated, all citations are in Title 40 of the Code of Federal Regulations (CFR).

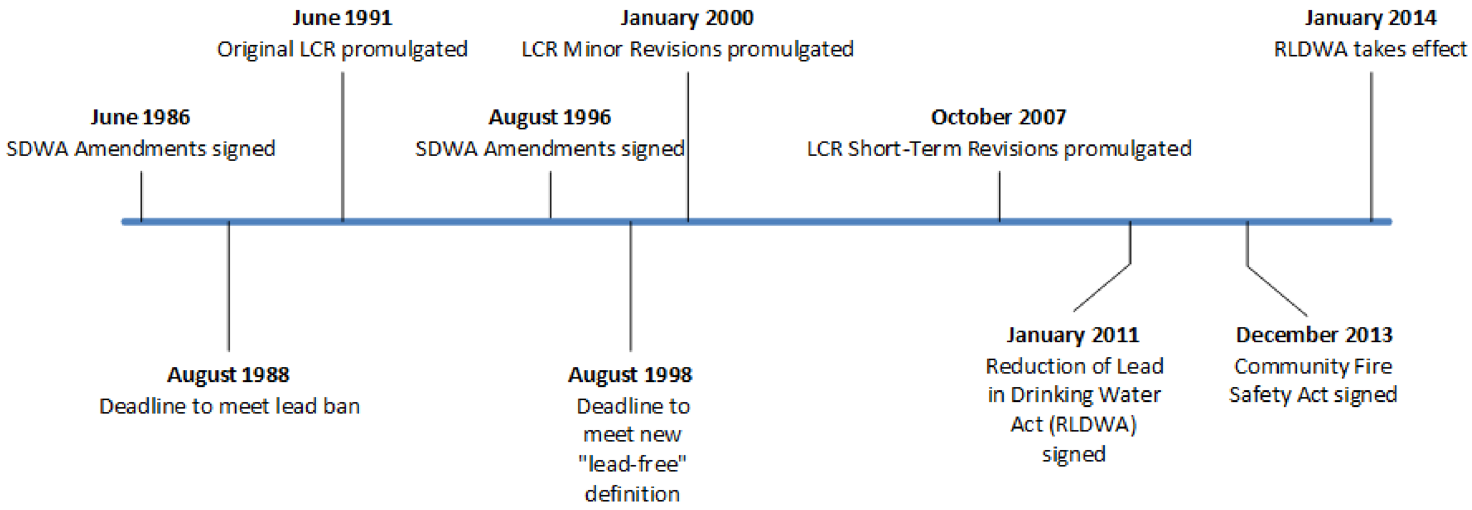

Exhibit 2.1: Timeline of Regulatory Actions Related to Lead and Copper

After the June 1991 LCR, EPA promulgated several technical amendments (USEPA, 1991c; USEPA, 1992b; USEPA, 1994; USEPA, 2004a) as well as more extensive revisions in January 2000 and October 2007 (USEPA, 2000; USEPA, 2007a). The goal of the January 2000 LCR Minor Revisions was to streamline requirements, promote consistent national implementation, and, in many cases, reduce monitoring and reporting requirements (USEPA, 2000). The goal of the 2007 LCR Short-Term Revisions was to enhance the implementation of the LCR in the areas of monitoring, treatment, consumer awareness, and LSL replacement, as well as to improve compliance with the public education requirements of the LCR (USEPA, 2007a).

2.1.2 Control of Lead Content in Plumbing Components

While the LCR regulates the amount of lead and copper in drinking water, the Safe Drinking Water Act (SDWA) also includes provisions aimed at reducing the amount of lead in plumbing components, which could result in lower lead levels in tap samples in the future. This section discusses key changes in SDWA to reduce lead in plumbing components. For additional information, see the references and web links provided herein.

The 1986 SDWA Amendments established requirements to minimize the lead content in source materials that are used in the conveyance and treatment of drinking water. Section 1417 of the 1986 SDWA Amendments banned the use of lead pipe and required the use of "*lead-free*" solders, fluxes, pipes and pipe fittings in the installation or repair of PWSs (also referred to as the "lead ban") (USEPA, 1987). Lead-free materials were defined as:

- Solders and fluxes with a lead content of ≤ 0.2 percent.
- Pipes and pipe fittings with a lead content of ≤ 8.0 percent.

The 1996 SDWA Amendments made it unlawful for anyone to introduce into commerce pipes, pipe or plumbing fittings or fixtures that are not lead free. The 1996 Amendments also required certain plumbing fittings and fixtures (endpoint devices) to be in compliance with a performance standard for lead release for plumbing fittings and fixtures.[3] This standard was satisfied by NSF International/American National Standards Institute (NSF/ANSI) Standard 61, Section 9,[4] which limited the amount of lead that can be leached from endpoint devices used for water intended for human consumption. After August 6, 1998, only those plumbing fittings and fixtures with a lead content of ≤ 8.0 percent that were in compliance with NSF/ANSI Standard 61, Section 9 by an ANSI-accredited certifier could be defined as *"lead-free"* (NSF, 2010).[5]

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[3] For a summary of the 1996 Amendments revisions to the lead ban, refer to Section 118. www.congress.gov/bill/104th-congress/senate-bill/1316.

[4] Devices specifically listed in NSF Standard 61, Section 9 include kitchen and bar faucets, lavatory faucets, water dispensers, drinking fountains, water coolers, glass fillers, residential refrigerator ice makers, supply stops and endpoint control valves. Devices that were not covered by section 9 of NSF 61 were not subject to the NSF performance-based standard, but if they were covered by Section 1417, they were subject to the 8.0 percent lead limit.

[5] This commerce restriction does not apply to pipes used for manufacturing and industrial processing.

Plumbing materials meeting the lead-free definition of ≤ 8.0 percent lead were still found to contribute to lead levels measured at the tap (Sandvig et al., 2008). Thus, efforts to reduce the lead content of materials continued, notably in the States of California, Maryland, Massachusetts, and Vermont. In response, manufacturers developed non-leaded alloys containing very low levels of lead (less than 0.25 percent lead) that can be used in the manufacture of brass faucets, meters, and fittings. Many utilities have also developed their own specifications for non-leaded components (Sandvig et al., 2007).

In 2011, The Reduction of Lead in Drinking Water Act of 2011 (RLDWA) revised Section 1417 to:

1. Redefine "*lead-free*" in SDWA Section 1417(d) to:
   - Lower the maximum lead content of the wetted surfaces of plumbing products such as pipes, pipe fittings, plumbing fittings and fixtures from 8.0% to a weighted average of 0.25%;
   - Establish a statutory method for the calculation of lead content; and
   - Eliminate the requirement that lead-free products be in compliance with voluntary standards established in accordance with SDWA 1417(e) for leaching of lead from new plumbing fittings and fixtures.
2. Create exemptions in SDWA Section 1417(a)(4) from the prohibitions on the use or introduction into commerce for:
   - Pipes, fittings and fixtures that are used exclusively for non-potable services where the water is not anticipated to be used for human consumption (SDWA 1417(a)(4)(A)); and
   - "toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, service saddles, or water distribution main gate valves that are 2 inches in diameter or larger." (SDWA 1417(a)(4)(B)).

A subsequent Act, The Community Fire Safety Act of 2013, signed on December 20, 2013, exempted fire hydrants from the new lead-free standard, and required EPA to consult with the National Drinking Water Advisory Council (NDWAC) on lead-free issues. Both The RLDWA and Community Fire Safety Act became effective on January 4, 2014. EPA has published a "Summary of The Reduction of Lead in Drinking Water Act and Frequently Asked Questions" that describes both of these Acts in more detail (USEPA, 2013).[6] On January 17, 2017, EPA issued a proposed rule to amend EPA's current regulations and reflect the changes to Section 1417 of SDWA as a result of the RLDWA.

Although the SDWA no longer requires third-party certification, some state or local laws require third-party certification. In addition, third-party certification bodies or agencies may be used by manufacturers to inform consumers which products meet a voluntary standard. One such standard, NSF/ANSI 372 is consistent with the requirements of the RLDWA. A third-party

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[6] This document is available at http://nepis.epa.gov/Exe/ZyPDF.cgi/P100M5DB.PDF?Dockey=P100M5DB.PDF.

certification against this standard could be a useful way to identify a product as meeting the requirements of Section 1417. Products will bear the mark of the laboratory that has independently certified the product as meeting the standard. EPA published a brochure to help the public identify the various marks that indicate a product has been certified as lead-free to satisfy the new requirement of the Act: “How to Identify Lead-Free Certification Marks for Drinking Water System & Plumbing Materials” (USEPA, 2015a).[7] EPA also recommends that PWSs incorporate this NSF/ANSI standard into their contract specifications for materials installed in their treatment and distribution systems, and to encourage their consumers to purchase certified products.

2.2 Sources of Lead and Copper

Lead and copper are rarely present in raw water sources. They are primarily present at the customer’s tap due to corrosion of lead and copper-based material. This section:

- Provides an overview of chemical and physical reactions that result in lead and copper release into drinking water (Section 2.2.1); and
- Discusses the relative contribution from supply lines and premise plumbing components (Section 2.2.2).

2.2.1 Corrosion and Metals Release

Corrosion in water systems is defined as the electrochemical interaction between a metal surface such as pipe wall or solder and water. During this interaction, metal is oxidized and transferred to the water or to another location on the surface as a metal ion. Depending on the material there are many forms of corrosion, but usually the most important for drinking water are: (1) uniform corrosion, where the electrochemical interaction occurs along the pipe wall, resulting in a relatively uniform loss of metal across the entire surface; (2) non-uniform corrosion, where metal is lost from a localized point, causing pitting and mounding in some cases; and (3) galvanic corrosion which comes from a coupling of dissimilar metals or internally in metallic alloys. While it is important to understand and control corrosion, the LCR is specifically concerned with controlling ***metals release*** (i.e., release of lead and copper) into the water. Metals release is a function of the reactions that occur between the metal ions released due to corrosion, and the physical, chemical, and biological characteristics of the water and the metal surface.

The form of lead and copper released into the water can be dissolved, colloidal, or particulate (i.e., bound up with other compounds such as iron and aluminum). Of great importance is the ***scale*** that builds up naturally on the metal surface. Pipe scales can be complex and can include two types of compounds: (1) passivating films that form when pipe material and water react directly with each other; and (2) deposited scale material that forms when substances in the water (e.g., iron, manganese, aluminum, calcium) precipitate out or sorb to, and then build up

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[7] This document is available at http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100LVYK.pdf.

on the pipe surface. Scales can have layers and are influenced by treatment history. The structure and compounds in the existing corrosion scale can influence the effectiveness of CCT.

Researchers have identified many different compounds on lead pipe scales depending on water quality and treatment history:

- In the absence of corrosion inhibitors, lead pipe scales are frequently dominated by compounds that result from the reaction of carbonate and divalent lead compounds (Pb^{++} or Pb(II)),[8] such as hydrocerussite [$(Pb_3(CO_3)_2(OH)_2$] and cerussite ($PbCO_3$) (Schock and Lytle, 2011). Plumbonacrite ($Pb_{10}(CO_3)_6(OH)_6O$) has been found to co-occur with Pb(II) carbonate compounds in scales and can be a predominant form in systems with high pH (>10) (DeSantis and Schock, 2014). Lead pipe scales may also include massicot and litharge (which are both forms of PbO) under higher alkalinity conditions (McNeill and Edwards, 2004). Carbonate containing scales are often off-white and slightly chalky when dry (Schock and Lytle, 2011).

- Newer research has confirmed that Pb(IV) compounds, i.e., lead oxide (PbO_2),[9] can be the predominant compounds in lead pipe scales under highly oxidative conditions[10] and under low organic matter conditions (Schock, 2007b; Schock, 2001; Schock and Giani, 2004; DeSantis and Schock, 2014).

- When orthophosphate is used, lead pipe scales are often dominated by crystalline Pb(II) orthophosphate compounds such as hydroxypyromorphite, $Pb_9(PO_4)_6$, or $Pb_3(PO_4)_2$. Scales in systems with blended phosphates do not follow the same trends as orthophosphate and seem to be influenced by calcium concentrations and phosphorus speciation (DeSantis and Schock, 2014).

Copper-based scales usually include cuprite (Cu_2O), cupric hydroxide ($Cu(OH)_2$), tenorite (CuO), and malachite ($Cu_2(OH)_2CO_3$). When orthophosphate is used, various copper phosphate scales may develop (Schock and Sandvig, 2006; Schock and Lytle, 2011)).

The characteristics of the scale and its structure dictate the amount of lead or copper that is released into the water. If conditions favor the formation of insoluble, adherent scale (i.e., scale that adheres well to the pipe wall), the rate of metals release will be low. However, if scales do not adhere well to the pipe wall or they are very soluble, the release of metals may be greater. Other compounds in the water including aluminum, iron, manganese, and calcium can significantly influence scale formation and properties. The type of scale will also dictate how

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[8] Pb^{++}, Pb(II), or divalent lead is the ionic form of lead that is transferred from the material to the water during the corrosion process.

[9] Pb^{++++}, Pb(IV), or tetravalent lead is an ionic form of lead that forms lead oxide (PbO_2), the only Pb(IV) compound that has been identified in lead pipe scales. Throughout this manual, Pb(IV) and PbO_2 are used interchangeably.

[10] For example, systems that have a free chlorine residual of 2 mg/L or greater. See Section 2.3 for more information on how disinfection affects ORP of the water and how this affects the types of lead compounds in the scale.

susceptible it is to releasing particulate lead following physical disturbances (e.g., infrastructure work).

2.2.2 Lead and Copper-Containing Material

The main sources of lead and copper in drinking water are the materials used for supply pipes from the water main to the building (also called "service lines") and premise plumbing. These include lead and copper pipe, lead-based solder, and brass materials used in faucets and fittings.[11] Exhibit 2.2 shows plumbing components that may be potential sources of lead.[12]

Researchers have performed various studies to identify the relative contribution of these materials to lead and/or copper levels measured at the tap in standing samples (Gardels and Sorg, 1989; Lytle and Schock, 1996; Kimbrough, 2001; Kimbrough, 2007; Sandvig et al., 2008; Kimbrough, 2009). They have found that LSLs contribute a significant percentage of the lead in samples collected at the tap (under normal household usage conditions), and that brass may also be a significant source of lead and copper depending on the quality of the drinking water and the composition of and manufacturing process for the brass faucet or fitting. There are, however, many different types of alloys used in brass faucets and fittings. Each may react differently under different water qualities and chemistries, as well as water use patterns, which makes it difficult to identify specific brass components that might cause problems with respect to lead and/or copper release in any given PWS. Appendix C provides methods for diagnostic monitoring that can help pinpoint the source of lead for a specific building.

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[11] Prior to the 1986 SDWA Amendments, 50:50 lead:tin solder could be used for potable applications. Brass alloys comprised of various amounts of copper and lead are used to manufacture pipes, pipe fittings, plumbing fittings, and fixtures (e.g., faucets and meters). As discussed in Section 2.1.2, the RLDWA of 2011 further limits the allowable lead content of these materials.

[12] Although the water utility often owns the portion of the supply pipe from the water main to the property boundary, the homeowner generally owns the portion from the property boundary or meter to the home and is responsible for premise plumbing. This makes lead and copper unique contaminants in that their source is under the control of the individual customer (except in the case of the portion of a LSL owned by the water utility).

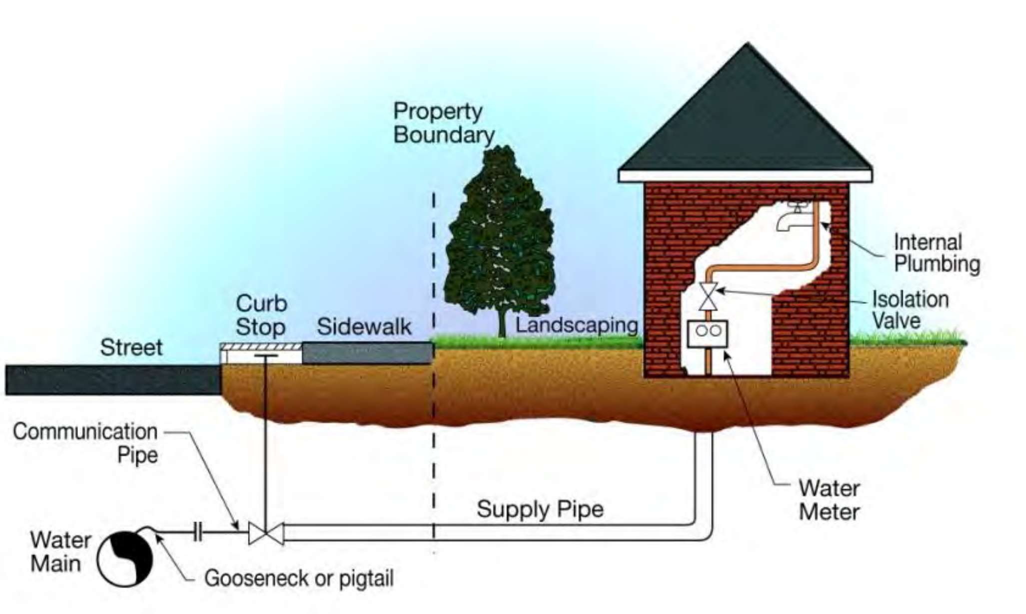

Exhibit 2.2: Typical Water Service Connection that May Provide Sources of Lead (Sandvig et al., 2008)

Copper pipe may be used for both the supply pipe (service line) and the interior piping. Brass fixtures typically are 60 – 90 % copper by weight. Copper release depends on water quality conditions (particularly pH, dissolved inorganic carbon (DIC), and oxidation-reduction potential (ORP)), the age of the copper pipe, and how long the water has been in contact with the pipe. Copper release is typically higher in newer copper plumbing (Cantor et al., 2000; Kimbrough, 2007; Schock and Lytle, 2011). The amount of time required for copper pipes to passivate (i.e., no longer release copper into the water) is highly dependent on water quality, particularly pH, alkalinity, and DIC.

New research has shown that iron and manganese can adsorb other metals such as lead. McFadden et al. (2011) showed that lead released from LSLs was adsorbed onto galvanized iron pipe in homes. Another study showed that iron- and manganese- rich scale provided a source of lead for more than four years after LSLs were fully removed (Schock, Cantor, et al., 2014). Thus, lead released “upstream” (e.g., from an LSL) can accumulate in these scales, providing a long-term source of lead even after LSLs and other lead-containing materials are removed. Residual aluminum in the finished water from the coagulation treatment step can also affect the type and stability of scales formed within LSLs (Schock, 2007b).

2.3 Water Quality Factors Affecting Release of Lead and Copper

New research conducted in recent years has continued to show the influence and importance of water quality on lead and copper levels in drinking water. Water quality can affect the rate of corrosion of lead and copper materials, the formation and characteristics of scales that form on lead and copper based materials, and ultimately, the release of metals into the water. New findings have shed light on the effects on lead and copper levels of natural organic matter (NOM) and metals including iron, aluminum, and manganese. Alkalinity, pH, DIC, and corrosion inhibitors remain critical parameters that directly impact lead release. In addition, new research has shown the importance of ORP in certain types of waters.

Understanding the water quality conditions that impact the release of lead and copper in drinking water provides a foundation for making effective treatment decisions. This section describes the following parameters, how they can be measured or approximated, and how they can affect lead and copper release in drinking water:

- Alkalinity, pH, and DIC.
- Corrosion inhibitors.
- Hardness (calcium and magnesium).
- Buffer Intensity.
- Dissolved oxygen (DO).
- Oxidation reduction potential (ORP).
- Ammonia, chloride, and sulfate.
- Natural organic matter (NOM).
- Iron, aluminum, and manganese.

2.3.1 pH, Alkalinity and DIC

The pH of water is a measure of its acidity, otherwise known as its hydrogen ion concentration (H^+ or H_3O^+). Alkalinity is the capacity of water to neutralize acid. It is primarily the sum of carbonate, bicarbonate, and hydroxide anions in the water as shown in Equation 1 (Stumm and Morgan, 1981).

$$\text{Alkalinity} = 2CO_3^{2-} + HCO_3^- + OH^- - H^+ \qquad \textit{Equation 1}$$

DIC is an estimate of the total amount of inorganic carbon as shown in Equation 2 (Stumm and Morgan, 1981).

$$\text{DIC} = CO_2 + H_2CO_3 + CO_3^{2-} + HCO_3^- \qquad \textit{Equation 2}$$

Alkalinity and DIC are closely related. Most alkalinity comes from bicarbonate and carbonate ions in the water. Although water operators are more familiar with alkalinity, DIC is the parameter more closely related to corrosion because it directly measures the available carbonate species in the water that can react with lead and copper to form the passivating scales. The water's pH influences many other corrosion-related parameters (i.e., buffer capacity, alkalinity, ORP) and has a large influence on corrosion inhibitor effectiveness.

It is best to measure pH in the field at the time of sample collection using a calibrated instrument. EPA Method 150.1 emphasizes the importance of proper sampling technique - the pH of highly purified waters and the pH of waters that are not in equilibrium with the atmosphere are subject to changes as dissolved gases are either absorbed or desorbed. To minimize these impacts, EPA recommends filling sampling containers completely and keeping them sealed prior to analysis (USEPA, 1982). Alkalinity is commonly measured by a certified laboratory and reported as mg/L as calcium carbonate ($CaCO_3$). DIC cannot be measured but can be predicted based on the pH, alkalinity, ionic strength, and temperature of the water, using the table in Appendix B. DIC is usually reported in mg/L as carbon (mg/L as C).There are optimal ranges of pH and DIC that result in the greatest formation of insoluble compounds in the scale, and in this way prevent the release of lead and copper. See Chapter 3 for technical recommendations on adjusting pH/alkalinity/DIC to prevent lead and copper release.

The pH, alkalinity, and DIC of water can be highly variable within the distribution system. The pH can fluctuate due to interactions between water and pipe material, microbiological activity, and changes in disinfectant residual. The water's ability to resist changes in pH is called its buffering capacity (also called buffer intensity). The carbonate and bicarbonate ions in the water provide this buffering; see Section 2.3.4 for additional information.

Regardless of the specific treatment used, understanding the pH and DIC range throughout a distribution system is an important part of maintaining corrosion control and minimizing the release of lead and copper.

2.3.2 Corrosion Inhibitors

Corrosion inhibitors are used not only to control lead and copper release, but also to prevent corrosion of iron pipe and other metals in the distribution system. The most common corrosion inhibitors used by water systems are phosphate-based, which means they have orthophosphate (PO_4^{3-}) in their formulation. Silicate-based corrosion inhibitors, which are mixtures of soda ash and silicon dioxide, have been used in a few cases.

Orthophosphate is commonly used for lead and copper control. Polyphosphates, which are polymers containing linked orthophosphate ions in various structures are used mainly for sequestering iron and manganese. They work by binding or coordinating the metals into their structures so they cannot precipitate on sinks or clothes. Polyphosphates can also sequester lead and copper, keeping them in the water and actually increasing the risk of exposure. Polyphosphates can revert to orthophosphate in the distribution system, but it is difficult to predict if and when this occurs. Research has confirmed that polyphosphates are generally ***not*** effective on their own for controlling the release of lead and copper (Holm and Schock, 1991; Cook, 1992; Dodrill and Edwards, 1995; Cantor et al., 2000). Blended phosphates, which contain a mixture of orthophosphate and polyphosphate, have been used for corrosion control and to sequester iron and manganese. Silicate-based inhibitors have been shown to successfully reduce lead and copper levels in first draw-samples at the tap (Schock, Lytle, et al., 2005), but their full-scale use has been limited.

See Chapter 3 for additional technical recommendations on using orthophosphate, blended phosphates, and silicate-based corrosion inhibitors for controlling lead and copper release.

2.3.3 Hardness (Calcium and Magnesium)

Hardness is primarily the sum of calcium and magnesium in water. It is a common water quality parameter measured in the laboratory and is typically reported as mg/L as $CaCO_3$ (calcium carbonate).

If finished water has high hardness, increasing the pH to control lead release can cause calcium carbonate precipitation, or scaling, in the distribution system. The Langelier Saturation Index (LSI), and other calcium carbonate-related indices such as the Ryznar Index and calcium carbonate precipitation potential (CCPP), can be used as indicators of scaling conditions (Schock and Lytle, 2011).[13] It is critical to note that, while these indices can be used to predict scaling potential as an adverse secondary impact of pH or alkalinity adjustment, they have no value as corrosivity indictors and should ***not*** be used to evaluate lead or copper control. The LSI is only important insofar as it provides information regarding the amount of pH adjustment that can be employed without causing precipitation.

In addition to contributing to scaling, calcium may be a particularly important component of scales laid down by blended phosphate corrosion inhibitors. See Chapter 3 for more information.

2.3.4 Buffer Intensity

Buffer intensity (also called buffer capacity) is a measure of the water’s resistance to changes in pH, either up or down. It is defined as the concentration of base required to raise the pH one unit and has units of moles/L/unit pH. Buffer intensity depends on the alkalinity, DIC, and pH of the water. Exhibit 2.3 shows the relationship of pH and buffer intensity at different DIC values, with the highest buffer intensity at a pH of approximately 6.3 and minimum intensity at pH values between 8.0 and 8.5. Thus, waters with pH between 8 and 8.5 and low DIC (less than about 10 mg/L as C) have low buffer intensity and may have more variable pH within the distribution system, whereas waters outside this pH range will have higher buffer intensity and may exhibit less variability in pH levels in the distribution system. Increasing DIC in waters with pH values in the 8 – 8.5 range will not result in appreciable increases in buffer intensity. Additional buffer intensity may result when phosphate or silicate chemicals are dosed at a high concentration relative to DIC.

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[13] The LSI is defined as the comparison between the measured pH of the water with the pH the water would have at saturation with $CaCO_3$.

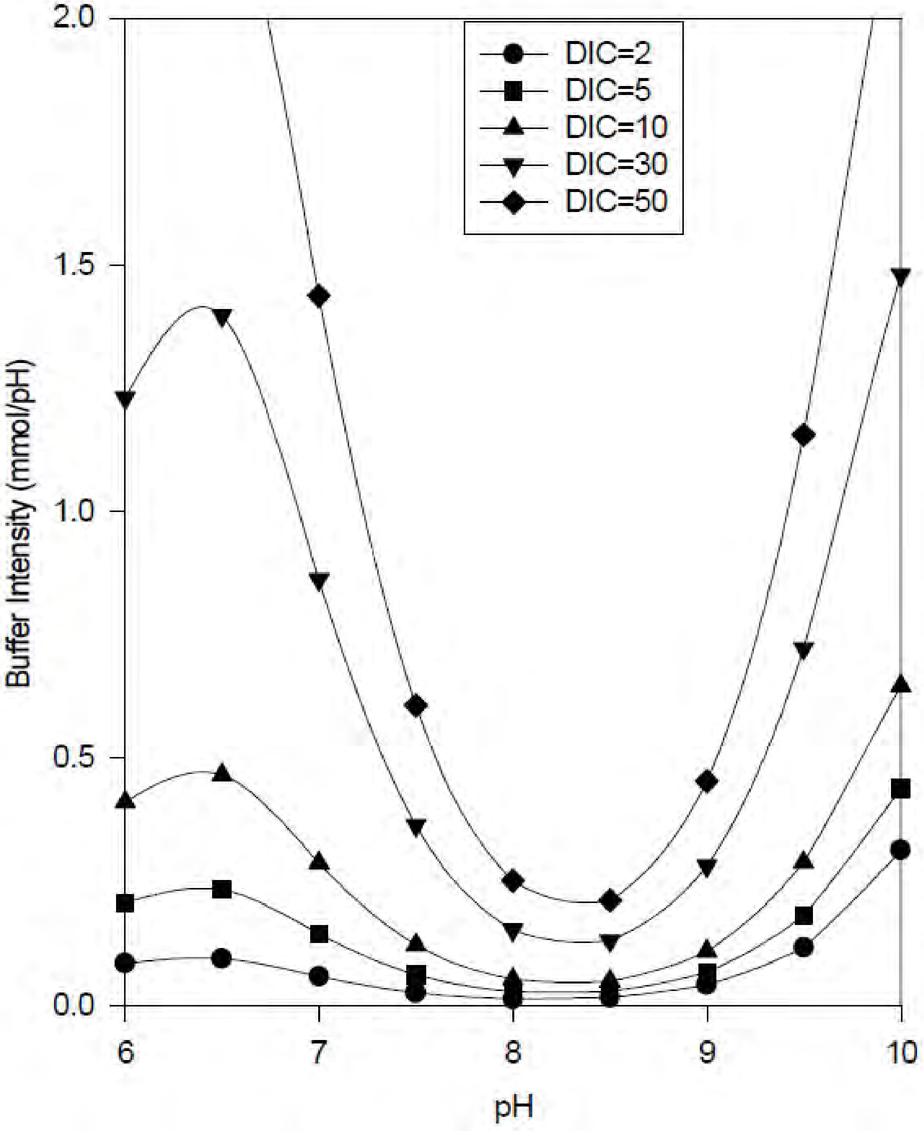

Exhibit 2.3: Buffer Intensity as a Function of pH at Different DIC Values (Clement and Schock, 1998, Figure 1)

2.3.5 Dissolved Oxygen

Oxygen is slightly soluble in water, seldom reaching dissolved concentrations above 15 mg/L. In ground water, DO can vary depending on the geochemistry and hydrogeology of the aquifer. Deep ground water or shallow ground water in areas where the recharge area has silty or clayey soils may have no DO. Shallow ground water in areas with fractured rock or sandy soils may contain higher concentrations of DO. Surface waters are generally more oxygenated, especially flowing sources (i.e., rivers). Stagnant water and waters with low DO content, however, can create oxygen-deficient conditions in some cases. The DO concentration depends on water temperature, but typical well-aerated water will have a DO concentration of about 8 or 9 mg/L. DO concentrations can be measured in the field using a calibrated DO meter.

DO concentration affects the solubility of iron, manganese, lead, and copper. Some ground water systems add dissolved oxygen through aeration processes to oxidize iron and manganese so that they can be removed through precipitation. Increasing DO in the water can increase copper corrosion, converting Cu(I) to Cu(II). However, water with high DO levels may provide corrosion benefits under some circumstances, by facilitating the production of different and more protective lead oxide scales than would have been formed under low DO conditions (see Section 2.3.6 on Oxidation-Reduction Potential for more information).

2.3.6 Oxidation-Reduction Potential

Oxidation-reduction potential, also called redox potential or ORP, is the electric potential required to transfer electrons from one compound (the oxidant) to another compound (the reductant). It is considered a quantitative measure of the state of oxidation in water treatment and distribution systems. Like pH, ORP is a fundamental characteristic of aqueous systems and affects how water interacts with solid substances such as metal pipe material. It is commonly measured using a platinum reference electrode and reported in units of volts (V) or millivolts (mV). Measured ORP values are often normalized with respect to the standard hydrogen electrode and reported as electric potential (E_h) by taking into account a material-specific conversion factor, generally provided by the electrode manufacturer or found in reference textbooks (Copeland and Lytle, 2014).

ORP varies with pH, temperature, and DIC, but is fundamentally driven by the type and concentration of disinfectant in the water (e.g., chlorine or chloramines) and the DO concentration. Laboratory studies by James et al. (2004) and Copeland and Lytle (2014) showed that ORP values are highest for free chlorine and chlorine dioxide, and that ORP decreases with increasing pH from 7 to 9, regardless of the oxidant used. Copeland and Lytle (2014) found an E_h range of 0.51 V (no disinfectant and pH of 9) to 1.02 V (chlorine disinfection and a pH of 7). In general, the influence of free chlorine on ORP is much greater than that of DO. As a result, for systems using a free chlorine residual in the distribution system, DO's influences on ORP are minor.

Under certain conditions, ORP can have a dramatic impact on lead release. Exhibit 2.4 shows the theoretical E_h and pH conditions that favor different dissolved and solid forms of lead. The hatched areas represent lead solids, and the un-hatched areas are lead complexes that are in solution. It is important to note that E_h-pH diagrams are based on theory, and the positions of the boundaries can vary depending upon the data used to construct them. Thus, these diagrams should be used to understand relationships and interpret field data, and not for predicting lead release.

Exhibit 2.4 shows that Pb(II) solids exist theoretically at low E_h values at typical pH levels in drinking water. At higher E_h values (> 0.7 V) and in the absence of corrosion inhibitors or other interfering surface deposits, PbO_2 (a Pb(IV) solid) could form on lead pipe surfaces. PbO_2 is insoluble and would prevent lead from being released to the water. Water quality changes that cause a reduction in pH or ORP from a change in disinfection practices (e.g., switching from chlorine to chloramines in the distribution system), however, can cause PbO_2 to convert to Pb(II) compounds and release lead into the water.

The high E_h values needed for PbO_2 formation may be found in systems that have a high chlorine residual (i.e., > 2 mg/L as free chlorine) for extended periods of time. PbO_2 has been observed to form between pH 7 and 9.5, with formation occurring more quickly at higher pH values. Field testing has shown that the amount of lead released from PbO_2 scales is very low and close to lead levels for non-lead pipes (Schock, Triantafyllidou, et al., 2014; Triantafyllidou et al., 2015).

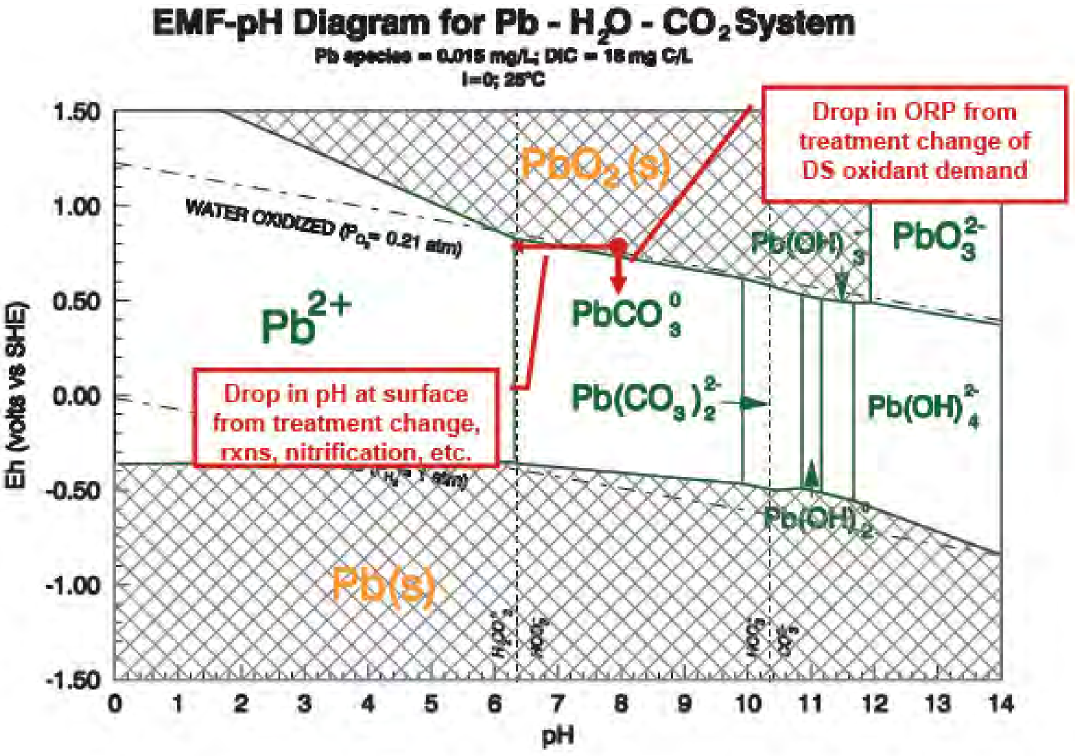

Exhibit 2.4: E_h-pH Diagram for a Lead-Water-Carbonate System. DS oxidant demand in upper box is 'distribution system oxidant demand' (Schock, 2007a; provided by author)

2.3.7 Ammonia, Chloride, and Sulfate

Excess ammonia (NH_3) may occur in the distribution system due to elevated source water ammonia levels and/or if the system uses chloramines for disinfection. The presence of excess ammonia can lead to nitrification in the distribution system. Nitrification occurs when nitrifying bacteria convert ammonia into nitrite and nitrate, which may lower the pH and alkalinity of the water. This can accelerate brass corrosion and cause problems with lead release (Uchida and

Okuwaki, 1999; Douglas et al., 2004). Ammonia may also form compounds with lead and copper, which can interfere with the effectiveness of CCT.

Research has shown that the ratio of chloride (Cl^-) to sulfate (SO_4^{2-}) in the water can be an indicator of potential lead release. An evaluation of LCR tap sampling data from 12 drinking water utilities collected as part of a Water Research Foundation (WRF) project found that all of the water systems with chloride-to-sulfate ratios less than 0.58 met the 90th percentile action level for lead, whereas only 40 percent of the systems with chloride/sulfate ratios greater than 0.58 met the lead action level (Reiber et al., 1997). More recent research has shown that that lead leaching increased when the chloride-to-sulfate mass ratio approached 0.4 to 0.6 (Nguyen et al., 2010; Nguyen et al., 2011); however, further increasing the chloride-to-sulfate mass ratio above 0.7 may not necessarily be an indicator of increased lead release (Wang et al., 2013). Lower chloride-to-sulfate ratios may be indicative of lower lead release due to the formation of an insoluble sulfate precipitate with lead. Higher ratios may result in the formation of a soluble chloride complex, where lead is galvanically connected to another metal such as copper (Nguyen et al., 2010; 2011).

The chloride and sulfate content in water can change with a switch from sulfate-based coagulants (such as aluminum sulfate (alum) and ferric sulfate) to chloride-based coagulants (such as ferric chloride). Conversely, a change from ferric chloride to alum may increase the sulfate content in the water, potentially reducing lead release. Other scenarios that may affect lead release by altering the chloride and sulfate concentration in the water (and hence the chloride-to-sulfate mass ratios) include blending of desalinated seawater, using anion exchange, or brine leaks from on-site hypochlorite generators (Nguyen et al., 2010; 2011). Galvanic connections and galvanic corrosion can occur in the distribution system with the use of lead solder on copper pipes, or from partial lead line replacements (Oliphant, 1983; Gregory, 1985; Reiber, 1991; Singley, 1994; Lauer, 2005; Nguyen et al., 2010; Triantafyllidou and Edwards, 2011; Clark et al., 2013; Wang et al., 2013).

2.3.8 Natural Organic Matter

NOM is a complex mixture of organic compounds that occur in both ground and surface water sources, but are more prevalent in surface water. NOM is difficult to measure, so utilities often use UV_{254} (specific absorption, the ratio of UV absorption to organic carbon concentration) as a surrogate (APHA, AWWA, and WEF, 2005).

The impact of NOM on metals release is unclear. NOM in finished water can help form the protective films that reduce corrosion, but it has also been shown to react with corrosion products to form soluble complexes with lead, which may increase lead levels in the water (Korshin et al., 1996, 1999, 2000, 2005). Organic matter can also provide nutrients for microorganisms, exacerbating problems with biofilm growth and depleting chlorine residuals. This additional microbial growth can cause microbially-induced copper corrosion (pinhole leaks) through localized decreases in pH or, in the case of sulfate-reducing bacteria, through the formation of sulfide (Schock and Lytle, 2011).

2.3.9 Iron, Manganese, and Aluminum

Iron and manganese are present in many ground water sources and in the lower depths of some thermally stratified lakes and reservoirs. While there is no health-based maximum contaminant level for these metals, EPA has established secondary maximum contaminant levels (SMCLs) for iron and manganese of 0.3 mg/L and 0.05 mg/L, respectively. These SMCLs are based on aesthetic issues (red water, staining of clothing). While aluminum occurs naturally in groundwater and soil due to the erosion of aluminum-bearing minerals (USEPA, 2006a), it is more frequently found in drinking waters treated with alum for coagulation. It can also be an impurity in lime. Aluminum can color water, so EPA has set a SMCL of 0.05 to 0.2 mg/L.[14] Iron, manganese, and aluminum are common water quality parameters that can be measured by a certified laboratory.

Systems that increase pH for lead and/or copper control may experience black or red water complaints due to oxidation of iron and manganese in the distribution system. Iron and manganese removal at the treatment plant, or possibly the use of sequestering agents or silicates, can be used in these cases (see Chapter 3 for more information).

New research has shown that manganese and iron can react with dissolved lead and form deposits on lead service lines and other pipes in premise plumbing. In the well-studied case of Madison, WI, manganese that accumulated on pipe scales (up to 10 percent by weight of scale composition) captured dissolved lead and later released it back into the drinking water (Schock, Cantor, et al., 2014). Manganese can also interfere with the formation of PbO_2 and other passivating films (Schock, Cantor, et al., 2014).

Aluminum can interfere with orthophosphate effectiveness by forming aluminum phosphate precipitates, which reduce the amount of orthophosphate available for lead and copper control. Aluminum phosphate precipitates also have the potential to form scales on the interior of piping systems that may reduce the effective diameter of the pipes, resulting in loss of hydraulic capacity and increases in system headloss and operational costs (AWWA, 2005).

The 2006 EPA Report, Inorganic Contaminant Accumulation in Potable Water Distribution Systems notes that, “Based on scale sample analysis from 10 water utilities that practice alum coagulation, Snoeyink et al. (2003) confirmed that aluminum is frequently a major component of lead pipe scale” (USEPA, 2006a). These scales, however, are generally not as stable compared to orthophosphate scales and are prone to sloughing with changes in flow or water quality, or when lead service lines are physically disturbed during routine maintenance and

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[14] “While EPA encourages utilities to meet a level of 0.05 mg/l for aluminum where possible, the Agency still believes that varying water quality and treatment situations necessitate a flexible approach to developing the SMCL. What may be appropriate in one case may not be appropriate in another. Hence, a range was developed for the aluminum SMCL.” (USEPA, 1991a).

repair activities. These dislodged scales can release metals that may become entrapped in the interior (premise) plumbing and/or the faucet screen, potentially increasing lead and copper levels in the water (Schock, 2007b).

2.4 Physical and Hydraulic Factors Affecting Release of Lead and Copper

In addition to water quality parameters, physical factors such as pipe disturbances, hydraulics, water use, and water temperature can affect lead and copper levels at the customer's tap. Understanding these factors can help primacy agencies and systems interpret lead and copper data and evaluate the effectiveness of OCCT.

2.4.1 Physical Disturbances

Field sampling has shown that physical disturbances to LSLs related to infrastructure work can result in lead release. Del Toral et al. (2013) found that most lead sampling results above the LCR lead action level of 0.015 mg/L occurred at sites with physical disturbances compared to undisturbed sampling sites.[15] Lower water usage at the disturbed sites may have also been a factor in the higher lead levels found.

Any physical disturbance to the premise plumbing system, from service to tap, can cause lead particulate release. Physical disturbances resulting in lead particulate release can occur during:

- Meter installation or replacement.
- Auto-meter-reader installation.
- Service line repair or partial replacement.
- External shut-off valve repair or replacement.
- Significant street excavation directly in front of the house.
- Repair or replacement of home plumbing fixtures or piping.

When any part of a home plumbing system is drained for repair work, or when infrastructure upgrades or repairs are completed (e.g., main breaks), air may get into the lines and scour deposits from the service lines to the tap. Tap flushing to remove air bubbles can disrupt pipe scales and release lead, copper and other accumulated material in the scales.

2.4.2 Hydraulic Factors

High water velocity can help reduce lead and/or copper by transporting the corrosion inhibitor to pipe surfaces at a higher rate; however, in some cases it can increase lead and/or copper corrosion by increasing the rate at which the oxidants in water come into contact with the metal surface. High water velocity can cause corrosion in copper pipes, and can also mobilize loosely adherent scale and cause sporadic lead release (Schock, 1999). Low water velocity in

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[15] Sampling included first draw and lead profile sampling. The percent of samples with lead levels greater than 0.015 mg/L was 36% for sites with known disturbances (13 sites and 327 samples), 37 % for indeterminate sites where the disturbance could not be verified (2 sites, 81 samples), and 2% for undisturbed sites (16 sites, 372 samples).

areas of low water usage can reduce the effectiveness of the corrosion control inhibitor in forming a passivating scale. Increased water age due to less frequent use can cause water quality changes such as reductions in pH and loss of free chlorine residual that could exacerbate corrosion as well as microbial problems.

Other hydraulic factors that can affect lead and copper release into the customer's service line or a building's plumbing include flow reversals and hydraulic pressure transients. Pressure transients may occur when valves are closed to perform maintenance (Friedman et al., 2010) or due to backflow from a cross connection. Residential backflow is more common than previously thought, according to a recent study that identified backflow events in 5 percent of homes with backflow sensing meters (Schneider et al., 2010). Hydraulic pressure transients may occur when there are sudden changes in water velocity due to valves slamming shut, power outages, or pump start/stop cycles (Friedman et al., 2010).

2.4.3 Water Use

The effectiveness of corrosion control inhibitors depends on delivery of the inhibitors to the pipe wall to form the passivating scale. Reductions in water use may adversely affect this process. Also, as stated above, increased water age from less frequent use can cause water quality changes, such as reductions in pH and loss of free chlorine residual, that can exacerbate corrosion as well as microbial problems.

2.4.4 Water Temperature

Water temperature effects are complex and depend on the water chemistry and type of plumbing material. More lead is often mobilized during warmer weather seasons, although temperature effects can vary depending on water quality conditions and plumbing configuration. For example, as reported by Schock and Lytle (2011), orthophosphate reacts more quickly at higher temperatures, so reduction in lead levels may take longer in colder months than in warmer months. Higher temperature can also exacerbate copper corrosion, although elevated temperature has been found in some instances to facilitate a better passivating copper pipe scale (Schock and Lytle, 2011).

Seasonal changes in water temperature can result in significant changes in water quality and can impact lead and copper release. Because of the many reactions happening in the distribution system, it is difficult to generalize temperature's impacts. Water systems should collect water quality and lead and copper data throughout the year to determine their own trends.

Chapter 3: Corrosion Control Treatment for Lead and Copper

This chapter provides technical information on available corrosion control treatment (CCT) methods for lead and copper (Section 3.1), technical recommendations for identifying treatment alternatives for individual systems (Section 3.2), and technical recommendations for identifying target water quality and dosages for treatment alternatives (Section 3.3). The information in this chapter can be used to support systems and primacy agencies in meeting CCT requirements of the Lead and Copper Rule (LCR). Note that this chapter provides background information and technical recommendations - see Chapters 4 and 5 for a review of the required CCT steps under the LCR and when CCT requirements apply.

3.1 Available Corrosion Control Treatment Methods

Alkalinity and pH adjustment have been used by many systems for corrosion control. The discussion of this method is expanded in this section to include dissolved inorganic carbon (DIC) adjustment because all three parameters are a better indicator of corrosion control effectiveness than pH and alkalinity alone.

Phosphate-based corrosion inhibitors have been widely used to control lead and copper release. Their applications for corrosion control have been updated in this chapter to include more recent information on chemical formulations, optimal pH ranges, and limitations to their use.

Information on the use and effectiveness of silicate-based corrosion inhibitors continues to be limited and more research is needed. They may be effective in reducing lead and copper release in some cases, however, so they are included as a treatment technique in this chapter.

Calcium hardness adjustment is not discussed in this chapter because newer research has shown that calcium carbonate films only rarely form on lead and copper pipe and are not considered an effective form of corrosion control (Schock and Lytle, 2011; Hill and Cantor, 2011). Calcium hardness is important, however, in evaluating the amount of pH adjustment that can be made without causing calcium carbonate precipitation and resultant scaling problems in the distribution system.

New research has found that lead service lines (LSLs) with PbO_2 scales can have very low lead release (levels as low as or lower than those found when orthophosphate treatment is used (Schock, Cantor, et al., 2014; Triantafyllidou et al., 2015)). This new information has significant implications for management of treatment and distribution systems to minimize the release of lead. Questions remain, however, on how systems and primacy agencies can ensure that disinfectant residuals required for the formation and maintenance of PbO_2 scales are maintained in LSLs throughout the distribution system. This may be a particular challenge with homes that go unoccupied for an extended period of time. Therefore, formation of PbO_2 scale is not included in this section as a corrosion control technique. If systems have PbO_2 scales, they should be very careful about making disinfection changes (see Chapter 6 for more information).

The remainder of this sub-subsection describes the specific chemical/physical methods that can be used for pH/alkalinity/DIC adjustment, phosphate-based corrosion inhibitors, and silicate-based corrosion inhibitors.

3.1.1 pH/Alkalinity/DIC Adjustment

As noted in Chapter 2, there are ranges of pH, alkalinity, and DIC that result in formation of insoluble compounds in the scale and in this way prevent the release of lead and copper (see Section 3.3.1 for recommended target pH/alkalinity/DIC ranges). Adjustment of pH/alkalinity/DIC can be accomplished by chemical or non-chemical means. Typical chemicals used for pH/alkalinity/DIC adjustment for corrosion control are listed in Exhibit 3.1. Additional information and guidance on pH adjustment methods are provided in USEPA (1992a) and Hill and Cantor (2011).

In addition to chemical methods, pH/alkalinity/DIC adjustment can be accomplished using limestone contactors or aeration. Limestone contactors, which are enclosed filters containing crushed high-purity limestone, have been used at small systems because they are relatively easy to operate. As the water passes through the limestone, the limestone dissolves, raising the pH, alkalinity, DIC, and calcium of the water. An empty bed contact time of 20 to 40 minutes is typically used to optimize pH and alkalinity adjustment. If a high pH is needed, other media types (e.g., dolomite, dolomitic materials) may be available regionally. The pH can be hard to control in limestone contactors and can depend on initial water quality and type of limestone used. When using limestone contactors, it is important to limit influent water quality to properly control effluent water chemistry. Suggested values for the influent are pH < 7.2, calcium < 60 mg/L, and alkalinity < 100 mg/L (Hill and Cantor, 2011). For influent pH > 7.2, carbon dioxide can be added prior to the contactors. Limiting iron, manganese, and aluminum is also recommended to prevent filter fouling. Limestone contactors can also be used for iron removal but require backwash capabilities to remove iron that accumulates on the limestone. Recommendations on the design and application of limestone contactors can be found on the following Environmental Protection Agency (EPA)-funded website www.unh.edu/wttac/WTTAC_Water_Tech_Guide_Vol2/limestone_intro.html. Calcite filters are a similar treatment that operate using the same principles as limestone contactors, except that they use a finer material that is housed in a cartridge. For the purposes of this document, “limestone contactor” is the generic term used to represent any filtration process of calcite-containing material used to add pH, alkalinity, and DIC to the water.

Aeration is a non-chemical method for adjusting pH where air is introduced into the water. Aeration is the only method that ***reduces*** excess DIC by removing carbon dioxide, which results in an increase in pH. Aeration systems include Venturi injector systems, tray systems, packed tower systems, and diffuse bubble systems. They can be designed to remove other constituents such as iron, manganese, radon, volatile organic compounds (VOCs) and hydrogen sulfide (H_2S). Aeration is most effective when there is an adequate carbon dioxide concentration in the water (4 - 10 mg/L CO_2), and the pH is < 7.2 (Spencer and Brown, 1997; Lytle et al., 1998; Spencer, 1998; AWWA, 1999; Schock et al., 2002; AWWA, 2005).

Exhibit 3.1: Typical Chemical Processes for pH/Alkalinity/DIC Adjustment

Chemical	Use	Composition	Alkalinity Change	DIC Change[1]	Notes
Baking Soda, $NaHCO_3$ (sodium bicarbonate)	Increases alkalinity with moderate increase in pH.	98% purity. Dry storage with solution feed.[2]	0.60 mg/L as $CaCO_3$ alkalinity per mg/L as $NaHCO_3$ [2, 3, 4]	0.14 mg/L as C per mg/L as $NaHCO_3$	Good alkalinity adjustment chemical but expensive.[2]
Carbon Dioxide, CO_2	Lowers pH. Converts hydroxide to bicarbonate and carbonate species.	Pressurized gas storage. Fed either through eduction or directly.[2]	None [2]	0.27 mg/L as C per mg/L as CO_2	Can be used to enhance NaOH or lime feed systems.[2]
Caustic Potash, KOH (potassium hydroxide)	Raises pH. Converts excess carbon dioxide to carbonate alkalinity species.	KOH is available as a 45% solution.[5] Has a low freezing point and may be stored at higher concentrations.	0.89 mg/L as $CaCO_3$ alkalinity per mg/L as KOH [3, 4]	None	pH control is difficult when applied to poorly buffered water.[5] Is a hazardous chemical, requires safe handling and containment areas.
Caustic Soda, NaOH (sodium hydroxide) [6]	Raises pH. Converts excess carbon dioxide to carbonate alkalinity species.	93% purity liquid bulk, but generally shipped and stored at < 50% purity to prevent freezing.[2]	1.25 mg/L as $CaCO_3$ alkalinity per mg/L as NaOH [3, 4]	None	pH control is difficult when applied to poorly buffered water.[2] Is a hazardous chemical, requires safe handling and containment areas.
Hydrated Lime, $Ca(OH)_2$ (calcium hydroxide) [7]	Raises pH. Increases alkalinity and calcium content (i.e., hardness).	95 to 98% purity as $Ca(OH)_2$. 74% active ingredient as CaO. Dry storage with slurry feed.[2]	1.35 mg/L as $CaCO_3$ alkalinity per mg/L as $Ca(OH)_2$ [3, 4]	None	pH control is difficult when applied to poorly buffered water. Slurry feed can cause excess turbidity. O&M is intensive.[2]
Potash, K_2CO_3 (potassium carbonate)	Increases alkalinity with moderate increase in pH.	Dry storage with solution feed.[5]	0.72 mg/L as $CaCO_3$ alkalinity per mg/L K_2CO_3 [3, 4]	0.09 mg/L as C per mg/L as K_2CO_3	More expensive than soda ash but more soluble and easier to handle.[5]

Chemical	Use	Composition	Alkalinity Change	DIC Change[1]	Notes
Soda Ash, Na_2CO_3 (sodium carbonate)	Increases alkalinity with moderate increase in pH.	95% purity. Dry storage with solution feed.[2]	0.94 mg/L as $CaCO_3$ alkalinity per mg/L as Na_2CO_3 [3, 4]	0.11 mg/L as C per mg/L as Na_2CO_3	More pH increase compared with $NaHCO_3$, but less costly.[2] Has increased buffer capacity over hydroxides.
Sodium Silicates, Na_2SiO_3	Moderate increases in alkalinity and pH.	Available in liquid form mainly in 1:3.2 or 1:2 ratios of Na_2O:SiO_2.[8]	Depends on formulation	None	More expensive than other options but easier to handle than lime and other solid feed options. Has additional benefits in sequestering or passivating metals.[8]

Notes and adapted sources:

[1] Calculated by the formula DIC Change = 12 x (moles carbon/mole compound) / molecular weight of compound.

[2] USEPA, 1992a

[3] Wachinski, 2016

[4] Simon, 1991

[5] USEPA, 2003

[6] Caustic potash (KOH), or potassium hydroxide, is an alternative that does not add sodium to water.

[7] Lime is available as hydrated or slaked lime ($Ca(OH)_2$) and quicklime (CaO).

[8] Schock, 1996

3.1.2 Phosphate-Based Inhibitors[16]

As noted in Chapter 2, phosphate-based corrosion inhibitors are chemicals that have orthophosphate in their formulation.[17] Orthophosphate reacts with divalent lead and copper (i.e., Pb^{++} and Cu^{++}) to form compounds that have a strong tendency to stay in solid form and not dissolve into water. The extent to which orthophosphate can control lead and copper release depends on the orthophosphate concentration, pH, DIC, and the characteristics of the existing corrosion scale (e.g., whether it contains other metals such as iron or aluminum).

Orthophosphate is available as phosphoric acid, in salt form (potassium or sodium), and as zinc orthophosphate. Phosphoric acid (H_3PO_4) is a common form that is available in concentrations between 36 and 85 percent. Because it is an acid, it requires special handling and feed facilities. Zinc orthophosphate inhibitors typically have zinc: phosphate weight ratios between 1:1 and 1:10. Recent research found that zinc orthophosphate did not provide additional lead and

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[16] As noted in Chapter 2, polyphosphates, which are used mainly as sequestrants for iron and manganese, have not been found to be effective on their own to control lead and copper release.

[17] Orthophosphate concentration can be measured as P (phosphorus) or PO_4 (phosphate). It is very important to be clear about which measurement is being used. An orthophosphate concentration of 3 mg/L as PO_4 is roughly equivalent to 1 mg/L as P.

copper control compared to orthophosphate (Schneider et al., 2010). The zinc did, however, provide better corrosion protection for cement at low alkalinity/hardness/pH conditions.

Blended phosphates are a mix of orthophosphate and polyphosphate, with the orthophosphate fraction ranging from 0.05 to 0.7. It is possible that blends can provide both sequestration of metals and reduce metals release (Hill and Cantor, 2011). It is important to note that blended phosphates may not function as corrosion inhibitors strictly on the basis of concentration and relative amount of orthophosphate. See Section 3.3 for more information and recommended special considerations for using blended phosphates.

3.1.3 Silicate Inhibitors

Silicate inhibitors are mixtures of soda ash and silicon dioxide. These treatment chemicals are available in liquid or solid form (AwwaRF, 1990; Reiber et al., 1997; USEPA, 2003). They have been shown in a few cases to reduce lead and copper levels in first draw, first liter tap samples (LaRosa-Thompson et al., 1997; Schock, Lytle, et al., 2005). They have not been used in many full-scale plants because they have traditionally been more expensive than phosphate-based inhibitors and can require high doses.

The mechanisms by which silicate inhibitors control lead and copper release have been debated in the literature. Silicates may form an adherent film on the surface of the pipe that acts as a diffusion barrier. Silicates will also increase the pH of the water, which may reduce lead and copper release. The effectiveness of the formation of a diffusion barrier depends on pre-existing corrosion products on the scale to provide a site for the binding of the silicate layer (LaRosa-Thompson et al., 1997).

Silicates are defined by a weight ratio of SiO_2:Na_2O. A ratio of 3.22 is typical, although sodium silicate solutions with ratios as low as 1.6 are commercially available (Schock and Lytle, 2011; Schock, Lytle, et al., 2005).

3.2 Technical Recommendations for Selecting Treatment Alternatives

The process that systems must follow before the primacy agency designates OCCT is established in the LCR and differs in part based on system size. All systems, however, must recommend to the primacy agency a treatment option for designation as OCCT. This section contains technical recommendations to support primacy agencies, water systems, and if applicable, outside technical consultants in evaluating treatment alternatives to control lead and copper release. These technical recommendations may be particularly useful for systems serving 50,000 or fewer people when developing their OCCT recommendation, or for larger systems identifying corrosion control alternatives for further study. See Chapters 4 and 5 for a review of CCT requirements under the LCR.

This section includes flowcharts to support the corrosion control selection process. These flowcharts are based on the 1997 EPA document, *Guidance for Selecting Lead and Copper*

Control Strategies (1997) and the revised guidance with the same name, published in 2003. This section reflects new research related to the control of copper corrosion and blended phosphates, as well as new research related to corrosion control in systems with raw water iron and manganese. These flowcharts are intended to serve as a general screening tool for identifying potential alternatives. They are not meant to substitute for pilot studies and other site-specific investigations or preclude the use of other technologies identified by the system, primacy agency, or technical experts. It is the system and primacy agency's responsibility to assess the pros and cons of each treatment alternative, and to ensure its optimization once installed.

The following technical recommendations are discussed in this section:

- STEP 1. Review Water Quality Data and Other Information.
- STEP 2. Evaluate Potential for Scaling.
- STEP 3. Select One or More Treatment Option(s).
- STEP 4. Identify Possible Limitations for Treatment Options.
- STEP 5. Evaluate Feasibility and Cost.

Section 3.3 follows with technical recommendations on setting dose and target water quality parameters. Special considerations for systems with LSLs, small systems, and systems with multiple sources are provided below.

- Considerations for ***systems with LSLs:*** Systems with LSLs may want to evaluate the feasibility and cost effectiveness of fully removing all LSLs (utility-side and customer-side). Full LSL removal has several operational benefits - for example, systems using orthophosphate may be able to reduce their dose when LSLs have been fully removed. Also, removing the source of lead reduces the vulnerability of the system to unexpected changes in lead release due to future water quality changes.

- Considerations for ***very small community water systems (CWSs) and non-transient, non-community water systems (NTNCWSs):*** Systems that directly control 100 percent of their plumbing fixtures and components may want to consider physically replacing all lead-containing or copper plumbing materials. Systems should verify that the new components are certified *"lead-free"* according to current standards (See Section 2.1 for the definition of "lead-free"). Point-of-use (POU) treatment units, if they meet the SDWA requirements, may be an option in limited circumstances.[18] Note systems that select plumbing replacement or POU devices must continue the CCT steps described in

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[18] For additional information refer to: 1) the preamble to the 2007 LCR Short-Term Revisions (USEPA, 2007a); and 2) *Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems*, EPA 815-R-06-10 (USEPA, 2006b). https://nepis.epa.gov/Exe/ZyPDF.cgi/P1009UBF.PDF?Dockey=P1009UBF.PDF.

Section 4.1 unless they are deemed optimized.[19] In cases where very small CWSs and NTNCWSs are identifying CCT, it may be beneficial to consider technologies that are easy to operate (e.g., limestone contactors, aeration) and select chemicals that are easy to store and work with, such as baking soda.

- Considerations for ***systems with more than one source:*** Many systems will have unique source and treatment scenarios that make system-wide corrosion control recommendations difficult. It may be prudent for systems with multiple wells or multiple sources, or systems that purchase waters of differing quality that enter the distribution system at various locations, to determine the most appropriate treatment separately for each source then undertake a system-wide evaluation of the most effective way to implement and operate corrosion control.

It is also important to recognize the potential limitations of treatment in chronic low water usage homes and homes that have been unoccupied for extended periods of time. The treatment may not be effective at lowering lead and/or copper levels at these sites, which can pose an ongoing risk to these residents. Systems can consider other potential actions they or residents can take to address the potential risk at these sites.

3.2.1 Technical Recommendations for Reviewing Water Quality Data and Other Information (STEP 1)

Lead and Copper Data

The forms in Appendix D can be used to organize lead and copper tap sampling data for system and primacy agency review. In addition to their own data, systems and primacy agencies should review any additional lead and copper data collected by others (e.g., universities).

Systems and primacy agencies should consider evaluating the dates and locations of individual sample results above the lead or copper action level(s) to determine if there are any spatial or temporal patterns. These results could be compared to water quality data collected at nearby distribution system locations at similar times to determine if they coincided with unusual water quality (e.g., changes in pH, corrosion inhibitor concentration, or microbiological activity). Systems should determine if sample results above the action level(s) coincided with a change in treatment or source. Lastly, systems should compare these sample results to previous rounds of lead and copper tap monitoring to see if there is a reoccurring pattern of lead and/or copper occurrence above the action level(s) at specific locations.

Systems may want to talk to residents where the sample results were above the action level(s) to discuss the resident's sampling procedure, ask for information on water use patterns and stagnation time prior to sampling, and ask about any physical disturbances that may have

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[19] One way for systems serving 50,000 or fewer people to be deemed to have optimized corrosion control is they conducted lead and copper tap monitoring for two consecutive 6-month monitoring periods without a lead or copper action level exceedance (§141.81(b)(1)).

occurred prior to sampling (e.g., building renovations and other construction work on the property). A good way to collect information ahead of time is on a comprehensive chain of custody (COC) form. The COC form, given to the resident to send in with the sample, can be designed to collect information on sampling procedure, stagnation time, and flushing time. Talking with residents about their sample results provides an opportunity for systems to discuss one-on-one with consumers the public health implications of lead and copper and ways in which residents can reduce their exposure.[20]

For locations with sample results above the action level(s), systems and primacy agencies may want to consider additional sampling[21] to determine the source of the lead so that the system and property owner might consider site-specific remediation in addition to actions required by the regulations. See Appendix C for technical recommendations on investigative sampling methods to determine the source of lead and copper.

Other Water Quality Data and System Information

Systems and primacy agencies should collect and review water quality data and other system information pertinent to corrosion of lead and copper containing materials. Systems can use the forms in Appendix D to organize available water quality data and information and submit it to their primacy agency.

Analysis of a broad range of water quality constituents can be a very cost effective approach to identification of appropriate treatment technologies. For example:

- Having very accurate pH and alkalinity/DIC data is important for assessing the feasibility of such simple treatments as aeration or limestone contactors.
- Having calcium, magnesium, sulfate, iron, manganese, and other water quality data may help define constraints on pH adjustment, phosphate dosing, use of packed tower aerators, membranes or other processes, because of scale buildup issues.
- Knowing whether arsenic or radon is present in the source water will dictate CCTs that are compatible with the removal processes for those contaminants. For example, aeration can be used for radon removal as well as for pH adjustment for corrosion control, potentially reducing or eliminating the need for chemical treatment.
- If iron and/or manganese are present, they can interfere with the effectiveness of CCT. A combination of a removal process or filtration following oxidation (e.g.,

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[20] Note that systems must conduct public education as required by the LCR when they exceed the lead action level (§141.85). Public education guidance for CWSs is provided in the document, "Implementing the Lead Public Education Provisions of the Lead and Copper Rule: A Guide for Community Water Systems" (USEPA, 2008a) and in a similarly titled guidance for NTNCWSs (USEPA, 2008b).

[21] All lead and copper tap sample results from the system's sampling pool collected within the monitoring period must be included in the 90th percentile calculation along with any samples where the system is able to determine that the site selection criteria in §141.86(a)(3)-(8) for the sampling pool are met. Other lead and copper tap data such as from customer requested sampling, investigative sampling, and special studies also must be submitted to the primacy agency (USEPA, 2004c; §141.90(g)).

aeration/disinfection) might be cost-effective and would reduce or eliminate the need for sequestration. Similarly, iron removal processes can often remove arsenic if present.

Primacy agencies and systems can use the information in Chapter 2 to review the data and identify water quality and physical factors that may be contributing to lead and/or copper release. When lead and copper monitoring data appear to be at odds with corrosion control theory, additional unknown factors may be involved. Those critical factors can only be determined by more specific evaluation and studies, such as direct examination of the pipe scales, additional data collection and evaluation, or examining the physical layouts of individual sampling sites.

3.2.2 Technical Recommendations for Evaluating the Potential for Scaling (STEP 2)

The presence of calcium in the water may limit the system's ability to raise the pH due to scaling problems in the distribution system. Scaling can clog pipes, reduce carrying capacity, and cause the water to be cloudy. Before selecting possible treatments, EPA recommends that systems and primacy agencies identify the ***saturation pH*** for calcium carbonate for the system. Maintaining the pH below the saturation pH should help to minimize, although not eliminate, the potential for precipitating calcium carbonate. It is important to note that other constituents in the water such as trace metals, natural organic matter (NOM), ligands, and phosphates can affect calcium carbonate precipitation rates and result in a higher or lower saturation pH.

The steps for determining the saturation pH are as follows:

- Determine the DIC of the water. If DIC data are not available but alkalinity and pH are known, use the table in Appendix B to determine the target DIC (in mg/L as carbon).
- Determine the finished water calcium concentration in mg/L. If this is not known but the system has total hardness data, approximate the calcium concentration by dividing the finished water hardness (as mg/L $CaCO_3$) by 2.5.
- On Exhibit 3.2, find the intersection of DIC on the x-axis (in "mg C/L") and calcium on the y-axis (in "mg Ca/L"). Find the pH curve closest to the intersection. This is the saturation pH for the system.

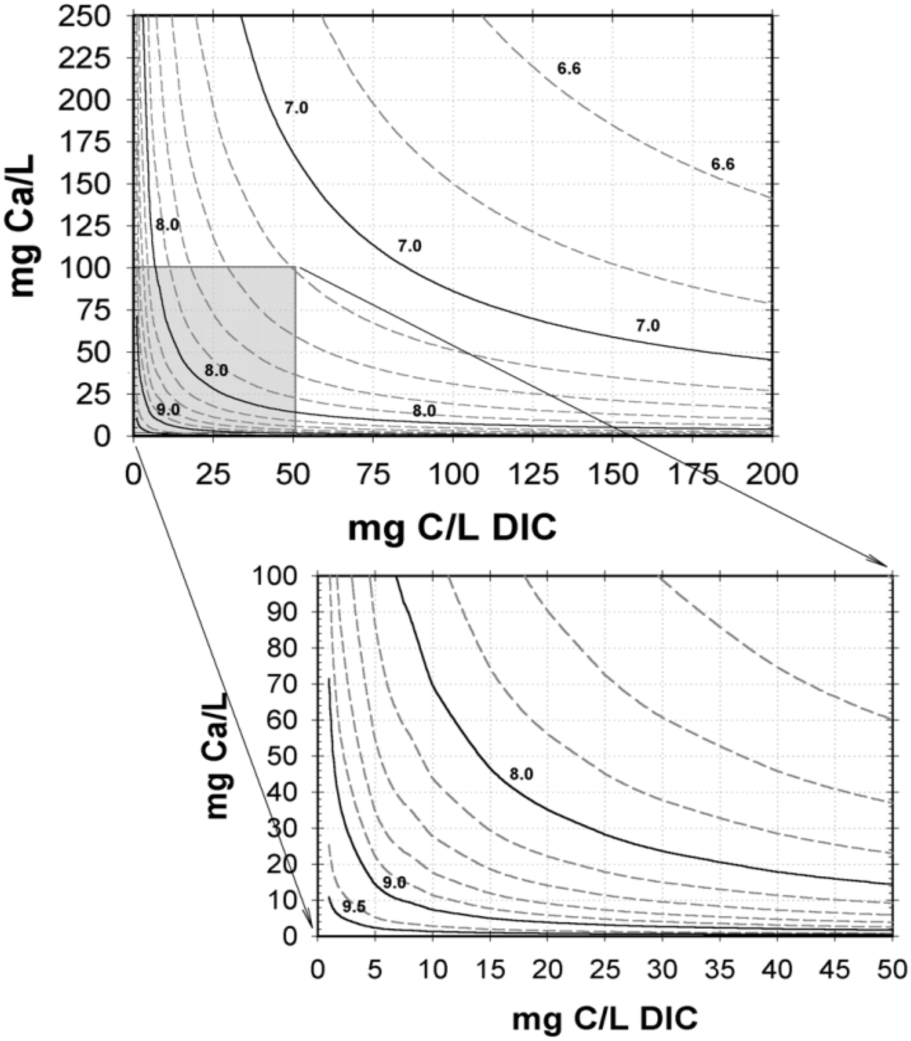


Exhibit 3.2: Theoretical Saturation pH for Calcium Carbonate Precipitation (USEPA, 2003)

Notes:
Solid lines are pH in whole numbers. Dashed lines are pH increments of 0.2
Calcium values are in mg Ca/L. To approximate calcium concentration (in mg Ca/L) from a measured hardness (as mg/L $CaCO_3$), divide the hardness value by 2.5.

3.2.3 Technical Recommendations for Selecting One or More Treatment Option(s) (STEP 3)

Systems and primacy agencies can use Flowcharts 1a through 3b in this section to select candidates for CCT. Exhibit 3.3 is a starting point for systems and primacy agencies to select the most appropriate flowchart for their situation based on whether the system has iron and/or manganese in finished water, is treating for lead and/or copper, and on pH in the distribution system.

These flowcharts were originally developed as a tool for small systems in EPA's 2003 revised guidance manual on selecting lead and copper corrosion strategies (USEPA, 2003), but they can be useful for all system types. The flowcharts have been updated to reflect new research conducted since 2003.

These flowcharts are a screening tool and are not meant to substitute for pilot studies and other site-specific investigations. They are meant to indicate likely possibilities and do not include information on optimizing any of the treatments. In particular, systems with LSLs should work with their primacy agencies to select treatment that most effectively reduces lead release from the service line and should also consider full LSL replacement as recommended earlier in this chapter. Also, as stated elsewhere in this document, the presence of other chemicals in the finished water such as aluminum, iron, manganese, and calcium may interfere with CCT and point to a need for additional studies and/or alternative control options.

Additional information on setting water quality parameters and dose for the treatment options is provided in Section 3.3.

Exhibit 3.3: Identifying the Appropriate Flowchart for Preliminary CCT Selection

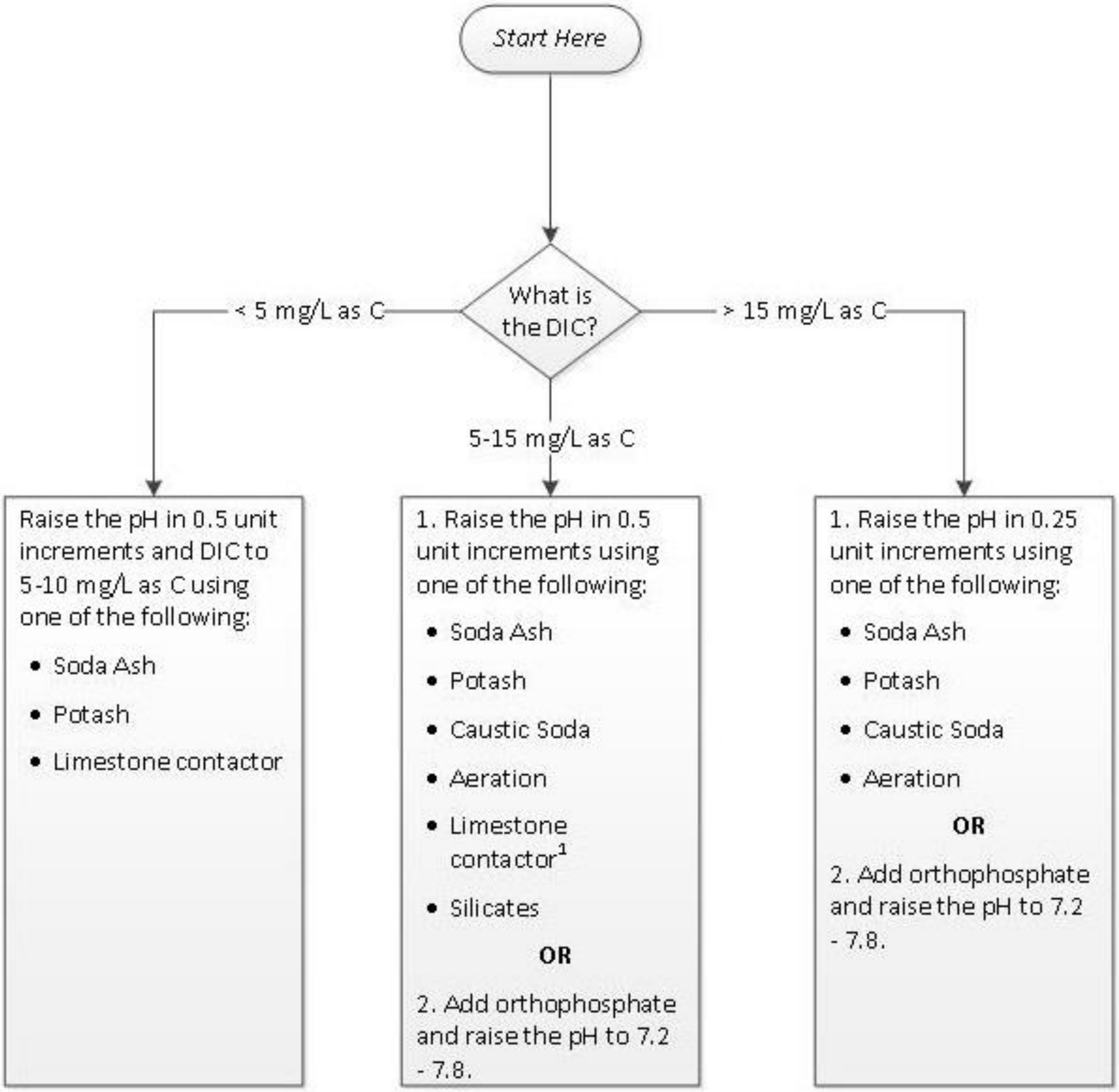
Is iron or manganese present in finished water?[1]	What is the contaminant to be addressed?	What is the finished water pH?	Use This Flowchart[2]
No	Lead only, or Both Lead and Copper	< 7.2	**1a**
		7.2 - 7.8	**1b**
		>7.8 - 9.5	**1c**
		>9.5	**1d**
	Copper only	< 7.2	**2a**
		7.2 - 7.8	**2b**
		>7.8	**2c**
Yes	Lead and/or Copper	< 7.2	**3a**
		≥ 7.2	**3b**

Notes:

[1] Flowcharts 3a and 3b present several treatment options for lead and copper that also reduce iron and manganese. Systems can also consider removing iron and manganese first, then using flowcharts 1a through 2c to control for lead and/or copper.

[2] As discussed in Section 3.1.1, the term “limestone contactor” generically identifies filtration processes where calcite-containing materials are used to add pH, alkalinity, and DIC to water.

Flowchart 1a: Selecting Treatment for Lead only or Lead and Copper with pH < 7.2

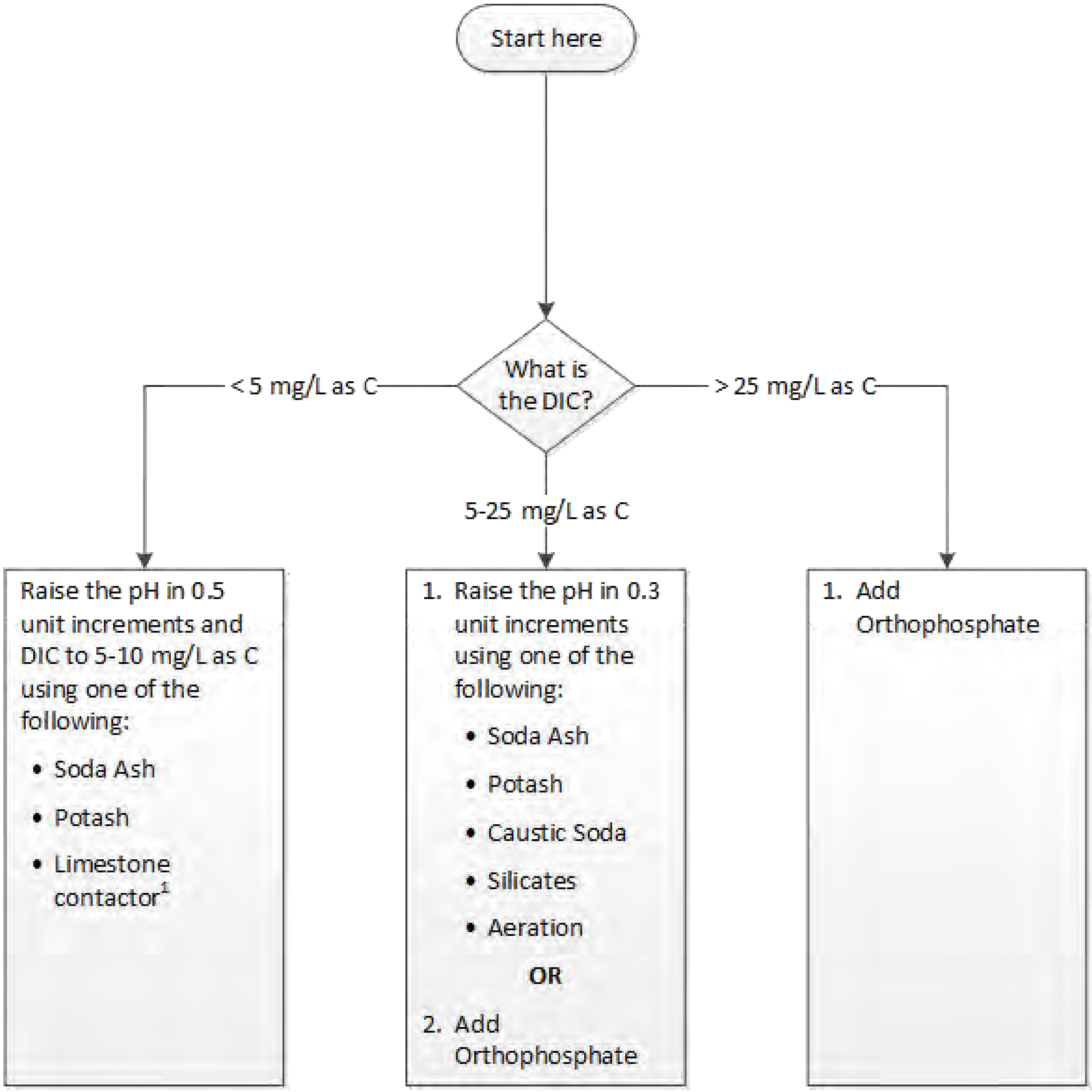


KEY:
AL = Action Level
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K2CO3)
Soda ash = sodium carbonate (Na2CO3)

Footnotes:

1. Limestone contactors may not be appropriate when DIC > 10mg/L as C.

Flowchart 1b: Selecting Treatment for Lead only or Lead and Copper with pH from 7.2 to 7.8

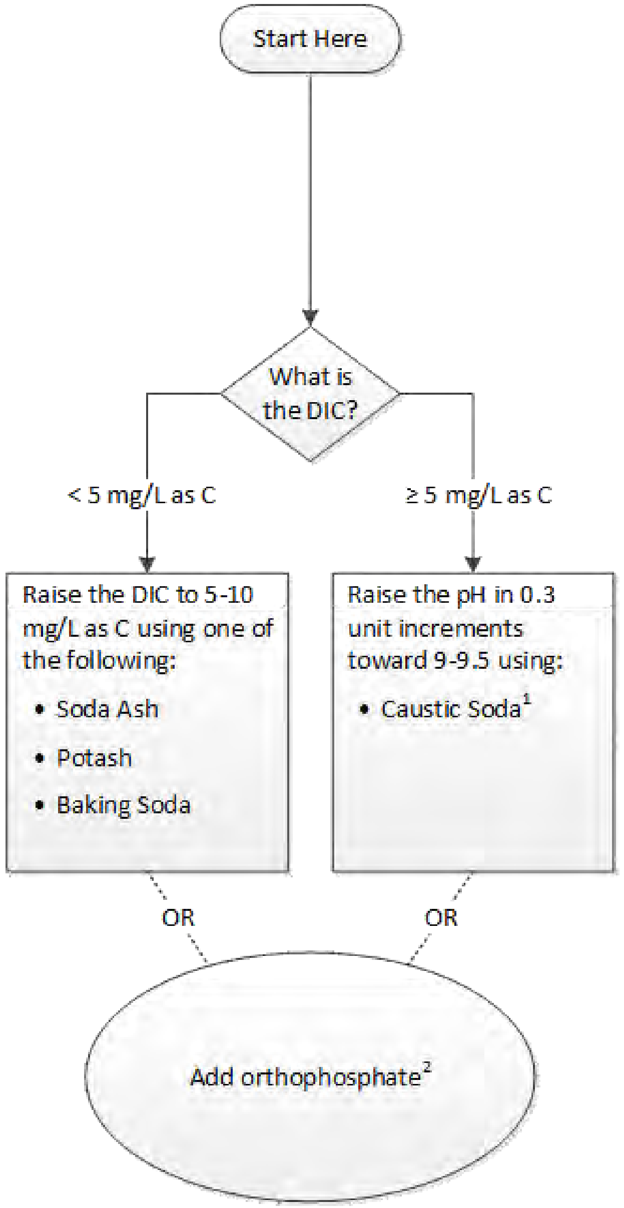


KEY:
AL = Action Level
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

Footnotes:

1. Carbon dioxide feed before the limestone contactor may be necessary.

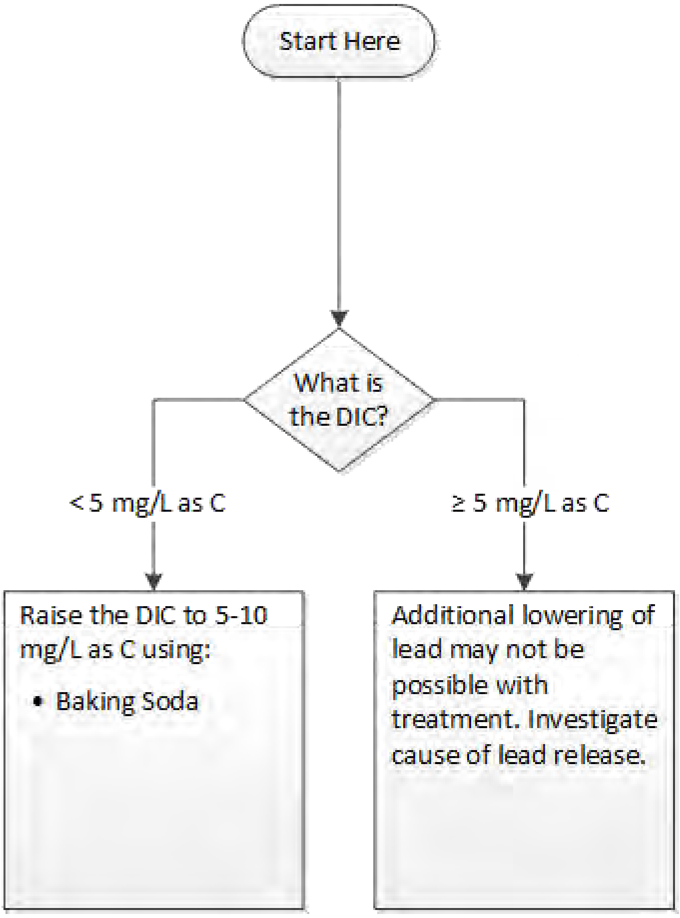
Flowchart 1c: Selecting Treatment for Lead only or Lead and Copper with pH > 7.8 to 9.5



KEY:
AL = Action Level
Baking soda = sodium bicarbonate ($NaHCO_3$)
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

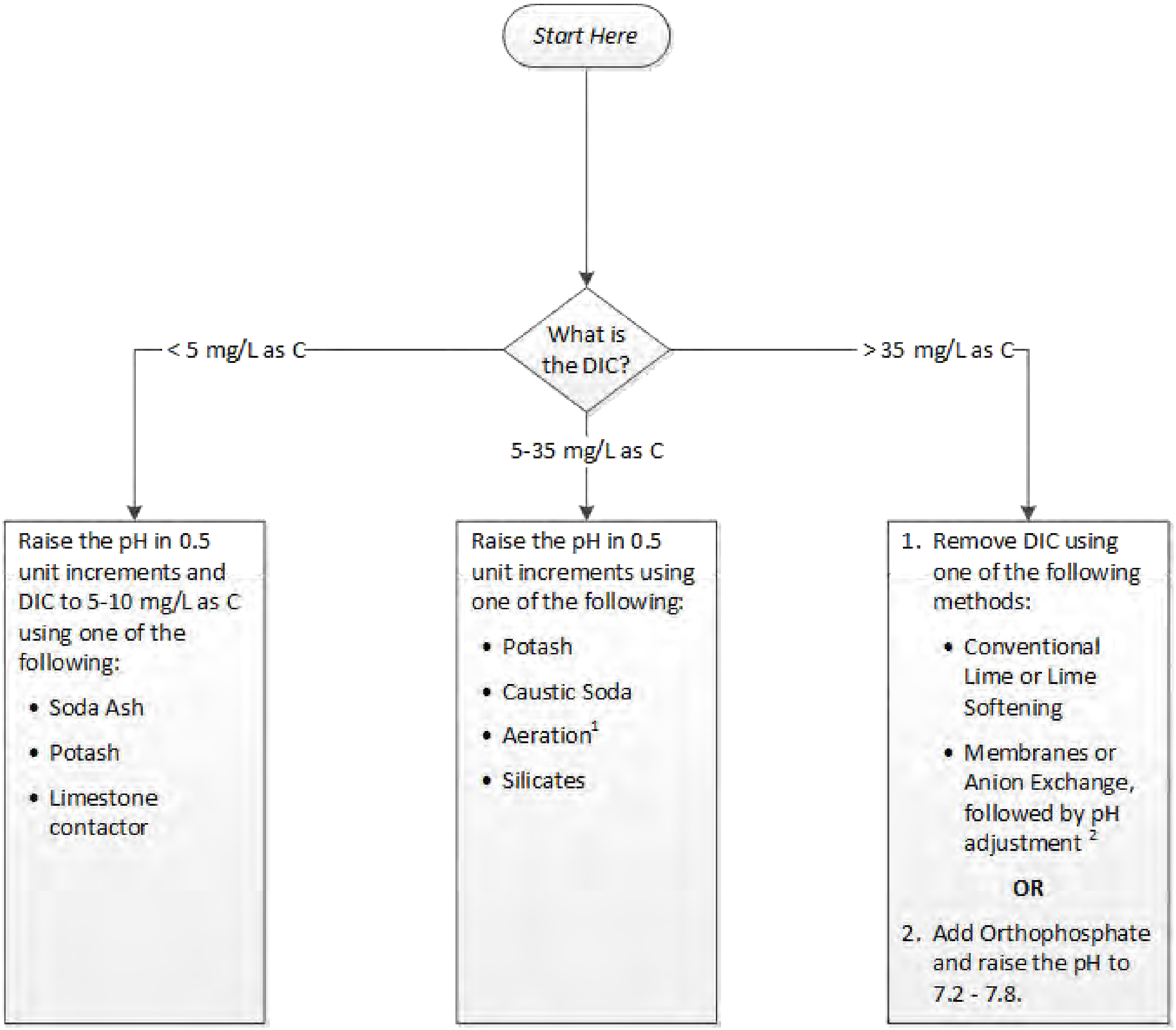
Footnotes
1. Systems with copper plumbing may experience copper pitting problems when operating at pH 9 – 9.5 and DIC of 5 – 15. Orthophosphate may be a better option for these systems.
2. Optimal pH range for orthophosphate is 7.2 - 7.8 but phosphate may be effective at higher pH depending on dose. Orthophosphate effectiveness is lowest in the pH range of 8 – 8.5. Systems should also avoid this range because of inadequate buffering in the distribution system.

Flowchart 1d: Selecting Treatment for Lead only or Lead and Copper with pH > 9.5



KEY:
AL = Action Level
Baking soda = sodium bicarbonate ($NaHCO_3$)
DIC = Dissolved Inorganic Carbon

Flowchart 2a: Selecting Treatment for Copper Only with pH < 7.2



Raise the pH in 0.5 unit increments and DIC to 5-10 mg/L as C using one of the following:

- Soda Ash
- Potash
- Limestone contactor

Raise the pH in 0.5 unit increments using one of the following:

- Potash
- Caustic Soda
- Aeration[1]
- Silicates

1. Remove DIC using one of the following methods:
    - Conventional Lime or Lime Softening
    - Membranes or Anion Exchange, followed by pH adjustment [2]

OR

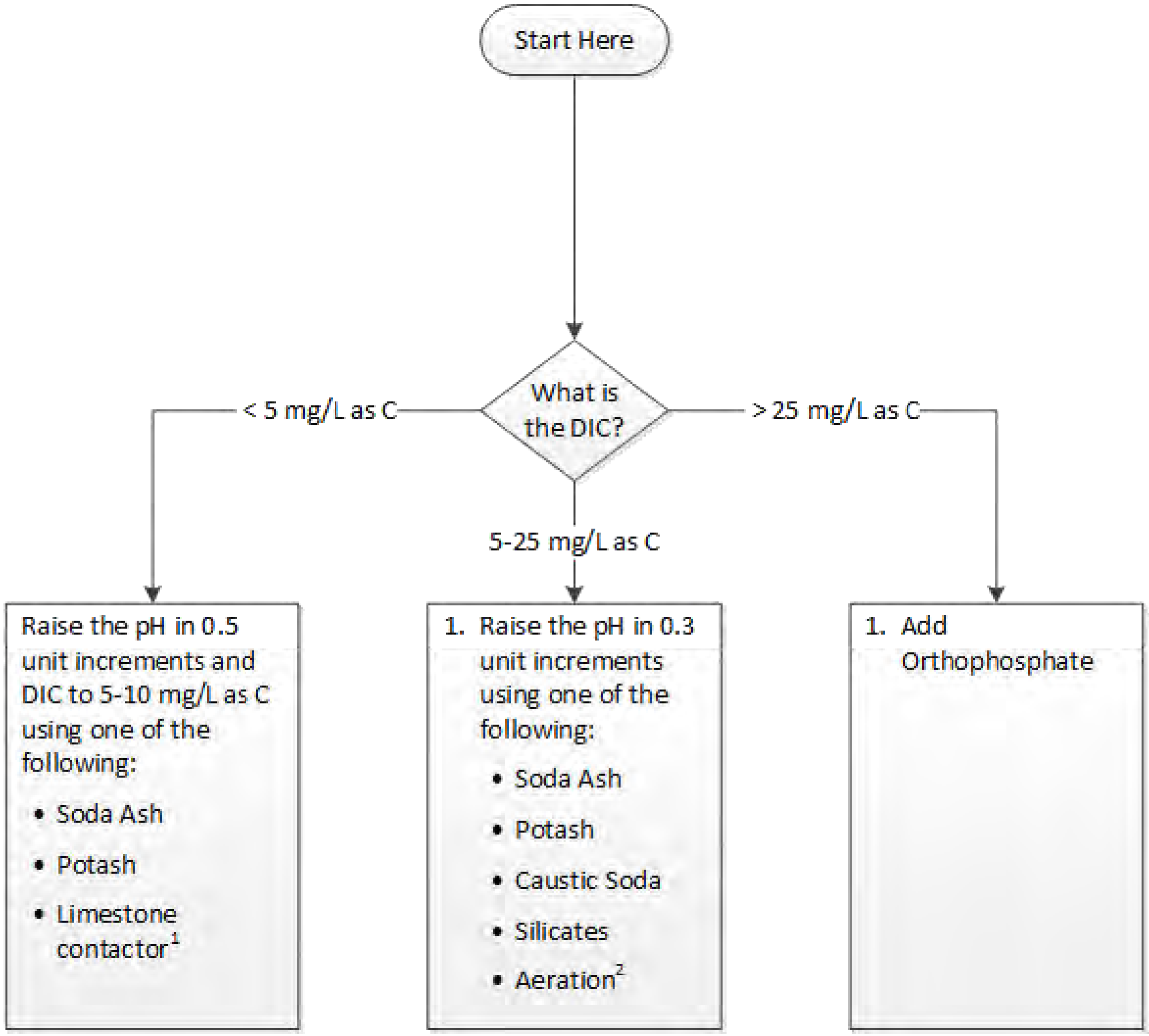
2. Add Orthophosphate and raise the pH to 7.2 - 7.8.

KEY:
AL = Action Level
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

Footnotes

1. May be most appropriate at higher end of DIC range
2. To achieve optimal levels, consider treating less than 100 percent of the water (i.e., split stream).

Flowchart 2b: Selecting Treatment for Copper Only with pH from 7.2 to 7.8

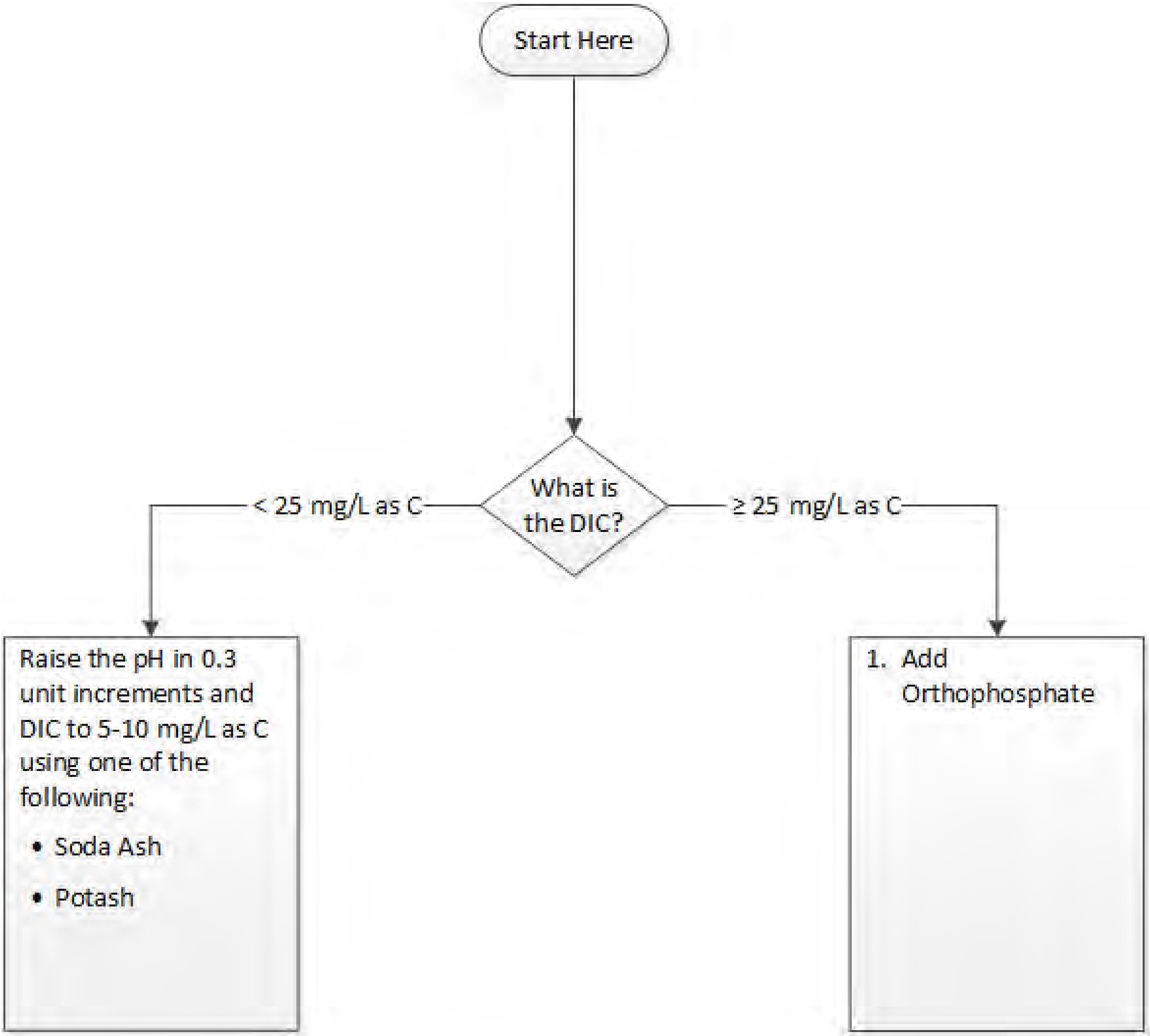


KEY:
AL = Action Level
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

Footnotes:

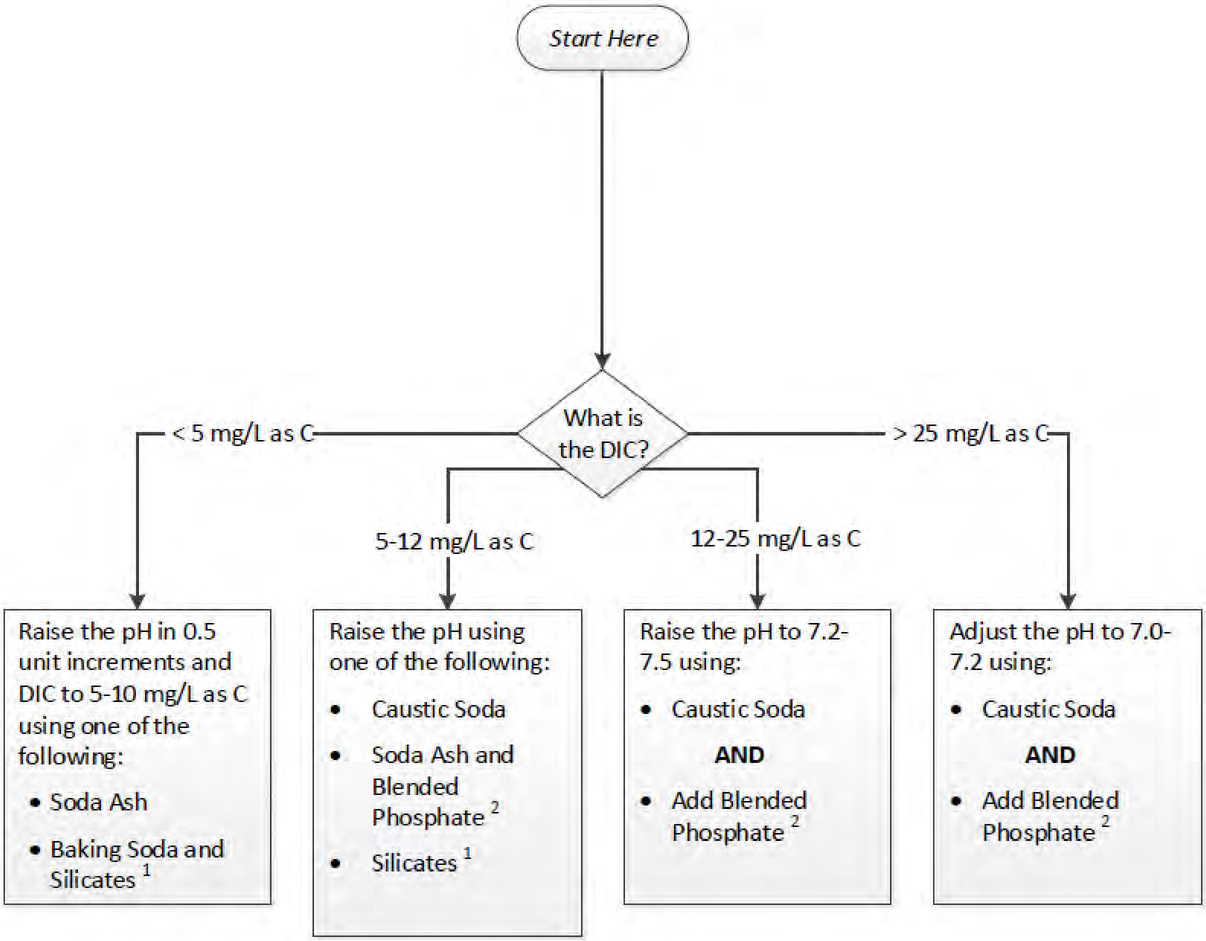
1. Carbon dioxide feed before the limestone contactor may be necessary.
2. May be most appropriate at higher end of DIC range

Flowchart 2c: Selecting Treatment for Copper Only with pH > 7.8



KEY:
AL = Action Level
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

Flowchart 3a: Selecting Treatment for Lead and/or Copper with Iron and Manganese in Finished Water and pH < 7.2

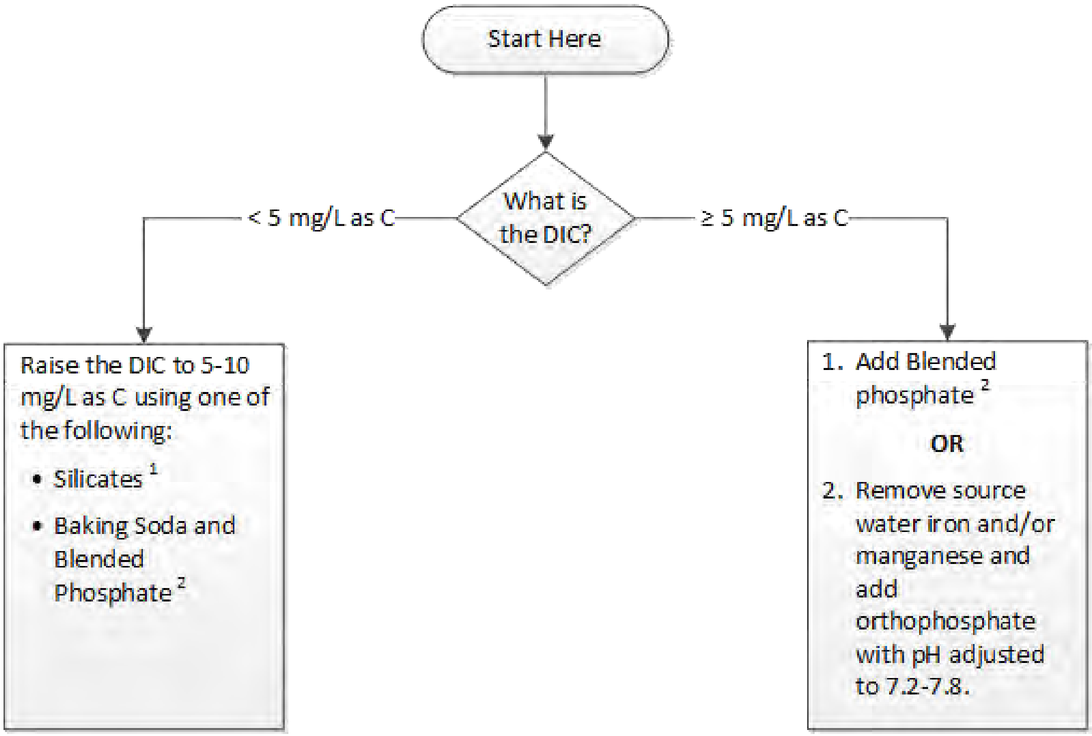


KEY:
AL = Action Level
Baking soda = sodium bicarbonate ($NaHCO_3$)
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Soda ash = sodium carbonate (Na_2CO_3)

Footnotes:

1. Silicates are most effective when combined iron and manganese concentrations are less than 1.0 mg/L.
2. The effectiveness of blended phosphate varies based on the formulation. Additional evaluation and/or monitoring is recommended. See Section 3.3.2 for additional discussion.

Flowchart 3b: Selecting Treatment for Lead and/or Copper with Iron and Manganese in Finished Water and pH ≥ 7.2



KEY:
AL = Action Level
Baking soda = sodium bicarbonate ($NaHCO_3$)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon

Footnotes:

1. Silicates are most effective when combined iron and manganese concentrations are less than 1.0 mg/L.
2. The effectiveness of blended phosphate varies based on the formulation. Additional evaluation and/or monitoring is recommended. See Section 3.3.2 for additional discussion. Blended phosphates are less effective for controlling copper at DIC greater than 25 mg/L as C.

3.2.4 Technical Recommendations for Identifying Possible Limitations for Treatment Options (STEP 4)

Once the treatment option(s) are selected from the flowcharts, review the information in this section to identify secondary impacts and possible constraints. Many of these constraints can be overcome with additional treatment modifications at the water treatment plant or wastewater treatment plant (WWTP). Observations and actions to address secondary impacts can be documented using Form E.2 in Appendix E.

Possible Limitations of pH/alkalinity/DIC Adjustment

Although many systems have successfully adjusted pH, alkalinity, and DIC to control lead and copper release, this corrosion control method has secondary impacts that may limit its use. Because silicate addition raises the pH of the water, secondary impacts for this treatment option are similar to the secondary impacts of raising pH for controlling lead and copper release.

Three factors that could limit the use of pH/alkalinity/DIC adjustment and silicates are: (1) optimal pH for other processes, particularly disinfection; (2) calcium carbonate precipitation; and (3) oxidation of iron and manganese. Observations and actions to address secondary impacts can be documented using Form E.2 in Appendix E.

(1) Optimal pH for other processes

Different treatment processes within the plant such as coagulation and disinfection have different target pH ranges. Determining the proper location to add a pH and/or alkalinity adjustment chemical should be considered in light of other process objectives.

Adjusting pH for corrosion control can affect disinfection performance and compliance with Surface Water Treatment Rules and possibly the Ground Water Rule (for those ground water systems that are required to provide 4-log virus inactivation). For systems that use chlorine for primary disinfection, increasing the pH prior to the chlorine contact chamber may reduce disinfection performance and require an increase in chlorine dose or contact time to meet the required CT.[22] For systems that consider contact time in the piping prior to the first customer as part of their CT calculation, a higher chlorine dose may be needed to meet CT. To minimize disinfection impacts, systems should adjust pH for corrosion control after CT has been achieved if possible. A system that plans to make a significant change to its disinfection practice to comply with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), such as a change in disinfectant type or process, must develop disinfection profiles and calculate disinfection benchmarks for *Giardia lamblia* and viruses (§§141.708-709).

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[22] CT is chlorine concentration multiplied by contact time. Required CT for chlorine is very dependent on pH, with greater CT required at higher pH levels.

Changing the pH and/or alkalinity may also impact the ability of a system to maintain a disinfectant residual in the distribution system. In most cases however, increasing the pH for corrosion control can help maintain the disinfectant residual because the disinfectant will react at a slower rate with metals being released at the pipe surface.

Changes in pH can also affect formation of disinfection byproducts (DBPs). Total trihalomethanes (TTHM) formation tends to increase at higher pH levels, while formation of haloacetic acids (HAA5) tends to decrease. See the EPA Simultaneous Compliance Guidance Manual for the Stage 2 and LT2 Rules (USEPA, 2007b) for more information on how pH changes can impact DBP formation.

(2) Calcium Carbonate Precipitation

If the finished water has high hardness (specifically the calcium portion of hardness), raising the pH and DIC may cause calcium carbonate to precipitate in the distribution system, clogging hot water heaters and producing cloudy water. Calcium carbonate precipitation is site-specific and depends on many factors; therefore, a system evaluation should be conducted as described in Step 2 above.

If calcium carbonate precipitation is determined to be a potential problem, systems can take one of the following approaches:

- Choose a different CCT method such as using phosphate-based corrosion inhibitor,
- Remove DIC with ion exchange or membrane filtration, or
- Add softening to remove calcium.

(3) Oxidation of Iron and Manganese

Iron and manganese in oxidized form can agglomerate into larger particles causing aesthetic problems in water distribution systems, resulting in black and/or red water complaints. Dissolved oxygen and chemical oxidants such as chlorine may oxidize iron and manganese, and increasing the pH can increase the rate of oxidation. The two standard approaches for these situations are removing iron and manganese at the plant, or sequestering it. Wherever possible, removal of source water iron and manganese is the preferred approach. A common removal strategy is aeration or chlorination followed by filtration. Aeration will also raise the pH so this strategy may meet the system's goals of both iron and manganese removal and pH adjustment for reducing lead and copper release.

Sequestering agents such as polyphosphates and sodium hexametaphosphate may reduce black and/or red water complaints from iron and manganese oxidation, but may also cause increases in lead and copper levels measured at the tap (Schock, 1999; Cantor et al., 2000; Edwards and McNeil, 2002). Vendors often recommend blended phosphates as a lead and copper control strategy for systems with elevated iron and manganese. Blended phosphates include both polyphosphate and orthophosphate in different percentages. Blended phosphates should be used with caution; see Section 3.3 for more information. Silicates can also be used to sequester iron and manganese depending on their concentration in the raw water (Schock et al., 1996; Kvech and Edwards, 2001).

Possible Limitations of Phosphate-Based Corrosion Inhibitors

Although phosphate-based corrosion inhibitors are used widely by water systems, there are limitations to their application. Two factors that could limit the use of phosphate-based corrosion inhibitors are: (1) reactions with aluminum; and (2) impacts on wastewater treatment plants. Observations and actions to address secondary impacts can be documented using Form E.2 in Appendix E.

(1) Reactions with Aluminum

Aluminum can occur in the distribution system as an impurity introduced with lime or when a system uses alum for coagulation. As noted in Section 2.3.9, aluminum can interfere with orthophosphate effectiveness by forming aluminum phosphate ($AlPO_4$) precipitates, which reduces the amount of orthophosphate available for lead and copper control. Aluminum phosphate precipitates can result in smaller pipe diameters, increased head-loss, and increased operational cost (AWWA, 2005). Although aluminum may also provide some protection of lead surfaces by forming films with hydroxide, silicate, or phosphate, these films are prone to sloughing when there are changes in flow or water quality or when LSLs are physically disturbed during routine maintenance and repair activities. These dislodged scales can release metals that may become entrapped in the interior (premise) plumbing, potentially increasing lead and copper levels in the water (Schock, 2007b).

(2) Impacts on Wastewater

Because of problems with nutrient enrichment of surface waters in the United States, there has been concern about adding phosphate-based corrosion inhibitors to drinking water because it will increase the phosphorus loading to the wastewater treatment plant. Some wastewater utilities have stringent limits on the amount of phosphorus that can be discharged to receiving waters and remove it at the plant using biological and/or chemical treatment. Regardless of the situation, it is important that systems communicate with wastewater treatment personnel and evaluate potential impacts of adding phosphate-based corrosion inhibitors before making the final treatment selection and setting the target dose.

Survey findings from 14 utilities showed that adding a phosphate-based corrosion inhibitor increased the phosphorus load to the wastewater treatment plant by 10 to 35 percent, with a median of 20 percent (Rodgers, 2014). Slightly less than half of the survey's respondents removed phosphorus at the WWTP (Rodgers, 2014). This percentage might increase in the future. Rodgers (2014) reported that in 2013, five states had statewide phosphorus limits for lakes and reservoirs.

Phosphorus can be removed at the WWTP using biological or chemical means. In the District of Columbia, the Blue Plains WWTP added more ferric chloride to chemically remove phosphorus after an orthophosphate corrosion inhibitor was added to drinking water; the additional cost was minor compared to their overall operations budget (Cadmus Group, 2004). Wastewater utilities can also use biological phosphorus removal or a combination of biological and chemical removal techniques.

Prior to selecting a phosphate-based corrosion inhibitor, water systems and primacy agencies should work with wastewater utility personnel to estimate the additional phosphorus load to the WWTP and assess if the load could cause the plant to exceed permit limits or cause other operational problems. Additional information on nutrient enrichment and phosphorus removal strategies can be found in EPA's Nutrient Control Design Manual (USEPA, 2010a).

Use of a zinc orthophosphate corrosion inhibitor can increase zinc loading to the WWTP. Schneider et al. (2011) noted that, based on three case studies, most of the zinc in zinc orthophosphate makes its way into the wastewater treatment stream. Although many systems have successfully used zinc orthophosphate for corrosion control, zinc can inhibit biological wastewater treatment processes, particularly nitrification and denitrification. Moreover, EPA has set limits for zinc in processed sludge that is land applied (USEPA, 2004b). Schneider et al. (2011) notes that "The results of the utility case studies indicate that release of zinc in wastewater residuals and/or receiving streams can be a concern for some utilities." Water systems and primacy agencies should work with wastewater utility personnel to determine if additional zinc loading may be an issue.

3.2.5 Technical Recommendations for Evaluating Feasibility and Cost (STEP 5)

Systems should consider operability, reliability, system configuration, and other site-specific factors when evaluating CCT alternatives. In cases where more than one treatment option can meet the OCCT definition of the rule,[23] systems may want to consider cost factors including costs for capital equipment, operations, and maintenance.

3.3 Setting the Target Dose and Water Quality

This section provides technical recommendations on setting the target dose and water quality for pH/alkalinity/DIC adjustment, phosphate-based corrosion inhibitors, and silicate inhibitors. Note that the recommendations provided in this section are intended as generalized guidelines for the reader's reference. The characteristics of individual systems (e.g., water quality, distribution system configuration, sources of lead and copper, etc.) may warrant considering other values that are distinct from those provided below. For these reasons, they should not be interpreted or prescribed as default minimums and/or maximums.

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[23] As noted in Chapter 1 and Appendix A, the LCR defines OCCT as "the corrosion control treatment that minimizes the lead and copper concentrations at users' taps while insuring that the treatment does not cause the water system to violate any national primary drinking water regulations." (§141.2)

3.3.1 pH/Alkalinity/DIC Adjustment

As explained previously, the pH, alkalinity, and DIC of the water have a significant influence on lead and copper release. As a reminder, these three parameters are interrelated – if you know two of them, you can estimate the third using the table in Appendix B. The following discussion provides technical recommendations for determining the target pH, alkalinity, and DIC when controlling for lead only or lead and copper, or when controlling for copper only.

To Control for Lead Only or Lead and Copper

The following technical recommendations can assist with the establishment of target pH, alkalinity, and DIC ranges for controlling lead only, or both lead and copper release in drinking water systems. Note that in general, lower pH levels can be used when controlling only for copper release – see the next section for guidelines for those systems that do not have a lead release problem but are targeting copper corrosion control only. Note also that the guidelines below are based on formation of adherent lead carbonate scales based on Pb(II) chemistry[24].

- The target pH should be **8.8 to 10**. Systems with lead service lines that are not using a corrosion inhibitor should consider increasing the pH to **9.0 or greater**. Note that lower pH values, particularly between 8.2 and 8.5, can result in poor buffer intensity of the water (regardless of DIC levels) and wide swings in distribution system pH. See Section 2.3.4 for additional discussion of buffer intensity.
- Sufficient alkalinity and DIC are needed to form the protective scale and provide buffer intensity, but too much can solubilize lead. These factors should be considered when determining a target alkalinity/DIC range. The graph in Exhibit 2.3 can be used to evaluate the effect of DIC on buffer intensity and identify a minimum DIC range for the system's target pH. In general, the higher the pH is in the 8.8 to 10 range, the less DIC is needed to buffer the water. Information on the relationship between DIC and lead solubility is provided in Schock and Lytle (2011) for a modeled water. Lead solubility increases (i.e., more lead is released into the water) with increasing DIC concentrations above approximately 20 mg/L (as C). Schock and Lytle (2011, Figure 20-21) show minimum lead solubility at DIC between 5 and 10 mg/L as C.

As a reminder, increasing the pH to 8.8 – 10 may cause calcium carbonate precipitation if calcium is present, see Section 3.2.2 for additional discussion.

To Control for Copper Only

Adjustment of pH/alkalinity/DIC for copper control can generally be achieved at a lower target pH (as low as 7.8) than the pH needed for lead control. Copper corrosion can be controlled at even lower pH levels (i.e., between 7.0 and 7.8), but alkalinity and DIC become the limiting factors. Schock and Lytle (2011) note that hard, high alkalinity ground waters are often

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[24] For more information on Pb(II) chemistry and also influences of Pb(IV) scale, see Sections 2.2.1 and 2.3.6.

aggressive towards copper and hard to treat with pH adjustment because of calcium carbonate precipitation potential. These waters may not be candidates for pH/alkalinity/DIC adjustment and warrant considering orthophosphate or possibly removal of DIC through ion exchange, membranes, or aeration.

3.3.2 Phosphate-Based Inhibitors

The effectiveness of orthophosphate treatment depends on many factors, including phosphate dose, pH, DIC, and other constituents in the water (e.g., aluminum, iron, manganese). As noted earlier, polyphosphates alone should *not* be used to treat for lead and copper; they are mainly used to sequester iron and manganese. Special considerations for use of blended phosphates are provided at the end of this section.

Conventional wisdom is that orthophosphate treatment for controlling lead and copper should target residual concentrations of **0.33 to 1.0 mg/L as P** (1.0 to 3.0 mg/L as PO_4)[25] at the tap when pH is within the range of **7.2 to 7.8**. ***Higher orthophosphate doses*** (1.0 to 1.2 mg/L as P, or 3 to 3.5 mg/L PO_4 and higher) may be needed under the following circumstances:

- To control lead release from LSLs.
- To control copper corrosion from new copper pipe in high DIC water.
- To mitigate copper pitting in some water qualities.
- If the system has aluminum carry-over from alum coagulation and/or presence of iron, manganese, and/or magnesium in finished water.

While the pH range of 7.2 to 7.8 is still considered optimal, systems ***should not*** automatically reduce the pH of their water if it is 8 or higher when starting orthophosphate treatment. Orthophosphate may be effective at pH as high as 9, although dose requirements may not be the same as for pH from 7.2 to 7.8. Laboratory results suggest that less effective control of lead release occurs between pH 8 and 8.5 than either above or below that range (Schock et al., 1996; Miller, 2014). Systems should therefore avoid operating between pH 8 and 8.5, if possible, to control for lead release. For copper, orthophosphate effectiveness is not strongly affected by pH when pH is between 7 and 8; dose is much more important.

Systems and primacy agencies should also consider the DIC of finished water when determining the target orthophosphate dose. In general, orthophosphate is more effective at low DIC (<10 mg C/L). Also, the pH is less important for lead control in low DIC waters.

Note that the target orthophosphate concentration is the level needed to control corrosion in ***premise plumbing***. Because orthophosphate will react with metals and other compounds, the concentration leaving the treatment plant may need to be higher to achieve the target

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[25] Note that these concentrations are a general point of reference; they are not intended to be interpreted or universally prescribed as default minimums or maximums. Characteristics of individual systems (e.g., water quality, distribution system configuration, sources of lead and copper, etc.) may warrant consideration of other target concentrations, distinct from those provided above. Systems may also benefit from supplemental diagnostic monitoring to verify optimization.

concentration at the tap. In particular, aluminum (e.g., that was carried over from alum coagulation) can react with orthophosphate and reduce the amount available in premise plumbing. During start-up, systems should be prepared to adjust the dose at the treatment plant to meet the target dose at the tap throughout the distribution system. See Chapter 5 for additional recommendations on start-up of orthophosphate treatment.

Some systems have started orthophosphate treatment using a higher passivation dose, followed by a lower maintenance dose for long-term treatment. Hill and Cantor (2011) recommend that the passivation dose be 2 to 3 times higher than the target maintenance dose in order to build up a protective film as quickly as possible. The amount of time needed for the initial passivation dose to form adequate scale is unknown, and will vary depending on the system's specific water quality. Lead levels may continue to decline for years after an optimal orthophosphate dose has been applied, due to the slow rate of scale formation.

Systems with LSLs should evaluate whether the orthophosphate dose is enough to passivate disturbed LSLs in a timely manner. Routine maintenance or repairs such as water main replacements, meter installations, service line and shut-off valve replacements, and leak repairs may disrupt LSL scales and result in high lead levels. When evaluating the success of OCCT, systems and primacy agencies should consider the impact of these physical disturbances on lead levels at the tap (Del Toral et al., 2013). In addition, when establishing a maintenance dosage, it is important to consider other factors such as homes with chronically low water use that have LSLs. Ongoing diagnostic monitoring at these sites before and after treatment installation or adjustment can provide useful information for establishing a proper maintenance dose.

Special Consideration for Blended Phosphates

Blended phosphates have been used for corrosion control and to sequester iron and manganese. Blended phosphates have been shown to be effective for reducing lead levels; however, the lead corrosion scale may not be as robust as the scale created by orthophosphate and, thus, may be more susceptible to physical disturbances and low water use conditions (Del Toral et al., 2013; Wasserstrom et al., 2017). It is unclear if blended phosphates work well to control copper corrosion, especially at high alkalinities.

The effectiveness of blended phosphates cannot be based on the orthophosphate concentration in the blend for the following reasons:

- Blended phosphates control corrosion by creating a barrier film from the interaction of calcium and aluminum in the bulk water with phosphorus containing compounds (Wasserstrom et al., 2017). Thus, calcium and aluminum play a role in effectiveness.

- If the polyphosphate portion of the blend has a high affinity for sequestering lead or copper, it may counteract the benefit of the orthophosphate portion in forming solid lead and copper compounds.

The percent of orthophosphate in the blend can vary widely (from 5 to 70 percent (Hill and Cantor, 2011)). Blended phosphate should contain a minimum orthophosphate concentration of 0.5 mg/L as P (1.5 mg/L as PO_4) as a starting point for evaluation. The orthophosphate ratio in the blend and/or the dose may need to be increased to provide adequate lead control. In some cases, however, simply adding more blended phosphate may not be effective because, if there is excess polyphosphate available beyond what is bound up with other constituents in the water, it can sequester the lead and copper. EPA recommends a demonstration study, additional monitoring, or both for systems that recommend blended phosphates to control lead release.

3.3.3 Silicate Inhibitors

The effectiveness of silicate inhibitors depends on silicate level, pH, and DIC of the water. Adding silicates can raise the pH, so lead and copper level reductions may occur due to an increase in pH as well as passivation. In addition to providing lead and copper control, silicates can sequester iron and manganese if the levels of these constituents are not too high (not greater than 1 mg/L combined) (Schock et al., 1996; Schock, Lytle, et al., 2005).

Many systems have not considered silicate inhibitors for lead and copper control due to the lack of research and field information proving its effectiveness, the estimated operating costs and high dosage rates required, and the time it takes to reduce lead concentrations (Hill and Cantor, 2011).The literature does report a successful case study for a small system in Massachusetts that instituted chlorination and sodium silicate addition in three wells to address LCR compliance and intermittent red water problems (Schock, Lytle, et al., 2005). An initial silicate dosage rate of 25-30 mg/L was effective for reducing lead and copper levels by 55 and 87 percent, respectively, and raised the pH from 6.3 to 7.1. LCR compliance was achieved when the silicate dosage rate was increased to 45-55 mg/L at two wells which raised the pH to 7.5. In another study, Vaidya (2010) found that sodium silicate significantly reduced lead and copper release in bench-scale studies using coupons from 30 to 35-year-old distribution pipes.

Relatively high silicate doses (in excess of 20 mg/L) may be required to control lead release (Schock, Lytle, et al., 2005). A startup dose of 24 mg/L is recommended, followed by a gradual reduction after 60 days to a maintenance dose of 8 to 12 mg/L (Schock and Lytle, 2011; Hill and Cantor, 2011). Chloride, calcium, and magnesium concentrations in the water can affect the optimum dose (Hill and Cantor, 2011). A review of several case studies and literature reports suggested that a pre-existing layer of corrosion products on the pipes was required in order for silicate to properly form a protective layer, at least in copper pipes (LaRosa-Thompson et al., 1997). Similar to phosphate-based inhibitors, it is important to maintain continuous dosing of the silicate inhibitor to ensure effective corrosion control.

Chapter 4: Review of Corrosion Control Treatment Steps under the LCR

Corrosion control treatment (CCT) requirements under the Lead and Copper Rule (LCR) differ depending on the system size (i.e., population served). Most systems serving more than 50,000 people were required to meet a series of deadlines beginning in 1993 to determine optimal corrosion control treatment steps (OCCT) and install OCCT by January 1, 1997.[26] Any system that served 50,000 or fewer people at the time of the LCR, but that grew in population or combined with another system so that they now serve more than 50,000 people (called systems ***newly*** serving more than 50,000 people for the purposes of this document) must also complete CCT steps. Because the regulatory deadlines for systems serving more than 50,000 people have passed, systems newly serving 50,000 people must follow the schedule for systems serving 3,301-50,000 people.[27] Systems serving 50,000 or fewer people are not required to conduct CCT steps under the LCR unless they exceed the lead and/or copper action level (AL).

This chapter presents a review of CCT steps as required by the LCR along with additional technical recommendations to systems and primacy agencies for the following categories of systems:

- Those serving 50,000 or fewer people that exceed the lead and/or copper AL (Section 4.1).
- Systems newly serving more than 50,000 people (Section 4.2).
- Existing systems serving more than 50,000 people that previously installed CCT but have subsequent action level exceedances (Section 4.2).

Chapter 5 follows with a review of LCR requirements and provides additional technical recommendations for CCT installation, startup, follow-up monitoring, and long-term corrosion control monitoring.

These sections are supported by the following appendices:

- Appendix D contains forms that can be used by systems to submit water quality data and system information to the primacy agency.
- Appendix E contains OCCT recommendation forms for systems serving 50,000 or fewer people.
- Appendix F summarizes tools available for conducting a corrosion control study.

Systems and primacy agencies can use the ***OCCT evaluation templates*** to complete many of the tables in the appendices related to their OCCT determination. The templates also provide an

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[26] All systems serving more than 50,000 people are required to conduct CCT steps unless they are deemed to have optimized corrosion control under §141.81(b)(2) or (b)(3).

[27] The schedule for completing CCT was clarified in the guidance manual, *Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems* (USEPA, 2010b) as footnote 1 in Exhibit I-1. It specifies that a "system whose population exceeds 50,000 after July 1, 1994, must follow the schedule for medium-size systems, beginning with the requirement to complete a corrosion control study."

opportunity for primacy agencies to customize forms and to enter specific dates for compliance milestones. As a reminder, requirements in this section are based on the LCR as of the date this document was published.

4.1 Corrosion Control Treatment Steps for Systems Serving ≤ 50,000 People

Exhibit 4.1 summarizes the required CCT actions and deadlines when a system serving 50,000 or fewer people exceeds the lead and/or copper action level. The column furthest to the right shows the related section or Chapter where relevant technical recommendations are provided for the system or primacy agency.

It is important to note that in accordance with the LCR, systems serving 50,000 or fewer people have no more than ***6 months*** from the end of the monitoring period in which they had the AL exceedance to recommend OCCT to their primacy agency. The primacy agency then determines if a study is needed. If a study is not required, the primacy agency designates the OCCT within 24 months from the end of the monitoring period in which the system had the AL exceedance for those serving 3,300 or fewer people or within 18 months for those serving 3,301 to 50,000 people. If the primacy agency requires a study, the system must complete the study within 18 months after the primacy agency required the study to be conducted, after which the primacy agency designates the OCCT.

Also note that in accordance with the LCR, systems serving 50,000 or fewer people can discontinue the steps outlined in Exhibit 4.1 whenever their 90th percentile levels are at or below both ALs for two consecutive six-month monitoring periods. However, if these systems then exceed the lead or copper AL, they must recommence completion of the applicable CCT steps beginning with the first treatment step that was not completed in its entirety. The primacy agency may require a system to repeat treatment steps previously completed by the system where the Agency determines that this is necessary to properly implement the treatment requirements.

Exhibit 4.1: Review of CCT Requirements and Deadlines for Systems Serving ≤ 50,000 People (§141.81(e))

Requirement	Timetable for Completing Corrosion Control Treatment Steps[1]	Section Where Technical Recommendations Can Be Found
STEP 1: System exceeds the lead or copper action level (AL).		
STEP 2: System recommends OCCT.	Within 6 months[2]	Section 4.1.1
STEP 3: Primacy agency decides whether system must perform a corrosion control study. If system must conduct a corrosion control study, go to Step 5. If not, go to Step 4.	Within 12 months[2]	Section 4.1.2
STEP 4: Primacy agency designates OCCT for systems that were not required to conduct a study. Go to Step 7.	● Within18 months[2] for systems serving 3,301-50,000 people ● Within 24 months[2] for systems serving ≤ 3,300 people	Section 4.1.3
STEP 5: System completes corrosion control study.[3]	Within 18 months after primacy agency requires that such a study be conducted	Section 4.1.4
STEP 6: Primacy agency designates OCCT.[3]	Within 6 months after completion of Step 5	Section 4.1.5
STEP 7: System installs OCCT.	Within 24 months after the primacy agency designates such treatment	Section 5.1
STEP 8: System conducts follow-up sampling for 2 consecutive 6-month periods.	Within 36 months after the primacy agency designates OCCT	Section 5.2
STEP 9: Primacy agency designates OWQPs.[4]	Within 6 months after completion of Step 8	Section 5.3
STEP 10: System conducts continued WQP and lead and copper tap sampling.	The schedule for required monitoring is based on whether the system exceeds an AL and/or complies with OWQP ranges or minimums	Section 5.4

Notes:

[1] Systems serving 50,000 or fewer people can discontinue these steps whenever their 90th percentile levels are at or below both action levels for two consecutive six-month monitoring periods. However, if these systems then exceed the lead or copper action level, they must recommence completion of the applicable CCT steps.

[2] The required timetable (i.e., number of months) for completing Steps 2, 3, and 4 represent the number of months after the end of the monitoring period during which the lead and/or copper action level was exceeded in Step 1.

[3] These steps only apply to systems that were required to conduct a corrosion control study.

[4] If a small or medium system has installed corrosion control treatment, the primacy agency is obligated to fulfill Step 9. The primacy agency shall review the system's installation of treatment and designate optimal water quality parameters within 6 months after completion of Step 8, in accordance with 141.81(e)(7) and 141.82(f).

4.1.1 System Serving ≤ 50,000 People Makes OCCT Recommendation (STEP 2)

The LCR does not specify precisely how systems serving ≤ 50,000 are required to develop their OCCT recommendation. To help systems evaluate CCT alternatives and make their recommendation, EPA has provided technical information and recommendations in Chapter 3. Systems can use the forms in Appendix D to organize water quality data and other information and forms in Appendix E to document the results of their assessment and submit their data and recommendation to the primacy agency. Note that primacy agencies may also require a system to collect additional data/information under §141.82(a).

4.1.2 Primacy Agency Determines Whether a Study Is Required for System Serving ≤ 50,000 People (STEP 3)

Primacy agencies should review the data provided by the system (using forms in Appendices D and E) for completeness. If data are not sufficient to make a CCT determination, the primacy agency can request additional information from the system.

Once primacy agencies have reviewed the data and OCCT recommendation, they should determine if a study is needed. Exhibit 4.2 provides a checklist to support the primary agency in determining whether or not to require a CCT study. If more than two questions are answered "Yes," the primacy agency should consider requiring a study. Importantly, as stated in EPA's LCR guidance, EPA recommends that primacy agencies require all systems with ***lead service lines*** to conduct a corrosion control study.

If the primacy agency does not require a study, their next step is to designate OCCT (go to Section 4.1.3). Section 4.1.4 provides technical recommendations to support primacy agencies in the event that a corrosion control study is required.

Exhibit 4.2: Recommended Checklist to Support Determination of the Need for a CCT Study for Systems Serving ≤ 50,000 People

Category	Question	Response (YES or NO)
Presence of LSLs	Does the System have lead service lines?[1]	
pH stability	Is the range of pH values measured at the Entry Point > 1.0 pH units (Range = Max entry point pH – Min entry point)?	
	Is the range of pH values measured in the Distribution System > 1.0 pH units (Range = Max pH – Min pH)?	
Iron Deposition Potential	Is average Entry Point iron > 0.3 mg/L?	
	Is average Distribution System iron > 0.3 mg/L?	
Manganese Deposition Potential	Is average Entry Point manganese > 0.05 mg/L?	
	Is average Distribution System manganese > 0.05 mg/L?	
Calcium Carbonate Deposition Potential	Is average Hardness > 150 mg/L as $CaCO_3$? *Entry point of distribution system values may be used.*	
Chloride-to-Sulfate Mass Ratio (CSMR) Issues	Is the CSMR for either Entry Point or Distribution System data > 0.6? *Use Average Chloride Level divided by the Average Sulfate Level.*	
Source Water Changes in the Future	Did the system indicate that there may be source water changes in the future?	
Treatment Process Changes	Did the system indicate that there may be treatment process changes in the future including changes in coagulant?	

Note:

[1] If the system has LSLs, EPA guidance recommends the primacy agency require a study.

4.1.3 Primacy Agency Designates OCCT for System Serving ≤ 50,000 People (STEP 4)

As stated in the LCR, if the primacy agency determines that a study is not required, they must either approve the OCCT option recommended by the system or designate alternative CCT(s) from among those listed in §141.82(c)(1) (§141.82(d)). They must do this ***within 18 months*** after the end of the monitoring period during which the system exceeds the lead or copper AL for systems serving more than 3,300 people, ***and within 24 months*** for systems serving 3,300 or fewer people. Primacy agencies can use information in Chapters 2 and 3 to help make this determination.

The primacy agency must notify the system of its OCCT decision in writing and explain the basis for the determination (§141.82(d)(2)). The primacy agency should work closely with the system to determine the implementation approach and follow-up monitoring (See Chapter 5 for technical recommendations).

4.1.4 System Serving ≤ 50,000 People Conducts Corrosion Control Study (STEP 5)

As stated in the LCR and summarized in Exhibit 4.1, systems are required to complete the corrosion control study ***within 18 months*** of the primacy agency's determination that a study is required. Exhibit 4.3 summarizes corrosion control study requirements for systems from the LCR. Following the exhibit are: (1) technical recommendations for primacy agencies on what type of study to require; (2) technical recommendations for systems on study tools and other considerations; and (3) technical recommendations for systems on corrosion control study reporting.

Exhibit 4.3: Corrosion Control Study Requirements[1]

Corrosion Control Study Component	LCR Requirements
Corrosion Control Study Tools	Systems must evaluate the effectiveness of each CCT specified in §141.82(c)(1) and, if appropriate, combinations of treatments using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration (§141.82(a) and (c)(2)).
Monitoring Requirements	Systems must measure the following water quality parameters in any tests before and after evaluating the CCTs: Lead, copper, pH, alkalinity, calcium, conductivity, orthophosphate (when an inhibitor containing a phosphate compound is used), silicate (when an inhibitor containing a silicate compound is used), and water temperature (§141.82(c)(3)).
Identification of Constraints	Systems must identify all chemical or physical constraints that limit or prohibit the use of a particular CCT and document such constraints with at least one of the following (§141.82(c)(4)): • Data and documentation showing that a particular CCT has adversely affected other water treatment processes when used by another water system with comparable water quality characteristics; and/or • Data and documentation demonstrating that the water system has previously attempted to evaluate a particular CCT and has found that the treatment is ineffective or adversely affects other water quality treatment processes.
Effects on Other Treatment Processes	Systems must evaluate the effect of the chemicals used for CCT on other water quality treatment processes (§141.82(c)(5)).
Reporting	On the basis of an analysis of the data generated during each evaluation, the water system must recommend to the primacy agency in writing the treatment option that the corrosion control studies indicate constitutes OCCT for that system. Systems must provide a rationale for their recommendation along with all supporting documentation (§141.82(c)(6)).

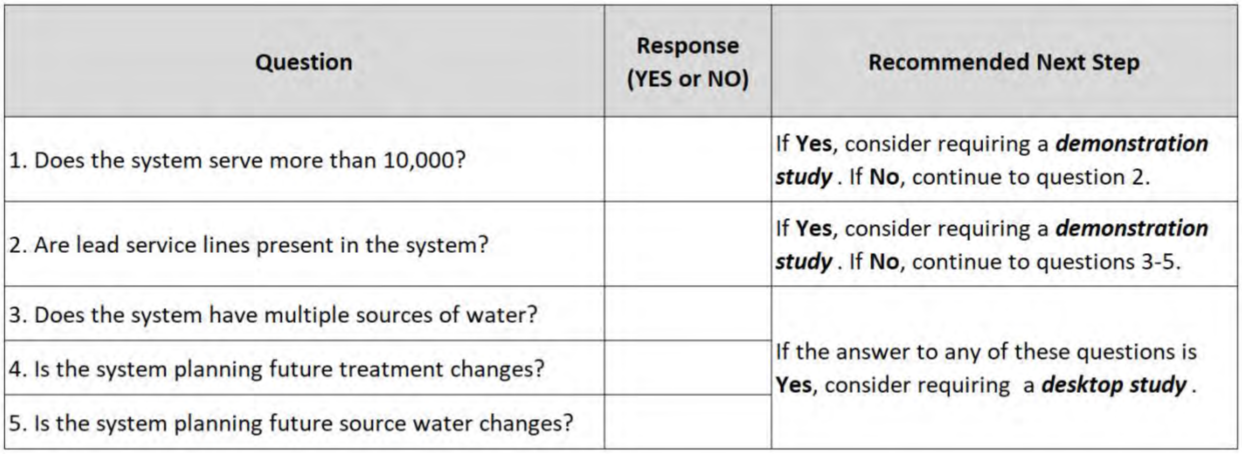
Note:

[1] Corrosion control studies may be required by the primacy agency. If they are, specific requirements for conducting the studies apply regardless of system size. They are from the LCR and are current as of the date of this publication.

(1) Technical Recommendations Regarding Type of Corrosion Control Study

There are several potential approaches to a CCT study. A study can be approached as a "desktop study" based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration, or a "demonstration study" using at least one of the following study tools: pipe rig/loop tests, metal coupon tests, or partial system tests. Systems serving 50,000 or fewer people may be able to satisfy CCT study requirements by performing a desktop study of analogous systems. Exhibit 4.4 provides a recommended checklist for primacy agencies to use when evaluating case-specific factors that may warrant requiring those systems to perform a demonstration study instead.

Exhibit 4.4: Recommended Checklist to Support Primacy Agency Determination of When to Require a Demonstration Study for Systems Serving ≤ 50,000 People



Question	Response (YES or NO)	Recommended Next Step
1. Does the system serve more than 10,000?		If **Yes**, consider requiring a ***demonstration study*** . If **No**, continue to question 2.
2. Are lead service lines present in the system?		If **Yes**, consider requiring a ***demonstration study*** . If **No**, continue to questions 3-5.
3. Does the system have multiple sources of water?		If the answer to any of these questions is **Yes**, consider requiring a ***desktop study*** .
4. Is the system planning future treatment changes?		
5. Is the system planning future source water changes?		

(2) Corrosion Control Study Tools

Appendix F describes tools that can be used for conducting desktop and demonstration corrosion control studies. It includes the study tools required by the rule (analyses based on documented analogous treatments (desktop study); or pipe rig/loop tests, metal coupon tests, or partial-system tests (demonstration studies)) – along with other tools such as pipe scale analysis and models that can be used to supplement the requirements. The appendix is not meant to be exhaustive – other tools might also be useful for determining the most effective CCT for the system.

Note that systems conducting desktop studies must at a minimum evaluate ***analogous treatments at other systems*** of similar size, water chemistry, and distribution system configuration to meet the corrosion control study requirements of the LCR.

(3) Corrosion Control Study Reporting

The system must provide the primacy agency with its recommended OCCT option along with the rationale for its recommendation and supporting documentation as described §141.82(c)(1) – (6). The system must also identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with at least one of the following (§141.82(c)(4) and (c)(6)):

- Data and documentation showing that a particular CCT has adversely affected other water treatment processes when used by another water system with comparable water quality characteristics; and/or

- Data and documentation demonstrating that the water system has previously attempted to evaluate a particular CCT and has found that the treatment is ineffective or adversely affects other water quality treatment processes.

The system must also evaluate the effect of the chemicals used for CCT on other water quality treatment processes (§141.82(c)(5) and (c)(6)).

EPA recommends that the system submit to the primacy agency a report that includes the required information identified above and additional data and analyses as follows:

- Options for addressing identified constraints, so that the system would be able to achieve and maintain OCCT, meet other water quality goals, and remain in compliance with all applicable drinking water regulations.
- The corrosion control study's conclusion (i.e., the recommended treatment) and a target level for pH, alkalinity, and corrosion inhibitors (if used).
- Recommended operating ranges for key parameters (pH, alkalinity, and inhibitor (if used)) both at the entry point and in the distribution system.
- Treatment chemicals and dosages that will be used to maintain OCCT, recommendations for quality assurance testing of chemicals, and follow-up monitoring recommendations.
- The system's plan for treatment start-up (see Sections 3.3 and 5.1 for technical recommendations for start-up of pH/alkalinity/dissolved inorganic carbon (DIC) adjustment and phosphate-based corrosion inhibitor treatment).

Exhibit 4.5 and Exhibit 4.6 provide possible outlines for desktop and demonstration study reports, respectively.

Exhibit 4.5: Possible Outline for a Desktop Study Report

Executive Summary

- **I. Introduction**
- **II. Project Background**
- **III. Review of Existing Information**
    - A. Water System Information (provide a system schematic)
    - B. Water Quality Data
        - 1. Raw water
        - 2. Entry Point
        - 3. Distribution system
        - 4. Tap
    - C. Pipeline and Plumbing Materials
    - D. Summary of Water Quality Complaints
    - E. Analogous System Information
- **IV. Potential Causes of Elevated Lead and/or Copper Levels in the System**
- **V. Identification and Assessment of Corrosion Control Alternatives**
- **VI. Evaluation of Corrosion Control Alternatives**
    - A. Performance
    - B. Constraints
    - C. Recommended OCCT

Exhibit 4.6: Possible Outline for a Demonstration Study Report

Executive Summary

- **I. Introduction**
- **II. Project Background**
- **III. Review of Existing Information**
  - A. Water System Information (provide a system schematic)
  - B. Water Quality Data
    - 1. Raw Water
    - 2. Entry Point
    - 3. Distribution System
    - 4. Tap
  - C. Pipeline and Plumbing Materials
  - D. Summary of Water Quality Complaints
  - E. Analogous System Information
- **IV. Special Studies**
  - A. Bench Scale Studies
    - 1. Methods and Materials
    - 2. Results
  - B. Pipe Loop Studies
    - 1. Methods and Materials
    - 2. Results
  - C. Partial System Testing
    - 1. Methods and Materials
    - 2. Results
- **V. Potential Causes of Elevated Lead and/or Copper Levels in the System**
- **VI. Identification and Assessment of Corrosion Control Alternatives**
- **VII. Evaluation of Corrosion Control Alternatives**
  - A. Performance
  - B. Constraints
  - C. Recommended OCCT

4.1.5 Primacy Agency Designates OCCT for Systems Serving ≤ 50,000 People (STEP 6)

Exhibits 4.7 and 4.8 provide technical recommendations for primacy agencies for their review of desktop and demonstration study reports, respectively. Primacy agencies should refer to Chapter 2 for background on sources of lead and copper and impacts of water quality and physical system characteristics on lead and copper release. The information in Chapter 3 can also be used as a reference when evaluating the recommended OCCT option.

Upon its own initiative or in response to a request from a water system, a primacy agency may modify its OCCT determination or optimal water quality control parameters for the system (§141.82(h)). The primacy agency may modify its determination where it concludes that such a change is needed to ensure the water system will continue to provide optimized corrosion control treatment. Such modifications may be appropriate where water systems are contemplating changes to their source water, treatment, or other system components in a manner that could adversely impact their current treatment optimization.

Exhibit 4.7: Recommendations for Primacy Agency Review of Desktop Study

1) Make sure all components of a desktop study are included in the report.
    - → If they are not, coordinate with system to complete study and check against recommended outline of required components for desktop studies.
    - → If they are, continue.
2) Evaluate raw, entry point, and distribution system water quality information.
    - → Evaluate key water quality parameters (pH, alkalinity, conductivity, hardness, other anions and cations) and their impact on lead and/or copper release to water (entry point and distribution system) and treatability (raw water).
    - → Evaluate differences in entry point versus distribution system data for key water quality parameters, particularly variations in pH and DIC.
3) Review regulatory tap monitoring data for lead and copper and other supplemental lead and copper data (e.g., from special studies by universities).
    - → Assess 90th percentile lead and copper levels and that sites selected for regulatory monitoring meet the criteria in the LCR.
    - → Assess available supplemental lead and copper data, if available.
4) Review materials and customer complaint history.
    - → Determine primary sources of lead and copper in drinking water (lead pipe, lead solder, brass, copper pipe).
    - → Identify other materials in the system that may be impacted by CCT (unlined cast iron pipe, asbestos cement pipe, etc.).
5) Review analogous system information.
    - → Ensure that systems described are similar in source, water quality, and materials profiles.
6) Evaluate causes of elevated lead and/or copper levels.
    - → Use water quality and materials information along with corrosion theory to determine primary causes of elevated lead and/or copper levels.
7) Evaluate potential CCT alternatives identified in study.
    - → Evaluate if alternatives have been compared with respect to their abilities to reduce lead and/or copper levels in the system (performance) and the effects that additional CCT will have on water quality parameters (WQPs) and on other water quality treatment processes.
8) Evaluate final recommended OCCT and approve installation if warranted.

Exhibit 4.8: Recommendations for Primacy Agency Review of Demonstration Study

1) Make sure all components of a demonstration study are included in the report.
   - → If they are not, coordinate with system to complete study and check against recommended outline of required components for demonstration studies.
   - → If they are, continue.
2) Evaluate raw, entry point, and distribution system water quality information.
   - → Evaluate key water quality parameters (pH, alkalinity, conductivity, hardness, other anions and cations) and their impact on lead and/or copper release to water (entry point and distribution system) and treatability (raw water).
   - → Evaluate differences in entry point versus distribution system data for key water quality parameters, particularly variations in pH and DIC.
3) Review regulatory tap monitoring data for lead and copper and other supplemental lead and copper data (e.g., from special studies by universities).
   - → Assess 90th percentile lead and copper levels and that sites selected for regulatory monitoring meet the criteria in the LCR.
   - → Assess available supplemental lead and copper data, if available.
4) Review materials and customer complaint history.
   - → Determine primary sources of lead and copper in drinking water (lead pipe, lead solder, brass, copper pipe).
   - → Identify other materials in the system that may be impacted by CCT (unlined cast iron pipe, asbestos cement pipe, etc.).
5) Review analogous system information.
   - → Ensure that systems described are similar in source, water quality, and materials profiles.
6) Evaluate causes of elevated lead and/or copper levels.
   - → **Bench scale/Pipe Rack:** Ensure that materials evaluated are similar to lead and copper source materials in system. Also ensure that water quality conditions are similar to system conditions. For pipe rack studies, ensure that study was conducted long enough for stable scales to form on the pipes.
   - → **Scale Analyses:** Identify if representative pipe specimens were gathered in the field (representative of lead and/or copper source material that is contributing to elevated lead and copper levels in the water) and that scale analyses were completed using appropriate methods with proper quality assurance and quality control.
   - → **Partial System Testing:** Testing area should be selected to represent sites with elevated lead and/or copper levels similar to those used for regulatory compliance sampling under the LCR. Study should continue long enough for CCT to be effective.
   - → **Other:** Any additional sampling should be conducted at sites representative of sites used for LCR compliance sampling.
   - → Results from special studies should be used to inform recommendations on causes of elevated lead and/or copper levels, performance of potential treatment alternatives, and constraints and secondary impacts that may occur with implementation of CCT.
7) Evaluate potential CCT alternatives identified in study.
   - → Evaluate if alternatives have been compared with respect to their abilities to reduce lead and/or copper levels in the system (performance) and the effects that additional CCT will have on WQPs and on other water quality treatment processes.
8) Evaluate final recommended OCCT and approve installation if warranted.

4.2 Corrosion Control Steps for Systems Serving > 50,000 People

As noted earlier in this chapter, most systems serving more than 50,000 people were required to install OCCT by January 1, 1997. Systems that served 50,000 people or fewer at that time may have since experienced population growth, combined with other systems, and/or made other changes so that their new population served is more than 50,000 people. These systems then become subject to the requirements for large systems, including the specific CCT steps applicable to large systems unless they are deemed to have optimized CCT under §141.81(b)(2) or (b)(3).

Exhibit 4.9 summarizes the required actions and deadlines for CCT steps for these systems. It also shows the related section in this document where additional technical recommendations are provided for the system or primacy agency. Those systems serving more than 50,000 people with existing CCT – but that have subsequent lead or copper action level exceedances – can also follow these steps, where applicable, while also complying with the LCR's ALE-triggered source water, public education, and lead service line replacement requirements in §§141.83-85. Note that for these systems, the LCR does not prescribe a schedule for CCT adjustment; instead, one will likely be set by the primacy agency.

Exhibit 4.9: Summary of CCT Requirements and Deadlines for Systems Serving > 50,000 People (§141.81(e))

Requirement[1]	Timetable for Completing Corrosion Control Treatment Steps	Corresponding Section of this Document
STEP 1: System completes Corrosion Control Study.	Within 18 months after the end of the monitoring period which triggered a study[2]	Section 4.2.1
STEP 2: Primacy agency designates OCCT.	Within 6 months after study is completed	Section 4.2.2
STEP 3: System installs OCCT.[3]	Within 24 months after primacy agency's decision regarding type of treatment to be installed	Section 5.1
STEP 4: System conducts follow-up monitoring for 2 consecutive 6-month periods.	Within 36 months after primacy agency designates OCCT	Section 5.2
STEP 5: Primacy agency designates OWQPs.	Within 6 months of Step 4	Section 5.3
STEP 6: System conducts continued WQP and lead and copper tap monitoring.	The schedule for required monitoring is based on whether the system exceeds an AL and/or complies with OWQP ranges or minimums	Section 5.4

Notes:

[1] This schedule applies to systems newly serving > 50,000 people that are installing CCT. Because the regulatory deadlines for systems serving more than 50,000 people have passed, systems newly serving 50,000 people must follow the schedule for systems serving 3,301-50,000 people.

[2] In other words, the end of the monitoring period in which the system became a system serving > 50,000 people.

[3] For systems with existing CCT, this step would involve adjusting CCT.

4.2.1 Systems Serving >50,000 People Conduct a Corrosion Control Study (STEP 1)

Corrosion control study requirements (e.g., study tools, identification of constraints, reporting) were summarized previously in this Chapter in Exhibit 4.3.

In addition to the corrosion control study and OCCT recommendation, EPA recommends that systems provide their primacy agencies with the water quality and other system-specific information as identified in Appendix D. Primacy agencies may also require a system to collect this additional data/information as per §141.82(a) and (d)(2). The recommended data and information collection forms in Appendix D can be customized for individual systems. Data should be sufficient to characterize raw water, treated water quality (entry point), distribution system water quality, and lead and copper in tap samples. The frequency of data collection should be based on the complexity of the system and how water quality may vary over time and location. Systems should be encouraged to provide multiple years of data that represent different seasons (e.g., quarterly data). Water quality samples should be collected as close in time as possible to lead and copper tap samples. Primacy agencies may be able to verify information using the system's latest sanitary survey report. Recommendations for reviewing water quality data are provided in Section 3.2.1.

As noted in Exhibit 4.3, systems performing corrosion control studies must use either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration for their CCT study. Because there is less likelihood of truly analogous systems once the population served is more than 50,000 people, EPA recommends that these systems use one of the demonstration study tools (i.e., pipe rig/loop, metal coupon, or partial-system test) to meet CCT requirements. Additional desktop and demonstration study tools can be used to supplement the requirements – see Appendix F for a description of the required and additional CCT study tools. Systems may also find the recommended approach for selecting OCCT (provided in Chapter 3) helpful as a screening tool for identifying which treatments warrant further study.

The system must provide the primacy agency with its recommended OCCT option along with the rationale for its recommendation and supporting documentation as described §141.82(c)(1) – (6). The system must also identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with at least one of the following (§141.82(c)(4) and (c)(6)):

- Data and documentation showing that a particular CCT has adversely affected other water treatment processes when used by another water system with comparable water quality characteristics; and/or
- Data and documentation demonstrating that the water system has previously attempted to evaluate a particular CCT and has found that the treatment is ineffective or adversely affects other water quality treatment processes.

The system must also evaluate the effect of the chemicals used for CCT on other water quality treatment processes (§141.82(c)(5) and (c)(6)).

EPA recommends that the system submit to the primacy agency a report that includes the required information identified above and additional data and analyses as follows:

- Options for addressing identified constraints, so that the system would be able to achieve and maintain OCCT, meet other water quality goals, and remain in compliance with all applicable drinking water regulations.
- The corrosion control study's conclusion (i.e., the recommended treatment) and a target level for pH, alkalinity, and corrosion inhibitors (if used).
- Recommended operating ranges for key parameters (pH, alkalinity, and inhibitor (if used)) both at the entry point and in the distribution system.
- Treatment chemicals and dosages that will be used to maintain OCCT, recommendations for quality assurance testing of chemicals, and follow-up monitoring recommendations.
- The system's plan for treatment start-up (see Sections 3.3 and 5.1 for technical recommendations for start-up of pH/alkalinity/DIC adjustment and phosphate-based corrosion inhibitor treatment).

Exhibit 4.5 and Exhibit 4.6, presented earlier in this section, provide possible outlines for desktop and demonstration study reports, respectively.

4.2.2 Primacy Agency Reviews the Study and Designates OCCT for System Serving > 50,000 People (STEP 2)

Primacy agencies can use the checklist in Exhibit 4.8 in Section 4.1.5 to support their review of the study's design and findings. Primacy agencies should refer to Chapter 2 for background on sources of lead and copper and impacts of water quality and physical system characteristics on lead and copper release. The information in Chapter 3 can also be used as a reference when evaluating the recommended OCCT option.

Upon its own initiative or in response to a request from a water system, a primacy agency may modify its OCCT determination or optimal water quality control parameters for the system (§141.82(h)). The primacy agency may modify its determination where it concludes that such a change is needed to ensure the water system will continue to optimize corrosion control treatment. Such modifications may be appropriate where water systems are contemplating changes to their source water, treatment, or other system components in a manner that could adversely impact their current treatment optimization.

Chapter 5: Requirements and Technical Recommendations for OCCT Start-Up and Monitoring

This chapter picks up where Chapter 4 ended – after the primacy agency designates optimal corrosion control treatment (OCCT), the system will install OCCT and conduct follow-up monitoring. The primacy agency will then designate optimal water quality parameters (OWQPs). This chapter is organized as follows:

- Section 5.1 provides technical recommendations for systems on corrosion control treatment (CCT) start-up.
- Section 5.2 discusses required and recommended elements of follow-up monitoring during the first year of OCCT operation.
- Section 5.3 provides requirements and technical recommendations for primacy agencies on evaluating OCCT and setting OWQPs.
- Section 5.4 provides requirements and technical recommendations for comprehensive long-term monitoring for corrosion control.

Systems are encouraged to refer to the document *Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems* (USEPA, 2010b) for direction on follow-up and continued lead and copper tap and water quality parameter (WQP) monitoring.[28]

5.1 CCT Start-up

In accordance with the Lead and Copper Rule (LCR), after the primacy agency designates OCCT, the system has 24 months to install it (§141.81(e)(5)).[29] During that time, systems may be adding a new chemical (i.e., a corrosion inhibitor) to the finished water and/or adjusting the finished water pH by adding a new chemical or increasing the dose of an existing chemical. These types of changes can have temporary adverse impacts on water quality in the distribution system (e.g., red water from sloughing of corrosion scale, microbial changes). Therefore, the Environmental Protection Agency (EPA) has provided recommendations in the next two sections for systems to consider when starting pH/alkalinity/dissolved inorganic carbon (DIC) adjustment (5.1.1) and when adding a corrosion inhibitor (5.1.2) to help minimize these potential adverse effects.[30] EPA recommends that systems discuss corrosion control treatment start-up procedures with their primacy agency when the agency is designating OCCT. Additional recommendations for CCT start-up can be found in Hill and Cantor (2011).

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[28] This guidance is available at http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100DP2P.pdf.

[29] The required time period for installing OCCT (24 months) applies to systems serving ≤ 50,000 people and systems newly serving > 50,000 people. The schedule for CCT adjustment for systems that already have CCT is not prescribed in the LCR. The primacy agency will likely set a schedule for systems serving > 50,000 people that previously installed CCT but have a subsequent action level exceedance.

[30] Silicate-based inhibitors are not included here because information on their use and effectiveness continues to be limited and more research is needed.

5.1.1 Start-up of pH/Alkalinity/DIC Adjustment

Changes in pH/alkalinity/DIC result in a new water quality equilibrium to be established in the distribution system. To minimize adverse impacts (e.g., sloughing of corrosion scale, aesthetic issues), systems should consider raising the pH in increments, e.g., by 0.2 or 0.3 pH units over a 12-month period, or increasing the pH incrementally every 3 months (USEPA, 2007b; MOE, 2009). The approach will be system specific, but consideration should be given to the amount of lead and/or copper reduction that is needed and the potential for secondary impacts as the distribution system equilibrates. The amount of time needed to see results from implementation of pH adjustment will also be system specific. Some systems have seen lead and/or copper reduction within a matter of days following pH adjustment (MOE, 2009); however, other systems have required up to a year to produce a new stable target pH in the distribution system (MWRA, 2010).

5.1.2 Start-up of Phosphate-Based Corrosion Inhibitors

When starting orthophosphate treatment, some systems have gradually increased their orthophosphate doses over time. For example, in a partial distribution system test, an initial orthophosphate dose of 1 mg/L as PO_4 (~0.3 mg/L as P) was gradually increased to 3 mg/L as PO_4 (~1 mg/L as P) over seven months. At three weeks, the orthophosphate concentration reached the target dose at the far ends of the system (MOE, 2009).

Some systems have started orthophosphate treatment with a higher passivation dose, then after a certain time period, switched to a lower maintenance dose for long-term corrosion control. For example, Hill and Cantor (2011) recommend starting inhibitors at 2 to 3 times the maintenance dose in order to more quickly establish a passivating layer. See Section 3.3.2 for technical recommendations related to passivation and maintenance doses.

5.2 Follow-up Monitoring during First Year of Operation

The LCR requires systems to conduct two types of follow-up monitoring during the two consecutive, 6-month periods directly following installation of OCCT (§141.81(d)(5) and (e)(6)):

- Lead and copper tap monitoring; and
- WQP monitoring.

The next two sections summarize follow-up monitoring requirements and recommendations. Systems can use the forms in Appendix G and the forms in the ***OCCT evaluation templates*** to document the results of follow-up monitoring.

As will be discussed in Section 5.3, the primacy agency will use the results of follow-up lead and copper tap monitoring and results from samples collected prior to the system's installation of CCT to determine if the system has properly installed and operated OCCT, and to set OWQPs.

5.2.1 Follow-up Lead and Copper Tap Monitoring

All systems, regardless of size, must conduct two consecutive six-month rounds of follow-up lead and copper tap monitoring at the same number of sites as required for routine monitoring under the LCR (§141.86(c) and (d)(2); see Exhibit 5.1).

Exhibit 5.1: Required Number of Sites for Follow-up Lead and Copper Tap Monitoring

Population Served	Required Number of Sites[1]
≤100	5
101 – 500	10
501 – 3,300	20
3,301 – 10,000	40
10,001 – 100,000	60
>100,000	100

Note:

[1] §141.86(c) and (d)(2). The number of sites is the same as the number of sites required for routine monitoring.

EPA recommends that systems with lead service lines (LSLs) and their primacy agencies consider collecting special tap samples during follow-up monitoring to evaluate the lead released directly from the LSLs. Systems can conduct premise plumbing profiles (see Appendix C for more information), or ask homeowners to collect samples that would capture water from within the LSL for lead analysis. Dissolved and particulate lead should be measured for these special samples. In addition, primacy agencies may wish to consider data from chronically low flow homes and homes with LSL disturbances when evaluating the effectiveness of the CCT.[31]

5.2.2 Follow-up WQP Monitoring

Requirements for WQP follow-up monitoring and recommendations for additional monitoring are summarized in Exhibits 5.2 and 5.3, respectively. Required WQP follow-up monitoring must be conducted at entry points to the distribution system and at tap monitoring locations. Entry point samples must be collected from locations that are representative of each source after treatment. Systems with multiple sources that are combined before distribution must sample at each entry point to the distribution system during periods of normal operating conditions to allow the sample to be representative of all sources being used (§141.87(a)(1)(ii); USEPA 2010b). Tap samples must be representative of water quality throughout the distribution system taking into account the number of persons served, the different sources of water, the different treatment methods employed by the system, and seasonal variability. Tap monitoring

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[31] All lead and copper tap sample results from the system's sampling pool collected within the monitoring period must be included in the 90th percentile calculation along with any samples where the system is able to determine that the site selection criteria in §141.86(a)(3)-(8) for the sampling pool are met. Other lead and copper tap data such as from customer requested sampling, investigative sampling, and special studies also must be submitted to the primacy agency (USEPA, 2004c; §141.90(g)).

locations can be the sites used for coliform monitoring or the sites used for lead and copper tap monitoring (§141.87(a)(1)(i)).

As summarized in Exhibit 5.2, the LCR requires:

- One sample from each entry point at least once every two weeks for:[32]
    - pH;
    - When alkalinity is adjusted, a reading of the dosage rate of the chemical used to adjust alkalinity and the concentration of alkalinity; and
    - When an inhibitor is used, a reading of the dosage rate of the inhibitor used and the concentration of orthophosphate or silicate (whichever is used).
- AND two sets of samples from a specified number of taps (see Exhibit 5.3) during both consecutive 6-month monitoring periods for:
    - pH;
    - Alkalinity;
    - Calcium, when calcium carbonate stabilization is used;
    - Orthophosphate, when a phosphate-based inhibitor is used; and
    - Silica, when a silicate-based inhibitor is used.

Note that the LCR requires systems serving 50,000 or fewer people to conduct follow-up WQP monitoring only during monitoring periods in which they have a lead and/or copper action level exceedance (§141.87(c)). Monitoring is not required if these systems no longer exceed the action level after installing OCCT. However, EPA recommends that primacy agencies consider requiring follow-up WQP monitoring during the first year after OCCT installation regardless of whether the system exceeds the action level in order to demonstrate that the treatment is operating properly.

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[32] Except ground water systems that have primacy agency approval to limit this monitoring to representative sites.

Exhibit 5.2: Follow-up WQP Monitoring Requirements[1] and Recommendations

Type	Parameters	Required [1]		Recommended	
		Number of Sites	**Frequency of Sampling**	**Number of Sites**	**Frequency of Sampling**
Entry point	pH, alkalinity dosage rate and concentration,[2] inhibitor dosage rate and orthophosphate or silicate concentration (whichever is used)[3]	At each entry point[4]	At least once every two weeks	No Change	No Change
Tap (Distribution system samples)[5]	pH, alkalinity, orthophosphate or silica[3], calcium[6]	Number of sites based on system size, See Exhibit 5.3	At least twice per tap every six months (4 sample periods)	At ***more taps than required.*** See Exhibit 5.3.	All parameters: ***Monthly***

Notes:

[1] Required for all systems serving more than 50,000 people (§141.87(c)). Systems serving 50,000 or fewer people are required to conduct follow-up WQP monitoring during any monitoring period in which they exceed either action level or if required by the primacy agency (§141.81(b) and §141.87(c)). Follow-up monitoring occurs during the 12-month period following OCCT installation (§141.81(e)(6) and §141.87(c)).

[2] Required at entry point locations if alkalinity is adjusted as part of corrosion control (§141.87(c)(2)(ii)).

[3] Required if an inhibitor is used. Monitoring for orthophosphate is only required if a phosphate-containing inhibitor is used (§141.87(c)(1)(iii) and (c)(2)(iii)). Monitoring for silica is only required if a silicate-containing inhibitor is used (§141.87(c)(1)(iv) and (c)(2)(iii)).

[4] Ground water systems can limit entry point monitoring to representative sites with approval from their primacy agency (§141.87(c)(3)).

[5] WQP tap samples are collected at locations that are representative of the water quality throughout the distribution system. Systems may sample from sites used for coliform monitoring (§141.87(a)).

[6] Required if calcium carbonate stabilization is used (§141.87(c)(1)(v)).

Exhibit 5.3: Required and Recommended Number of Sites for Follow-up WQP Tap Monitoring

Population Served	Required Number of Sites[1]	Recommended Number Sites
≤100	1	2
101 – 500	1	5
501 - 3,300	2	10
3,301 - 10,000	3	15
10,001 - 50,000	10	20
50,001 - 75,000	10	25
75,001 - 100,000	10	30
100,001 - 500,000	25	40
500,001 - 1,000,000	25	50
>1,000,000	25	>50

Note:

[1] Required each six-month monitoring period for systems serving more than 50,000 people (§141.87(c)). Systems serving 50,000 or fewer people are required to conduct follow-up WQP monitoring during any monitoring period in which they exceed either action level or if required by the primacy agency (§141.81(b) and §141.87(c)).

For follow-up WQP tap monitoring, two samples must be collected from the required number of sites shown in Exhibit 5.3 during both six-month monitoring periods specified in §141.86(d)(2) (§141.87(c)(1)). As shown in Exhibit 5.2, EPA recommends that systems and primacy agencies consider increasing the frequency of WQP tap sampling to ***monthly.*** More frequent monitoring is recommended to capture seasonal variations and influences of temperature on treatment effectiveness.

EPA also recommends that systems and primacy agencies consider follow-up WQP tap monitoring at more locations than required by the LCR (See Exhibit 5.3). Collecting WQP samples at an increased number of tap monitoring locations is especially important for systems that experience fluctuations in distribution system water quality. In particular, pH variations can have a large impact on corrosion control treatment effectiveness. The pH can fluctuate widely in systems with low buffering capacity, high water age (e.g., in dead-end areas), high microbiological activity, and in systems that experience nitrification. It is important that distribution system monitoring represents all pressure and water quality zones to adequately assess treatment effectiveness in all parts of the system. Follow-up WQP samples from tap sites should be collected as close in time as possible to when lead and copper tap samples are collected so that the system can evaluate the influence of water quality fluctuations on lead and copper tap monitoring results.

Primacy agencies and systems may want to consider additional monitoring for iron, manganese, chloride, sulfate, hardness, calcium, total dissolved solids (TDS), and/or oxidation-reduction potential (ORP) if they believe that these parameters may change or were not adequately characterized prior to CCT installation.[33] Primacy agencies can use the forms in Appendix G and electronic versions in the ***OCCT Evaluation Templates*** to document additional follow-up monitoring requirements for systems.

5.3 Evaluating OCCT and Setting Optimal Water Quality Parameters

Primacy agencies are required to evaluate results of follow-up tap and water quality monitoring and results collected prior to the installation of CCT to determine whether the system has properly installed and operated the OCCT and to designate (§141.82(f)):

- A minimum value or a range of values for pH measured at each entry point to the distribution system;
- A minimum pH value, measured in all tap samples, that is equal to or greater than 7.0, unless the primacy agency determines that meeting a pH level of 7.0 is not technologically feasible or is not necessary for the system to optimize corrosion control;
- If alkalinity is adjusted as part of OCCT, a minimum concentration or a range of concentrations for alkalinity, measured at each entry point to the distribution system and in all tap samples;
- If a corrosion inhibitor is used, a minimum concentration or a range of concentrations for the inhibitor, measured at each entry point to the distribution system and in all tap samples, that the primacy agency determines is necessary to form a passivating film on the interior walls of the pipes of the distribution system; and
- If calcium carbonate is used as part of corrosion control, a minimum concentration or a range of concentrations for calcium, measured in all tap samples.

Primacy agencies can designate values for additional water quality control parameters (e.g., free chlorine residual, conductivity, ORP) that reflect optimal corrosion control for the system (§141.82(f)).

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[33] Under §141.82(f), the primacy agency may designate values for additional water quality control parameters determined by the primacy agency to reflect optimal corrosion control for the system. The primacy agency must notify the system in writing of these determinations and explain the basis for its decisions.

EPA recommends that primacy agencies also use results of follow-up monitoring to further evaluate the OCCT and recommend re-evaluation if the results of the treatment are not what were predicted.

Note that the LCR includes a provision (§141.82(h)) for primacy agencies to modify their determination of OCCT or OWQP designations where they conclude that such change is necessary to ensure that the system continues to optimize CCT. Such modifications may be appropriate where water systems are contemplating changes to their source water, treatment, or other system components that could adversely impact their current CCT optimization. A request for modification can also be in response to a written request with supporting documentation from a system or other interested party. The revised determination must be in writing, and include the new treatment requirements, the basis for the primacy agency's decision, and an implementation schedule for completing the treatment modifications.

Appendix G provides technical recommendations for primacy agencies to consider when designating OWQPs for pH/alkalinity/DIC adjustment, orthophosphate treatment, blended phosphate treatment, and use of a silicate inhibitor based on data gathered during the follow-up monitoring.

A recent publication by Cornwell et al. (2015) examined the use of control charts as a diagnostic tool for determining parameter variability and setting acceptable ranges. This approach may be useful to primacy agencies and systems for controlling WQPs and determining when treatment adjustment is needed to bring a parameter back within its goal range.

5.4 Required and Recommended Long-Term Corrosion Control Monitoring

This section describes WQP monitoring required by the LCR once the primacy agency has set OWQPs. It also provides technical recommendations for additional data collection and tracking that could be used to enhance a system's understanding of CCT effectiveness. For the purposes of this document, the combination of required WQP monitoring and additional recommended monitoring is referred to as "long-term corrosion control monitoring."

Generally, systems serving more than 50,000 people must conduct routine monitoring and determine compliance with OWQPs every six months, while systems serving 50,000 or fewer are required to conduct monitoring during periods in which they have a lead and/or copper action level exceedance (§141.87(d)).

Required WQP Monitoring

Systems are required to collect two sets of samples every six months (§141.87(c)(1) and (d)) at the number of WQP tap sampling sites specified for the system size in §141.87(a)(2) (see Exhibit 5.3) for:

- pH;
- Alkalinity;

- Calcium, when calcium carbonate stabilization is used;
- Orthophosphate, when a phosphate-based inhibitor is used; and
- Silica, when a silicate-based inhibitor is used.

They must also collect one set of samples at each entry point (except those ground water systems that can limit entry point monitoring to representative sites) at least once every two weeks for:

- pH;
- When alkalinity is adjusted as part of optimal corrosion control, a reading of the dosage rate of the chemical used to adjust alkalinity and the concentration of alkalinity; and
- When an inhibitor is used, a reading of the dosage rate of the inhibitor used and the concentration of orthophosphate or silicate (whichever is used).

Systems that meet their OWQPs for a specified period of time can qualify for reduced WQP monitoring that allows for fewer and less frequent monitoring at tap locations (§141.87(e)). The LCR does not allow reduced monitoring for WQP samples collected at entry points. Refer to Section III.H in the *Lead and Copper Rule Monitoring and Reporting Guidance for Public Water Systems* (USEPA, 2010b) for additional information.

Technical Recommendations for Additional Monitoring

Additional monitoring could include monitoring for additional WQPs, customer complaint tracking, and monitoring associated with lead source replacement programs.

In addition to required WQP monitoring, systems may want to consider analyzing other water quality parameters that can affect lead and copper release. These may include ORP, ammonia, chloride, sulfate, aluminum, iron, and manganese. See Section 2.3 for discussion of how these water quality parameters influence corrosion.

Customer complaints provide useful information on conditions occurring at customer's taps. Common complaints include red water (iron) and darker tint to the water (manganese), which can indicate an increase in source water levels of iron and manganese or sloughing of scale from cast iron pipe. Complaints of taste/odor issues (earthy or musty flavor) can indicate changes in natural organic matter (NOM) due to algae blooms. Systems can obtain important information from customer complaints of blue water or a metallic taste, which can indicate copper corrosion (customers can begin to notice the taste from copper at concentrations of 3 to 10 mg/L per Dietrich et al., 2008). It is important to note that while customer complaint records can provide information on copper corrosion, lead in drinking water has no taste or color.

Systems should consider additional monitoring to evaluate the effectiveness of lead source replacement programs. The monitoring, whether taken at the tap or directly from the service line, would occur before and after the lead source is removed. Both total and dissolved lead should be analyzed to determine the percentages of particulate and dissolved lead. Replacement of lead sources, such as lead service lines, may increase lead levels (especially particulate lead levels) for a period of time due to the physical disturbance of the system (Sandvig et al., 2008; Muylwyk et al., 2009; Swertfeger et al., 2006; Del Toral et al., 2013). Some disturbances, along with other factors, may elevate lead levels for years (Del Toral et al., 2013). Particulate lead can also be released as part of normal (ongoing) corrosion processes in the system and is common when pipe scales contain substantial amounts of iron, manganese, and other coatings, or when corrosion of brass or solder is galvanically driven.

Recommendations for monitoring programs can be found in Kirmeyer et al. (2000, 2002, 2004); USEPA (2003, 2007d); and MOE (2009).

Chapter 6: Impacts of Source Water and Treatment Changes on Lead and Copper in Drinking Water

Research over the last several years has shed new light on the impacts of source water and treatment changes on lead and copper corrosion control. In particular, for systems with lead service lines, research has shown that lead release is dependent upon many water quality parameters (WQPs), and that treatment change once thought to be independent of corrosion control can have a significant impact on lead release.

Section 6.1 reviews the Lead and Copper Rule (LCR) requirements for maintaining optimal corrosion control treatment (OCCT) and explains when a system is required under the LCR to notify their primacy agency and obtain approval prior to a source or treatment change. Section 6.2 provides technical information on the effects of source water changes and Section 6.3 follows with technical information about the effects of treatment changes on lead and copper levels in drinking water.

6.1 Review of LCR Requirements Related to a Change in Source or Treatment

All systems optimizing corrosion control must continue to operate and maintain the treatment, including maintaining WQPs at or above minimum values or within ranges established by the primacy agency (§141.81(b) and §141.82(g)). Prior to the addition of a new source or any long-term change in water treatment, water systems are required to notify the primacy agency in writing of the change or addition. The primacy agency must review and approve the addition of a new source or long-term change in treatment before it is implemented by the water system. Primacy agencies also have the authority to modify OCCT determinations or OWQP designations upon their own initiative or in response to a request from a water system or other interested party (§141.82(h)). The primacy agency may modify these where it concludes the modifications are necessary to ensure the system will continue to provide optimized corrosion control treatment after changing the source water, treatment, or other system components in such a way that could adversely impact the current optimization.

Switching from purchased water to a new source is an example of source change (USEPA, 2015b). Examples of long-term treatment changes are provided in the LCR and discussed later in this section. The systems that are subject to this requirement are systems that are either: (1) deemed to have optimized corrosion control pursuant to §141.81(b)(3); (2) subject to reduced monitoring under §141.86(d)(4); or (3) subject to a monitoring waiver under §141.86(g). (§141.90(a)(3)).

As described in a November 3, 2015, memorandum from Dr. Peter Grevatt, Director of the Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water (USEPA, 2015b):

1) The LCR requires that any large system (i.e., those serving > 50,000 people) that has met OCCT requirements through the installation of corrosion control treatment to continue

operating and maintaining the treatment and to continue meeting the OWQPs established by the primacy agency (§141.81(b) and §141.82(g)).

2) Systems deemed to have OCCT without the installation of corrosion control treatment are required to notify the primacy agency in writing of any upcoming changes in treatment or source and request that the primacy agency modify its determination of the OCCT and OWQPs applicable to the system. The primacy agency must then review and approve the change and designate OCCT and OWQPs prior to its implementation by the system (§141.81(b)(3)(iii)).

3) Systems subject to reduced monitoring under §141.86(d)(4) or monitoring waivers under §141.86(g) must notify the primacy agency of any upcoming changes in treatment or source and the primacy agency must subsequently review or approve it (§141.90(a)(3)).

EPA recommends that systems that are not subject to a notification requirement also notify the primacy agency prior to the addition of a new source or treatment and request the primacy agency to modify its determination of the OCCT and OWQPs applicable to the system (USEPA, 2015b).

Examples of long-term treatment changes include the addition of a new process or modification of an existing treatment process ((§141.90(a)(3)). Examples of modifications include switching secondary disinfectants, switching coagulants (e.g., alum to ferric chloride), and switching corrosion inhibitor products (e.g., orthophosphate to blended phosphate). Long-term changes can include dose changes to existing chemicals if the system is planning long-term changes to its finished water pH or residual inhibitor concentration. Long-term treatment changes would not include chemical dose fluctuations associated with daily raw water quality changes ((§141.90(a)(3)).

Due to the unique characteristics of each system (e.g., source water, existing treatment processes, distribution system materials) it is critical that public water systems, in conjunction with their primacy agencies and, if necessary, outside technical consultants, evaluate and address potential impacts resulting from treatment and/or source water changes prior to making the change. The evaluation may include a system-wide assessment of source water or treatment modifications to identify existing or anticipated water quality, treatment, or operational issues that may interfere with or limit the effectiveness of corrosion control treatment (CCT) optimization or re-optimization. In addition, systems should conduct ongoing monitoring to ensure compliance with OCCT prior to, during, and after a source or treatment change (USEPA 2015b).

6.2 Impacts of Source Water Changes

Changes in source water can have a significant impact on water quality, corrosion control treatment effectiveness, and lead and copper release. Examples of source changes include:

- Switching from a purchased treated water source to an untreated water source that requires treatment;
- Switching from a purchased treated water source to a different treated source;
- Changing from a ground to surface water source; and
- Adding a new source, such as a new ground water or purchased source, in the distribution system.

Not only can source water changes directly impact corrosion control treatment (e.g., pH, alkalinity, dissolved inorganic carbon (DIC), and corrosion inhibitor concentration), but they can also impact the effectiveness of corrosion control treatment through changes in water quality parameters such as natural organic matter (NOM), metals (e.g., iron and manganese), ions such as chloride and sulfate, oxidation-reduction potential (ORP), and buffer intensity. See Section 2.3 for information on how water quality can impact the release of lead and copper into drinking water.

The literature includes examples of how source water changes have impacted lead and copper release (Boyd et al., 2006; 2008). For example, changes in lead release associated with blending groundwater, treated surface water, and desalinated seawater sources were determined to be a function of temperature, alkalinity, pH, chloride and sulfate (Taylor et al., 2005; Tang et al., 2006). Total copper release has been attributed to changes in temperature, alkalinity, pH, sulfate, and silica (Imran et al., 2006; Xiao et al., 2007). In another study (Zhang et al., 2012), lead release from leaded solder increased with blending of desalinated seawater in pilot-scale pipe loops.

Source water changes can impact trace inorganic contaminant release from deposits or scales in the distribution system (Lytle et al., 2004; Schock, Hyland, and Welch, 2008; Friedman et al., 2010; Peng et al., 2012). As discussed in Section 2.3.9, dissolved lead can react with iron and manganese and form deposits on lead service lines and other pipe materials (Schock, Cantor, et al., 2014). Shifts in water chemistry (e.g., changes associated with blending disparate sources) can potentially affect release and remobilization of these contaminants in the distribution system (Schock, Lytle, et al., 2005; Hill et al., 2010; McFadden et al., 2011; Friedman et al., 2016), which can then impact the formation of passivating scales on lead- and copper-containing materials.

6.3 Impacts of Treatment Changes

Treatment changes that can potentially affect the corrosivity of treated water are identified in several references (USEPA, 2003; USEPA, 2007b; MOE, 2009; Schendel et al., 2009; Grigg, 2010), and discussed in more detail below.

6.3.1 Corrosion Control Treatment

Any proposed change to a system's CCT can have consequences for water quality in the distribution system and corrosion control effectiveness. Even small changes to pH/alkalinity/DIC adjustment processes and inhibitor doses can affect lead and copper levels. If a system proposes changes to any of these key parameters (e.g., lowers pH, lowers or shuts off corrosion inhibitor), there is the potential for increases in lead and/or copper in the water.

Changes in the inhibitor chemical used for treatment can also affect lead and copper release. For example, changing from an orthophosphate chemical to a blended phosphate chemical is significant because the mechanisms by which the two chemicals control lead release are different, and the effectiveness of blended phosphates depends on other constituents in the water (e.g., calcium). Changing to a different manufacturer of blended phosphates can impact lead and copper release, even if the percentage of orthophosphate in the blend is similar (see Chapter 3 for more information on blended phosphates). Systems may design for a specific corrosion control product, but obtain bids for different products with different formulations. Additional drivers for changing the inhibitor chemical include pricing, finished water quality, operational changes, and changes at the receiving wastewater treatment plant (Brown et al., 2013a).

6.3.2 Disinfection

Changing disinfectant from free chlorine to chloramine may destabilize Pb(IV) scales formed under highly oxidizing conditions (high free chlorine residual). This destabilization may cause higher lead levels to be observed (Boyd et al., 2008; Boyd et al., 2009). In order to prevent elevated lead levels, systems can maintain the current conditions where Pb(IV) was the predominant scale, can adjust the pH/alkalinity/DIC to convert scales to Pb(II) passivating films (i.e., pH greater than approximately 9.0 and DIC of 5 to 10 mg/L as C), or can use an orthophosphate inhibitor (optimally at pH in the 7.2 to 7.8 range) (Lytle et al., 2009). There may be a period of time during the conversion from Pb(IV)-based to Pb(II)-based scales where lead levels may increase. A real-world example occurred in the District of Columbia with the DC Water and Sewer Authority (currently known as DC Water) (Schock and Giani, 2004; USEPA, 2007b), in which conversion from free chlorine to chloramines for disinfection, along with pH variations in the distribution system and the presence of lead service lines, contributed to elevated lead levels over a sustained period of time.

Additional monitoring can help determine the typical range of ORP values (i.e., the baseline) in the distribution system prior to disinfectant changes. Special laboratory studies to determine the composition of the lead scales present in the system (e.g., Pb(II) or Pb(IV) scales) can be completed using pipe sections removed from the distribution system (Clement et al., 1998b; Sandvig et al., 2008). Primacy agencies can identify systems that may switch to chloramines or another disinfectant in the future by reviewing compliance with the Stage 2 Disinfection By-products Rule (DBPR).

For systems that use chloramines, nitrification may occur in the distribution system. In a corrosion control guidance manual developed for the Province of Ontario, a case study was presented in which nitrification reduced the pH from approximately 8.5 to 7.8, which resulted in increased lead release. In response, the system raised the finished water pH to 9.2 and observed reductions in lead levels at some sites (MOE, 2009). Nitrification can also be a problem for ground water systems that add chlorine and have high levels of ammonia in their source water.

Important Information about Pb(IV)

Do my lead service lines have Pb(IV) scales?

Pb(IV) (also known as Lead IV or Pb^{++++}) can occur on any lead surface. It forms under highly oxidative conditions. If you have lead service lines with a moderate pH (7 to 8), a consistent free chlorine residual throughout the system (typically 1 to 2 mg/L or higher), no corrosion inhibitor, and no lead problems, you might have predominantly Pb(IV) scales. To help determine if your systems is a candidate for Pb(IV) scales, you can measure ORP of the water. E_h values of 0.7 volts or higher are indicative of Pb(IV) scales. You can also evaluate the scale on exhumed lead service lines to find out for sure.

Can I promote formation of Pb(IV) scales to reduce lead levels?

Although some utilities are targeting the development of a Pb(IV) scale in their systems to control lead release (Brown et al., 2013a), questions remain as to how systems and primacy agencies can ensure that disinfectant residuals required for the formation and maintenance of Pb(IV) scales are maintained within lead service lines throughout the distribution system and to the customer's taps. This may be a particular challenge with homes that go unoccupied for an extended period of time. Therefore, EPA has not included formation of Pb(IV) scale as a corrosion control treatment technique in this document at this time.

What happens if I have Pb(IV) scales and I change treatment?

Changing disinfectant from free chlorine to chloramine for disinfection may destabilize Pb(IV) scales. Systems can use other corrosion control treatments such as pH/alkalinity/DIC adjustment or phosphate-based corrosion inhibitors, but lead levels may increase as the scale is converting from Pb(IV) to Pb(II)-based scale.

The type of chlorine used for disinfection may also have an impact on corrosion. Use of gaseous chlorine lowers the pH of the water resulting in potentially more corrosive water. For systems with low alkalinity water, this effect can be amplified (Schock, 1999). Sodium hypochlorite, a base, can increase the pH of the water.

6.3.3 Coagulation

Switching from a sulfate-based to a chloride-based coagulant may increase the chloride content of the water, increasing the chloride-to-sulfate mass ratio (CSMR). This may aggravate lead release from galvanic connections such as lead solder on copper pipes or partial lead line replacements (Oliphant, 1983; Gregory, 1985; Reiber, 1991; Singley, 1994; Lauer, 2005; Nguyen et al., 2010; Triantafyllidou and Edwards, 2011; Clark et al., 2013; Wang et al., 2013). See Section 2.3.7 for additional discussion on the impacts of changes in chloride and sulfate on lead release.

Changes in pH to optimize the effectiveness of a new coagulant may impact the distribution system pH and cause changes in lead and copper release (USEPA, 2007d; Duranceau et al., 2004). Switching coagulants, or increased use of coagulants to achieve enhanced coagulation will also remove additional NOM. Changes in NOM can impact corrosion control in the distribution system; see Section 2.3.8 for more information.

6.3.4 Water Softening

Changing how softening is practiced at a treatment plant can affect corrosion control. Adding softening will raise the pH and change alkalinity, helping to control lead and copper release, whereas discontinuing softening will change these parameters, which may cause metal release (USEPA, 2007b).

6.3.5 Filtration

Nanofiltration and reverse osmosis remove alkalinity, hardness, and other dissolved compounds but do not remove carbon dioxide, resulting in a lower pH which can cause increases in lead and copper levels measured at the tap. They also remove NOM, which can impact corrosivity of the water (AwwaRF and DVGW-T, 1996; Mays, 1999; Kirmeyer et al., 2000; Duranceau et al., 2004; Schippers et al., 2004; USEPA, 2007b).

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Appendix A – Glossary

Term	Definition
90th Percentile	The concentration of lead or copper in tap water that is exceeded by 10 percent of the sites sampled during a monitoring period. For systems collecting five samples, the 90th percentile is the average of the fourth and fifth highest lead or copper result. For systems that are allowed by their primacy agencies to collect fewer than five samples, this value is the highest lead or copper result. The 90th percentile level is compared to the lead or copper action level (AL) to determine whether an AL has been exceeded.
Action Level (AL)	The concentration of lead or copper in tap water which determines whether a system may be required to install corrosion control treatment (CCT), collect water quality parameter (WQP) samples, collect lead and copper source water samples, replace lead service lines (LSLs), and/or deliver public education materials to consumers about lead. The action level for lead is 0.015 mg/L. The action level for copper is 1.3 mg/L.
Action Level Exceedance	Occurs when the 90th percentile lead or copper sample result is above its respective AL.
Aeration	A non-chemical method used for oxidation or adjusting pH where air is introduced into the water. This removes carbon dioxide, which results in an increase in pH.
Alkalinity	The capacity of water to neutralize acid. It is the sum of carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), and hydroxide (OH^-) anions in the water.
Aluminum Carryover	This may occur when a system uses aluminum-containing compounds in their treatment and the aluminum passes through the treatment plant processes into the distribution system. It may affect hydraulic capacity or tie up orthophosphate needed for effective corrosion control treatment.
Analogous Systems	Water systems with similar water quality, treatment, and distribution systems.
Anion	A negative ion; an atom or group of atoms that has gained one or more electrons.
Anode	The component of an electrochemical cell where oxidation occurs and electrons are generated.
Anodic Inhibitor	A substance which can be used to reduce oxidation reactions at the anode.
Buffer Index	The ability of water to provide buffering against a pH increase or decrease caused by a corrosion process or water treatment chemical addition.
Buffer Intensity	Also called buffer capacity, this is a measure of the resistance of water to changes in pH, either up or down. It is related to alkalinity (sum of bicarbonate, carbonate, and hydroxyl ions) but varies with pH.
Cation	A positive ion; an atom or group of atoms that has lost one or more electrons.

Term	Definition
Chloride-to-Sulfate Mass Ratio (CSMR)	The relative ratio of chloride ions (Cl^-) to sulfate ions (SO_4^{2-}) in the water.
Community Water System (CWS)	A public water system (PWS) that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.
Corrosion	The physicochemical interaction between a metal and its environment which results in changes in the properties of the metal.
Corrosion Control Treatment (CCT)	A treatment designed to reduce the corrosivity of water toward metal plumbing materials, particularly lead and/or copper.
Corrosion Rate	The rate at which a metal or alloy will deteriorate over time as a result of electrochemical oxidation. The rate will vary according to the specific properties of the metal or alloy and its environmental conditions.
Corrosivity	The ability of a substance to break down (corrode) materials.
Coupon Study	Study that uses metal pieces (i.e., coupons) of lead, copper, iron, or steel to help determine how specific water treatments may help prevent release of metals from these materials.
Cu	The chemical symbol for copper.
Demonstration Study	A study to evaluate alternative treatment approaches for reducing lead and/or copper levels which includes development and implementation of testing protocols. Demonstration testing can incorporate pipe loops, coupon tests, scale analysis, or partial system testing.
Desktop Study	A study to determine appropriate corrosion control treatment for reducing lead and/or copper levels which includes evaluations of literature, historical data and information, theory, and similar system information.
Dissolved Inorganic Carbon (DIC)	An estimate of the amount of total carbonates in the form of carbon dioxide gas (CO_2 or H_2CO_3), bicarbonate ion (HCO_3^-), and carbonate ion (CO_3^{2-}).
E_h Value	The electrical potential as measured by an oxidation-reduction potential (ORP) probe. The higher the E_h value the more oxidizing the conditions.
Electromotive Force (EMF)	Energy supplied by a source divided by the electric charge transported through the source. For a galvanic cell it is equal to the electric potential difference for zero current through the cell.
Entry Point	Refers to points of entry into the drinking water distribution system from which samples will be representative of each source after treatment.
Finished Water	Water that has been treated and is ready to be delivered to customers.
Flushed Sample	A water sample collected after the water has been allowed to run for a specified period of time.
Galvanic Corrosion	Occurs when two different types of metals or alloys physically contact each other. One of the metals serves as the anode, with its corrosion rate accelerated, while the other serves as the cathode, with its corrosion rate reduced.

Term	Definition
Hardness	A measure of the amount of calcium and magnesium in the water. Hardness is typically reported as "mg/L as $CaCO_3$" (calcium carbonate). Hardness must be taken into consideration when corrosion control is selected and implemented because too much hardness can cause unintended side effects such as increased scaling, either within the pump station/treatment plant or out in the service area.
Ionic Strength	A measure of the concentration of ions in solution.
Langelier Saturation Index (LSI)	The comparison between the measured pH of water with the pH that water would have at saturation with $CaCO_3$. The LSI should only be used to predict scaling potential as an adverse secondary impact of pH or alkalinity adjustment and has no value as a corrosivity indicator for lead and copper.
Large Water System	System serving more than 50,000 people.
LCR	An acronym used to describe the Lead and Copper Rule, which was originally published on June 7, 1991 and also includes subsequent revisions to the rule.
Lead-free	The Reduction of Lead in Drinking Water Act was enacted on January 4, 2011 to amend the Safe Drinking Water Act (SDWA) to redefine the definition of "lead-free." The bill specifies a maximum weighted average of 0.25 percent for wetted surfaces of pipes, fittings, and fixtures and retains the maximum lead content of 0.2 percent for solder and flux. This revised definition became effective on January 4, 2014.
Lead Service Line (LSL)	A service line made of lead which connects the water main to the building inlet and any lead pigtail, gooseneck, or other fitting which is connected to such lead line (§141.2).
Limestone Contactor	A method for increasing pH, alkalinity, and calcium level by having water flow through a bed of crushed limestone.
Maximum Contaminant Level Goal (MCLG)	The level of a contaminant in drinking water below which there is no known or expected risk to health. It is set at zero for lead and 1.3 mg/L for copper.
Medium Water System	A water system that serves 3,301 to 50,000 people.
Microbial and Disinfection Byproducts Rules (MDBPR)	A series of rules from the Environmental Protection Agency (EPA) designed to protect drinking water supplies from microbial contamination while minimizing health risks from the formation of disinfection byproducts.
Natural Organic Matter (NOM)	Organic material derived from plants and animals in the environment.
Nitrification	Nitrification occurs when nitrifying bacteria convert ammonia (NH_3) into nitrite (NO_2^-) and nitrate (NO_3^-), which may lower the pH and alkalinity of the water, potentially accelerating brass corrosion and causing problems with lead release.

Term	Definition
Non-transient, Non-Community Water System (NTNCWS)	A public water system that is not a community water system and regularly serves at least 25 of the same persons during a minimum of 6 months of each year.
Optimal Corrosion Control Treatment (OCCT)	The corrosion control treatment that minimizes the lead and copper concentrations at users' taps while ensuring that the treatment does not cause the water system to violate any National Primary Drinking Water Regulations (NPDWRs) (§141.2).
Optimal Water Quality Parameters (OWQPs)	Specific ranges or minimums that are determined by the primacy agency for each relevant WQP. OWQPs represent the conditions under which systems must operate their corrosion control treatment to most effectively minimize the lead and copper concentrations at their users' taps while not violating any NPDWRs.
Orthophosphate	The active agent for phosphate-based inhibitor chemicals that, when added to the water, can combine with lead and copper to form several different compounds that have a strong tendency to form a passivating scale, inhibiting lead and copper release into drinking water).
Oxidant	A chemical compound that readily transfers oxygen atoms, or a substance that gains electrons in a redox chemical reaction.
Oxidation-Reduction Potential (ORP)	Also termed redox potential. An electrical measurement that describes the ability of water to oxidize or reduce substances. It affects how the water interacts with solid substances, such as pipe materials in a distribution system, and it affects the thermodynamic stability of minerals.
Partial System Testing	A type of demonstration study in which CCT is evaluated full-scale by applying the treatment to a hydraulically isolated portion of the distribution system.
Passivating Scale	A protective layer comprised of insoluble forms of metals that forms on the pipe surface and helps to prevent the release of lead or copper into drinking water.
Pb	The chemical symbol for lead.
pH	The pH of water is a measure of its acidity, otherwise known as hydrogen ion concentration (H^+ or H_3O^+).
Phosphate Inhibitors	Chemicals used to control lead by forming passivating phosphate-based compounds that help prevent (or inhibit) lead and copper from going into solution. Orthophosphate is the active agent for phosphate-based inhibition.
Pipe Loop Testing	Pipe loops consist of pipes or pipe sections made of a variety of materials, including lead pipe (new or excavated); copper pipe; copper pipe with lead soldered joints; or brass components (faucets or meters). Pipe loop testing is used to evaluate the ability of corrosion control treatments to reduce the presence of metals in drinking water.
Point-of-Use (POU) Treatment Unit	Treatment unit applied to a single tap to reduce contaminants in the drinking water at that tap.

Term	Definition
Polyphosphates	Polymers comprised of linked units of orthophosphate that are used to sequester (or bind) iron, manganese, and other constituents in the water to keep them in solution.
Pourbaix Diagram	Also known as a potential-pH diagram, predicts what aqueous species or corrosion by-product solid phases are thermodynamically stable under different conditions of electrochemical potential and pH.
Premise Plumbing	Premise plumbing includes that portion of the potable water distribution system associated with schools, hospitals, public and private housing, and other buildings.
Profile Testing	A type of demonstration study in which several sequential stagnation samples are collected at the tap and analyzed for lead and/or copper. This protocol for sampling can be used to evaluate lead and/or copper release from specific portions of the service line and premise piping system in a residence, and can help identify both the sources of lead and copper and the impact of replacing plumbing materials containing lead and copper.
Public Water System (PWS)	A system that provides piped water for human consumption, which has at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days of the year. It includes: 1) the collection, treatment, storage, and distribution facilities operated and used by the system, and 2) any collection or pretreatment storage facilities not under the control of the system, but which it primarily uses.
Redox (Lead) Chart	A chart which shows lead speciation as a function of pH and the oxidizing or reducing environment; can be used to identify the potential for changes in ORP to influence lead or copper levels.
Secondary Standards	Non-enforceable federal guidelines regulating contaminants that may cause cosmetic, aesthetic effects (such as taste, odor, or color), or technical effects (corrosion, staining, scaling, and sedimentation) in drinking water. Iron (Fe) and manganese (Mn) are two contaminants with secondary standards (of 0.3 mg/L and 0.05 mg/L, respectively) based on their aesthetic and technical effects.
Sequestering Agents	Chemicals used to absorb metals such as iron and manganese that may interfere with treatment and/or cause customer complaints such as staining or taste problems. Examples include polyphosphates, sodium hexametaphosphate, and silicates.
Silicate Inhibitors	A mixture of soda ash and silicon dioxide that can form metal silicate compounds that serve as anodic inhibitors (i.e., they inhibit the oxidation and dissolution of the metal). They can passivate the surface of lead and copper based materials and help to reduce lead and copper levels. They can also sequester iron and manganese.
Small Water System	A water system that serves ≤ 3,300 people.
Solder	A metallic compound used to seal joints in plumbing. Until the lead ban took effect in 1988, most solder contained about 50 percent lead.

Term	Definition
Solubility (Lead or Copper) Chart	Used to predict the theoretical amount of lead or copper that may be released into water under specific water quality conditions (pH and DIC levels). They can be used as a general indication of the impact that changing water quality conditions may have on lead and copper release and its control.
Soluble/Insoluble	A substance which dissolves in a liquid is termed soluble. A substance that does not dissolve or has very low solubility is termed insoluble.
Standard 61, Section 9	A standard developed by NSF International for American National Standards Institute (ANSI) that limits the amount of lead that can be leached from endpoint devices for water intended for human consumption.
Water Distribution System	Refers to the piping, devices, and related fittings that are used to carry a system's drinking water to its users.
Water Quality Parameters (WQPs)	Used to help systems and primacy agencies determine what levels of CCT work best for the system and whether this treatment is being properly operated and maintained over time. WQPs include: pH, temperature, conductivity, alkalinity, calcium, orthophosphate, and silica.

Appendix B – Estimated Dissolved Inorganic Carbon (mg/L as C) based on Alkalinity and pH (with water temperature of 25 degrees C and TDS of 200)[1, 2, 3]

Total Alkalinity	pH																				
	6.4	**6.6**	**6.8**	**7.0**	**7.2**	**7.4**	**7.6**	**7.8**	**8.0**	**8.2**	**8.4**	**8.6**	**8.8**	**9.0**	**9.2**	**9.4**	**9.6**	**9.8**	**10.0**	**10.2**	**10.4**
0	0																				
2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0					
4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0			
6	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0		
8	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0		
10	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	0	
12	5	4	4	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	
14	6	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2	1	1	0
16	7	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2	1	0
18	8	7	6	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	2	2	1
20	9	7	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	3	3	2	1
22	10	8	7	6	6	6	6	5	5	5	5	5	5	5	5	4	4	4	3	2	1
24	11	9	8	7	7	6	6	6	6	6	6	6	5	5	5	5	4	4	3	2	2
26	11	10	8	8	7	7	7	6	6	6	6	6	6	6	6	5	5	4	4	3	2
28	12	10	9	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	3	2
30	13	11	10	9	8	8	8	7	7	7	7	7	7	7	6	6	6	5	4	3	2
35	15	13	11	10	9	9	9	9	9	8	8	8	8	8	8	7	7	6	5	4	3
40	18	15	13	12	11	10	10	10	10	10	10	9	9	9	9	8	8	7	6	5	4
45	20	16	14	13	12	12	11	11	11	11	11	11	10	10	10	9	9	8	7	6	5
50	22	18	16	14	14	13	13	12	12	12	12	12	12	11	11	10	10	9	8	7	5
55	24	20	18	16	15	14	14	14	13	13	13	13	13	12	12	11	11	10	9	8	6
60	26	22	19	17	16	16	15	15	15	14	14	14	14	14	13	12	12	11	10	8	7
65	29	24	21	19	18	17	16	16	16	16	15	15	15	15	14	14	13	12	10	9	8

Total Alkalinity	**pH**																				
	6.4	**6.6**	**6.8**	**7.0**	**7.2**	**7.4**	**7.6**	**7.8**	**8.0**	**8.2**	**8.4**	**8.6**	**8.8**	**9.0**	**9.2**	**9.4**	**9.6**	**9.8**	**10.0**	**10.2**	**10.4**
70	31	26	22	20	19	18	18	17	17	17	17	16	16	16	15	15	14	13	11	10	8
75	33	27	24	22	20	19	19	19	18	18	18	18	17	17	16	16	15	14	12	11	9
80	35	29	26	23	22	21	20	20	19	19	19	19	19	18	18	17	16	14	13	12	10
85	37	31	27	25	23	22	21	21	21	20	20	20	20	19	19	18	17	15	14	12	11
90	40	33	29	26	24	23	23	22	22	22	21	21	21	20	20	19	18	16	15	13	11
95	42	35	30	28	26	25	24	23	23	23	23	22	22	22	21	20	19	17	16	14	12
100	44	37	32	29	27	26	25	25	24	24	24	24	23	23	22	21	20	18	17	15	13
125	55	46	40	36	34	32	31	31	30	30	30	29	29	28	27	26	25	23	21	19	17
150	66	55	48	43	41	39	38	37	37	36	36	35	35	34	33	32	30	28	25	23	20
175	77	64	56	51	47	45	44	43	43	42	42	41	41	40	39	37	35	32	30	27	24
200	88	73	64	58	54	52	50	49	49	48	48	47	46	45	44	42	40	37	34	31	28
225	99	82	72	65	61	58	57	56	55	54	54	53	52	51	50	48	45	42	38	35	32
250	110	91	80	72	68	65	63	62	61	60	60	59	58	57	55	53	50	47	43	39	36
275	121	100	88	80	75	71	69	68	67	66	66	65	64	63	61	58	55	51	47	43	39
300	132	110	96	87	81	78	76	74	73	72	72	71	70	68	66	64	60	56	52	47	43
325	143	119	104	94	88	84	82	80	79	78	77	77	75	74	72	69	65	61	56	51	47
350	154	128	112	101	95	91	88	86	85	84	83	82	81	80	77	74	70	65	60	55	51
375	165	137	120	109	102	97	94	93	91	90	89	88	87	85	83	79	75	70	65	59	54
400	176	146	128	116	108	104	101	99	97	96	95	94	93	91	88	85	80	75	69	63	58

Notes:

[1] This table is meant to help primacy agencies and water systems identify potential carbonate precipitation constraints when evaluating CCT alternatives in Section 3.2. DIC values may be up to 20% higher at temperatures as low as 10 degrees C, and may vary slightly at higher and lower TDS.

[2] Shaded cells indicate chemically impossible conditions. May indicate analytical quality or total dissolved solids (TDS) assumption error.

[3] See USEPA (2003) for information on the formula used to calculate the DIC values provided above. Equilibrium constants are referenced from Butler and Cogley (1998); Plummer and Busenberg (1982); Schock (1980); and USEPA (2003).

Appendix C – Investigative Sampling to Determine the Source of Lead and Copper

Investigative sampling can be used to help identify the sources of lead and copper in tap water samples for a specific building. This type of information can help water systems and building owners determine the most effective lead source replacement strategy.

Systems can take two consecutive, first draw, 125-mL standing samples to identify whether the faucet, the brass underneath the faucet, or both components are contributing to lead in a tap water sample. Another method identified in the literature is collecting samples to develop premise plumbing profiles. This method may be used to determine where metals are being released within the premise plumbing and service line and can provide information on the stability and solubility of pipe scales within lead service lines (LSLs). A typical procedure is as follows:

- The water utility first collects pipe material data and estimates the length and diameter of plumbing in the home from the sample tap to the water main.
- After at least 6 hours of stagnation, water utility staff collect sequential 1-liter bottles of water without turning off the tap, typically from a kitchen sink, until all of the estimated volume in the pipe and service line has been collected (up to the water main, typically 10 to 15 bottles). Smaller volumes (e.g., 125 mL) can be collected for the first several samples to isolate potential sources of lead in the faucet from the underlying plumbing materials (connectors, valves).
- As an option, the utility can filter a small volume of water from specific samples (e.g., approximately 200 mL) on-site using a 0.45 micron filter to determine the particulate vs. dissolved portion of lead. A 'water hammer' sample can also be taken by rapidly opening and closing the tap several times to provide an indication of the amount of 'loose' particulate on the pipe walls.
- Analyzing samples for lead, copper, zinc, and iron can provide useful co-occurrence information that can be used to identify potential sources of lead in the plumbing network (Del Toral et al., 2013).

Exhibit C.1 provides an example of a lead profile at a residential home with a LSL, and identifies which portions of the premise plumbing are contributing to elevated lead levels. The home had 8 ft of copper pipe from the kitchen tap to the meter/LSL and 89 ft of LSL following that (Del Toral et al., 2013).

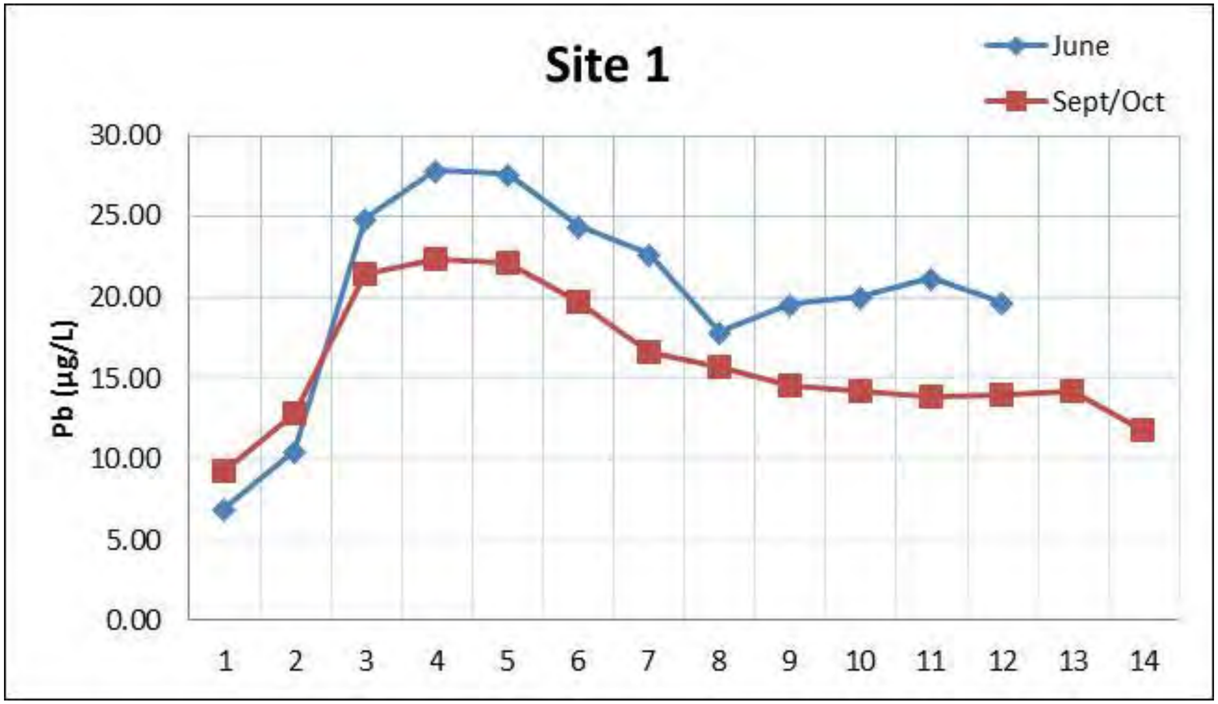

Exhibit C.1: Example of a Lead Profile (Del Toral et al., 2013)

Note: the x-axis represents sequential samples (typically liters)

Appendix D – Water Quality Data and Information Collection Forms

This appendix contains the following forms:

- D.1 Water Quality Data – Raw Water
- D.2 Water Quality Data – Entry Point
- D.3 Water Quality Data – Distribution System
- D.4 LCR Data Summary
- D.5 Treatment Process Information
- D.6 Lead Service Line (LSL) Information
- D.7 Distribution System Materials and Operation

These forms and recommended procedures are also available electronically in the ***OCCT Evaluation Templates***.

Important notes about these forms are below.

1) These are technical recommendations only, and can be changed by the primacy agency to reflect system-specific conditions and/or primacy agency needs.

2) These tables can be included in the system's corrosion control treatment (CCT) study report or submitted separately to the primacy agency.

3) Environmental Protection Agency (EPA)-approved analytical methods must be used for regulatory sample analyses (§141.89(a)). Primacy agency approved analytical methods may be used for analysis of additional samples. In some cases, this may include use of field test kits.

Exhibit D.1: Water Quality Data – Raw Water

Exhibit D.1 Water Quality Data - Raw Water[1]

Source Name (if more than one source, copy this section and complete for each source)	
Source ID	
Source Type	

Parameter	Required Monitoring			Recommended Monitoring			System Data						
	No. of Samples	Frequency	Duration of Sampling	No. of Samples	Frequency	Duration of Sampling	No. of Sites	No. of Samples	Date Range When Samples Were Collected		Minimum Value	Maximum Value	Average Value
									Start (dd/mm/yyyy)	End (dd/mm/yyyy)			
Lead (mg/L)				2	2x/year	1 year							
Copper (mg/L)				2	2x/year	1 year							
pH				6	every other month	1 year							
Alkalinity (mg/L as CaCO$_3$)				4	quarterly	1 year							
Hardness (mg/L as CaCO$_3$)				4	quarterly	1 year							
Temperature (°C)				6	every other month	1 year							
Calcium (mg/L as Ca)				4	quarterly	1 year							
Total Dissolved Solids (mg/L)[2]				4	quarterly	1 year							
Conductivity (as µmho/cm @ 25 °C)[2]				6	every other month	1 year							
Total Chlorine (mg/L as Cl$_2$)				NA	NA	NA							
Free Chlorine (mg/L as Cl$_2$)				NA	NA	NA							
Chloride (mg/L)				2	2x/year	1 year							
Sulfate (mg/L)				2	2x/year	1 year							
Iron (mg/L)				4	quarterly	1 year							
Manganese (mg/L)				4	quarterly	1 year							
Silica (mg/L as SiO$_2$)				4	quarterly	1 year							

[1] Under the Lead and Copper Rule, no raw water monitoring is required. However, if raw water monitoring data are available, this may assist the system in selecting the corrosion control treatment that will work best with the system's water quality.

[2] Either total dissolved solids or conductivity can be measured.

NA = not applicable

Exhibit D.2: Water Quality Data – Entry Point

Exhibit D.2 Water Quality Data - Entry Point[1]													
Source Name (if more than one source, copy this section and complete for each source)													
Source ID													
Source Type													
Parameters	**Entry Point**[4]												
	Required Monitoring under LCR			**Recommended Monitoring**			**System Data**						
	No. of Samples	**Frequency**	**Duration of Sampling**	**No. of Samples**	**Frequency**	**Duration of Sampling**	**No. of Sites**	**No. of Samples**	**Date Range When Samples Were Collected**		**Minimum Value**	**Maximum Value**	**Average Value**
									Start (dd/mm/yyyy)	**End (dd/mm/yyyy)**			
Lead (mg/L)[1]				1	1x/year	1 year							
Copper (mg/L)[1]				1	1x/year	1 year							
pH				12(5)	monthly	1 year							
Alkalinity (mg/L as $CaCO_3$)				12(5)	monthly	1 year							
Orthophosphate (mg/L as P)				12	monthly	1 year							
Hardness (mg/L as $CaCO_3$)				12	monthly	1 year							
Temperature (°C)				12	monthly	1 year							
Calcium (mg/L as Ca)				12	monthly	1 year							
Total Dissolved Solids (mg/L)[2]				6	every other month	1 year							
Conductivity (as µmho/cm @ 25 °C)[2]				12	monthly	1 year							
Disinfectant Residual[3]													
Total Chlorine (mg/L as Cl_2)				12(5)	monthly	2 year							
Free Chlorine (mg/L as Cl_2)				12(5)	monthly	3 year							
Chloride (mg/L)				6	every other month	1 year							
Sulfate (mg/L)				6	every other month	1 year							
Iron (mg/L)				4	quarterly	1 year							
Manganese (mg/L)				4	quarterly	1 year							
Silica (mg/L as SiO_2)				4	quarterly	1 year							

[1] Enter data for each entry point. Copy sheet for multiple entry points.

[2] Either total dissolved solids or conductivity can be measured.

[3] Both total and free chlorine should be measured.

[4] If there is no treatment, then system is only required to sample at the entry point, unless water is piped a significant distance, or stored, between the raw water point and the entry point.

[5] Additional data may be available from the system depending on process control data collection schedules.

Exhibit D.3: Water Quality Data – Distribution System

Exhibit D.3 Water Quality Data - Distribution System															
Source Name (if more than one source, copy this section and complete for each source)															
Source ID															
Source Type															
Parameter	**Required Monitoring under LCR**			**Recommended Data Collection**			**System Data**								
	No. of Samples	**Frequency**	**Duration of Sampling**	**No. of Sites**	**Frequency**	**Duration of Sampling**	**No. of Sites**	**No. of Samples**	**Date Range When Samples Were Collected**		**Minimum Value**	**Maximum Value**	**Average Value**		
									Start (dd/mm/yyyy)	**End (dd/mm/yyyy)**					
pH				12(3)	monthly	1 year									
Alkalinity (mg/L as $CaCO_3$)				6	monthly	1 year									
Orthophosphate (mg/L as P)				12(3)	monthly	1 year									
Hardness (mg/L as $CaCO_3$)				6	monthly	1 year									
Temperature (°C)				12(3)	monthly	1 year									
Calcium (mg/L as Ca)				6	monthly	1 year									
Total Dissolved Solids (mg/L)[1]				6	monthly	1 year									
Conductivity (as µmho/cm @ 25 °C)[1]				12	monthly	1 year									
Disinfectant Residual[2]															
Total Chlorine (mg/L as Cl_2)				12 (3)	monthly	1 year									
Free Chlorine (mg/L as Cl_2)				12 (3)	monthly	1 year									
Chloride (mg/L)				4	quarterly	1 year									
Sulfate (mg/L)				4	quarterly	1 year									
Iron (mg/L)				4	quarterly	1 year									
Manganese (mg/L)				4	quarterly	1 year									
Silica (mg/L as SiO_2)				4	quarterly	1 year									

[1] Either total dissolved solids or conductivity can be measured.

[2] Both total and free chlorine should be measured.

[3] Select a combination of sites at various distances from the entry point.

Exhibit D.4: LCR Data Summary

Exhibit D.4 Lead and Copper Rule (LCR) Data Summary

Parameters	First Round of Regulated Tap Samples							
	No. of Samples	Minimum Value	Maximum Value	Average	90th Percentile	# Samples > 0.015 mg/L for lead or > 1.3 mg/L for copper	Sample Period Start Date (dd/mm/yyyy)	Sample Period End Date (dd/mm/yyyy)
Lead (mg/L)								
Copper (mg/L)								

Parameters	Second Round of Regulated Tap Samples							
	No. of Samples	Minimum Value	Maximum Value	Average	90th Percentile	# Samples > 0.015 mg/L for lead or > 1.3 mg/L for copper	Sample Period Start Date (dd/mm/yyyy)	Sample Period End Date (dd/mm/yyyy)
Lead (mg/L)								
Copper (mg/L)								

In the Last 10 Years	How Many Times Has the 90th Percentile of Sampling Results Exceeded the Action Level[1] (indicate the year in which these occurred in parentheses)
Lead (mg/L)	
Copper (mg/L)	

1. Action Levels are 0.015 mg/L for lead and 1.3 mg/L for copper.

Exhibit D.5: Treatment Process Information

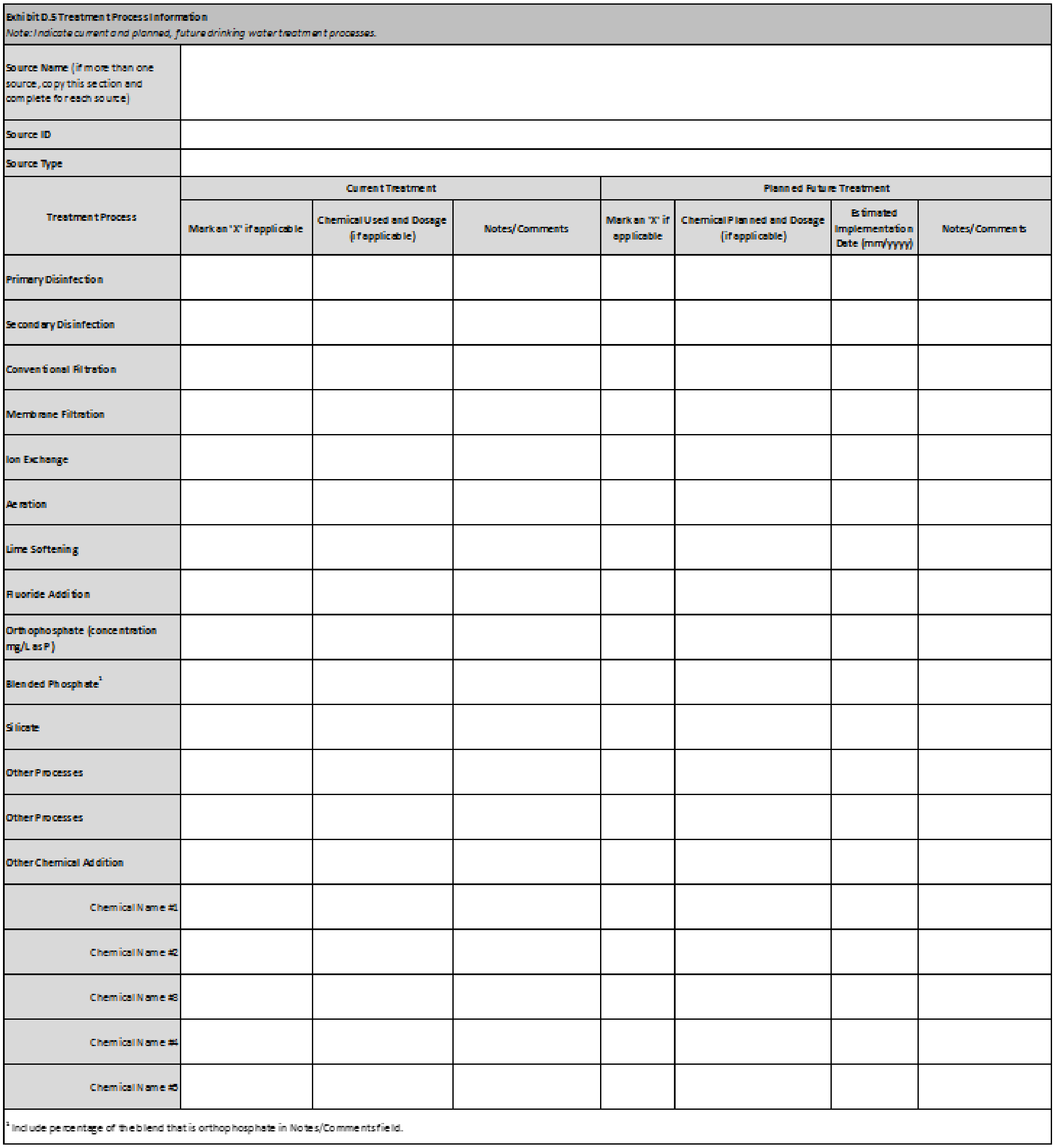

Exhibit D.5 Treatment Process Information *Note: Indicate current and planned, future drinking water treatment processes.*							
Source Name (if more than one source, copy this section and complete for each source)							
Source ID							
Source Type							
Treatment Process	Current Treatment			Planned Future Treatment			
	Mark an "X" if applicable	Chemical Used and Dosage (if applicable)	Notes/Comments	Mark an "X" if applicable	Chemical Planned and Dosage (if applicable)	Estimated Implementation Date (mm/yyyy)	Notes/Comments
Primary Disinfection							
Secondary Disinfection							
Conventional Filtration							
Membrane Filtration							
Ion Exchange							
Aeration							
Lime Softening							
Fluoride Addition							
Orthophosphate (concentration mg/L as P)							
Blended Phosphate[1]							
Silicate							
Other Processes							
Other Processes							
Other Chemical Addition							
Chemical Name #1							
Chemical Name #2							
Chemical Name #3							
Chemical Name #4							
Chemical Name #5							
[1] Include percentage of the blend that is orthophosphate in Notes/Comments field.							

Exhibit D.6: Lead Service Line Information

Exhibit D.6. Lead Service Line Information	
Question	**Response**
Does your system have **ANY** full[1] or partial[2] lead service lines (YES or NO)?	
If **YES**, approximately how many <u>full</u> lead service lines are in place?	
If **YES**, approximately how many <u>partial</u> lead service lines are in place?	
What was the approximate range of years the lead service lines were installed (YYYY to YYYY)?	

[1] A <u>full</u> lead service line refers to the pipe from the water main to the residence being lead pipe, see illustration below (Source: Sandvig et al., 2008).

[2] A <u>partial</u> lead service line refers to only a portion of the pipe from the main to the residence being lead pipe. This could be the portion of the pipe that is under the control of the utility or the portion of the pipe that is under the control of the property owner, see illustration below (Source: Sandvig et al., 2008).

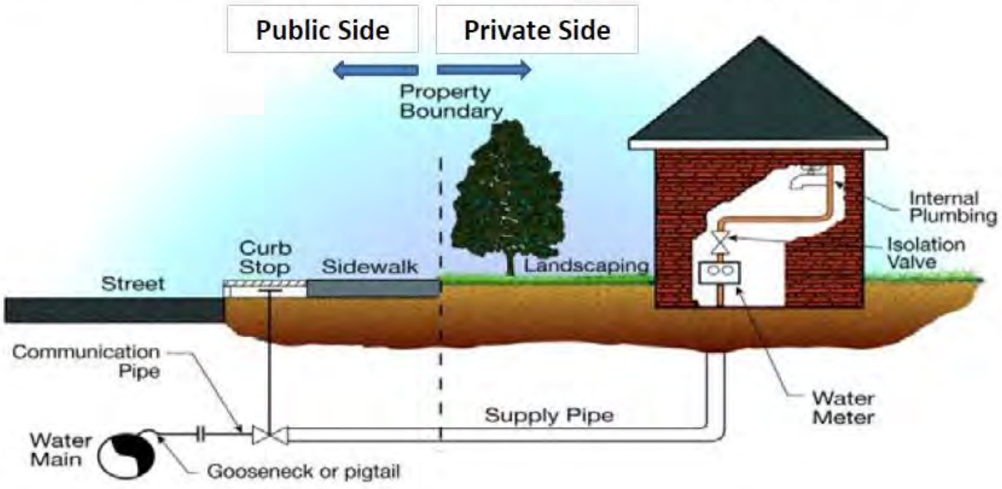

Exhibit D.7: Distribution System Materials and Operation

Exhibit D.7 Distribution System Materials and Operation		
Question	**Response**	
When was your last material survey completed (40 CFR §141.86(a))?		
What percentage of water mains are unlined cast iron? What is the approximate total length of unlined cast iron mains (feet)?		
Provide any additional comments on distribution system materials (e.g., list all types).		
Do you flush your system (YES or NO)?		
If **YES**, how often do you flush your system?		
Do you have dead-ends in your system that have experienced water quality problems (YES or NO)?		
If you chloraminate, do you use free chlorine periodically during the year (YES or NO)?		
If **YES**, approximately how often do you use free chlorine and at what dose?		
If **YES**, approximately how long is free chlorine used? (i.e. one week, one month, etc...)		
Do you have red water complaints?		
If **YES**, how often do they occur? Rarely (a few times a year), Sometimes (monthly), Regularly (weekly)		
Does your system purchase any water (YES or NO)?		
If **YES**, how much? If it varies by month please list an average per month.		
What is the source of the purchased water?		
Do you have plans to change your source water or purchase water from another system (YES or NO)?		
If **YES**, please describe.		
If applicable, do you have plans to change your coagulant in the near future (i.e. in the next 1-3 years) (YES or NO)?		
	Current Coagulant	Future Coagulant
If **YES**, please list your current coagulant and the coagulant you plan to use. Please include the planned implementation date.		

Appendix E – OCCT Recommendation Forms for Systems Serving ≤ 50,000 People

Appendix E supports Chapter 4 by providing forms systems can use to identify corrosion control treatment options, evaluate secondary impacts, and document conclusions and rationale for the optimal corrosion control treatment (OCCT) recommendation.

This appendix contains the following forms:

- E.1 Identification of Potential Corrosion Control Treatment Options
- E.2 Evaluation of Secondary Impacts
- E.3 Documentation of OCCT Recommendation

These forms and recommended procedures are also available electronically in the ***OCCT Evaluation Templates***.

Important notes about these forms are below.

1) The procedures in Exhibits E.1 through E.3 are technical recommendations only, and can be changed by the primacy agency to reflect system-specific considerations and/or primacy agency needs.

2) These tables can be included in the system's corrosion control treatment (CCT) study report or submitted separately to the primacy agency.

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options		
CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH		
Raise DIC (alkalinity)		
Add orthophosphate[1]		
Add silicate		
Add blended phosphate[1]		

[1] For orthophosphate and blended phosphate, provide in mg/L as P. For blended phosphate, include the percent of the blend that is orthophosphate.

Exhibit E.2: Evaluation of Secondary Impacts

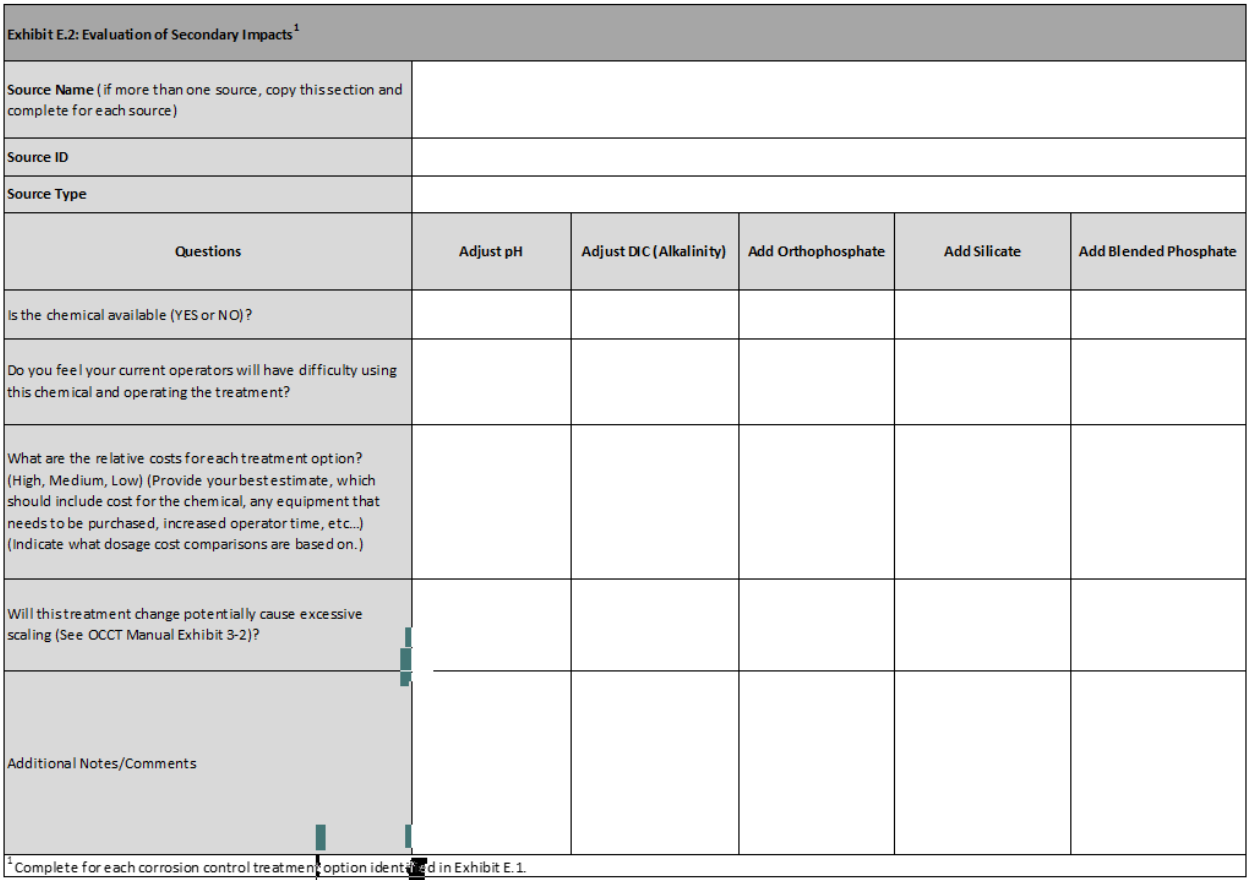

Exhibit E.2: Evaluation of Secondary Impacts[1]					
Source Name (if more than one source, copy this section and complete for each source)					
Source ID					
Source Type					
Questions	**Adjust pH**	**Adjust DIC (Alkalinity)**	**Add Orthophosphate**	**Add Silicate**	**Add Blended Phosphate**
Is the chemical available (YES or NO)?					
Do you feel your current operators will have difficulty using this chemical and operating the treatment?					
What are the relative costs for each treatment option? (High, Medium, Low) (Provide your best estimate, which should include cost for the chemical, any equipment that needs to be purchased, increased operator time, etc...) (Indicate what dosage cost comparisons are based on.)					
Will this treatment change potentially cause excessive scaling (See OCCT Manual Exhibit 3-2)?					
Additional Notes/Comments					

[1] Complete for each corrosion control treatment option identified in Exhibit E.1.

Exhibit E.3: Documentation of OCCT Recommendation

Exhibit E.3: Documentation of OCCT Recommendation					
Source Name (if more than one source, copy this section and complete for each source)					
Source ID					
Source Type					
Identify Recommended Treatment Approach	**Adjust pH**	**Adjust DIC (Alkalinity)**	**Add Orthophosphate**	**Add Silicate**	**Add Blended Phosphate**
Recommended Chemical or Process					
Recommended Dosage					
Recommended Levels at the Entry Point	**pH**	**Alkalinity (mg/L as $CaCO_3$)**	**Inhibitor**[1]		
Minimum					
Maximum					
Average					
Recommended Levels in the Distribution System	**pH**	**Alkalinity (mg/L as $CaCO_3$)**	**Inhibitor**[1]		
Minimum					
Maximum					
Average					

[1] For orthophosphate and blended phosphate, provide in mg/L as P.

PRINTED NAME and Signature of Responsible Party from Public Water System

Date

Appendix F – Tools for Conducting Corrosion Control Studies

This appendix provides a description of tools that can be used to conduct desktop or demonstration-type corrosion control studies. Note that the Lead and Copper Rule (LCR) requires the use of specific types of studies - see Chapter 4 for regulatory requirements. This appendix describes both the required types of studies and additional study tools that can be used to help identify the best corrosion control treatment.

F.1 Desktop Study Tools

Desktop study tools use analogous systems, charts and other information related to corrosion control theory, and models to select appropriate corrosion control treatment strategies. These tools are described below.

Analogous Systems[34]

Drinking water systems can evaluate and compare data from other systems with similar water quality, treatment, and distribution systems (analogous systems) to help identify corrosion control treatment options. A description of the raw source water, water treatment processes, distribution system, source water usage, and the performance of their corrosion control strategy should be included in the corrosion control study report. Systems may want to start with neighboring water systems using the same aquifer or surface source. Systems can also conduct a survey of similar systems to obtain this information; seek technical assistance from engineering consultants or industry associations; or review literature sources, such as the report by The American Water Works Association's (AWWA's) Water Industry Technical Action Fund which provides information on lead, copper, and other water quality information for 400 US water systems (AWWA, 1993). An additional resource is the Distribution System Optimization Program developed by the Partnership for Safe Water and the Water Research Foundation. Participating systems can benchmark their performance against utilities with similar water quality issues.

Corrosion Control Treatment Theory

Chapter 3 contains significant background information on corrosion control treatment. This information can help systems conduct their study and evaluate different treatment strategies.

Models

Modeling software can be used to evaluate corrosion characteristics of water and to predict changes in those characteristics with changes in treatment. However, systems and primacy

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[34] Systems conducting a desktop study (with no demonstration testing) must conduct analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration to meet the requirements of the LCR.

agencies should consider any relevant limitations that may be inherent to the modeled data. Many models are not valid for scaling potential in the presence of phosphates, silicates, or natural organic matter (NOM), and some trace metals that inhibit nucleation and growth of $CaCO_3$. Also, calcite may not be the proper solid phase in some systems. Utilities with corrosion inhibitors or naturally occurring scale-inhibiting factors should consider marble testing or field studies to predict scale potential.

F.2 Demonstration Study Tools

This section describes coupon tests, pipe loop studies, solid and scale analysis, and partial system tests. Several documents can be referenced for more detailed information on the usefulness and relative costs of these tools (USEPA, 2007d; AWWA, 2005; Kirmeyer et al., 2004; USEPA, 1992a; AwwaRF, 1990). A guidance document prepared by the Ontario Ministry of Environment (MOE, 2009) provides a summary of these different tools and recommendations on which to use given a system's size and complexity. This document can be found at https://ia802301.us.archive.org/18/items/guidancedocument00snsn21738/guidancedocument00snsn21738.pdf.

Coupon Studies

Coupon studies use flat metal pieces (i.e., coupons) of lead, copper, iron, or steel to help determine how specific corrosion control treatments (CCTs) may help prevent release of metals from these materials. These coupons can be evaluated using a variety of different protocols (static dump and fill, mounted in a flow-through pipe rig, or mounted in the distribution system) after which they can be taken out and weighed to determine total weight loss. Coupons can also be used to measure the instantaneous corrosion rate of the metal using a variety of electrochemical techniques (ASTM, 2005; AwwaRF, 1990; Schock, 1996; USEPA, 2007d). It is important to note that coupon studies can be useful in determining the corrosion rate, but may have limited use in predicting the concentrations of lead or copper in the water (Schock, 1996).

Pipe Loop Testing

Pipe loops consist of pipes or pipe sections made of a variety of materials, including lead pipe (new or excavated), copper pipe, copper pipe with lead soldered joints, or brass components (faucets or meters). Pipe loop studies can be designed as either flow-through systems (where water flows through the apparatus once and is discharged to waste) or as recirculating systems (where a batch of water is continuously recirculated through the loops for a set period of time). There are several references that provide detailed information on the design and operation of pipe loop systems (Schock and Lytle, 2011; AwwaRF, 1990; and Kirmeyer et al., 1994). Pipe loops may need to be operated for several months or years to develop scales that are similar to what would be found on premise piping in the system, and to measure stable metal levels. One limitation of pipe loops is that they do not provide indication of contribution of lead release from physical disturbances that occur as part of routine system operations, maintenance and repairs.

Scale and Solids Analysis

The analysis of actual pipe scale, and solids released from pipe scales, can provide an understanding of their composition and role in release of lead and/or copper to the water. These types of analyses may be particularly valuable to larger systems with lead service lines (LSLs) that are contemplating a water quality and/or treatment change (particularly a switch from free chlorine to chloramines for disinfection). Many techniques are available to examine the scale: visual inspection, X-ray emission spectroscopy, X-ray diffraction, X-ray fluorescence, Raman spectroscopy, inductively coupled plasma mass spectroscopy (ICP-MS), and scanning electron microscopy with energy dispersive spectroscopy (EDS). There is currently no standardized approach for evaluating pipe scales and solids, but there are references that provide information on the application of these techniques and typical results (Smith et al., 1997; Sandvig et al., 2008; Rego and Schock, 2007).

Partial System Testing

CCTs can be evaluated full-scale by applying the treatment to a hydraulically isolated portion of the distribution system. Systems can collect samples from residential taps for lead and copper analysis and additional water quality parameters in the distribution system. Partial system testing can be relatively expensive, but it does provide a direct means for examining the potential secondary impacts of implementing a particular CCT and for monitoring the implementation timeframes for installation of CCT (i.e., length of time needed for an inhibitor to be effective).

Appendix G – Forms for Follow-up Monitoring and Setting OWQPs

Appendix G supports Chapter 5 by providing data collection forms for follow-up monitoring and technical recommendations for primacy agencies to consider when designating Optimal Water Quality Parameters (OWQPs) for pH/alkalinity/dissolved inorganic carbon (DIC) adjustment, orthophosphate treatment, blended phosphate treatment, and use of a silicate inhibitor.

This appendix contains the following forms:

- G.1 Results of Follow-up Lead and Copper Tap Monitoring
- G.2 Results of Follow-up WQP Monitoring – Entry Point
- G.3 Results of Follow-up WQP Monitoring – Taps
- G.4 Setting OWQPs for pH/Alkalinity/DIC Adjustment
- G.5 Setting OWQPs for Orthophosphate Inhibitor Addition
- G.6 Setting OWQPs for Blended Phosphate Inhibitor Addition
- G.7 Setting OWQPs for Silicate Inhibitor Addition
- G.8 OWQPs Designated for the System

These forms and recommended procedures are also available electronically in the ***OCCT Evaluation Templates*****.**

Important notes about these forms are below.

1) Environmental Protection Agency (EPA)-approved analytical methods must be used for regulatory sample analyses (§141.89(a)). Primacy agency approved analytical methods may be used for analysis of additional samples. In some cases, this may include use of field test kits.

2) The procedures in Exhibits G.4 through G.7 are technical recommendations only; see Chapter 5 for requirements for primacy agencies in setting OWQPs. Note that the water quality ranges in these exhibits are intended as general guidelines included for the reader's reference. As discussed in Section 3.3, these values may not apply to every situation; therefore, they should not be interpreted or universally prescribed as default minimums and/or maximums.

Exhibit G.1: Results of Follow-up Lead and Copper Tap Monitoring

Exhibit G.1 Results of Follow-up Lead and Copper Tap Monitoring										
Parameter	First Round of Follow-Up Monitoring									
	Required by the Primacy Agency			PWS Data						
	No. of Tap Sites	Frequency	Duration of Sampling	No. of Sites	No. of Samples	Date Range When Samples Were Collected		Minimum Value	Maximum Value	Average Value
						Start (dd/mm/yyyy)	End (dd/mm/yyyy)			
Lead (mg/L)								mg/L	mg/L	mg/L
Copper (mg/L)								mg/L	mg/L	mg/L

Parameter	Second Round of Follow-Up Monitoring									
	Required by the Primacy Agency			PWS Data						
	No. of Tap Sites	Frequency	Duration of Sampling	No. of Sites	No. of Samples	Date Range When Samples Were Collected		Minimum Value	Maximum Value	Average Value
						Start (dd/mm/yyyy)	End (dd/mm/yyyy)			
Lead (mg/L)								mg/L	mg/L	mg/L
Copper (mg/L)								mg/L	mg/L	mg/L

Exhibit G.2: Results of Follow-up WQP Monitoring – Entry Point

Exhibit G.2 Results of Follow-up WQP Monitoring - Entry Point[1]								
Source Name (if more than one source or multiple entry points/source, copy this section and complete for each source/entry point combination)								
Source ID								
Source Type								
Parameter	**Required by the Primacy Agency**		**PWS Data**					
	Frequency	**Duration of Sampling**	**No. of Samples**	**Date Range When Samples Were Collected**		**Minimum Value**	**Maximum Value**	**Average Value**
				Start (dd/mm/yyyy)	**End (dd/mm/yyyy)**			
pH								
Alkalinity (mg/L as $CaCO_3$)								
Inhibitor Concentration (phosphate inhibitor in mg/L as P (not as orthophosphate); silicate inhibitor in mg/L as SiO_2)								
Hardness (mg/L as $CaCO_3$)								
Temperature (°C)								
Calcium (mg/L as Ca)								
Total Dissolved Solids (mg/L)[2]								
Disinfectant Residual Total Chlorine (mg/L as Cl_2)								
Free Chlorine (mg/L as Cl_2)								
Chloride (mg/L)								
Sulfate (mg/L)								
Iron (mg/L)								
Manganese (mg/L)								

[1] Enter data for each entry point. Copy sheet for multiple entry points.

[2] Either Total Dissolved Solids or Conductivity (as µmhos/cm @ 25 C or µS/cm)

Exhibit G.3: Results of Follow-up WQP Monitoring – Taps

Exhibit G.3 Results of Follow-up WQP Monitoring - Tap Samples[1]										
Source Name Associated with tap samples (if there are additional tap samples associated with a different source, copy this section and complete for each source/tap sample set. If multiple sources are associated with the tap samples listed below, list all sources here)										
Source ID(s)										
Source Type										
Parameter	**Required by the Primacy Agency**			**PWS Data**						
	No. of Tap Sites	**Frequency**	**Duration of Sampling**	**No. of Sites**	**No. of Samples**	**Date Range When Samples Were Collected**		**Minimum Value**	**Maximum Value**	**Average Value**
						Start (dd/mm/yyyy)	**End (dd/mm/yyyy)**			
pH										
Alkalinity (mg/L as $CaCO_3$)										
Inhibitor Concentration (phosphate inhibitor in mg/L as P (not as orthophosphate); silicate inhibitor in mg/L as SiO_2)										
Hardness (mg/L as $CaCO_3$)										
Temperature (°C)										
Calcium (mg/L as Ca)										
Total Dissolved Solids (mg/L)[2]										
Disinfectant Residual										
Total Chlorine (mg/L as Cl_2)										
Free Chlorine (mg/L as Cl_2)										
Chloride (mg/L)										
Sulfate (mg/L)										
Iron (mg/L)										
Manganese (mg/L)										

[1] Tap should be flushed prior to collecting samples for all parameters except lead and copper which are standing samples.

[2] Either Total Dissolved Solids or Conductivity (as µmhos/cm @ 25 C or µS/cm)

Exhibit G.4: Setting OWQPs for pH/Alkalinity/DIC Adjustment

Exhibit G.4 Setting OWQPs for pH/Alkalinity/DIC Adjustment		
Step 1: Are the recommended minimums or ranges for pH and/or alkalinity met at the Entry Point and in the Distribution System?[1]	YES	Go to Step 2.
	NO	Work with system to re-evaluate pH and/or alkalinity adjustment process.
Step 2: Is the range of pH values measured at the Entry Point < 0.4 pH units (Range = Max entry point pH - Min entry point pH)?[1]	YES	Go to Step 3.
	NO	The pH range may be too wide for effective control of lead and/or copper levels at the tap. Work with system to re-evaluate pH adjustment process. Review process control charts for pH chemical dosages and resultant pH levels. Evaluate seasonal changes in raw source water quality and impacts on maintenance of pH at the entry point. Also go to Step 3.
Step 3: Is the range of pH values measured in the Distribution System < 0.6 pH units (Range = Max distribution pH - Min distribution pH)?[1]	YES	Identify WQP minimums and ranges based on existing system information (both regulatory WQP monitoring data and additional diagnostic monitoring data if available).
	NO	The pH may be too variable for effective corrosion control. Re-evaluate pH adjustment process and reasons for variability in pH in the distribution system (evaluate buffer intensity, distribution system materials, distribution system operations). If low alkalinity water (< 20 mg $CaCO_3$/L), may need to increase DIC.

[1] The standard deviation is another tool that can be used to evaluate variability of pH measurements, in addition to the minimum, maximum, and range.

Exhibit G.5: Setting OWQPs for Orthophosphate Inhibitor Addition

Exhibit G.5 Setting OWQPs for Orthophosphate Inhibitor Addition		
Step 1: Is the residual orthophosphate level in the distribution system $\geq$ 1.0 mg P/L ($>$ 3.0 mg/L PO_4)?	YES	Go to Step 2.
	NO	If system has recommended an orthophosphate residual in the distribution system that is $<$ 1.0 mg P/L, then determine if inhibitor chemical dosage needs to be increased to provide optimal reduction in lead and/or copper levels. If system has recommended an orthophosphate residual in the distribution system that is $\geq$ 1.0 mg P/L, then evaluate orthophosphate demand in the system (difference between entry point orthophosphate versus residual orthophosphate in the distribution system) and potential for adjusting required dosage to meet recommended residual in the distribution system. Go to Step 2.
Step 2: Are the minimum pH values measured at the Entry Point $>$ 7.2 pH units?	YES	Go to Step 3.
	NO	Minimum pH should be higher for orthophosphate use. Have system re-evaluate pH adjustment process, or raise pH if 7.2 or below.
Step 3: Is the distribution system pH between 7.2 and 7.8 pH units?	YES	Go to Step 4.
	NO	The pH is not in the optimal range for use of orthophosphate inhibitors. Have system re-evaluate the pH control treatment process, pH variability in the distribution system, and adequacy of recommended orthophosphate dosage and residual in the distribution system.
Step 4: Is the range of pH values measured at the entry point $<$ 0.4 pH units (Range = max entry point pH - min entry point pH)?	YES	Go to Step 5.
	NO	The pH may be too variable for effective corrosion control. System should re-evaluate the pH adjustment process (i.e., review process control charts and operations).
Step 5: Is the range of pH values measured in the distribution system $<$ 0.6 pH units (Range = Max distribution pH - Min distribution pH)?	YES	Identify OWQP minimums and ranges based on existing information (both regulatory WQP monitoring data and additional diagnostic monitoring data if available).
	NO	Evaluate causes for pH variability in the system. Evaluate buffer intensity, distribution system materials, and distribution system operations, and adjust treatment and operations to achieve a narrower range of pH and alkalinity.

Exhibit G.6: Setting OWQPs for Blended Phosphate Inhibitor Addition

Exhibit G.6 Setting OWQPs for Blended Phosphate Inhibitor Addition		
Step 1: Is the residual orthophosphate level in the distribution system ≥ 0.5 mg P/L?	YES	Go to Step 2.
	NO	If system has recommended a blended phosphate product dose that results in an orthophosphate residual of < 0.5 mg P/L in the distribution system, then determine if inhibitor chemical dosage needs to be increased to provide optimal reduction in lead and/or copper levels. If system has recommended an orthophosphate residual in the distribution system that is ≥0.5 mg P/L, then evaluate orthophosphate demand in the system (difference between entry point orthophosphate versus residual orthophosphate in the distribution system) and potential for adjusting required dosage to meet recommended residual in the distribution system. Go to Step 2.
Step 2: Are the minimum pH values measured at the entry point > 7.2 pH units?	YES	Go to Step 3.
	NO	Minimum pH should be higher for orthophosphate use. Have system re-evaluate pH adjustment process, or raise pH if 7.2 or below.
Step 3: Is the distribution system pH between 7.2 and 7.8 pH units?	YES	Go to Step 4.
	NO	The pH may not be in the optimal range when using blended phosphate inhibitors, check with the chemical supplier for optimal pH range. Have system re-evaluate the pH control treatment process, pH variability in the distribution system, and adequacy of recommended orthophosphate dosage and residual in the distribution system.
Step 4: Is the range of pH values measured at the entry point < 0.4 pH units (Range = max entry point pH - min entry point pH)?	YES	Go to Step 5.
	NO	The pH may be too variable for effective corrosion control, check with the chemical supplier to verify quality of the product used to adjust pH. System should re-evaluate its pH adjustment process (process control charts and operations).
Step 5: Is the range of pH values measured in the distribution system < 0.6 pH units (Range = max distribution pH - min distribution pH)?	YES	Identify OWQP minimums and ranges based on existing information (both WQP monitoring data and additional diagnostic monitoring data if available).
	NO	Evaluate causes for pH variability in the system. Evaluate buffer intensity, distribution system materials, distribution system operations and adjust treatment and operations accordingly.

Exhibit G.7: Setting OWQPs for Silicate Inhibitor Addition

Exhibit G.7 Setting Optimal WQPs for Silicate Inhibitor Addition		
Step 1: Is the silicate level at the entry point approximately 20 mg/L as SiO_2?	YES	Go to Step 2.
	NO	Silicate addition process should be re-evaluated. Relatively high dosages may be required (in excess of 20 mg/L as SiO_2, depending on the system) for adequate corrosion control.
Step 2: Is the pH at the entry point less than the pH measured in the distribution system?	YES	Go to Step 3.
	NO	Silicate addition process should be re-evaluated. Silicate addition should increase pH in the distribution system, so recommended dosage may not be high enough for adequate corrosion control.
Step 3: Is the range of silicate levels measured in the distribution system from 10 to 20 mg/L as SiO_2?	YES	Identify OWQP minimums and ranges based on existing information (both regulatory WQP monitoring data and additional diagnostic monitoring data if available).
	NO	Re-evaluation of silicate treatment should be completed. Relatively higher dosages may be required (in excess of 20 mg/L) in order to maintain adequate levels in the distribution system for effective corrosion control.

Exhibit G.8: OWQPs Designated for the System

Exhibit G.8 OWQPs Designated for the System				
Parameter[1]	**Entry Point**		**Distribution System**	
	Minimum	**Maximum**	**Minimum**	**Maximum**
pH[2]				
Alkalinity[3] **(mg/L as $CaCO_3$)**				
Inhibitor Concentration **(mg/L as P or SiO_2)**[4]				

Notes:

[1] In addition to pH, alkalinity, or corrosion inhibitor concentrations, primacy agencies have the authority to designate values for other additional water quality parameters determined by the primacy agency to reflect optimal corrosion control treatment for the system.

[2] Under the Lead and Copper Rule, the minimum pH value measured in all tap samples must be equal to or greater than 7.0, unless the primacy agency determines that meeting a pH of 7.0 is not technologically feasible or is not necessary for the system to optimize corrosion control.

[3] Under the Lead and Copper Rule, primacy agencies must designate a minimum or a range of alkalinity concentrations if it is adjusted as part of the system's optimal corrosion control treatment.

[4] For systems using a corrosion inhibitor as part of the optimal corrosion control treatment.

CORROSION CONTROL STUDY REPORT

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November 2019

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Div. of Public Water Supplies
Illinois EPA

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CONTENTS

LIST OF TABLES

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LIST OF FIGURES

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CHAPTER 1
INTRODUCTION AND OBJECTIVES

INTRODUCTION

The objective of this report is to identify and present recommendations for optimal corrosion control treatment based upon studies of the effectiveness of corrosion control treatments (CCT). This report characterizes the water quality characteristics distributed in University Park (UP), particularly focusing on corrosion control considerations and consequences, and results from corrosion control studies investigating potential improvements to corrosion control within the distribution system. The current chapter provides an introduction and background, including descriptions of the water source and distribution system in University Park. Chapter 2 provides additional background on water quality characteristics of the water distributed in UP. Chapter 3 focuses on theoretical copper solubility in the UP system. This evaluation of copper solubility includes use of water quality data from Chapter 2 and information published in the literature. Chapter 4 of this report deals with lead solubility control. Chapter 4 also includes results from pipe scale harvesting and analysis. Chapter 5 includes the recommendations for corrosion control treatment in the UP system.

SYSTEM DESCRIPTION

Prior to 2018, the UP system was operated under permits approved by Illinois EPA (IL-EPA) as a separate PWSID (IL1975030). The water distributed in the UP system prior to 2018 was supplied by 7 groundwater wells (called "Well 1" through "Well 7"), with Wells 1, 2, and 3 as the primary supply, supplemented by the other wells when needed. Water from these wells was chloraminated before distribution. Prior to June 2017 a blended phosphate (60 percent orthophosphate and 40 percent polyphosphate – the product also included zinc) was added to chloraminated well water prior to distribution. In July 2017 a different product was added, a proprietary blended phosphate product containing orthophosphate and polyphosphate. Limited data are available on the product's composition since the formulation is proprietary, but the product is listed as having a 7.6% by weight orthophosphate as PO_4, with a minimum polyphosphate content of 22.7% by weight (expressed as PO_4).

During December 2017 UP converted the supply from the UP wells described above to treated water from the Kankakee Water Treatment Plant (WTP). The Kankakee WTP source is still being used as the primary supply, with Wells 2 and 7 retained as an emergency supply and with the other 5 wells abandoned or inactivated.

The Kankakee WTP uses the Kankakee River as a raw water source, with treatment that includes lime softening, ferric chloride coagulation, dual media granular filtration (anthracite over sand), chloramination, and fluoride addition (H_2SiF_6). The treated water from the Kankakee WTP travels through the Kankakee distribution system (PWSID IL0915030) and enters the UP system via an interconnect designated "CC01" by IL-EPA. Before the water is distributed in UP, a corrosion inhibitor is added at the UP booster station at Central Avenue, and then the water is transmitted into the UP system via the UP entry point ("TP03"). For more than a year the corrosion inhibitor added after the conversion to the Kankakee treated water source was the same proprietary blended phosphate used in the 5 months prior to the source water conversion. On or about June 15, 2019, after notification to the IEPA, use of the proprietary blended phosphate was discontinued and a different product was used. The new product, called "LPC-132", is manufactured by Hawkins, Inc. (Roseville, MN) and has a 90:10 ratio of orthophosphate to polyphosphate. This product does not contain zinc. In Chapter 4 the studies that are described as using a "blended phosphate" or a "90/10 blended phosphate" were evaluated using this same LPC-132 product currently used in University Park.

CHAPTER 2
WATER QUALITY

This chapter summarizes water quality data from the treated surface water from the Kankakee WTP, UP Distribution System monitoring data, and information on UP water quality prior to the conversion to Kankakee treated water. The first section of this chapter summarizes the daily data available for most constituents characterizing the Kankakee treated water. The later section of this chapter compares the original ground water quality in UP to the water in the UP system after the conversion to the Kankakee treated water supply.

UP SOURCE WATER QUALITY – KANKAKEE WTP TAP

Figure 2-1 below is an example of a box and whisker plot used in this report, including this chapter. The line in the middle of the box in this figure depicts the median (50th percentile) and the top and bottom of the gray box are the 25th and 75th percentiles. The spindle above the top of the box is the 90th percentile and the similar one at bottom is the 10th percentile. The red star depicts the 5th and 95th percentile values.

The data for Kankakee treated water is derived from monthly operating reports for the Kankakee WTP from January 1, 2017 through October 31, 2019. Figure 2.2 depicts the seasonal change in water temperature. This is important because lead corrosion, like most chemical interactions, can be accelerated in warmer temperatures. Consequently, the corrosion of lead, copper, and other metals can be greater in the June to September period when the water temperature peaks, versus lower temperatures in other times of the year. The water temperature ranges from 1 to 29.

Figures 2-3 through 2-12 depict the seasonal fluctuation of data during the January 1, 2017 to October 31, 2019 period. Figures 2-3 and 2-4 depict pH as water leaves the Kankakee WTP, Figures 2-5 and 2-6 depict measured alkalinity, Figures 2-7 and 2-8 depict dissolved inorganic carbon (DIC), Figures 2-9 and 2-10 depict total hardness and the Langelier Saturation Indexes (LSI), and Figures 2-11 and 2-12 depict the total chlorine residual. The pH is generally 8.5 to 9.0 but does vary seasonally, lower in warmer summer months, and higher at the end and beginning of each year (Figure 2-4). Analogous seasonal fluctuations were observed for the other data depicted below. DIC varied from about 10 to 16 mg/L throughout the year. The DIC, alkalinity, and pH are key considerations for evaluating corrosion control characteristics. LSI, though not useful for indicating conditions conducive for lead or copper corrosion, is a useful indicator for the stability of calcium carbonate ($CaCO_3$) scales (LSI <0 means these scales dissolve, and LSI>0 indicates conditions are conducive to $CaCO_3$ deposition).The results for LSI in Figure 2-10 suggest the Kankakee treated water does not promote dissolution of $CaCO_3$ scale.

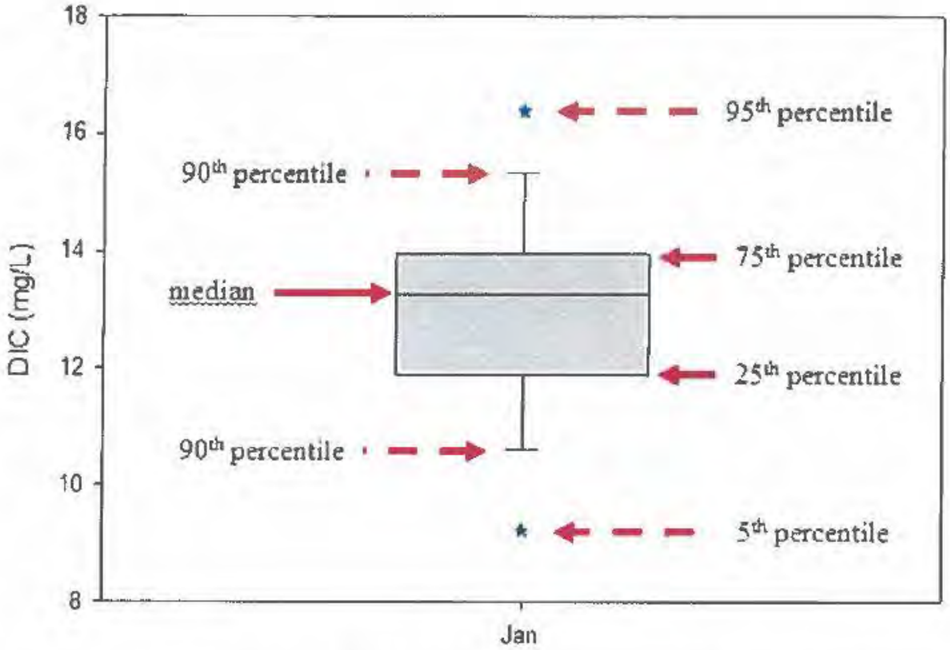

Figure 2-1 Example "Box and Whisker" Plot (See Later "Monthly" Graphs)

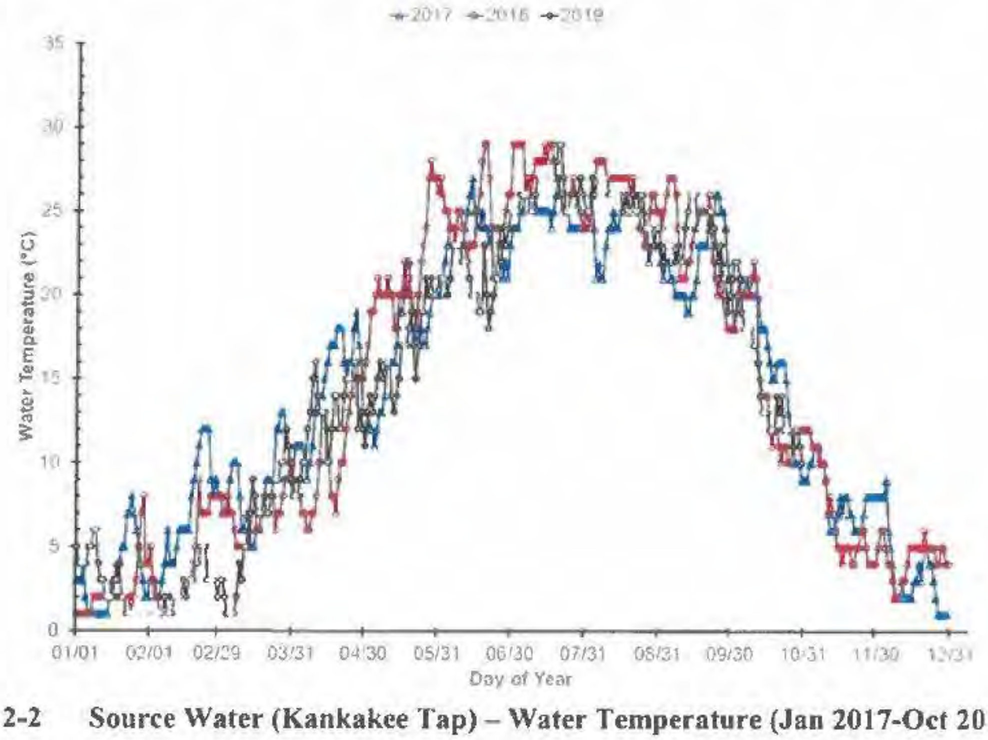

Figure 2-2 Source Water (Kankakee Tap) – Water Temperature (Jan 2017-Oct 2019)

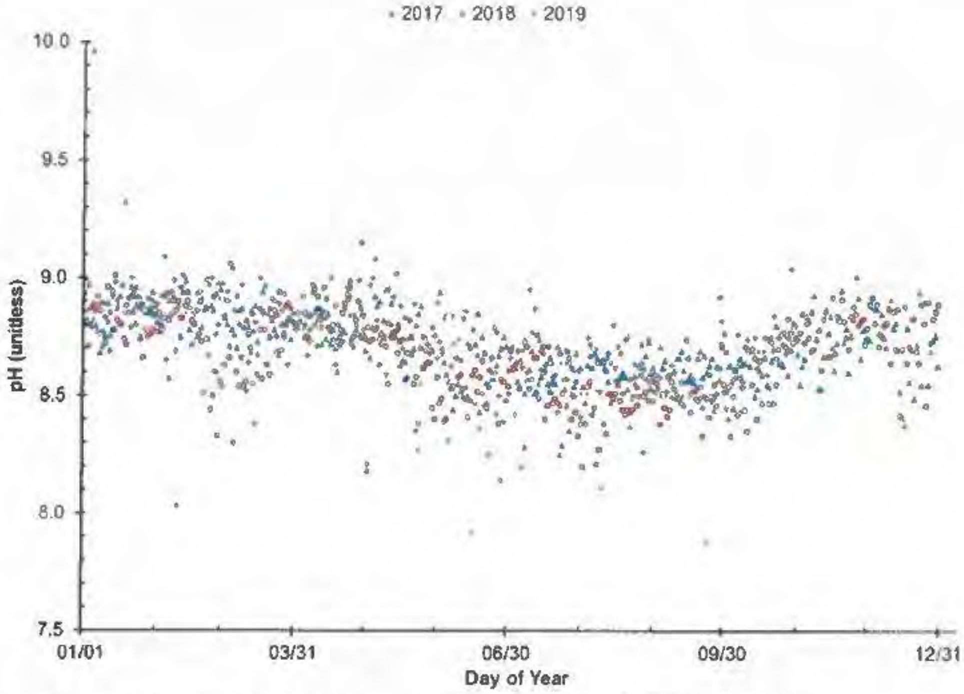

Figure 2-3 Source Water (Kankakee Tap) – pH (Jan 2017-Oct 2019)

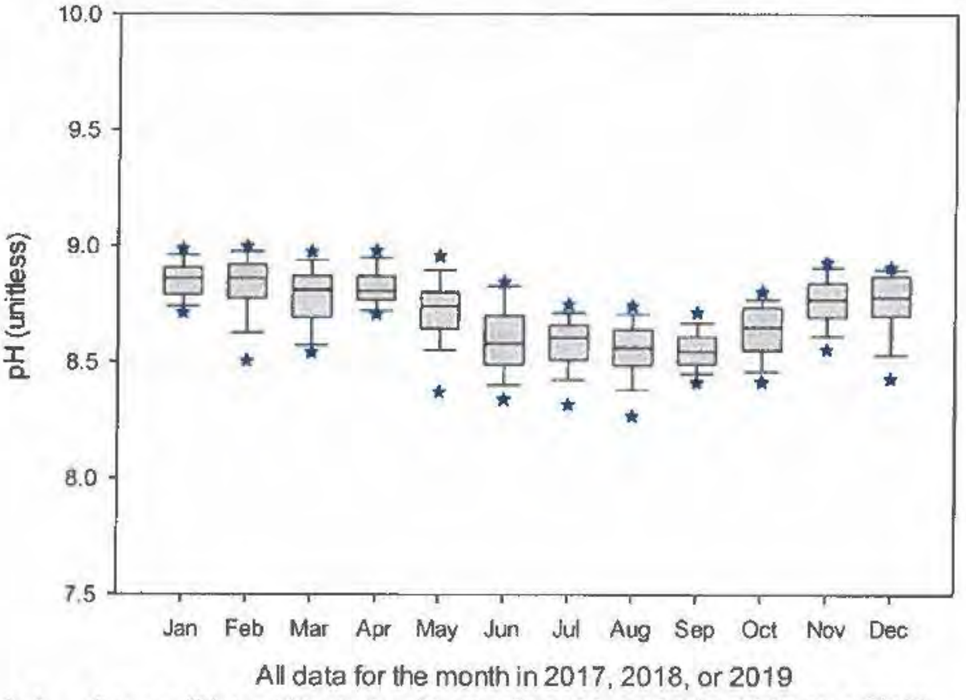

Figure 2-4 Source Water (Kankakee Tap) – Monthly pH (Jan 2017-Oct 2019)

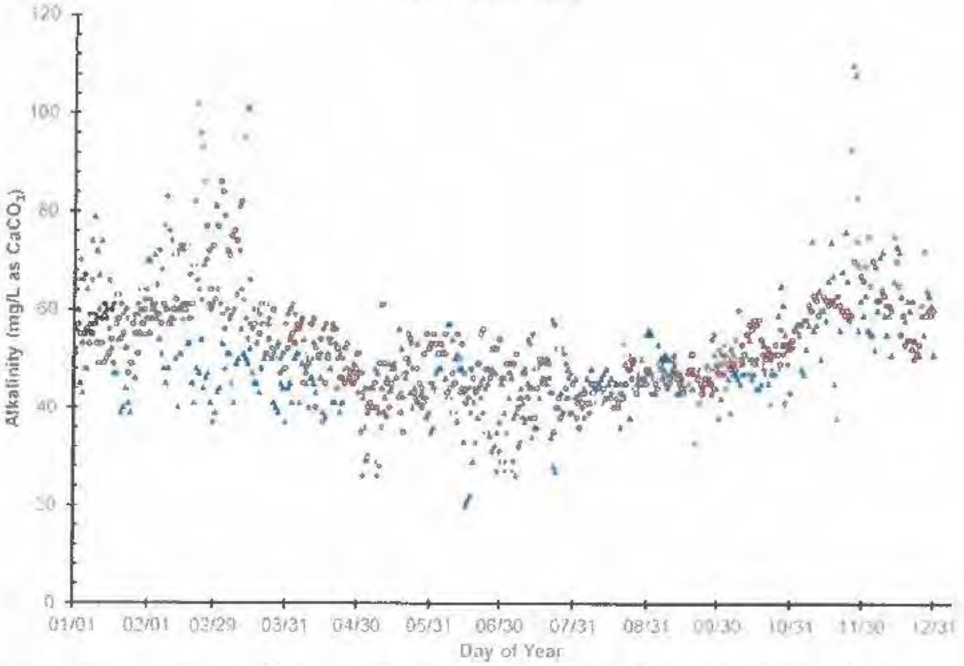

Figure 2-5 Source Water (Kankakee Tap) – Alkalinity (Jan 2017-Oct 2019)

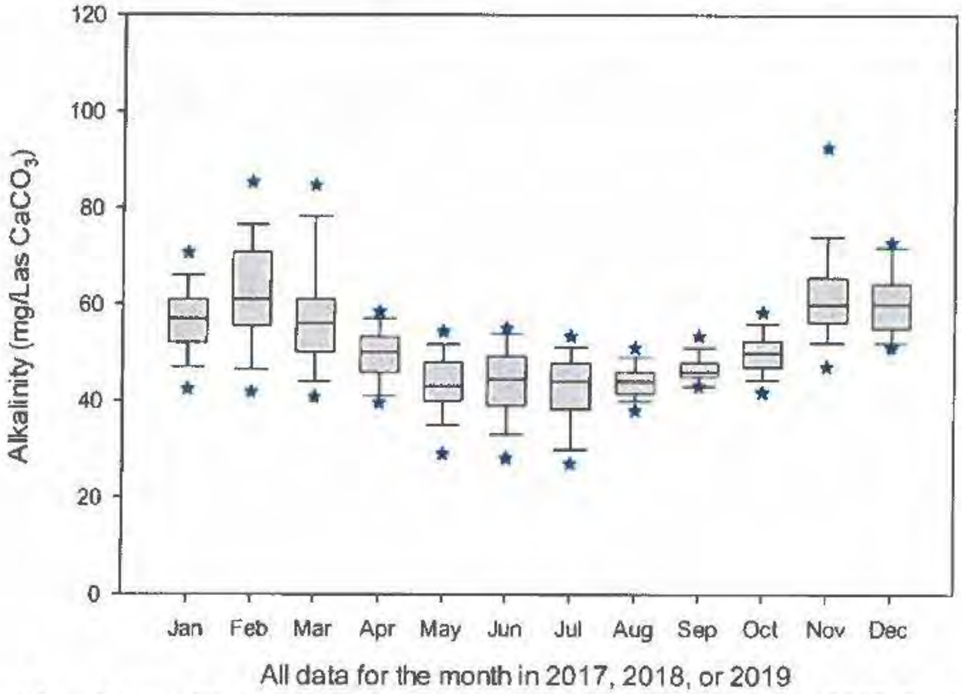

Figure 2-6 Source Water (Kankakee Tap) – Monthly Alkalinity (Jan 2017-Oct 2019)

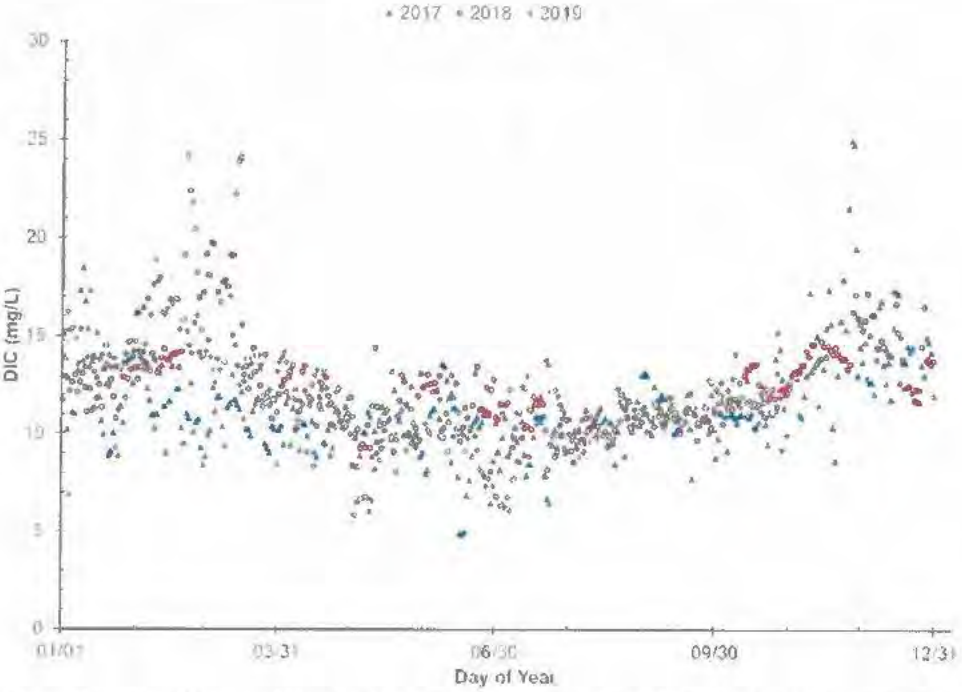

Figure 2-7 Source Water (Kankakee Tap) – Calculated Dissolved Inorganic Carbon (DIC) – Jan 2017-Oct 2019

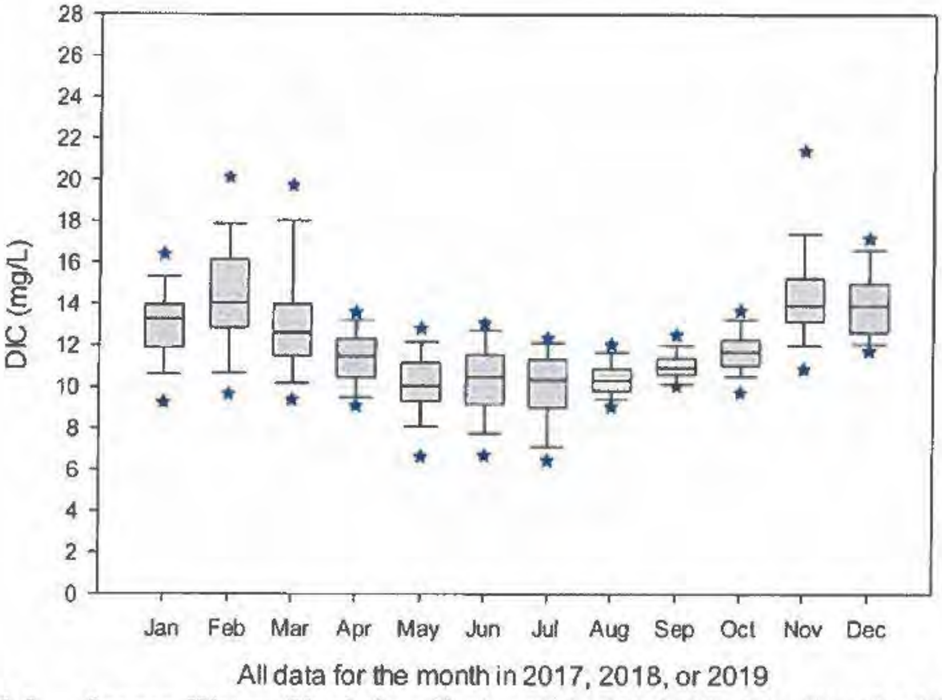

Figure 2-8 Source Water (Kankakee Tap) – Calculated Monthly Dissolved Inorganic Carbon (DIC) – Jan 2017-Oct 2019

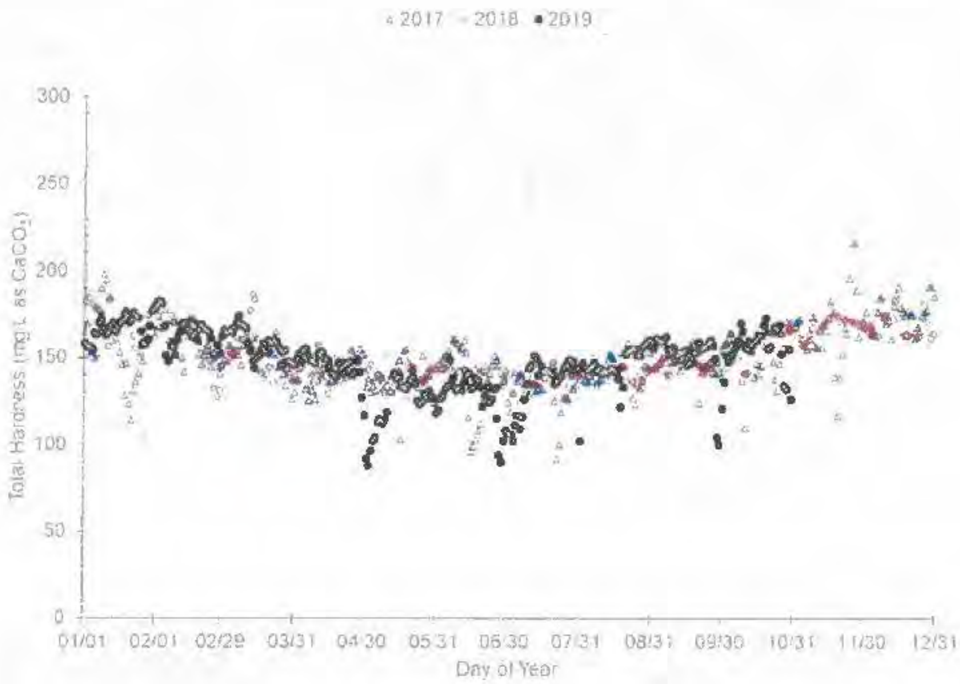

Figure 2-9 Source Water (Kankakee Tap) – Hardness (Total) – Jan 2017-Oct 2019

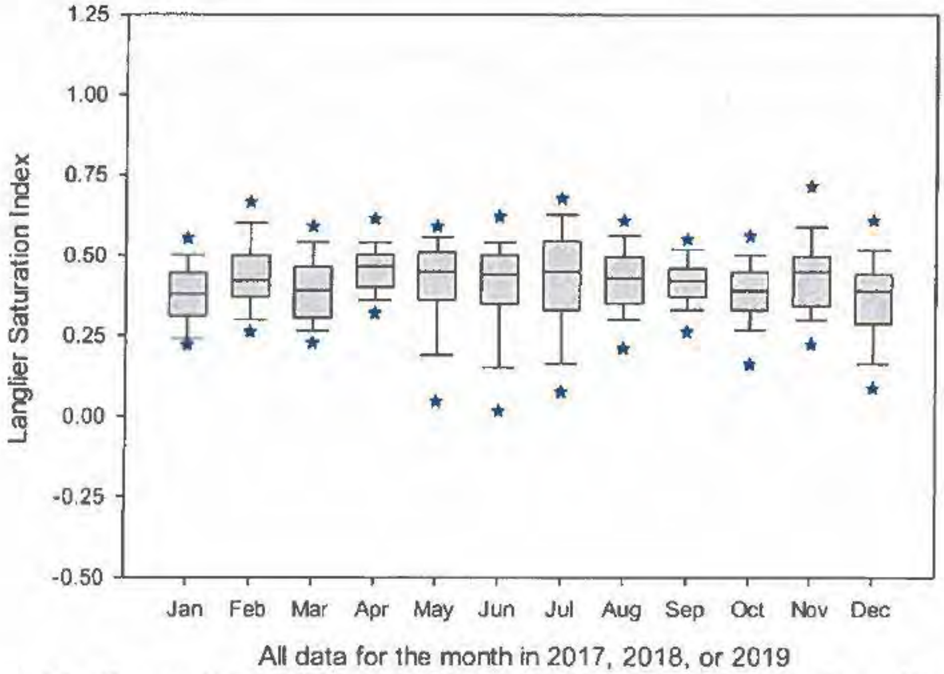

Figure 2-10 Source Water (Kankakee Tap) – Calculated Monthly Langelier Solubility Index (LSI) – Jan 2017-Oct 2019

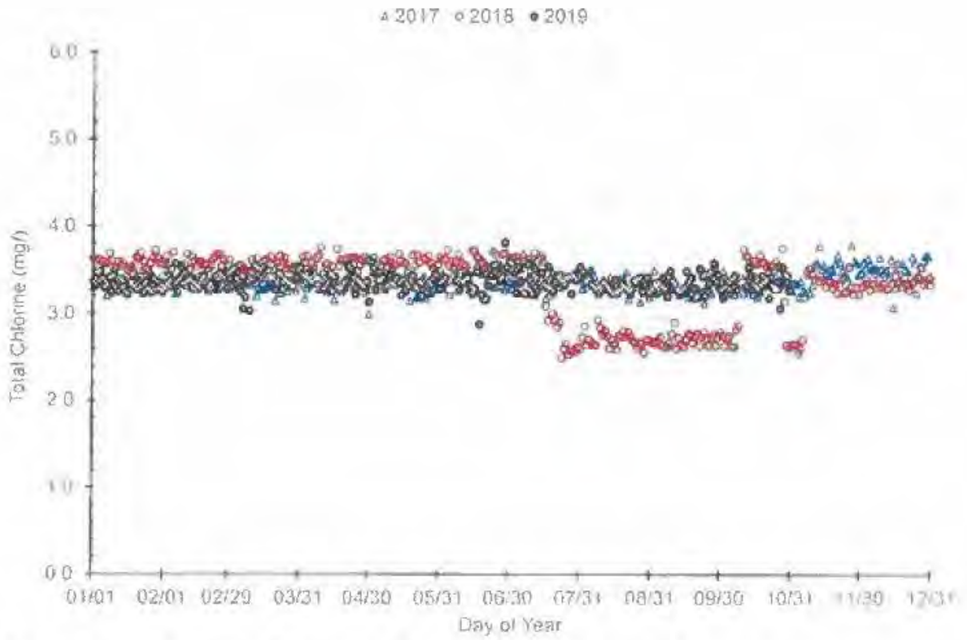

Figure 2-11 Source Water (Kankakee Tap) – Total Chlorine Residual – Jan 2017-Oct 2019

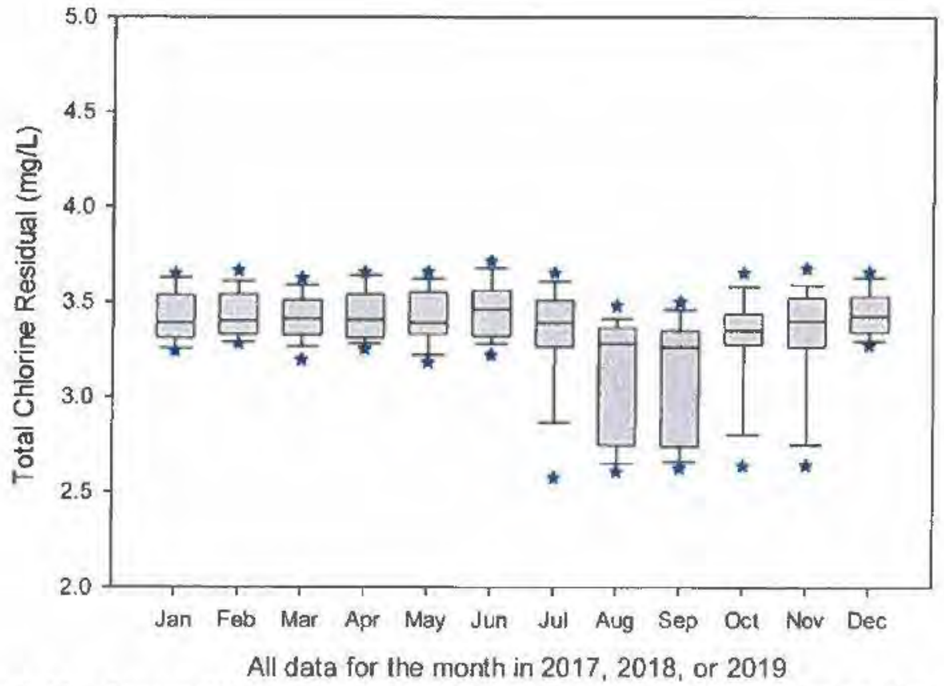

Figure 2-12 Source Water (Kankakee Tap) – Monthly Total Chlorine Residual – Jan 2017-Oct 2019

UP DISTRIBUTION SYSTEM WATER QUALITY

Table 2-1 and Figure 2-13 summarize water quality data in the UP system during June to November 2019. During this period, the UP system was receiving Kankakee treated water with the 90/10 blended phosphate added at the UP entry point prior to distribution. In the UP distribution system the pH is slightly lower than when the water leaves the Kankakee WTP (8.5 to 9.0 at the WTP (Figure 2-3) versus ~8.0 in the UP System (Figure 2-13a)). The DIC is about the same, as expected (10 to 14 mg/L (Figures 2-7 and 2-13d)). The total hardness is similar (140 to 150 mg/L as $CaCO_3$). The total chlorine residual decreased by about 1.5 mg/L, from 3 to 4 mg/L at the plant to 1.5 to 2.5 in the UP System. As shown in Figure 2-13b, the orthophosphate and total phosphate residuals in the distribution system were fairly steady during this period, about 1.4 mg/L as P (4.2 mg/L as PO4) for orthophosphate and 1.6 mg/L as P (4.8 mg/L as PO4) for total phosphate.

Table 2-2 summarizes data from the UP wells indicating the water quality entering the UP System prior to the conversion to the Kankakee treated water. The data suggest that groundwater quality prior to the conversion had a lower pH and a higher DIC, alkalinity, and hardness than the water currently supplied into the UP system.

Another potentially important factor that can impact lead CCT, as reported by Nguyen et al. (2011), is that a high chloride to sulfate ratio (CSMR) can increase galvanic corrosion when CSMR ratios >0.5 mg/mg are present, if lead or brass plumbing is also present. The CSMR for the UP wells is reported to be <0.1 mg/mg (Table 2-2), but for water in the UP system after conversion to Kankakee water source the CSMR increased, but was ~0.4 mg/mg, which is below the threshold referenced in Nguyen et al. (2011).

Table 2-1
Median water quality in the University Park (UP) distribution system
(June – November 2019)

Parameter †	Count	Median	Notes
General Characteristics, Including Carbonate Chemistry			
Field pH (unitless)	555	8.0	98% >7.5
Conductivity (µhmos/com or µS)	12	358	
Alkalinity (mg/L as $CaCO_3$)	541	46	
DIC (mg/L as C) *	541	11	
Total Hardness (mg/L as $CaCO_3$)	70	145	
Calcium Hardness (mg/L as $CaCO_3$) *	73	95	
Orthophosphate and Total Phosphate Residual			
Orthophosphate (mg as P)	615	1.4	99% >1.0 mg/L as P
Total Phosphate (mg as P)	71	1.6	100% >1.0 mg/L as P
Chloramine Residual, Nitrification, and Microbiological Activity			
Total Chlorine (mg/L as Cl_2)	598	2.0	98% >0.2 mg/L
Cellular ATP (pg/mL)	32	0.4	0 to 23 pg/mL
Ammonia (mg/L as N)	69	0.2	ND – 0.44 mg/L as N
Nitrate (mg/L as N)	74	1.3	1.0 – 2.7 mg/L as N
Nitrite (mg/L as N)	74	1.0	0.1 – 1.0 mg/L as N
Other Inorganic Chemical Characteristics			
Fluoride	74	0.8	
Chloride	74	34	
Sulfate	74	79	
CSMR (mg/mg) *	74	0.4	
Potassium	74	4.0	92% ≤ DL (0.01 mg/L)
Sodium	73	14	
Iron	67		Two detections, max 0.12 mg/L
Manganese	67		One detection, >3 mg/L
Aluminum	67	0.01	100% ≤DL (0.01 mg/L)

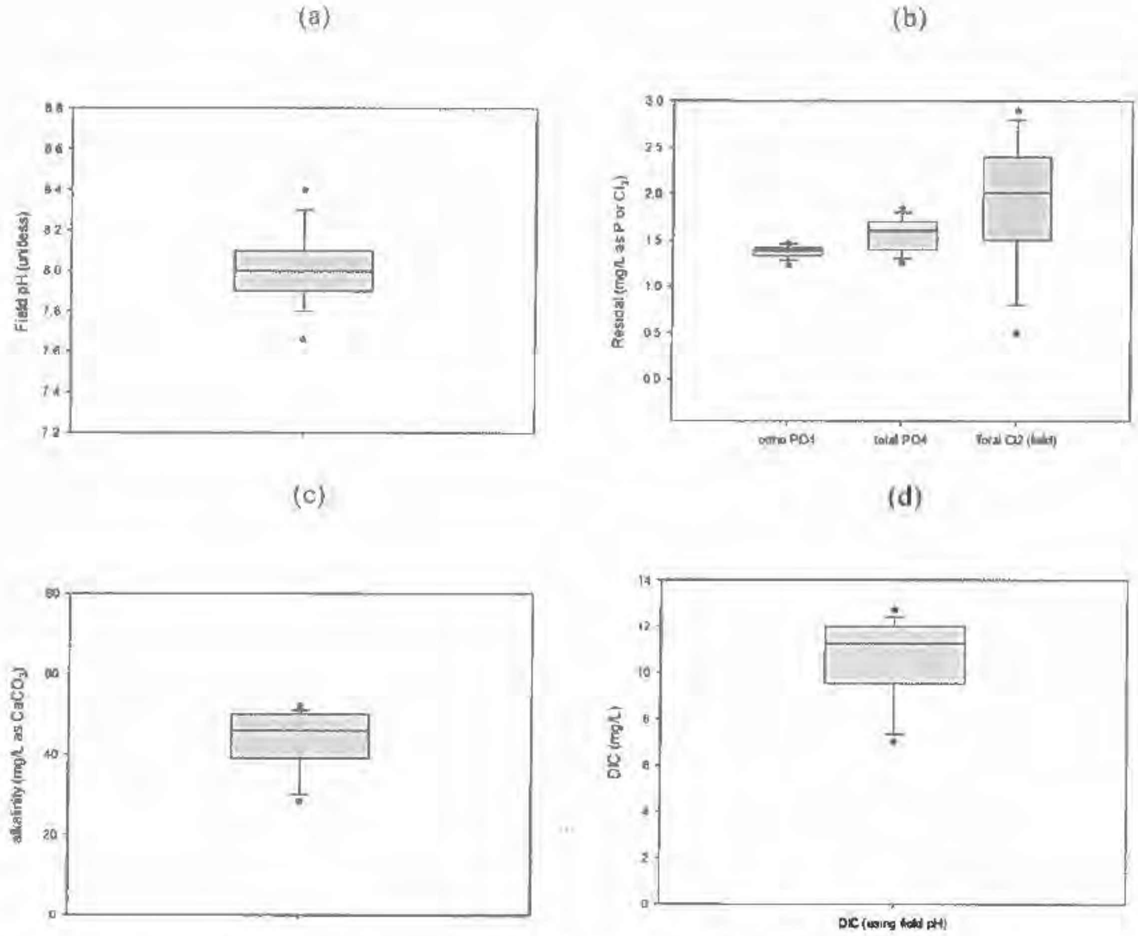

Figure 2-13 **UP Distribution System Water Quality: a) Field pH, b) Orthophosphate and Total Chlorine Residuals, c) Alkalinity, and d) DIC**

Note: Data was collected from >500 samples for each parameter/constituent during June through October 2019 for alkalinity, field pH, orthophosphate (o-PO_4) residual, and total chlorine residual. Total phosphate (total PO_4) was based on 71 samples submitted to the Aqua PA Laboratory (Bryn Mawr, PA). DIC was calculated for dates and locations with both recorded field pH and alkalinity data. Note that the reported data for o-PO_4 was in units of mg/L as PO_4. Data for o-PO_4 was plotted in units of mg/L as P by multiplying by a factor of 31/95.

Table 2-2
Historical water quality data from University Park (UP) wells

Parameter/Constituent †	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7
General Characteristics, Including Carbonate Chemistry							
pH (unitless)	7.2	7.2	6.4	7.1	7.1	7.2	7.3
Conductivity (µhmos/cm)	1,050	1,100	1,160	1,100	1,000	1,076	790
Alkalinity (mg/L as $CaCO_3$)	374	418	297	320	350	246	358
DIC (mg\L as C)	101	113	127	88	96	67	95
Hardness (mg/L as $CaCO_3$)	410	416	530	500	480	597	422
Calcium (mg/L as $CaCO_3$)	225	220	300	350	300	400	228
Nitrogen (mg/L as N)							
Ammonia-Nitrogen	0.13	<0.1	0.42	0.55	0.56	0.77	0.31
Nitrate-Nitrite	<0.1	<0.1	<0.1	<0.01	0.31	<0.01	0.30
Other Inorganic Chemical Characteristics							
Fluoride	1.2	0.9	0.4	0.8	0.7	0.5	0.3
Chloride	3.9	1.0	1.5	1.9	1.2	1.7	2.0
Sulfate	51	14	374	270	240	297	50
CSMR (mg/mg)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium	1.7	2.0	2.9	9.1	<0.01	5.8	2.1
Sodium	10	11	50	37	44	29	8
Iron	0.5	0.6	850.0	0.9	0.5	0.6	1.1
Manganese (µg/L)	21	<15	40	7	17	<15	29
Aluminum (µg/L)	<150	<100	<100	100	72	<100	

† units are mg/L unless noted otherwise

* Calculated from measured data (including calcium hardness calculated from measured calcium)

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CHAPTER 3
THEORETICAL COPPER SOLUBILITY

COPPER CORROSION

Over time, copper pipe naturally forms a scale of insoluble minerals such as malachite [$Cu_2CO_3(OH)_2(s)$] or tenorite [$CuO(s)$] (Schock & Sandvig, 2009; Grace et al., 2012). However, these scales form relatively slowly. While these minerals are forming, copper corrosion is controlled by the metastable cupric hydroxide [$Cu(OH)_2(s)$], which is much more soluble. This process of the pipe scaling thereby preventing further copper release is often referred to as "passivation". Therefore, under water quality conditions that are conducive to copper corrosion (i.e. "aggressive" water quality conditions), elevated copper levels would be more likely to be observed in new construction rather than at older homes, such as LCR monitoring sites. New copper pipes might never passivate in waters that are considered corrosive to copper. Furthermore, the presence of natural organic matter (NOM) can inhibit formation of these protective scales (Arnold et al. 2012).

NDWAC COPPER CORROSION SUSCEPTIBILITY

The National Drinking Water Advisory Committee (NDWAC) convened to address revisions to the LCR defined a range of water quality conditions deemed "corrosive" to copper as shown in the shaded areas of Figures 3-1 and 3-2 (NDWAC 2015 a&b). Water quality that falls in the unshaded region of each figure is considered to be non-corrosive to copper. For example, water quality with characteristics reflected in the unshaded region of Figure 3-1 are considered not aggressive (or non-corrosive to copper), whether o-PO_4 is present or not. However, water systems in the shaded region of Figure 3-1 are aggressive (corrosive) to copper, unless o-PO_4 is added under conditions consistent with unshaded regions of Figure 3-2. Although the shaded regions in these figures indicate potentially corrosive conditions, those conditions are only corrosive if the system adds an oxidant or aerates the water. Groundwater systems that are not chlorinated and are anoxic would not be corrosive even if they fall within the shaded region. Conversely, a water system that falls in the unshaded region of Figure 3-2 is considered not corrosive to copper, but only if the pH is within the effective range for control of copper corrosion with o-PO_4. For example, even if orthophosphate is present, if the pH is <7.0 the water would still be considered corrosive to copper due to the low pH.

Figure 3-1 compares the pH and alkalinity from the Kankakee WTP (January 1, 2017 through October 31, 2019) with data from the UP system (2019). The red symbols in this figure for Kankakee treated water indicates that the water leaving the Kankakee WTP is not conducive to copper corrosion. The water in the UP System (blue symbols) has a lower pH but these conditions are still not considered conducive to copper corrosion even without considering the impact of orthophosphate. Figure 3-2 depicts the orthophosphate residual and alkalinity data from the UP Distribution after adding orthophosphate with the current blended phosphate at the UP entry point. The data in this figure demonstrate that according to the water quality range identified by the NDWAC, the conditions in the UP System measured on these dates is not considered corrosive to copper.

THEORETICAL SOLUBILITY RELATIONSHIPS

The copper solubility curves on which the above NDWAC diagrams were based have been updated based on research published by Lytle et al. (2018). Equation 3.1 below is the result of that research, which is based on an empirical evaluation ("curve fitting") of experimental data investigating soluble copper concentrations under controlled conditions after adding a copper-containing salt (copper perchlorate) that readily dissolves in water. Consequently, these studies start with dissolved copper under controlled conditions of pH, DIC, and orthophosphate and predict the soluble copper remaining at equilibrium after some of the copper precipitates. Readers should note the difference in this experimental approach versus corrosion monitored in a distribution system (solid copper pipe or copper-containing scales are present and we monitor the soluble copper that dissolves after stagnant contact with the solid forms of copper). Data from recent work by Cornwell indicates that for a variety of reasons, perhaps including this difference in how the solubility data were derived, the actual soluble copper levels for new copper are lower (as much as an order of magnitude lower) than predicted by the NDWAC figures or the data from Lytle et al. 2018.

Equation 3.1 Copper solubility as function of pH, orthophosphate, and DIC as reported by Lytle et al. 2018

$$Cu=56.68\times e^{-0.77\times pH}\times e^{-0.20\times PO4}\times DIC^{0.59}$$

Where:

Cu = predicted copper solubility (mg/L)
pH = pH (unitless)
PO_4 = orthophosphate residual in mg/L as PO_4
DIC = dissolved inorganic carbon (mg/L as C)

SUMMARY AND DISCUSSION

The data presented in this chapter and in the NDWAC and Lytle solubility graphs all suggest that the Kankakee treated water does not create conditions conducive to copper corrosion, and the addition of orthophosphate reduces the copper solubility still further. Consequently, the current use of Kankakee treated water, supplemented by orthophosphate, produces conditions that not only improve lead solubility control (see Chapter 4) but also copper solubility (see figures above).

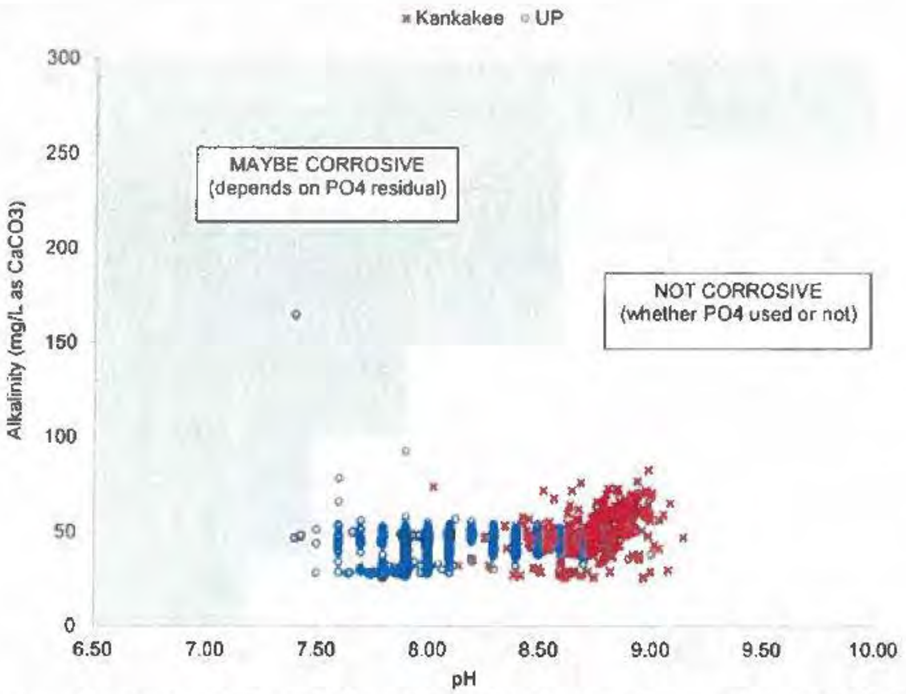

Figure 3-1 Kankakee (2017-2019) and UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (without PO_4)

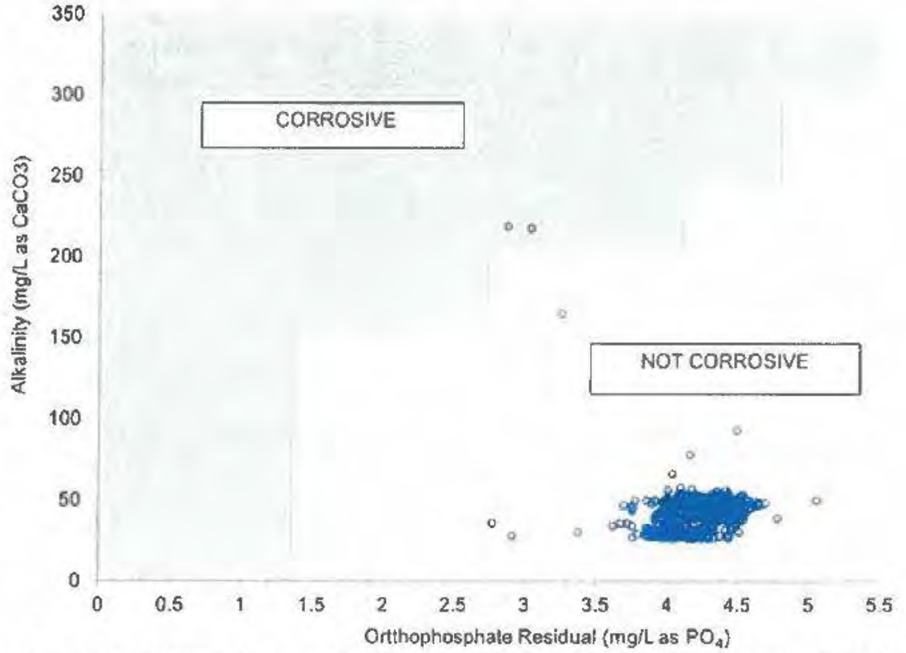

Figure 3-2 UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (with PO_4)

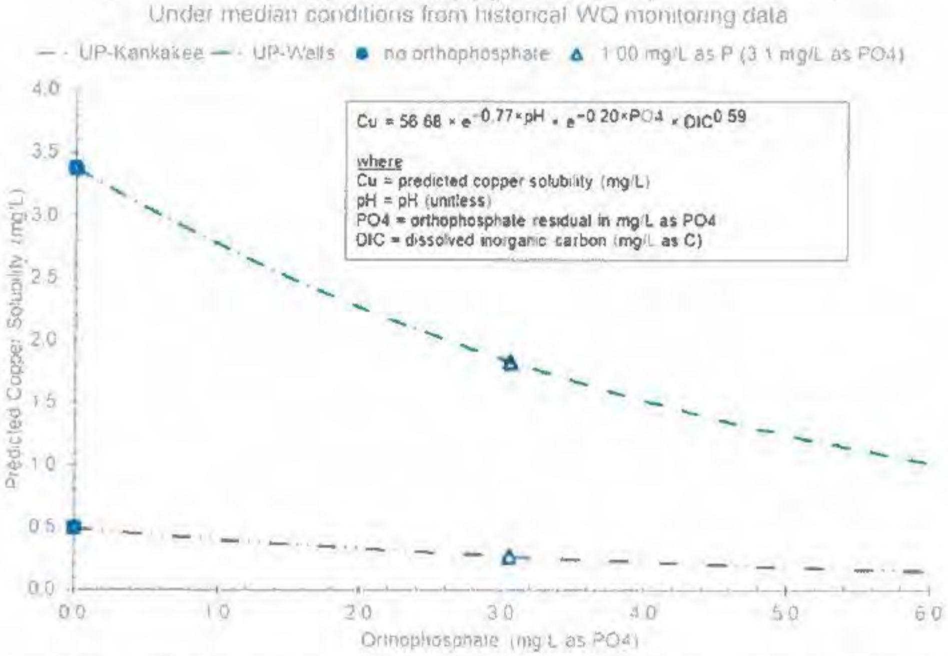

Figure 3-3 Theoretical Copper Solubility UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (with PO_4)

CHAPTER 4
BENCH SCALE TESTING

This chapter presents a summary of bench scale testing methods including lead solubility tests with lead coupons, dump & fill studies conducted with harvested pipe and fittings containing either brass or copper with lead/tin solder, and pipe scale analysis of harvest copper pipe (containing lead/tin solder) performed by Cornwell (Cornwell Engineering Group, Newport News, VA). Also included in this chapter are the results of experiments conducted by researchers at Virginia Tech (Virginia Polytechnic Institute and State University, Blacksburg, VA) investigating the impact of phosphate-based corrosion inhibitors on galvanic corrosion of harvested copper pipe in contact with lead/tin solder.

LEAD SOLUBILITY TESTING

Background

Lead solubility testing as described in Cornwell and Wagner (2019) was conducted using treated water from the Kankakee WTP during 2018 and 2019 as discussed below.

Fall 2018

Treated surface water was collected by Aqua-IL staff from the Kankakee WTP, stored in 5-gallon plastic (HDPE) buckets, and shipped to Cornwell (Newport News, VA) for the Fall 2018 lead solubility testing conducted between November and December 2018. Figure 4-1 depicts a typical lead solubility study container, including a lead coupon suspended in a 500 mL HDPE bottle.

Figure 4-1 Typical Jar with Lead Coupon (500 mL HDPE Bottle)

The water in each 1.5 L beaker was first dosed with the target phosphoric acid (H_3PO_4) dose (1.8, 2.4, or 3.0 mg/L as PO_4). Ammonium chloride (NH_4Cl) was added to all beakers. A sodium hypochlorite (NaOCl) stock solution was also added to all beakers to achieve a target monochloramine residual of 3.2 mg/L. The targeted chlorine/ammonia ratio was 4.75 mg Cl_2 per mg N. The total chlorine or monochloramine residuals were measured and adjusted, as needed, before proceeding to the next step. The pH after adding these products was measured and adjusted to meet the pH target (8.2). Table 4-1 summarizes the test conditions.

Table 4-1
Lead solubility study test matrix – Kankakee WTP with added chloramines (in duplicate)

Description	Phosphoric Acid Dose (mg/L as PO_4)	Phosphoric Acid Dose (mg/L as P)	Target pH	Target Monochloramine Residual (mg/L)
		Phosphoric acid only – pH 8.2		
1.8 mg/L as P	1.8	0.6	8.2	3.2
2.4 mg/L as P	2.4	0.8	8.2	3.2
3.0 mg/L as P	3.0	1.0	8.2	3.2

After preparing water in beakers, approximately 600 mL water for each sample was transferred into a new, pre-labeled, nominal 500 mL HDPE bottle as shown in Figure 4-1. The coupon and lid were carefully transferred from the old containers to the new freshly prepared containers, making sure that excess water was added to the bottles so that after placement of the lid the water in the container was headspace-free. The old containers were sealed and shipped to the Aqua PA Laboratory in Bryn Mawr (PA), where samples were acidified (pH <2), stored for at least 16 hr, and then analyzed for total lead by ICP-MS. Two replicate jars were prepared and used during this study for each condition noted in Table 4.1.

The Fall 2018 lead solubility study findings are depicted in Figure 4-2. In this figure replicate 1 ("rep. 1") for each test condition in Table 4-1 is shown as a solid line and replicate 2 ("rep. 2) is depicted as a dashed line. The 1.8 mg/L as PO_4 dose of H_3PO_4 (blue lines), 2.4 mg/L as PO_4 of H_3PO_4 (red lines), 3.0 mg/L as PO_4 of H_3PO_4 (green lines) and achieved steady-state at <5 µg/L-day after 14 to 21 days. These results suggest that using H_3PO_4 at any of these doses, under the conditions tested, would result in a low lead solubility.

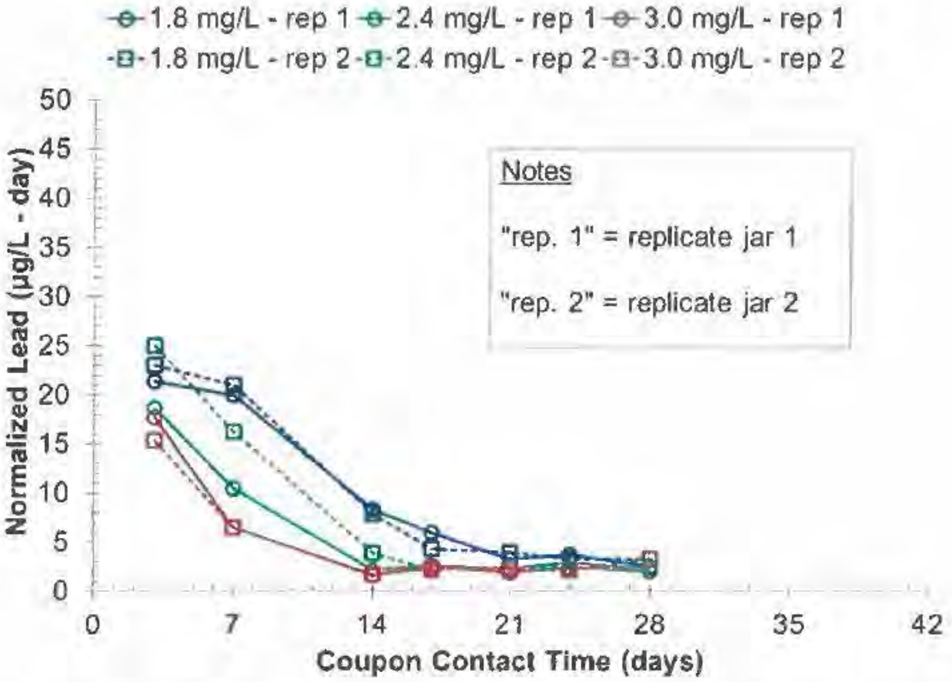

Figure 4-2 **Fall 2018 Lead solubility Test Results – H_3PO_4 (Nov-Dec 2018)**

Fall 2019

During Fall 2019 (September to November 2019) similar lead solubility studies were conducted using similar materials and similar procedures to those described above for Fall 2018. New 5-gal HDPE buckets of water from the Kankakee WTP were supplied. The Fall 2019 testing included 18 jars for nine test conditions (three phosphate products at three doses in duplicate). The three orthophosphate-containing products evaluated were:

a) Phosphoric acid (the same product used in Fall 2018),
b) Zinc orthophosphate (ZOP), SLI-321 from Shannon Chemical, containing 37% by weight as PO_4 (~12% as P) orthophosphate and a zinc-to-orthophosphate ratio of about 1:3.
c) Blended phosphate (LPC132) from Hawkins Inc. (Roseville, MN) with 90 percent by weight orthophosphate and 10% polyphosphate

The three doses tested were 1, 2, and 3 mg/L as PO_4 for the orthophosphate fraction of each of these products. The average results for the duplicate jars for each test condition are summarized in Figure 4-3 for H_3PO_4 at the three doses tested, and results are similarly depicted in Figure 4-4 for ZOP and Figure 4-4 for LPC132 (90/10 blended phosphate). The studies at these three doses were completed in November 2019.

Figure 4-6[*] compares the steady-state results (days 39 to 49) for both replicates at all doses with each product tested. Review of Figures 4-3, 4-4, and 4-5 indicates 6 sample dates within this time period, so each box in Figure 4-6 summarizes 12 data points (6 dates in duplicate)[†].

Interpretation of Figures 4-3 to 4-6 reveals the following:

- The 2 and 3 mg/L as PO_4 doses of ZOP and H_3PO_4 all leveled off at <5 µg/L-day
- The 3 as PO4 dose for the 90/10 blended phosphate appears to be achieving steady-state at <5 µg/L-day
- As often occurs, the orthophosphate dose needed for lowest lead solubility is higher in a blended phosphate due to the presence of polyphosphate in the blended product.

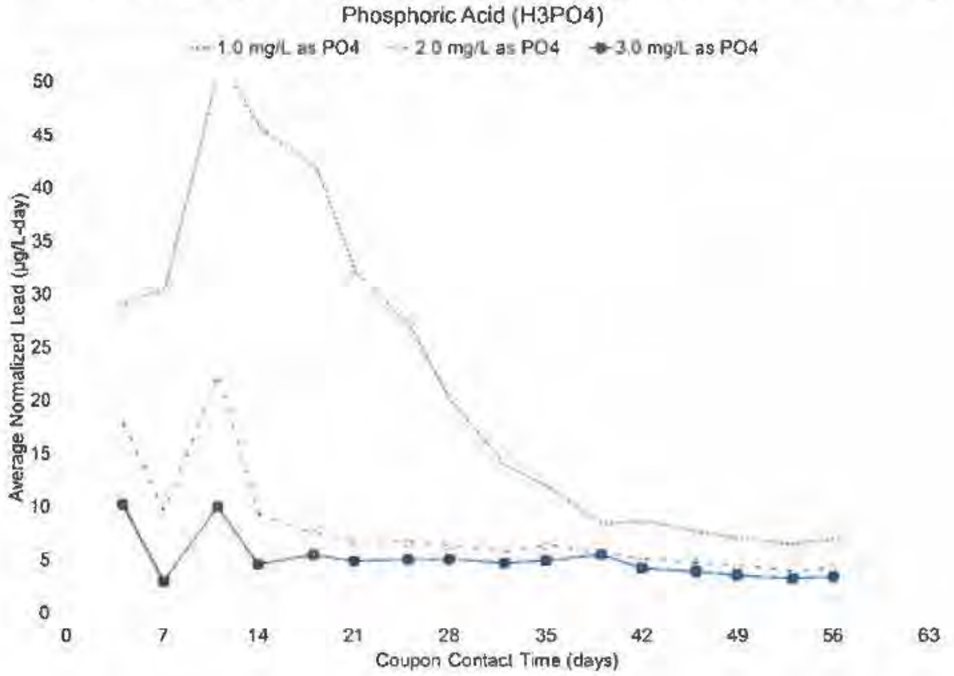

Figure 4-3 **Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – H_3PO_4 Phosphate (Sep-Nov 2019)**

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[*] For a review of interpretation of "box and whisker" plots in Figure 2-2).

[†] With 12 data points, it is possible to calculate the 10th and 90th percentile

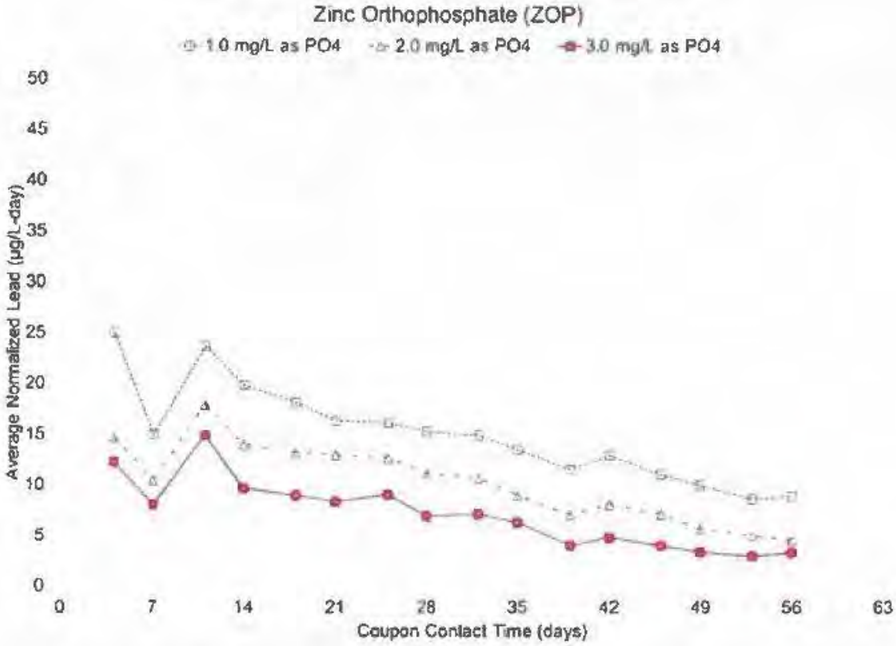

Figure 4-4 Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – ZOP (Sep-Nov 2019)

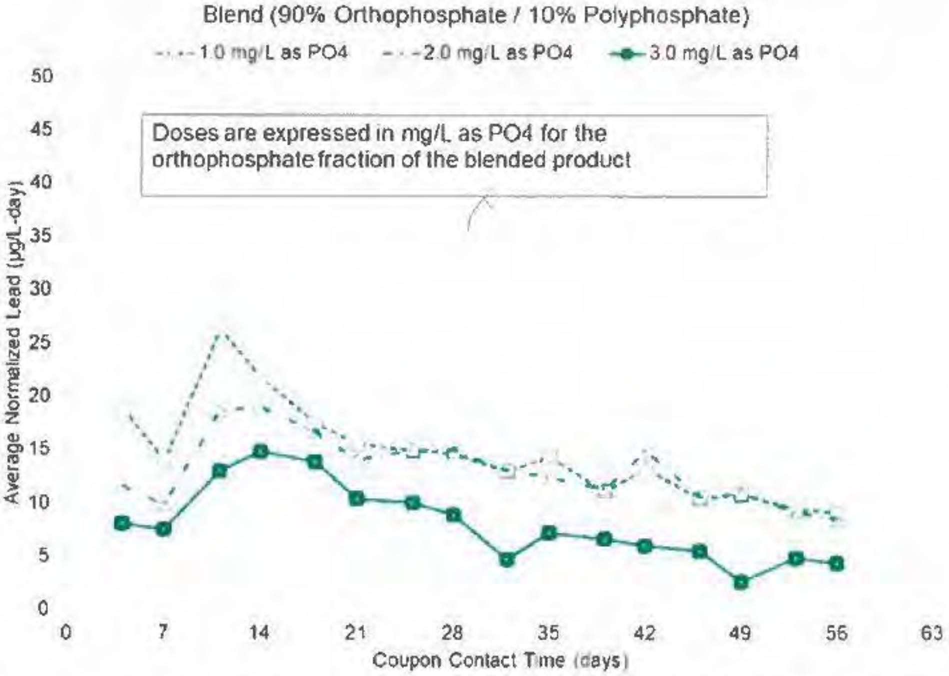

Figure 4-5 Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – Blended Phosphate (Sep-Nov 2019)

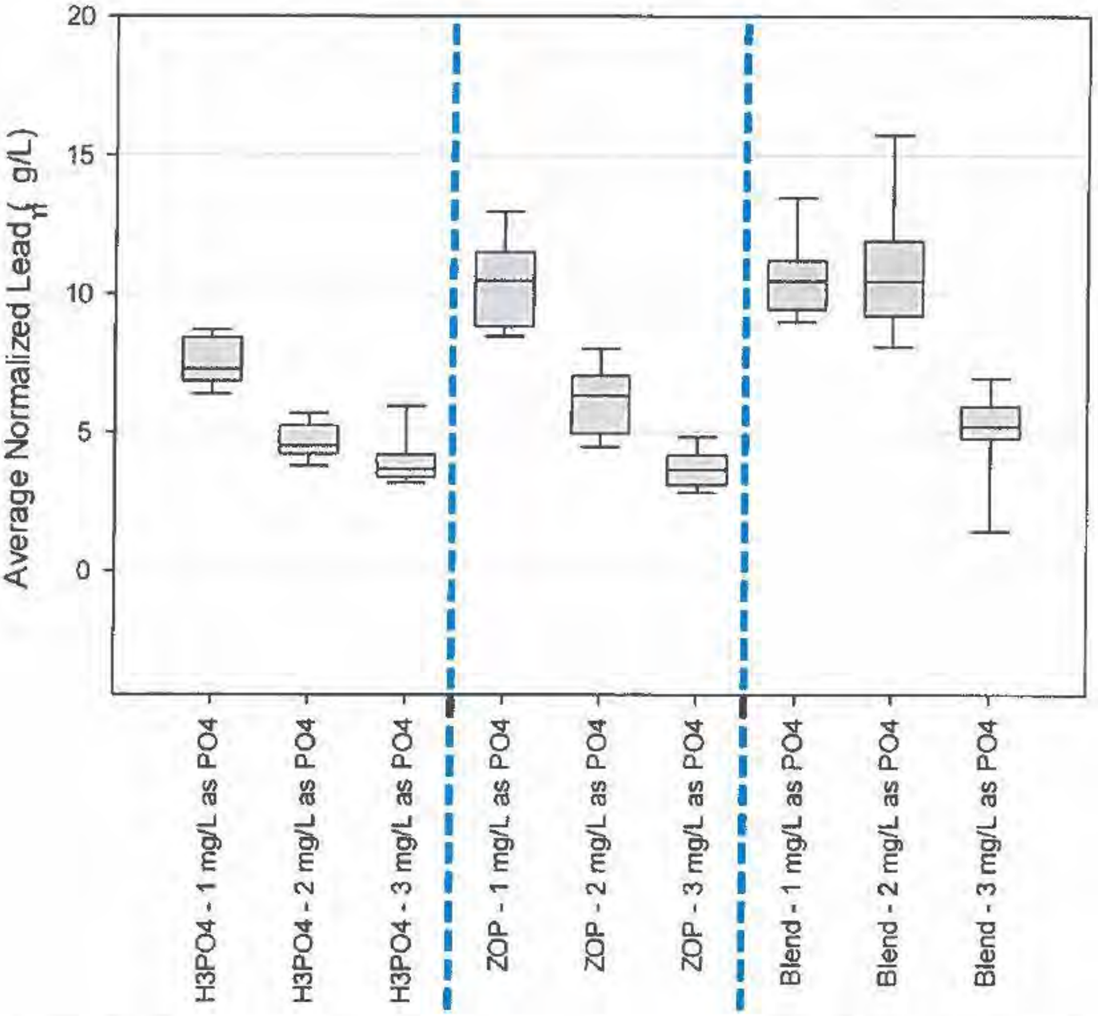

Figure 4-6 **Summer/Fall 2019 Steady-State Lead Solubility Test Results (Day 39 to 49, Two Replicates) – H_3PO_4 vs. ZOP vs. Blended Phosphate (Sep-Nov 2019)**

Summary of Fall 2018 and 2019 Lead Solubility Studies

These studies demonstrated that, under the conditions tested, when orthophosphate alone was used the lead solubility could be reduced to <5 µg/L-day with either 1.8, 2.0, 2.4, or 3.0 mg/L as PO_4 using either H_3PO_4, or at 2 and 3 mg/L as PO_4 with ZOP. When polyphosphate was present along with orthophosphate, using the 90/10 blended phosphate product tested, lead solubility comparable to orthophosphate alone could be achieved (<5 µg/L-day), but only at the 3 mg/L dose.

EXPERIMENTS WITH HARVESTED COPPER PIPE WITH LEAD SOLDER

Bench-scale dump-fill experiments were conducted on harvested copper pipe with lead solder in order to screen the potential impact of varying corrosion inhibitors and doses to existing University Park pipe scales. Eleven pipes were tested between late-June 2019 and mid-November 2019 during four main test phases, as shown in Table 4-2. As with the lead solubility (coupon) studies described earlier, the water prepared for the studies outlined below started with treated surface water from the Kankakee WTP.

Table 4-2
Copper pipe testing and sample information

Testing Phase	Pipe Number	Test Start Date	Test End Date
1		07/23/2019	08/22/2019
2	1	07/19/2019	08/07/2019
	2		
	3		
	4		
3	5	08/7/2019	09/12/2019
	6A		
	6B		
4	8	09/24/2019	11/13/2019
	10		
	14		

Testing Procedures

All pipes utilized for testing were harvested copper pipes containing a fitting with leaded solder. Pipes were prepared by sealing one end using parafilm and tape, and then suspending the pipe via a stand and burette clamp. Table 4-3 summarizes the test conditions for studies in Phases 1 through 4 below. Water was first prepared by dosing the appropriate corrosion inhibitor to the treated Kankakee water. If needed (see final column in Table 4-3), pH was manually adjusted prior to phosphate dosage using an HI902 titrator with 0.1N sodium hydroxide and/or 1.0N sulfuric acid. Once water was prepared, the previous sample stagnating in the pipe was collected by gently tipping the pipe over. The freshly prepared water was then poured into the re-clamped pipe, and the previous sample was acidified using 1:1 HNO_3 to achieve a pH of less than 2. Details of the individual products tested and other test conditions are summarized in Table 4-3 and in the discussion of the results for each "phase".

Table 4-3
Bench scale test matrix

Testing Phase	Pipe Number	Inhibitor	Orthophosphate Target Dose (mg/L PO_4)	pH Target (pre-Inhibitor)
1		Sodium o-PO_4	3.0	8.1
2a	1	Sodium o-PO_4	3.0	No Adjustment
	2			
	3			
	4			
2b	1	Sodium o-PO_4	3.0	8.4
	2	90/10 Blend		
	3	ZOP		
3a	5	90/10 Blend	3.0	8.4
	6	ZOP		
3b	5	90/10 Blend	3.0	8.4
	6A	ZOP		
	6B	90/10 Blend		
3c	6A	90/10 Blend	3.0	8.4
	6B	ZOP		
4	8	90/10 Blend	3.0	8.4
	10			
	14			

Results

Phase 1

The pipe in Phase 1 was the only pipe tested that had not been exposed to the 90/10 product prior to harvesting. This pipe was extracted from a home before the change of CCT occurred. Therefore, this pipe contained scales representative of conditions during the peak lead release event. It was dosed with sodium orthophosphate (Sodium o-PO_4), trade name SLI-5179 (Shannon Chemical Corporation, Malvern, PA). Results for this phase of testing are shown in Figure 4-7.

The results in Figure 4-7 suggest that the orthophosphate dose did result in stabilizing the total lead at <10 µg/L after about 4 weeks of daily water exchanges. Paired filtered and total lead samples were occasionally collected. The median filtered lead was 11 µg/L, ranging from 4 to 18 µg/L. These data measured for filtered lead and the trend for total lead presented in Figure 4-7 suggest that the filtered lead was ~10 µg/L during this contact period and the remainder of the total lead measured was particulate lead. Consequently, the improvement indicated in Figure 4-7 may have been exclusively due to a decrease in particulate lead, and therefore stabilization of the scales.

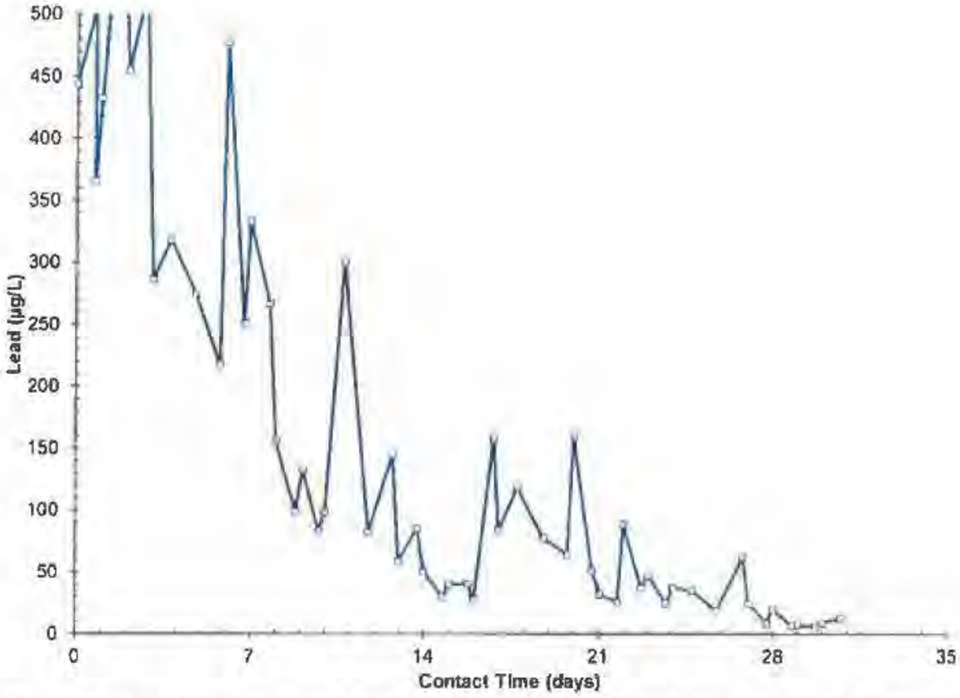

Figure 4-7 **Phase 1 Lead Results with Sodium Orthophosphate at 3 mg/L as PO_4**

Phase 2

Phase 2 originally consisted of four harvested copper pipes with small copper elbows. These were tested in a similar once-a-day complete fill and dump sampling, with pH adjustment to 8.4 before the addition of phosphate product. The pipes were first acclimated to 3 mg/L as PO_4 sodium o-PO_4 without pH adjustment (see Table 4-3). During this period, one pipe was dropped from the study due to an accident causing a partial loss of the first layer of scale in this pipe specimen. The remaining three pipe specimens were then evaluated in pH adjusted water (pH 8.4) for about 3 weeks using 3 mg/L as PO_4 for sodium o-PO_4 in one pipe, ZOP, in one pipe, and the 90/10 blended phosphate currently used in UP (LPC132) in the third pipe. The three products are the same as listed above for Phase 1 of the harvested pipe studies, or in the lead solubility (coupon) studies described earlier in this chapter. Results from these three pipes are depicted in Figure 4-8.

Results in Figure 4-8, coupled with observations from studies described earlier in this chapter, suggest that within 3 weeks the steady-state lead was <10 µg/L with orthophosphate alone (ZOP or sodium o-PO_4) or with the LPC132. There were a few high total lead variations within this first 3 weeks of water contact, which may have been variable releases of particulate lead.

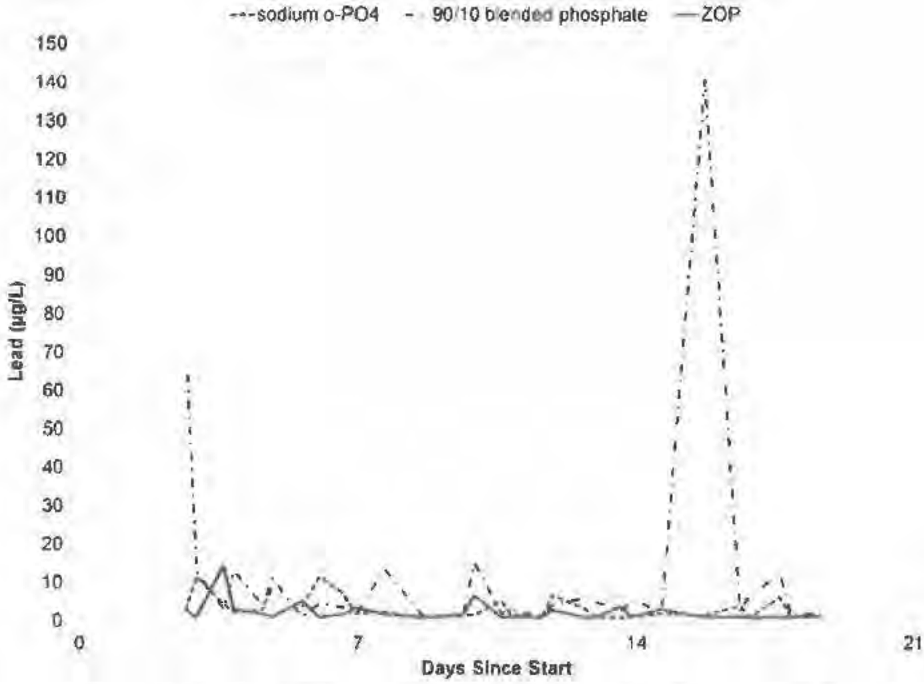

Figure 4-8 **Phase 2 Lead with 3.0 mg/L as PO_4 Sodium Orthophosphate**

Phase 3

A harvested copper pipe from Pipe 5 with a lead solder joint was evaluated in Phase 3 with a 3.0 mg/L as PO_4 dose and the same 90/10 blended phosphate discussed previously (LCP-132). A different copper pipe with two lead solder joints was harvested from another house and cut in half (one lead solder joint in the middle of each). After the pipe was split, one part (called 6B) was dosed with 3 mg/L of 90/10 blended phosphate. Pipe 6A was dosed with 3 mg/L as PO_4 of ZOP.

The monitoring results for these three pipe segments are summarized in Figure 4-9 for dates prior to Day 38. Prior to this time, the results in the pipe 5 (dosed with the 90/10 blended phosphate) had leveled off below 5 µg/L so testing of this pipe was halted. After Day 38, the corrosion control products in the 6A and 6B pipe segments were switched, so that before Day 38 pipe 6A was dosed with ZOP and after Day 38 with the blended phosphate, and for pipe 6B the switch on Day 38 was from blended phosphate to ZOP. The results in Figure 4-9 suggest the following:

- Pipe 5 leveled off at <5 µg/L after Day 6 and remained at this level until the study was terminated
- Pipe 6A also leveled off at <5 µg/L after ~3 weeks (with one spike >200 µg/L at Day 34), while dosed with ZOP, then leveled off at <4 µg/L after being switched to the blended phosphate after Day 38

- Pipe 6B released much higher lead then 6A. the lead was starting to come down around day 25. When switched to ZOP after Day 38, the decreasing trend in total lead continued from the previous week of contact with blended phosphate (Days 32 to 38) with no apparent change in lead trend due to the inhibitor change.

Overall, the results in Figure 4-9 show that the 90/10 blend was successful in reducing lead solubility over time.

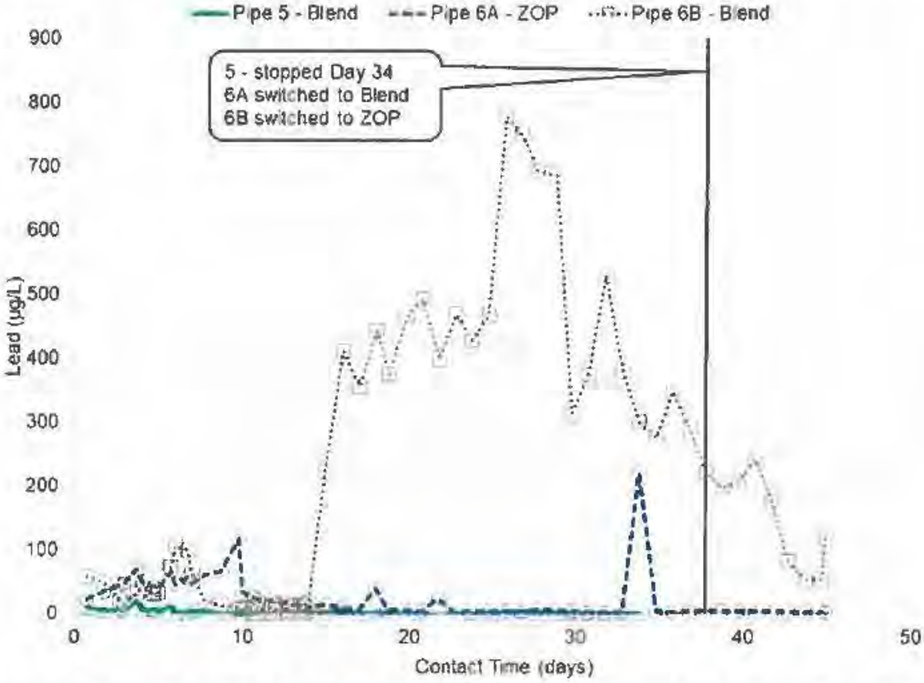

Figure 4-9 **Phase 3 Lead – 3 mg/L as PO_4 Blended Phosphate and ZOP, Including Two Adjacent Segments of Copper Pipe (Each with a Lead Solder Joint)**

Phase 4

Three additional pipes (copper with lead solder) were evaluated. All three received 3 mg/L as PO_4 of the LPC-132 blended phosphate described above, with pH adjusted to 8.4.

Lead data from these pipes (Pipes 8,10,14) are shown in Figure 4-10. Results from all three pipes leveled off within 3 weeks to <5 µg/L with the 3 mg/L as PO_4 blended phosphate dose (there was a spike at day ~33 for pipe 14 due to a random release of particulate lead in harvested pipe segment tested). These results, in comparison to other results presented in this chapter, suggest that lead solubility using copper pipes with lead solder harvested from several University Park locations all achieved steady-state within a few weeks when exposed to LPC-132.

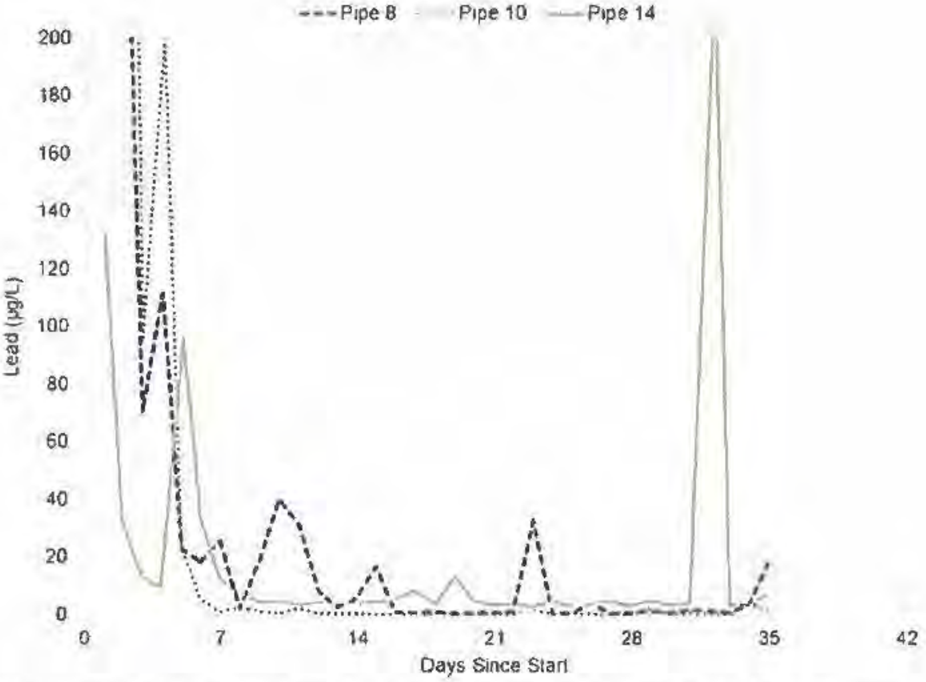

Figure 4-10 Phase 4 Lead – 3 mg/L as PO_4 Blended Phosphate in Pipe Segments (Copper with Lead Solder) at Three Houses

Summary of Stagnant Pipe Studies

The four phases of dump and fill studies described above all used harvested pipe with an elbow or joint containing lead solder. The results of these studies demonstrated that low lead could occur as fast as a few days and at least within 3 to 4 weeks. The same low levels (typically <10 µg/L and often <5 µg/L) could be achieved with either sodium orthophosphate, zinc orthophosphate (ZOP), phosphoric acid (H_3PO_4), or the 90/10 blended phosphate product. In particular, the results in Phase 1 and 4 demonstrated that higher lead levels (>100 µg/L) were present initially when water was placed in contact with the harvested materials, and then these leveled off to the lower levels described above after sufficient contact time.

PIPE SCALE ANALYSIS

Pipe Harvested from UP Prior to Switch to LPC-132

This pipe was received on June 15th, 2019 and had been harvested from a home located in UP prior to the use of the LPC-132 product. Therefore, it represented pipe scales that were last exposed to Kankakee treated water containing a polyphosphate and low orthophosphate blend. Extracted and prepared pipe scales were analyzed by x-ray diffraction (XRD) and scanning electron microscope / energy dispersive spectroscopy (SEM/EDS). Pipes were delivered to Cornwell where they were visually inspected. Cornwell laboratory then removed and separated three layers of scale and sent them to the University of Florida for analyses. Testing at UF was overseen by Dr. Cornwell. Figure 4-11 is a picture of the copper pipe as received. Figure 4-12 show more detail after cutting and splitting open the pipe prior to removing any scales. Figure 4-13 shows each of the layers.

Figure 4-11 Original Condition of Pipe Received

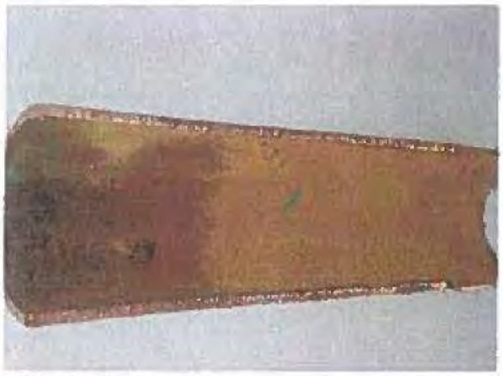

Figure 4-12 Pipe Prior to Scale Removal

Figure 4-13 Layers of Scale Removed from Harvested Pipe

Layer 1 was characterized as being very loose and easy to brush off. Layers 2 and 3 were more stable and had to be scraped off.

XRD analysis showed the presence in all three layers of cuprite and malachite. Both of these are fairly insoluble compounds and high copper levels would not be expected unless there is amorphous copper in layer 1 which has the loose scales. No lead compounds were identified.

The SEM/EDS results did show the presence of lead, although low quantities, as shown in Figure 4-14. The brighter dots are lead, but the dots are relatively dim so lead is present but not at high levels. The lead was highly associated with phosphorus and oxygen as was found by overlaying scans of those elements.

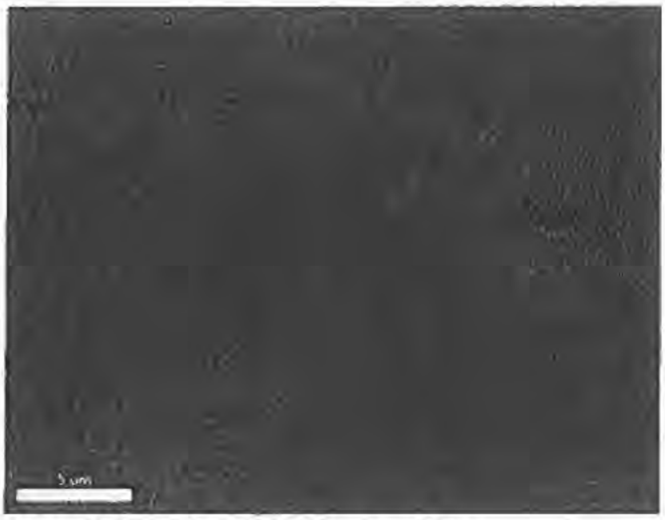

Figure 4-14 SEM Image Map of Lead in Layer 1 of Pipe

The semiquantitative results by SEM/EDS also showed large amounts of iron and significant calcium. Those elements are likely latent from when the well water was used. Layer 1 was also acid dissolved and analyzed by ICP MS. The following weight to weight concentrations were found:

Cu—21 %

Fe—14%

Pb---0.2%

The pipe was also inspected inside for the presence of visible solder at or near the solder joint. No solder was found. This indicates that the lead that was originally present as solder, had dissolved and some portion of that lead was trapped in the scales. The presence of lead in layer 1 and the loose nature of the scale are the likely contributors of lead to the water in this pipe. Some water chemistry changes likely disrupted the scale, releasing lead. The presence of high iron in layer 1 also is an indicator that if this scale was disturbed in some fashion it would be easy for loosely associated lead in the scale to be released in particulate form.

Pipes 6A and 6B

These pipes were both harvested from the same house around August 5th, 2019. Therefore, these pipes had been exposed to Kankakee water with 90/10 phosphate for about two months. These two pipes came from a single pipe in the home that had two lead solder joints with the joints located about 18 inches apart. Once the pipe was received at Cornwell, it was divided into two segments –6A and 6B. As discussed earlier, Pipe 6A was releasing very little lead into the water while 6B was releasing higher quantities in the laboratory testing.

As with the above pipe, after cleaning off the scales, there was no visible lead solder found on either pipe. Therefore, it was unlikely that intact solder was the lead source in pipe 6B. Figure 4-15 shows a close up of 6B at the joint. There is some visible lead in the copper seam where the pipe was cut, but none inside the pipe.

Figure 4-15 Close Up of Pipe 6B

There was also not a loose layer 1 like in the previous pipe. This lack of a loose layer could be because of the exposure for about 2 months to the 90/10 phosphate. Figure 4-16 shows the pipes before removing any scales. Three layers were removed from each pipe for analysis, but there was not enough material for any XRD tests. Some limited material was available for SEM microprobe, WDS, and EDS analysis.

Figure 4-16 Pipes 6A (top 2) and 6B (bottom 2) Prior to Scale Removal

Using a WDS (wavelength-dispersive spectroscopy) scan, it is interesting that for pipe 6A (Figure 4-17) there was little to no lead found in the scales. Recall that this is the pipe that was not releasing lead into the water in the laboratory tests (Phase 3 – see earlier discusion).

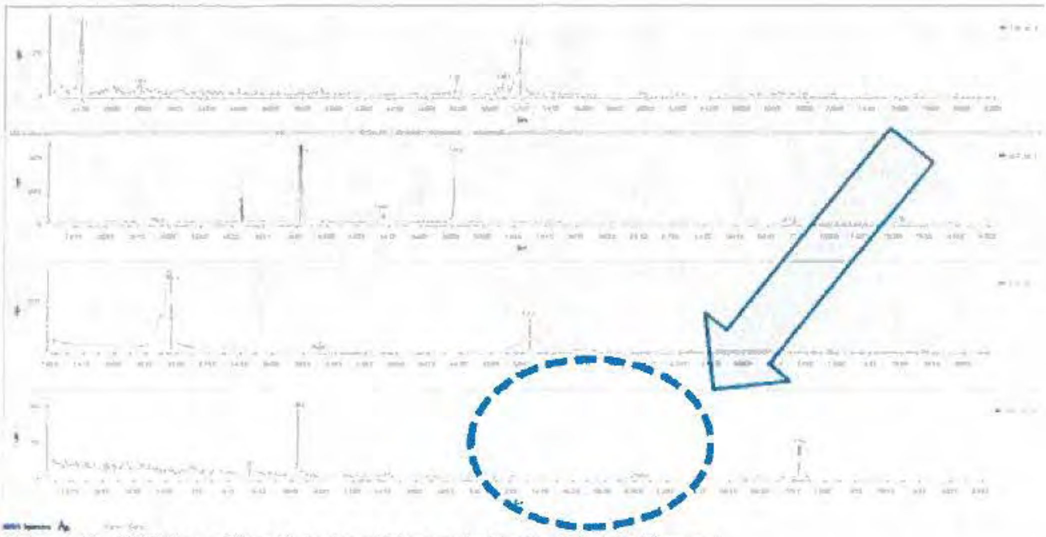

Figure 4-17 WDS Scan of Pipe 6A-lead would have spiked in the circle area if present

If lead were present a spike would have appeared in the circled area highlighted in Figure 4-17. In contrast, in pipe 6B lead was found in the scales as indicted by the spikes noted by the circle in Figure 4-18.

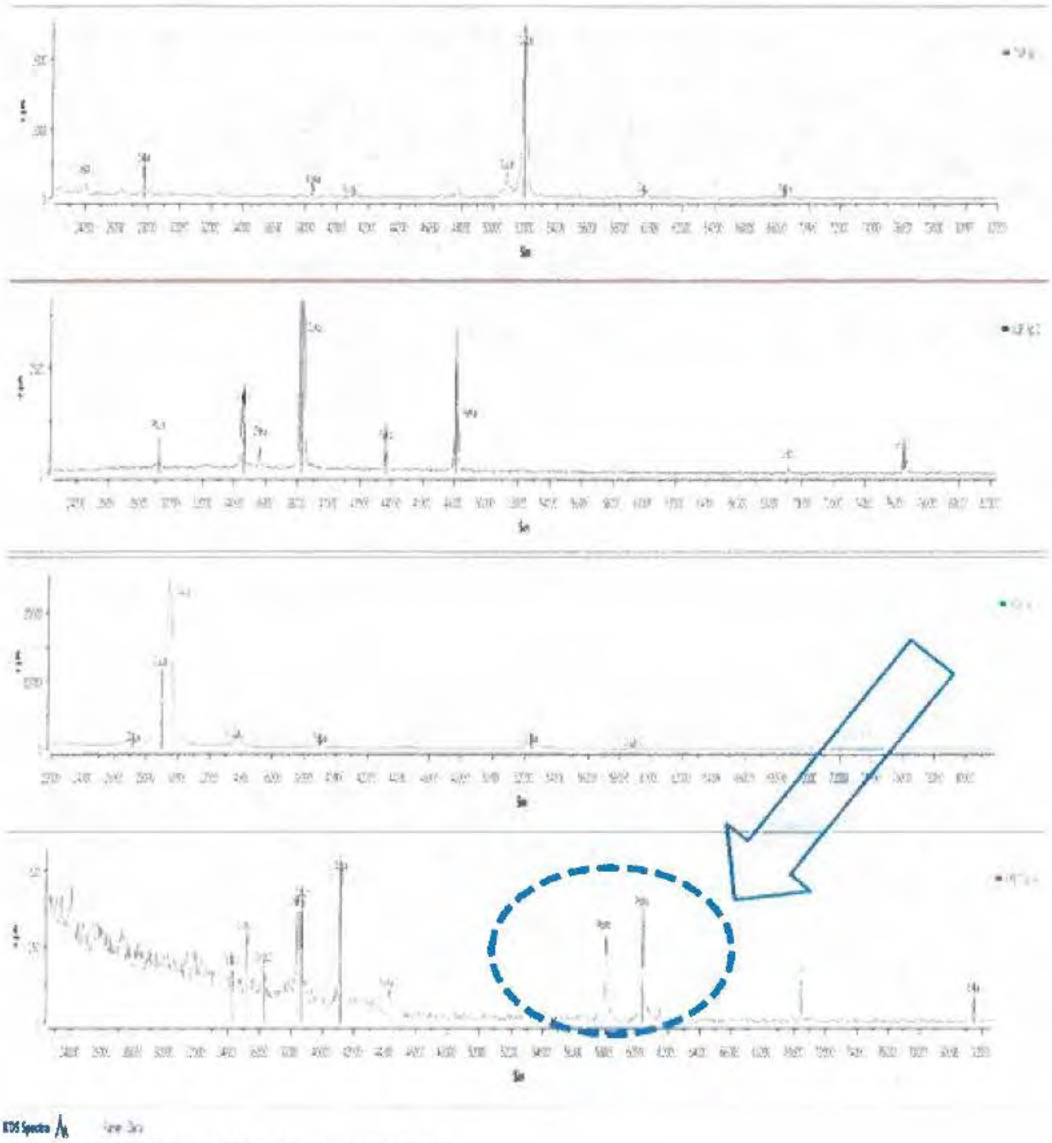

Figure 4-18 WDS Scan of Pipe 6B – peaks are circled

In Figure 4-19, zoomed at about a 300-micron scale, all of the bright spots were confirmed as lead using the microprobe feature scanning for lead.

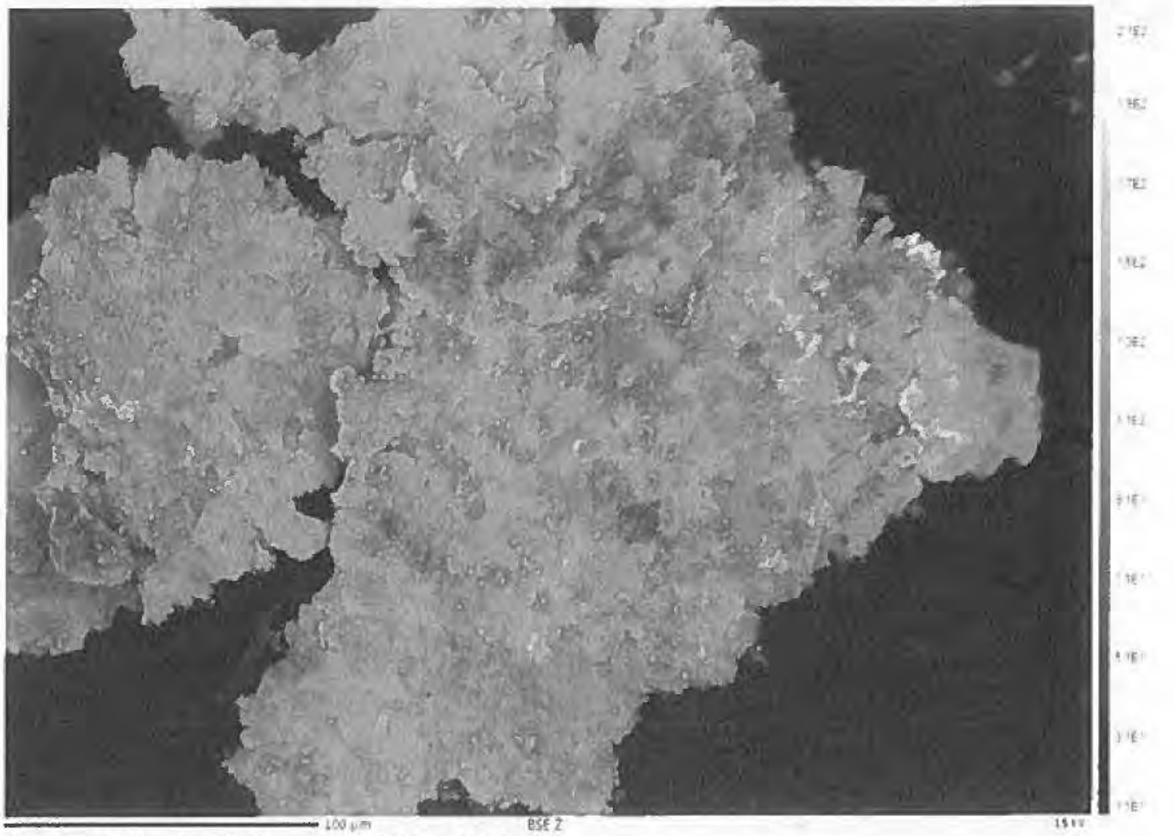

Figure 4-19 SEM Capture of Pipe 6B Scale

The scale results agree with the laboratory testing on lead leaching. Pipe 6A had little lead in the scales while 6B did have lead present in the scales, even though these two pipe segments are from the same house and same pipe within the house. The original lead present as solder in pipe 6A had apparently dissolved and not collected in the scales near that couple. The lead had either been flushed out or collected in downstream scales.

INVESTIGATING CORROSION INHIBITOR EFFECTIVENESS FOR GALVANIC COPPER AND SOLDER[‡]

Background

Analysis of samples shipped from homes with elevated lead to Virginia Tech, were subjected to strong acid (2% nitric) digestion and metals analysis. The results from a number of homes indicated a very strong correlation (R^2= 0.93) between lead and tin in water, demonstrating that the lead was somehow derived from lead:tin (Pb:Sn) solder corrosion.

The water lead from solder in 2019 could come from legacy corrosion issues decades ago when the pipes were new in the groundwater, if the switch to surface water somehow triggered sudden detachment of old rust layers on home plumbing. It is also possible that the high lead from solder could come from sudden corrosion of the lead solder joints starting in 2019. It is also possible that a combination of these two mechanisms was involved.

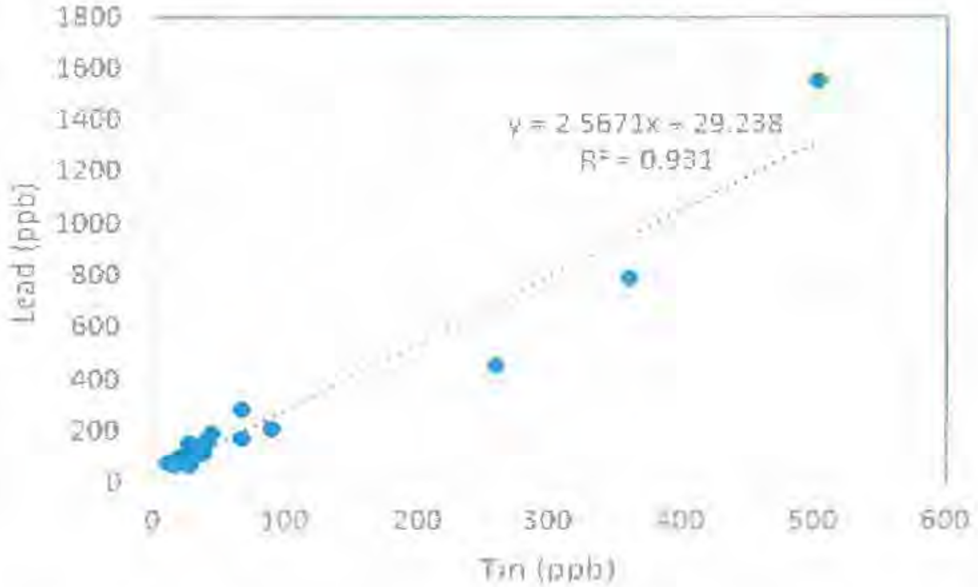

Figure 4-20 Lead Versus Tin in Water of University Park Homes Demonstrates a Strong Correlation and a Lead:Tin Solder Source

The goal of this research was to study trends in lead release from new lead solder galvanically connected to copper, in University Park water with a range of corrosion inhibitors. These tests had no legacy lead in the rust of the new pipe samples. Consequently, the results reveal the galvanic lead solder corrosion potential of the water with each inhibitor type.

[‡] Marc Edwards, Christian Lytle, Rusty Rouillier, and Jeff Parks

Testing Protocol

Seven water chemistries were tested to evaluate the relative effectiveness of corrosion control methods in University Park water derived from the Kankakee River (Table 4-5). The control water was treated Kankakee River without inhibitor. Conditions with polyphosphate, zinc orthophosphate, orthophosphate, ortho-poly 90:10 blend, polyphosphate + nitrate were also tested. The first phase of experiments was 2 weeks duration (Phase 1), after which time it was deemed desirable to try and test a more aggressive water condition in a second phase of experiments (Phase 2). Testing was conducted with 50:50 lead:tin solder galvanically connected to copper pipe (Figure 4-21).

The Phase 2 water involved mixing treated Kankakee water with a lower sulfate, lower alkalinity and similar chloride water in a ratio of 2/3 to 1/3, to obtain a water chemistry with a higher chloride to sulfate mass (CSMR) ratio (Figure 4-22). The Phase 2 water was designed to represent a future water quality if existing trends in Kankakee River alkalinity, chloride and sulfate were to continue for a period of years, and/or to test speculation about "worst-case" conditions during a very high rainfall event that occurred during 2019. In Phase 2 a higher dose of polyphosphate was also tested (Table 4-5). Another control condition without any inhibitors using Kankakee water in the 2/3 to 1/3 ratio was also tested in Phase 2.

Table 4-4
Water test conditions in terms of added (amended) total phosphorus (mg/L as P), total Zn+2 and nitrate (mg/L as N) in Kankakee River water

	Phase 1			Phase 2		
Name	**P**	**Zn^{+2}**	**Nitrate**	**P**	**Zn^{+2}**	**Nitrate**
Poly	0.5			1.4		
Zn Ortho	1	0.5		1	0.5	
Ortho P	1			1		
Ortho Poly	1			1		
Poly +Nitrate	1		3	1		3
*Phase 2 Control						
Control						

*1/3 Synthetic Water + 2/3 Kankakee


Copper pipe with Pb/Sn Solder

Kankakee Replicates
(most n = 5)

Figure 4-21 Apparatus Used for Testing. Solder Coupons in Glass Jars (Left) and 5 Replicates for Each Inhibitor Condition (Right)

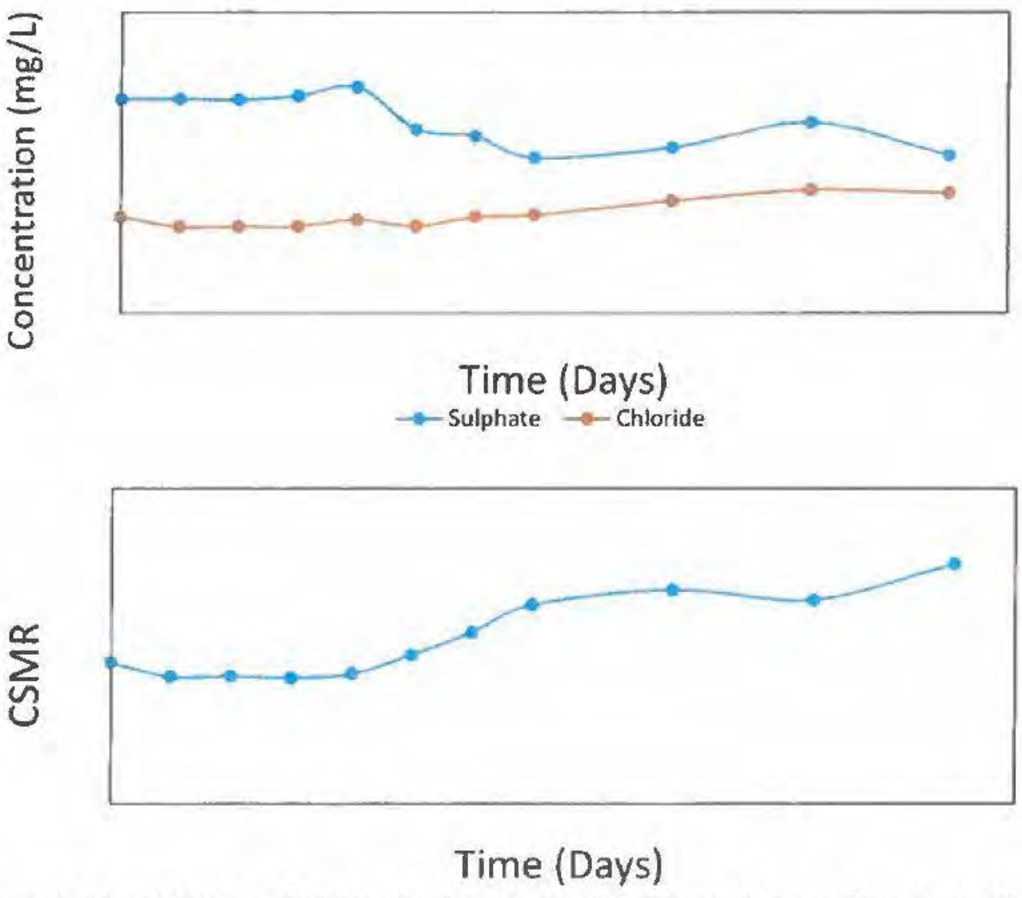

Figure 4-22 Sulfate and Chloride Levels During Phase 1 from Day 1 to 14 (100% Kankakee) and During Phase 2 from Day 15-42 with 2/3 Kankakee and 1/3 Synthesized Water (Upper). CSMR During the Study (Lower)

A 'dump-and-fill' testing procedure was used to simulate worst-case leaching conditions in service lines or buildings. Due to the long stagnation time and relatively new age of the plumbing, values reported in this work are not representative of those expected at the tap. They are "worst case" values which tend to be higher than those found in a typical potable water system, and results are suitable for rendering relative judgments in effectiveness of corrosion control for a galvanic couple. For the lead:tin solder galvanically connected to copper testing, the coupons were stored in glass vials. Five replicates were used for each water quality condition. The vials were manually filled and dumped every day. Compositive samples combining all 5 replicates were collected and analyzed for routine analysis, whereas at the end of each phase, each bottle replicate was sampled 3 days in a row to generate a dataset (typically n = 15, due to 5 replicates sampled 3 times). Samples were analyzed via inductively coupled plasma with mass spectroscopy (ICP-MS). Phosphorus, zinc, sulfate and chloride concentrations were also evaluated by ICP-MS. During Phase 2 water samples were occasionally allowed to stagnate for 72-96 hours, allowing comparison to results after 24 hours stagnation.

Results and Discussion

After discussing Phase 1 and Phase 2 results, the relative corrosivity and effects of stagnation time are evaluated.

Phase 1 composite trends and statistical results

During the initial two-week exposure (upper Figure 4-22) lead levels dropped rapidly as the pipe surfaces formed protective scales, before leveling off in this very short-term test. The zinc orthophosphate condition always had the lowest lead in Phase 1, whereas the 90:10 ortho:poly blend eventually produced very low lead results. For the final analysis both zinc orthophosphate and the ortho:poly blend had the lowest lead results and were statistically similar. Both of these conditions were statistically lower than any other condition tested. Relative to the Kankakee treated water with polyphosphate, lead levels with the zinc orthophosphate and ortho:poly blend were about 6 times lower.

Phase 2 composite trends and statistical analysis

During Phase 2 testing lead levels continued to drop, even though the water was altered in a manner deemed likely to increase corrosivity to lead:tin solder (upper Figure 4-23). The net result was the same ranking of inhibitor effectiveness as in Phase 1, with both zinc ortho and the ortho:poly blend producing the best performance (lower Figure 4-23). Both of these conditions were superior to any other condition tested.

Relative Effect of Phase 1 versus Phase 2 water

Ironically, lead levels were lower in the higher CSMR water (i.e., ratio Phase 2 concentration divided by Phase 1 concentration < 1.0), presumably because of the dominant effect of forming protective scale layers during this short-term test (Figure 4-24). The control condition with 100% Kankakee water showed the least improvement in Phase 2 versus Phase 1.

Relative Effect of Longer Stagnation Time

Contrary to expectations, lead levels with a longer 72-96 hour stagnation event, did not always indicate higher lead relative to results with a 24 hour stagnation event. Specifically, the ratio of the longer term stagnation lead concentration to the 24 hour stagnation result, was only 0.3 for the zinc ortho condition, and 0.9 for the poly and the ortho:poly blend (Figure 4-25). In other words, the concentration of lead after the longer stagnation was lower for these conditions versus the result after 24-hour stagnation. In contrast, all of the other conditions tested, demonstrated a 20-90% increase in lead after the longer term stagnation event compared to the 24 hour stagnation event.

Conclusion

Both zinc orthophosphate and a 90:10 ortho:poly blend, provided superior control of lead:tin solder galvanic corrosion for new pipes without pre-existing scale, compared to conditions with polyphosphate or no inhibitor. This was the case in both existing treated Kankakee water and in Kankakee water with higher CSMR.

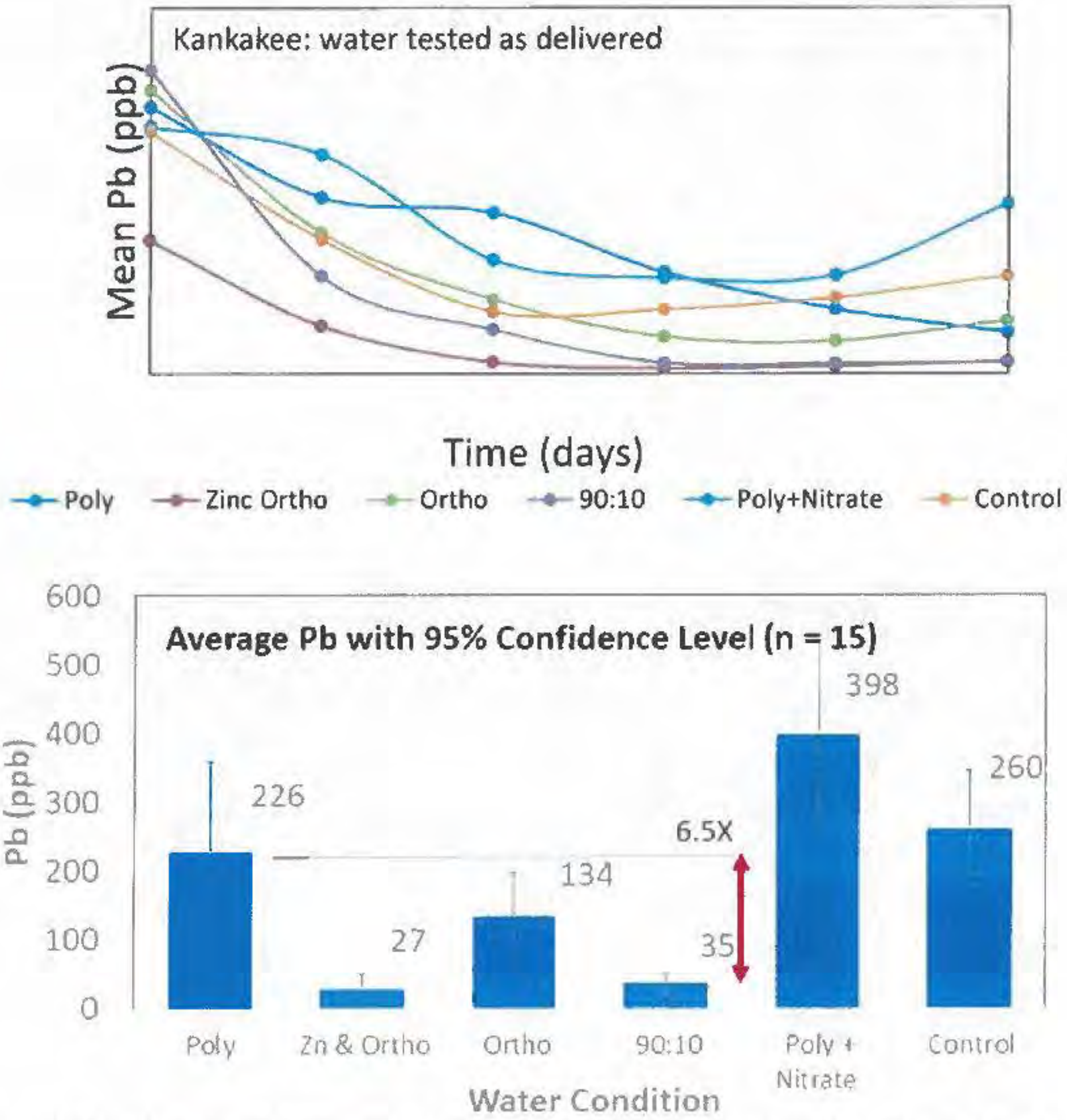

Figure 4-23 **Results of Composite Samples from All Replicates, Indicating Trends in Lead Release Using 100% Kankakee Water with Different Types of Corrosion Control (Upper)**

During the last three days of sampling, each of the five replicates was sampled on three sequential days (n=15) to create final results with 95% confidence intervals (lower).

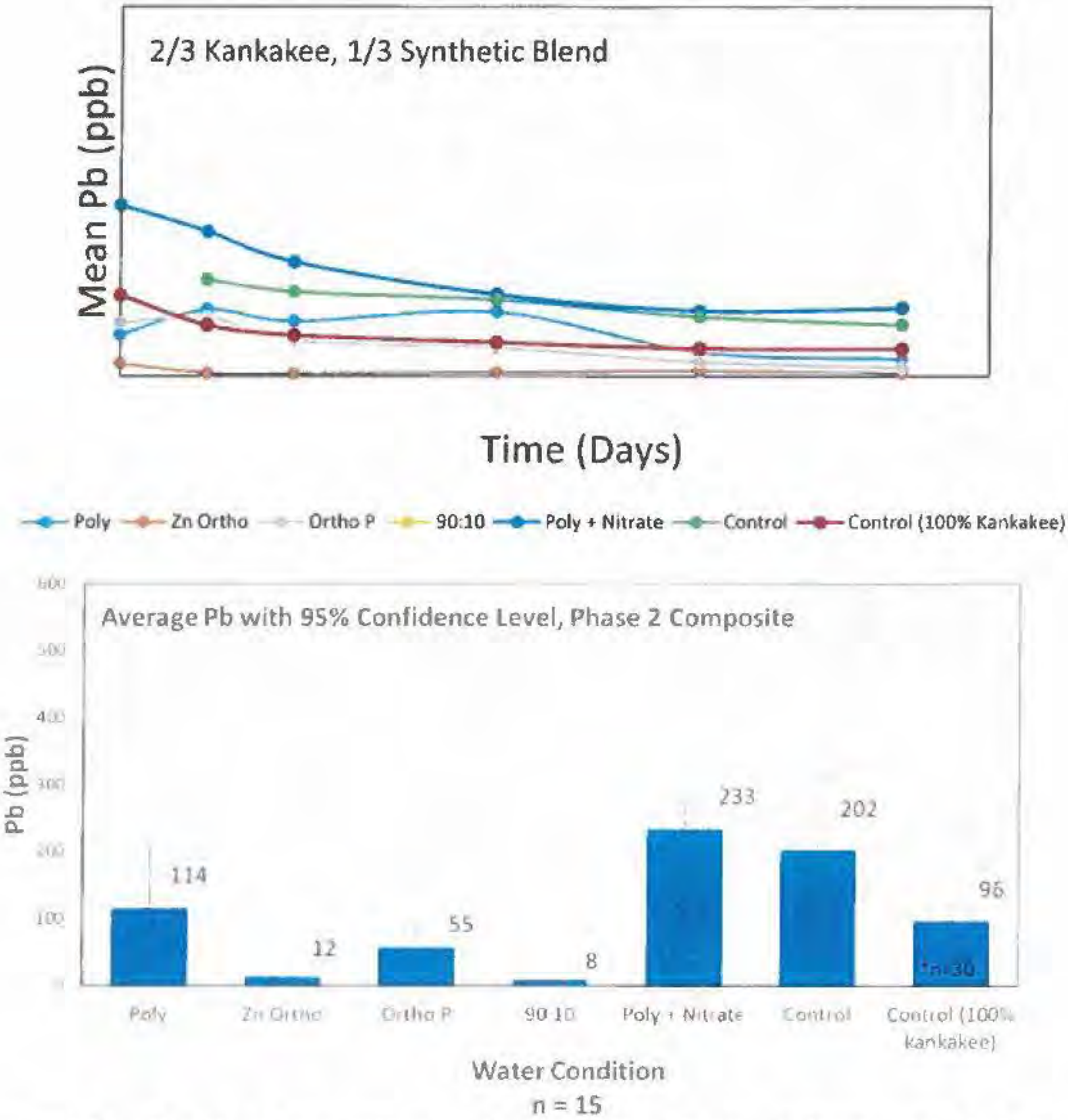

Figure 4-24 Results of composite samples from all replicates, indicating trends in lead release using a blend of 2/3 Kankakee and 1/3 synthetic water, designed to replicate hypothesized conditions that are more aggressive in terms of lower sulfate and alkalinity during runoff events or in a decade (upper)

Control sample in red is 100% Kankakee whereas all other samples represent the more aggressive conditions. The first data point is still using 100% Kankakee (Figure 4-20), whereas later dates are those representing the more aggressive water. After sampling on 3 sequential days with 5 replicates per condition (n = 15), final results are indicated with 95% confidence intervals (lower). The control with 100% Kankakee had n = 30 due to 10 replicates.

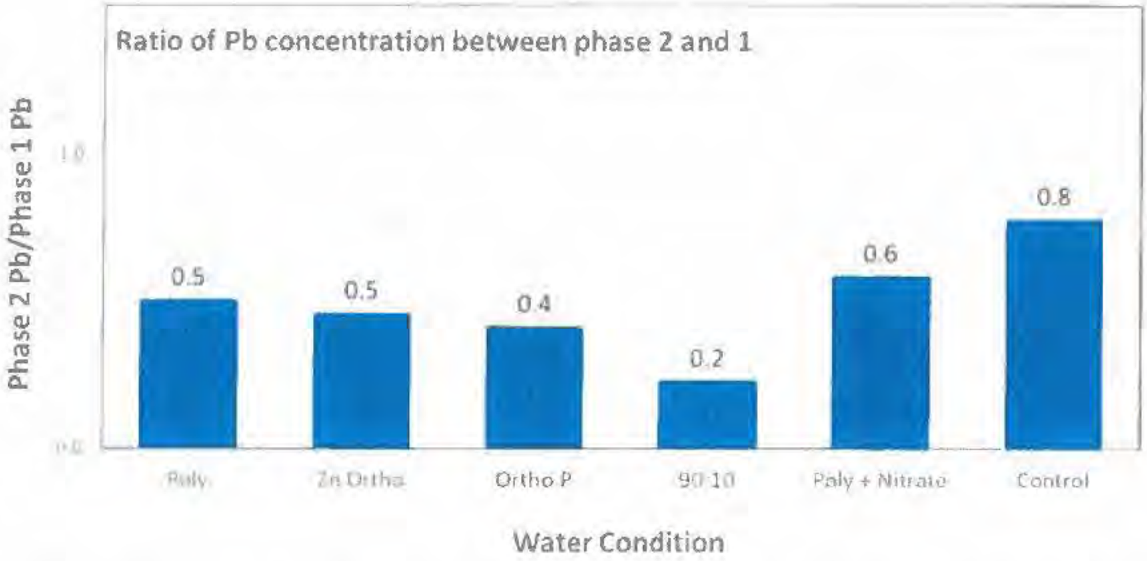

Figure 4-25 Relative Lead Leaching Under More Corrosive Conditions of Phase 2 (2/3 Kankakee and 1/3 Synthesized Water) Divided by Results of Phase 1 (100% Kankakee)

Surprisingly, the dominant effect was that a more protective scale continued to form during the experiment, which continued a downtrend in lead leaching in Phase 2 versus Phase 1, creating a ratio less than 1. The net result is that less lead was leached in the Phase 2 testing, despite the hypothesized more aggressive water.

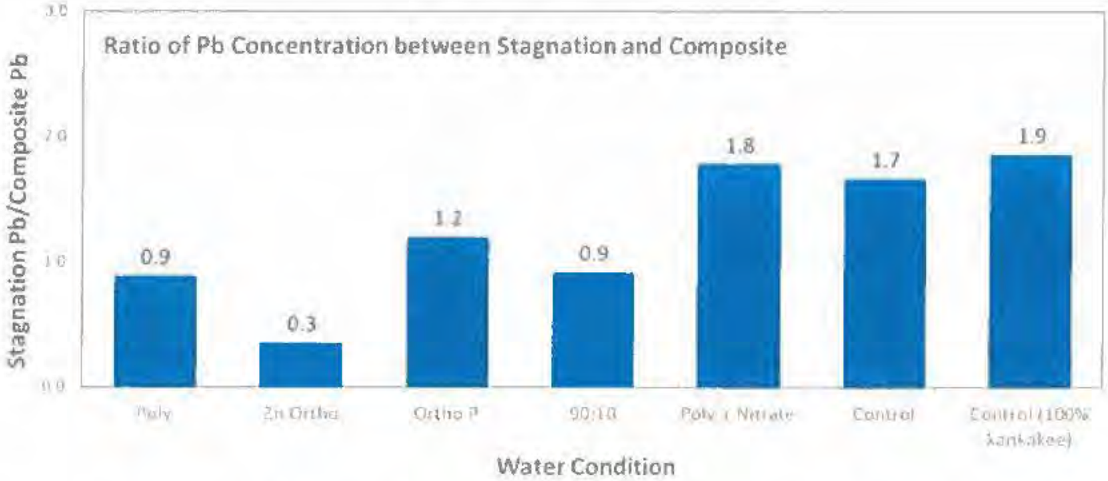

Figure 4-26 **Relative Level of Lead Under Long Stagnation Times (72-96 hours) Versus That Obtained During 24 Hour Composite Sampling (24 Hours)**
In the conditions with good corrosion control using zinc ortho and 90:10 blend, the lead level was slightly lower in the very long stagnation times (ratio < 1.0), where with conditions with the control water or with poly + extra nitrate, lead levels were higher with stagnation.

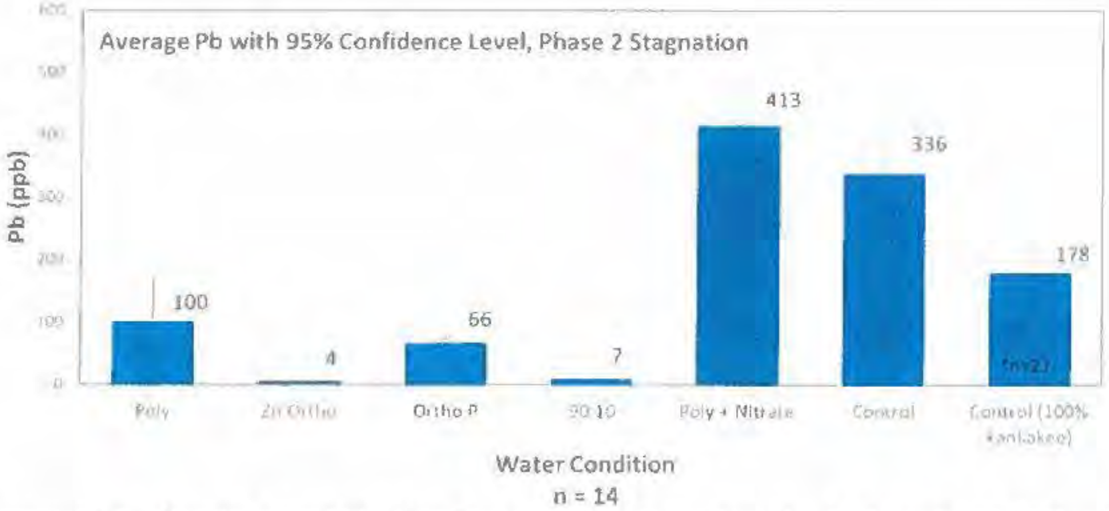

Figure 4-27 **Results with 95% Confidence Intervals for Samples Collected with Either 72 or 96 Hours Stagnation**

SUMMARY AND CONCLUSIONS (ALL BENCH-SCALE STUDIES)

The bench-scale testing results presented in this chapter demonstrate that low lead solubility can be achieved in the UP System, in the presence of copper pipe with lead solder and other lead-containing plumbing, applying a dose of 3 mg/L as PO_4 (1 mg/L as P) of the 90/10 blended phosphate currently used in University Park.

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CHAPTER 5
SUMMARY AND RECOMMENDATIONS

Based on the studies completed by Cornwell and Virginia Tech, and the results to date in University Park shown in Figure 5-1, it is recommended that the CCT be achieved in this system by targeting a dose of >3 mg/L as PO_4 using the current 90/10 blended phosphate (LC-132 by Hawkins, Inc.). Distribution system monitoring should target maintenance of an orthophosphate residual in representative locations in the University Park System of >3 mg/L as PO_4.

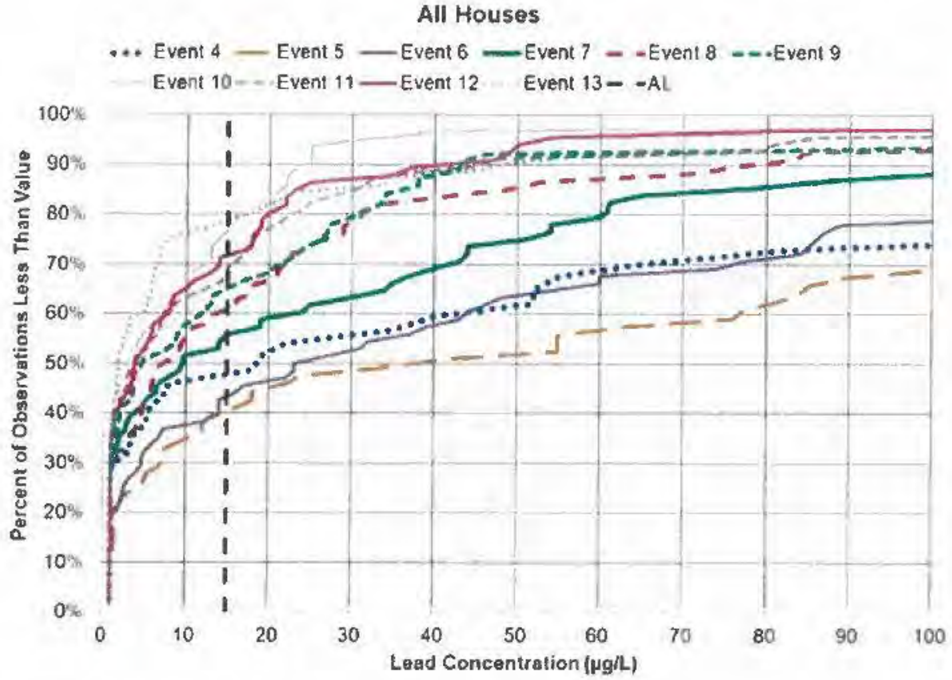

Figure 5-1 LCR Monitoring Data in University Park in 2019

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Illinois Environmental Protection Agency

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Optimal Corrosion Control Treatment (OCCT)
Evaluation of Treatment Alternatives

System

System Number: IL1975030 County: WILL

System Name: Aqua Illinois - University Park

Contact Name: Craig Blanchette

Street Address: 1000 S. Schuyler Ave

City: Kankakee State: IL Zip: 60901

Phone: 815-614-2030

Email: clBlanchette@aquaamerica.com

Engineer (Optional)

Engineer Name: Dr. David Cornwell (Illinois PE 062071727)

Company: Cornwell Engineering Group, Inc.

Street Address: 712 Gum Rock Court

City: Newport News State: VA Zip: 23606

Phone: 757-873-1534 x227

Email: dcornwell@cornwellinc.com

Form 141-C: Optimal Corrosion Control Treatment Recommendation

Attach a copy of the properly completed Form 141-C.

Step 1: Summary of Water Quality Data and Other PWS Information

1.1 General PWS Information

Approximate Population Served: 7,052

Water Source: ● Surface Water ○ Groundwater ○ Both

Is water purchased?: ○ Yes ● No If yes, enter the name and ID number below.

Name: ID Number:

Average Daily Usage: 1.3 ○ Gallons/Day ● MGD

ALE for: ● Lead ○ Copper ○ Both

Does the system have lead service lines?: ○ Yes ● No If yes, approximately how many?:

1.2 Description of Water Treatment System

1.2.1 Flowchart of Water System / Treatment

Attach a flowchart or schematic of the water system.

1.2.2 Chemicals Used

Identify the chemicals used and their feed rates.

Chemical	Feed Rate (mg/l)
LPC-132 blended phosphate by Hawkins (Roseville, MN) - 90% ortho and 10% poly	3

1.2.3 Change in Treatment

Has there been a chemical or physical change in the treatment system within 3 years prior to the date of the ALE to the present? ☑ Yes ○ No

If yes, describe below.

The original water supply in University Park was from local wells treated with chloramines and a 60/40 blended phosphate product (Carus 8600), the latter at a dose targeted to deliver an orthophosphate residual of 3.6 mg/L as PO4. Starting in July 2017, the original blended phosphate was replaced with a proprietary blended phosphate from a different manufacturer (~8% orthophosphate (as PO4) and >23% polyphosphate (as PO4) by weight) with a target dose 4.5 mg/L (as product) in the distribution system.

In December 2017, the water supply was switched from local wells to water from the Kankakee WTP (IL0915030), which includes treated water from the Kankakee River (lime softening, ferric chloride coagulation, chloramination). The connection point for the new water from the Kankakee WTP is designated by IL-EPA as "CC01". The Kankaee WTP water is already chloraminated so the addition of chlorine and ammonia in the University Park system has been discontinued but the addition of the proprietary blended phosphate in University Park continued until 2019 (see below). The Kanakee WTP water is supplied to the University Park Distribution System via the treated water entry point (IL-EPA location ID "TP03") where blended phosphate is added for the University Park system.

Since June 2019, use of the proprietary blended phosphate was discontinued and a 90/10 blended phosphate (LPC-132 from Hawkins, Inc.) has been dosed to achieve a target orthophosphate residual of >3 mg/L as PO4 (>1 mg/L as P).

1.2.4 Change in Sampling Plan

Has there been a change in the in the lead/copper sampling plan that occurred within 3 years prior to the date of the ALE to the present? ☑ Yes ○ No

If yes, describe below

Change in sampling plans as previously submitted to the IEPA

1.3 Water Quality Data

Provide water quality data for the finished/treated water from each source.

Water Quality Data - Entry Point

Entry Point Name: TP03 - Central Avenue BS w/ Orthophosphate

Sample Point ID: TP03 Source Type: CC01 - Connection to Kankakee WTP

Date	median				
Parameters	Results (mg/l)	Results (mg/l)	Results (mg/l)	Results (mg/l)	Average
pH	8				8
Alkalinity (Total as $CaCO_3$)	46				46
Hardness (Total as $CaCO_3$)	145				145
Calcium	38				38
Chloride	34				34
Sulfate	79				79
Aluminum	0				0
Iron	0				0
Manganese	0				0
TDS					
Conductivity	358				358
Temperature	15				15
Total Chlorine	2				2
Free Chlorine					
Orthophosphate	4.2				4.2

1.4 Water Quality & Physical Factors

Describe the water quality factors and physical factors that may be contributing to the lead and/or copper release.

The lead release mechanism is still being studied. It is believed that the water chemistry change has altered the scales on the copper pipes in the homes, resulting in a release of lead.

Step 2: Evaluate Potential for Scaling

Saturation pH & Potential for Scaling	
Parameter	Value
Alkalinity	46
System pH	8
DIC	11
Calcium	38
Saturation pH	8.5
Potential for Scaling	○ High ☑ Low

Step 3: Technical Recommendations for Selecting One or More Treatment Options

3.1 Identify the Appropriate Flowchart for Preliminary OCCT Selection

Is iron or manganese present in finished water?	● Yes ○ No
The OCCT is designed to treat:	○ Lead ○ Copper ● Both
The pH of the finished water is:	8
Recommended Flowchart per Exhibit 3.3:	1c

3.2 Identify the Recommended OCCT

The Recommended OCCT is:

addition of 90/10 ortho/poly blended phosphate from Hawkins Inc. (LPC-132) at a target dose >3 mg/L as PO4 for the orthophosphate fraction

Step 4: Identifying Possible Limitations for Treatment Options

4.1 Possible Limitations of pH / Alkalinity / DIC Adjustment

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.1.1 Optimizing pH for Other Purposes ○ Applicable ● Not Applicable

4.1.2 Calcium Carbonate Precipitation ○ Applicable ● Not Applicable

4.1.3 Oxidation of Iron and Manganese ○ Applicable ● Not Applicable

4.2 Possible Limitations of Phosphate-Based Corrosion Inhibitors

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.2.1 Reactions with Aluminum ○ Applicable ● Not Applicable

4.2.2 Impacts on Wastewater Treatment ○ Applicable ● Not Applicable

Step 5: Evaluation of Feasibility and Cost

5.1 Feasibility and Cost

Provide a discussion of the feasibility and cost of the selected OCCT.

The water system has selected the best option for CCT, which we believe to be easy to operate and cost effective

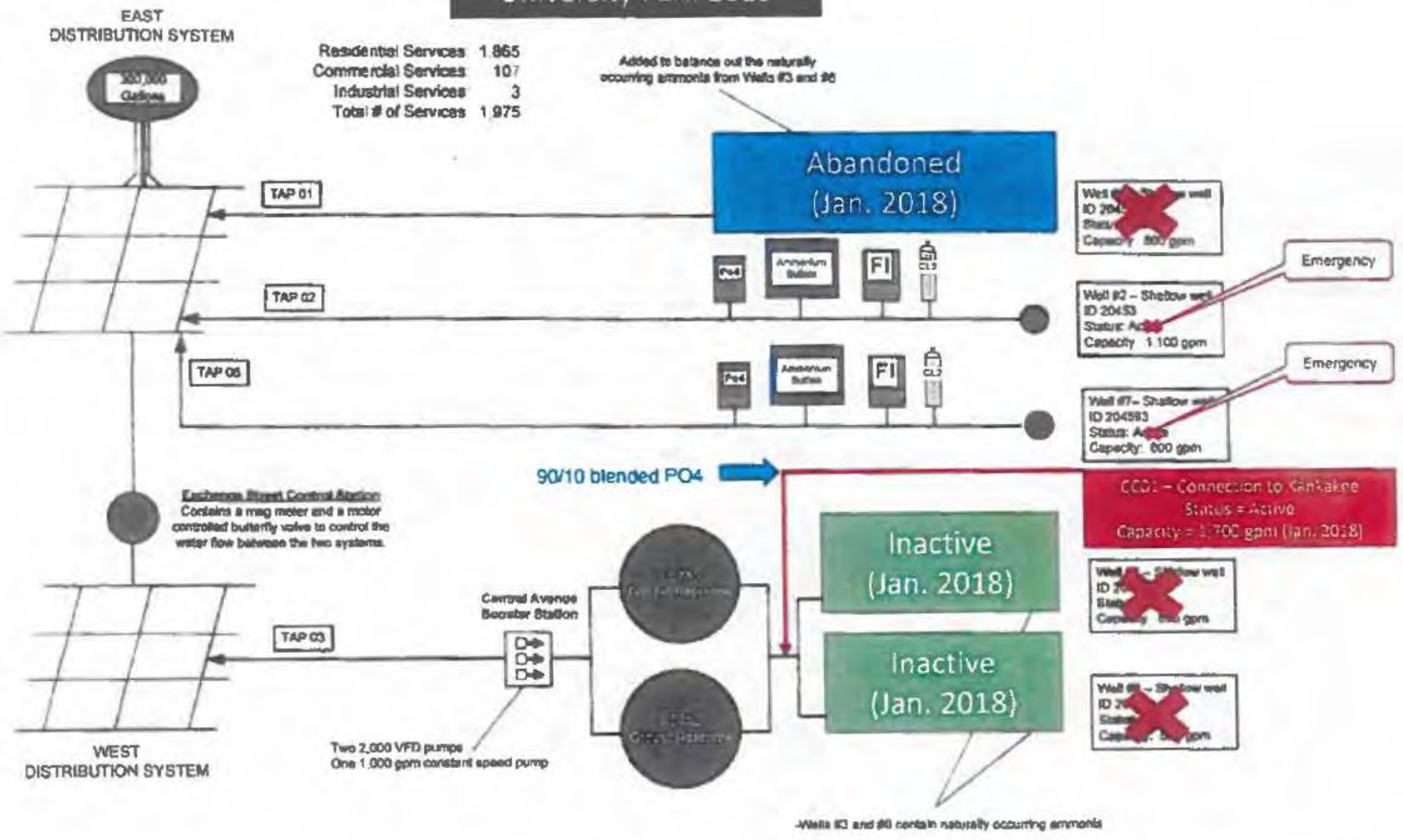
Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Craig Blanchette	President, Aqua-Illinois
Printed Name	Title
CBlanchett	11-25-19
Signature	Date

University Park 2019

Residential Services	1,865
Commercial Services	107
Industrial Services	3
Total # of Services	1,975



NO EMERGENCY INTERCONNECTIONS

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Optimal Corrosion Control Treatment (OCCT) Recommendation

Public Water Supply Systems required to submit an OCCT Recommendation to the Illinois EPA need to provide this form and all the information required in the IEPA's Instructions for an OCCT Evaluation of Treatment Alternatives.

This form may be completed in Acrobat, a copy saved locally, and then printed before it is signed. You may also complete a printed copy normally. Submit the completed and signed form the the Illinois EPA, Division of Public Water Supplies.

System

System Number: IL1975030 County: WILL

System Name: Aqua Illinois - University Park

Street Address: 1000 S. Schuyler Ave

City: Kankakee State: IL Zip: 60901

Contact Name: Craig Blanchette

Phone: 815-614-2030

Email: clBlanchette@aquaamerica.com

Number of People Served:

○ ≤ 100 ○ 101 to 500 ○ 501 to 3,000 ● 3,001 to 10,000 ○ 10,001 to 100,000 ○ > 100,000

OCCT Recommendation

The following OCCT is recommended:

○ pH / Alkalinity / DIC Adjustment

○ Orthophosphate

● Blended phosphate (90 / 10 ortho / poly ratio)

○ Silicates

○ Remove iron and/or manganese and add ortho phosphate

○ No treatment or treatment change at this time **(Attach justification)**

Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Craig Blanchette	President
Printed Name	Title
CBlanchett	11-25-19
Signature	Date

CORNWELL
ENGINEERING GROUP

July 27, 2020

Aqua Illinois – University Park
Addendum to OCCT Report
Desktop Study Report
Cornwell Engineering Group Project No.13113-2

Subject: Optimal Corrosion Control Treatment Studies and Recommendation for Aqua University Park System

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NOVEMBER 2019 OCCT EVALUATION AND RECOMMENDATION

In November 2019 Aqua Illinois (Aqua IL) submitted to the Illinois Environmental Protection Agency (ILEPA) information proposing its recommendation as to the optimal corrosion control treatment (OCCT) for University Park (PWSID IL1975030). The submitted information for University Park (UP) included:

- "Corrosion Control Study Report" – summary of water quality, desktop studies, scale analysis of harvested pipe from UP, and laboratory solubility studies with: a) lead coupons, b) harvested copper pipe with lead solder, c) new copper pipe with lead solder.
- ILEPA form "OCCT Evaluation of Treatment Alternatives", including associated ILEPA form 141-C and an UP schematic.

The solubility studies in the November 2019 report were performed by the Cornwell Engineering Group (Cornwell) and Dr. Marc Edwards (VPI) and included pH from 8.1 to 8.4 and orthophosphate from phosphoric acid (H_3PO_4), zinc orthophosphate (ZOP), or a 90/10 blended phosphate from Hawkins, Inc. (Roseville, MN). The latter is a blended phosphate containing 90 percept sodium orthophosphate (NaH_2PO_4) and sodium polyphosphate.

...so based on the findings of the solubility studies it would have been equivalent to choose any of the products tested, as long as the dose was ≥ 3 mg/L as PO_4.

The recommendation based on findings from the desktop, scale analysis, and solubility studies was to add orthophosphate at UP at a dose >3 mg/L as PO_4 (>1 mg/L as P). The ZOP and H_3PO_4 performed similar or better than the 90/10 blended phosphate tested, so based on the findings of the solubility studies it would have been equivalent to choose any of the products tested, as long as the dose was ≥ 3 mg/L as PO_4. Since polyphosphate had always been present in the UP distribution system in the past, the 90/10 blended

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phosphate product tested was selected. The UP system started feeding the 90/10 blended phosphate in June 2019 and continued until April 16, 2020, as discussed below.

PH IMPACT ON CCT WITH ORTHOPHOSPHATE AT UP

The optimal pH for lead solubility control with orthophosphate is typically 7.2 to 8.0, with pH ~7.4 typically optimal (Brown et al. 2013 and Schock and Lytle 2011). Cornwell is aware of several water systems within pH 8.0 to 8.4 that achieve satisfactory control of lead solubility in the presence of orthophosphate, and there are reports of orthophosphate working successfully at pH >9. However, in research reported by Schock and Lytle (2011 – Figure 20-24), shown below in Figure 1, the lead control is best at pH less than about pH 8.2 or at pH ~9 (Bae and Giammar 2019), but at pH ~8.3 to 8.6 the lead solubility is not well controlled. So, lead solubility can be achieved at pH >8 but in this pH range special attention to pH control is required to avoid the unstable conditions that can occur if pH creeps up into the pH 8.5 ± 0.1 range. Consequently, lead solubility control with orthophosphate at pH <8 is preferred (Schock and Lytle 2011, Brown et al. 2013), if these conditions are feasible.

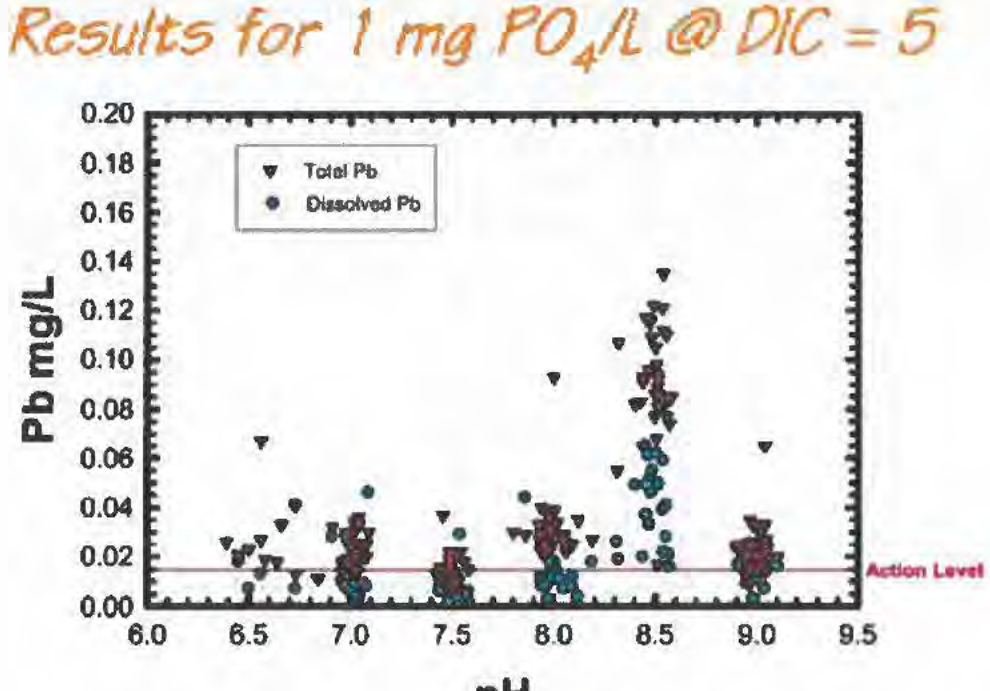

Figure 1 Relationship between pH and lead for orthophosphate

Note: Figure 20-24 in Schock and Lytle 2011

H_3PO_4 and ZOP will lower pH, unless some other pH adjustment chemical is added (e.g., caustic soda (NaOH)). The 90/10 blended phosphate has NaH_2PO_4 as the orthophosphate component, and this is equivalent to adding H_3PO_4 and NaOH. Consequently, the pH decrease after adding NaH_2PO_4 is not as great because the NaOH tends to offset the pH drop associated with the H_3PO_4 component. Consequently, as will be discussed below, the pH drop from adding H_3PO_4 to the water entering UP drops the pH by >1 pH unit, but adding the 90/10 blended phosphate (containing NaH_2PO_4) only drops pH ~0.2 pH units.

The pH in UP as primarily influenced by the pH leaving the Kankakee WTP, then a ~0.2 drop as the water flows from the Kankakee WTP, then another ~0.2 pH drop from adding the 90/10 blended phosphate product or a >1 pH drop if H_3PO_4 is added. The Kankakee WTP operates with treated water goals as follows: a) Langelier Saturation Index (LSI) ~0.4, b) pH 8.6 to 8.8, c) alkalinity 50 to 60 mg/L as $CaCO_3$, d) hardness in units of mg/L as $CaCO_3$ (total 150-160, non-carbonate ~110, calcium ~120), e) total chlorine residual 3 to 3.5 mg/L as Cl_2, and f) iron <0.01 mg/L.

The LSI is adjusted to be ~0.4 year-round, though at times of year when the water temperature is >25°C the LSI sometimes is as high as 0.6. To maintain the LSI at 0.4 the entire year, adjustments to treatment result in increasing pH, alkalinity, calcium hardness, and dissolved inorganic carbon (DIC) as water temperature decreases. In the November 2019 report (appendix A), data from January 1, 2017 through October 31, 2019 were used to characterize water quality at the Kankakee WTP. Figure 2 includes the water temperature data from the Kankakee WTP during this period as shown in Figure 2-2 of the November 2019 report (Appendix A). Figure 3 summarizes the number of times in the 34 month period depicted in Figure 2 when the water temperature was recorded between the minimum 1°C and maximum 29°C. The arrows and labels near the top of the figure depict the approximate temperature ranges for each of the 12 months, based on data from Figure 2. Figure 4 depicts data points ("x") for the LSI on each date the water temperature was between 1 and 29 °C, and also depicted with a line are the median values for LSI on dates with each water temperature. As this graph indicates, the Kankakee WTP treatment water has an LSI ~0.4 at all times when water temperature is <25°C, and drifts up to 0.6 at temperature >25°C. In order to keep the LSI at ~0.4 at lower water temperatures, the treatment is adjusted and the resulting pH, calcium harness, alkalinity, and DIC all increase. The increase in treated water pH as temperature varies is depicted in Figure 5. Similar data for DIC, alkalinity, and calcium harness are included in Appendix D. The pH in Figure 5 approaches ~9 at lower temperatures, and with a ~0.2 drop between the Kankakee WTP and the UP entry point, then another 0.2 drop from adding the 90/10 blended phosphate, can result in a pH ~8.6 which is where lead control with orthophosphate is unstable as shown in Figure 1. This appears to have happened during the winter of 2019-2020 as discussed below.

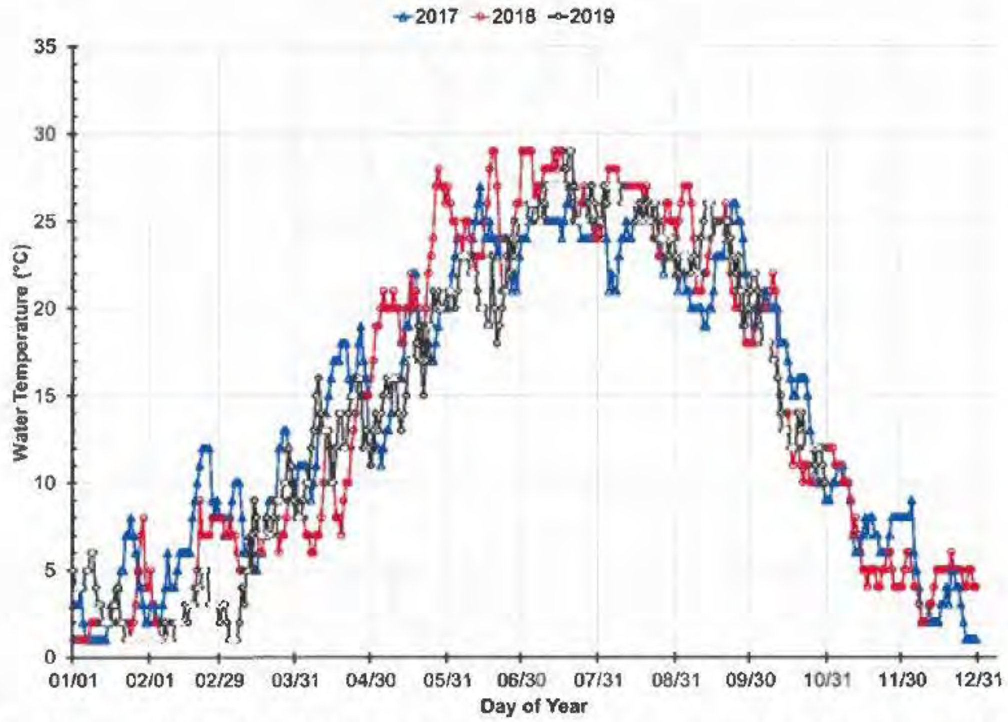

Figure 2 Source Water (Kankakee Tap) – Water Temperature (Jan 2017-Oct 2019)

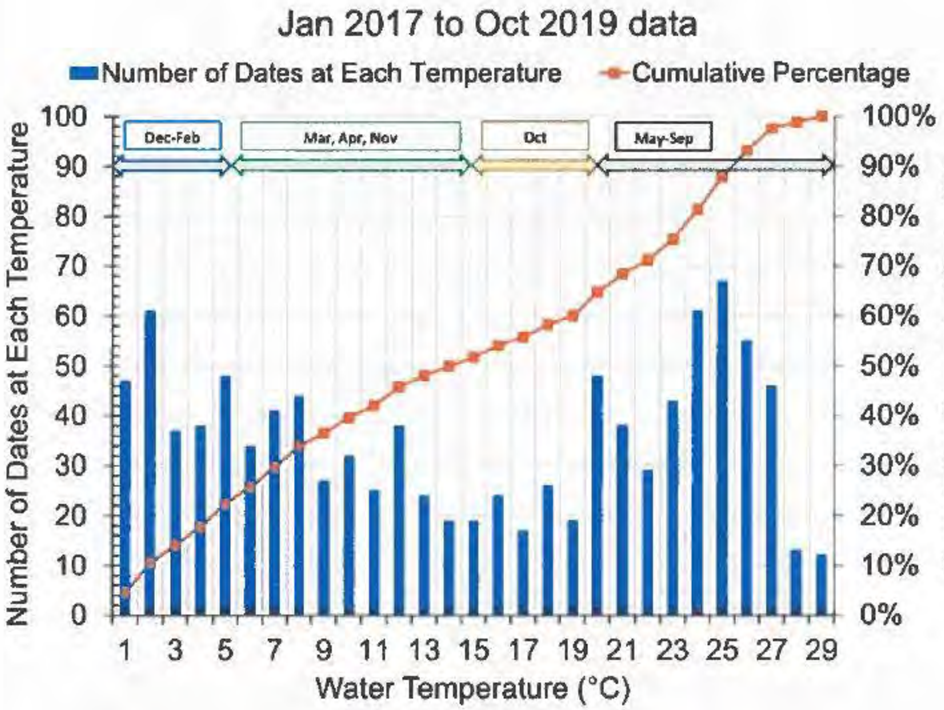

Figure 3 Number and cumulative percentage of occruences of water temperature (minimum 1°C and maximum 29 °C) from 2017 throuh 2019 Kankakee WTP data (see Figure 2)

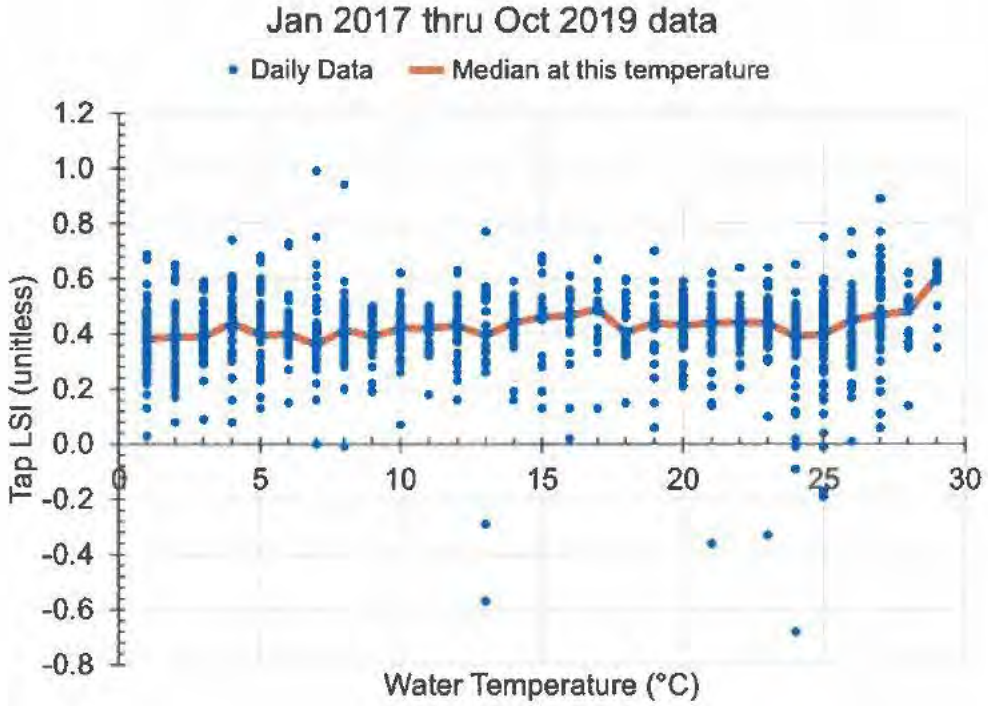

Figure 4 **Daily and median LSI data caclcuated on dates from Jan 2017 through October 2019 with the same temperaure**

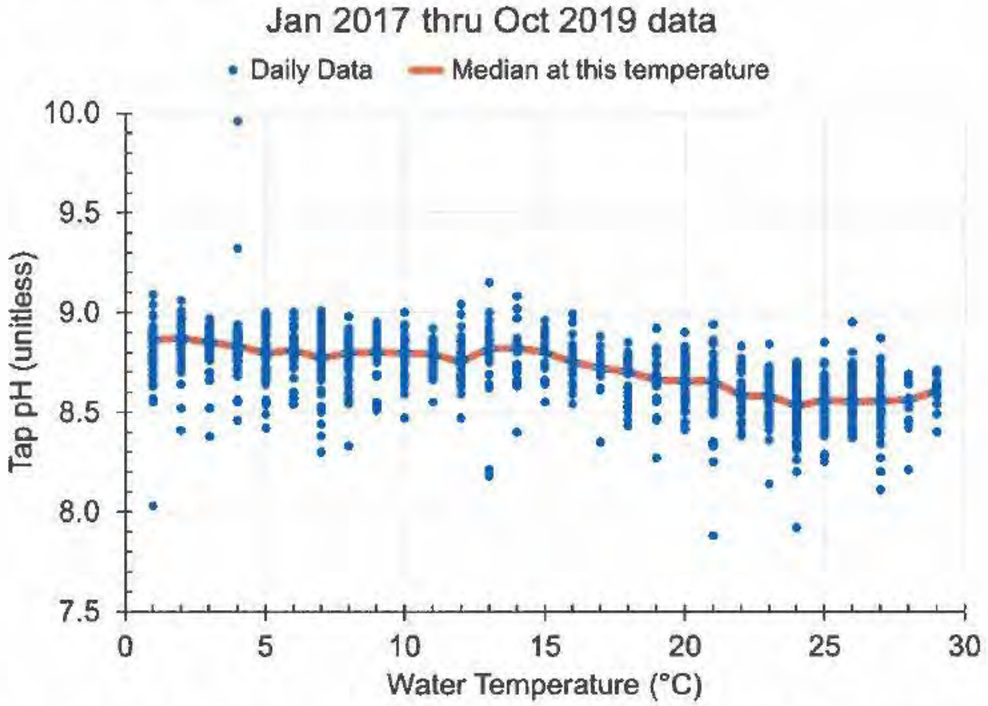

Figure 5 **Daily and median pH data measured on dates from Jan 2017 through October 2019 with the same temperaure**

Figure 6 depicts the weekly pH from February 2020 until July 2020 for: a) treated water leaving the Kankakee WTP, b) water arriving at the UP entry point prior to phosphate addition, c) water at hydrant UP-438 near the entry point (representative of well mixed water after phosphate addition), d) median of hydrant samples (at least 9 hydrants every week). This graph shows that in February and March 2020 the pH was routinely in the pH 8.5 ±0.1 range noted in Figure 1 as unstable for lead solubility control in the presence of orthophosphate. This continued in the colder water conditions of February and March, but the pH started to improve (decrease to <8) in April as the water temperature increased and as the pH from Kankakee WTP also decreased. At this point, the decision to switch from the 90/10 blended phosphate, and its KH_2PO_4 orthophosphate component, to phosphoric acid was decided.

At the lower pH at higher water temperatures, it is possible lead solubility control would have continued until colder conditions returned later this year. However, instead of waiting to make the change after the water gets colder, Aqua IL decided to propose the change to H_3PO_4 in April 2020 so that the UP distribution system could be acclimated to the maintenance of the orthophosphate residual at a lower pH for several months before the colder water temperatures are encountered later in the year. As shown in Appendix B, Aqua IL obtained from ILEPA the required permits and approved permit to allow the switch from the 90/10 blended phosphate to phosphoric acid (28% H_3PO_4 by Hawkins). Figure 6 shows that after the switch on April 17 the pH decreased in UP to as low as 7.3 and as high as 8.0 during the 3 months after the switch. Items to note in this figure after the April 2020 switch are: a) less fluctuation in pH at hydrant UP-438 and b) the pH calculated after the switch using theoretical chemical equilibrium models is similar to the measured pH at hydrants in the UP distribution system. The current permit requires maintenance of pH between 7.4 and 8.0 but these data show that adding H_3PO_4 can lower the pH in warmer temperatures to levels <7.4. The only way to maintain a pH $\geq$7.4 would be to add less phosphoric acid under these conditions. But, due to the importance of maintaining the target orthophosphate residual, it would appear to be better to change the allowable pH range from 7.4-8.0 to 7.2-8.0.

Appendix E includes some additional laboratory solubility studies that were not available at the time of the November 2019 report. These results used a constant orthophosphate dose of 3.0 mg/L as PO_4 and used harvested faucets and other plumbing from two UP houses. The results showed that at pH 8.4 the normalized lead solubility stabilised to <10 µg/L-day, but it took at least 50 to 60 days. These results, like those described in the November 2019 report, all indicate that H_3PO_4 (or ZOP) could be used to control lead solubility in Kankakee WTP treated water imported into UP.

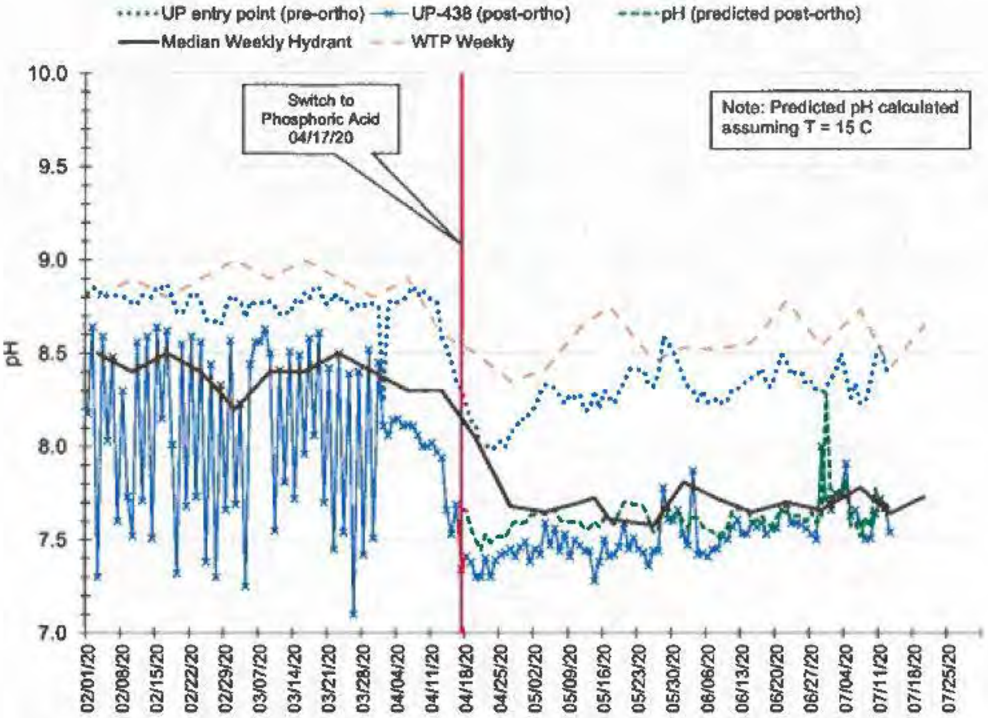

Figure 6 Measured and predicted pH in University Park before and after adding orthophosphate, before and after April 2020 switch to H_3PO_4

RECOMMENDATIONS

Based on results from studies conducted by Mike Shock of USEPA ORD on the relationship between pH and orthophosphate dose for lead reduction (shown in Figure 1) and the pH results to date in University Park shown in Figure 6, it is recommended that the OCCT be achieved in this system by maintaining pH between 7.2 and 8.0 and by continuing to target a residual of >3 mg/L as PO_4 using H_3PO_4. This is consistent with the findings from the November 2019 report (Appendix A) and recent laboratory solubility studies (Appendix E) which indicate that OCCT in UP should target an orthophosphate residual of 3.0 mg/L as PO_4. The higher pH in treated water from Kankakee WTP in colder water (see Figure 5) potentially create treated water pH conditions that are not optimal when the 90/10 blended phosphate is used because the orthophosphate component of this product does not decrease the pH much. A better solution for upcoming cold water conditions in future at UP is to use H_3PO_4 so a pH in the range of 7.2 to 8.0 can be achieved, which is within the optimal pH range expected for lead solubility control with orthophosphate (see Figure 1).

REFERENCES

Bae, Y. and D. Giammar. 2019. Processes Controlling the Time for Orthophosphate to Achieve Effective Corrosion Control. Denver, CO: Water Research Foundation.

Brown, R., N. McTigue, and D. Cornwell. 2013. "Strategies for assessing optimized corrosion control treatment of lead and copper." *Jour. AWWA,* 105 (5): 62-75.

Schock, M., and D. Lytle. 2011. "Internal Corrosion and Deposition Control". In *Water Quality and Treatment: A Handbook of Drinking Water*. 6th ed. New York: McGraw-Hill.

APPENDIX A

CORROSION CONTROL STUDY REPORT

PREPARED FOR:
AQUA ILLINOIS
UNIVERSITY PARK

Cornwell Engineering Group
712 Gum Rock Court
Newport News, VA 23606
(757) 873-1534

November 2019

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CONTENTS

LIST OF TABLES

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LIST OF FIGURES

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CHAPTER 1
INTRODUCTION AND OBJECTIVES

INTRODUCTION

The objective of this report is to identify and present recommendations for optimal corrosion control treatment based upon studies of the effectiveness of corrosion control treatments (CCT). This report characterizes the water quality characteristics distributed in University Park (UP), particularly focusing on corrosion control considerations and consequences, and results from corrosion control studies investigating potential improvements to corrosion control within the distribution system. The current chapter provides an introduction and background, including descriptions of the water source and distribution system in University Park. Chapter 2 provides additional background on water quality characteristics of the water distributed in UP. Chapter 3 focuses on theoretical copper solubility in the UP system. This evaluation of copper solubility includes use of water quality data from Chapter 2 and information published in the literature. Chapter 4 of this report deals with lead solubility control. Chapter 4 also includes results from pipe scale harvesting and analysis. Chapter 5 includes the recommendations for corrosion control treatment in the UP system.

SYSTEM DESCRIPTION

Prior to 2018, the UP system was operated under permits approved by Illinois EPA (IL-EPA) as a separate PWSID (IL1975030). The water distributed in the UP system prior to 2018 was supplied by 7 groundwater wells (called "Well 1" through "Well 7"), with Wells 1, 2, and 3 as the primary supply, supplemented by the other wells when needed. Water from these wells was chloraminated before distribution. Prior to June 2017 a blended phosphate (60 percent orthophosphate and 40 percent polyphosphate – the product also included zinc) was added to chloraminated well water prior to distribution. In July 2017 a different product was added, a proprietary blended phosphate product containing orthophosphate and polyphosphate. Limited data are available on the product's composition since the formulation is proprietary, but the product is listed as having a 7.6% by weight orthophosphate as PO_4, with a minimum polyphosphate content of 22.7% by weight (expressed as PO_4).

During December 2017 UP converted the supply from the UP wells described above to treated water from the Kankakee Water Treatment Plant (WTP). The Kankakee WTP source is still being used as the primary supply, with Wells 2 and 7 retained as an emergency supply and with the other 5 wells abandoned or inactivated.

The Kankakee WTP uses the Kankakee River as a raw water source, with treatment that includes lime softening, ferric chloride coagulation, dual media granular filtration (anthracite over sand), chloramination, and fluoride addition (H_2SiF_6). The treated water from the Kankakee WTP travels through the Kankakee distribution system (PWSID IL0915030) and enters the UP system via an interconnect designated "CC01" by IL-EPA. Before the water is distributed in UP, a corrosion inhibitor is added at the UP booster station at Central Avenue, and then the water is transmitted into the UP system via the UP entry point ("TP03"). For more than a year the corrosion inhibitor added after the conversion to the Kankakee treated water source was the same proprietary blended phosphate used in the 5 months prior to the source water conversion. On or about June 15, 2019, after notification to the IEPA, use of the proprietary blended phosphate was discontinued and a different product was used. The new product, called "LPC-132", is manufactured by Hawkins, Inc. (Roseville, MN) and has a 90:10 ratio of orthophosphate to polyphosphate. This product does not contain zinc. In Chapter 4 the studies that are described as using a "blended phosphate" or a "90/10 blended phosphate" were evaluated using this same LPC-132 product currently used in University Park.

CHAPTER 2
WATER QUALITY

This chapter summarizes water quality data from the treated surface water from the Kankakee WTP, UP Distribution System monitoring data, and information on UP water quality prior to the conversion to Kankakee treated water. The first section of this chapter summarizes the daily data available for most constituents characterizing the Kankakee treated water. The later section of this chapter compares the original ground water quality in UP to the water in the UP system after the conversion to the Kankakee treated water supply.

UP SOURCE WATER QUALITY – KANKAKEE WTP TAP

Figure 2-1 below is an example of a box and whisker plot used in this report, including this chapter. The line in the middle of the box in this figure depicts the median (50th percentile) and the top and bottom of the gray box are the 25th and 75th percentiles. The spindle above the top of the box is the 90th percentile and the similar one at bottom is the 10th percentile. The red star depicts the 5th and 95th percentile values.

The data for Kankakee treated water is derived from monthly operating reports for the Kankakee WTP from January 1, 2017 through October 31, 2019. Figure 2.2 depicts the seasonal change in water temperature. This is important because lead corrosion, like most chemical interactions, can be accelerated in warmer temperatures. Consequently, the corrosion of lead, copper, and other metals can be greater in the June to September period when the water temperature peaks, versus lower temperatures in other times of the year. The water temperature ranges from 1 to 29.

Figures 2-3 through 2-12 depict the seasonal fluctuation of data during the January 1, 2017 to October 31, 2019 period. Figures 2-3 and 2-4 depict pH as water leaves the Kankakee WTP, Figures 2-5 and 2-6 depict measured alkalinity, Figures 2-7 and 2-8 depict dissolved inorganic carbon (DIC), Figures 2-9 and 2-10 depict total hardness and the Langelier Saturation Indexes (LSI), and Figures 2-11 and 2-12 depict the total chlorine residual. The pH is generally 8.5 to 9.0 but does vary seasonally, lower in warmer summer months, and higher at the end and beginning of each year (Figure 2-4). Analogous seasonal fluctuations were observed for the other data depicted below. DIC varied from about 10 to 16 mg/L throughout the year. The DIC, alkalinity, and pH are key considerations for evaluating corrosion control characteristics. LSI, though not useful for indicating conditions conducive for lead or copper corrosion, is a useful indicator for the stability of calcium carbonate ($CaCO_3$) scales ($LSI < 0$ means these scales dissolve, and $LSI > 0$ indicates conditions are conducive to $CaCO_3$ deposition). The results for LSI in Figure 2-10 suggest the Kankakee treated water does not promote dissolution of $CaCO_3$ scale.

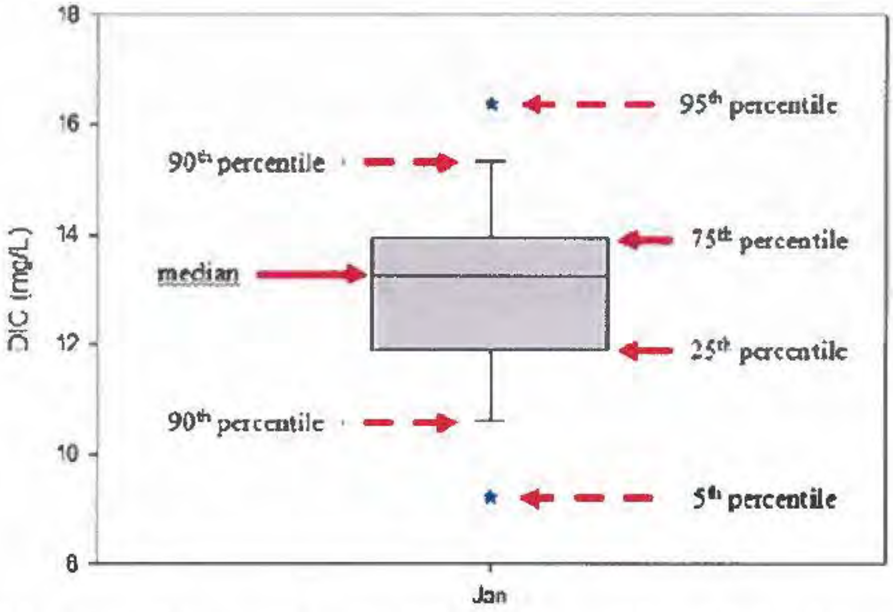


Figure 2-1 Example "Box and Whisker" Plot (See Later "Monthly" Graphs)

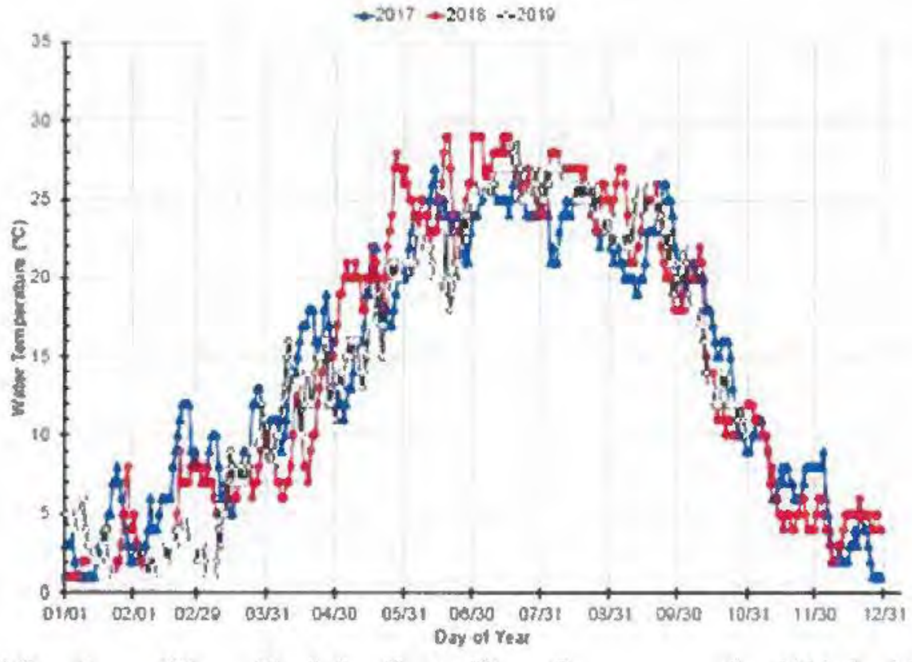


Figure 2-2 Source Water (Kankakee Tap) – Water Temperature (Jan 2017-Oct 2019)

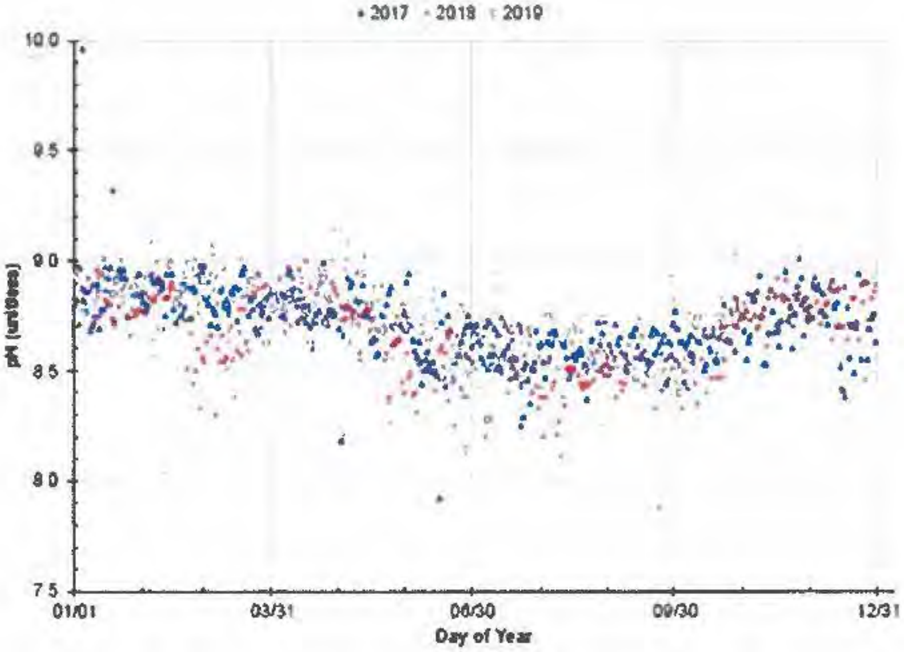


Figure 2-3 Source Water (Kankakee Tap) – pH (Jan 2017-Oct 2019)

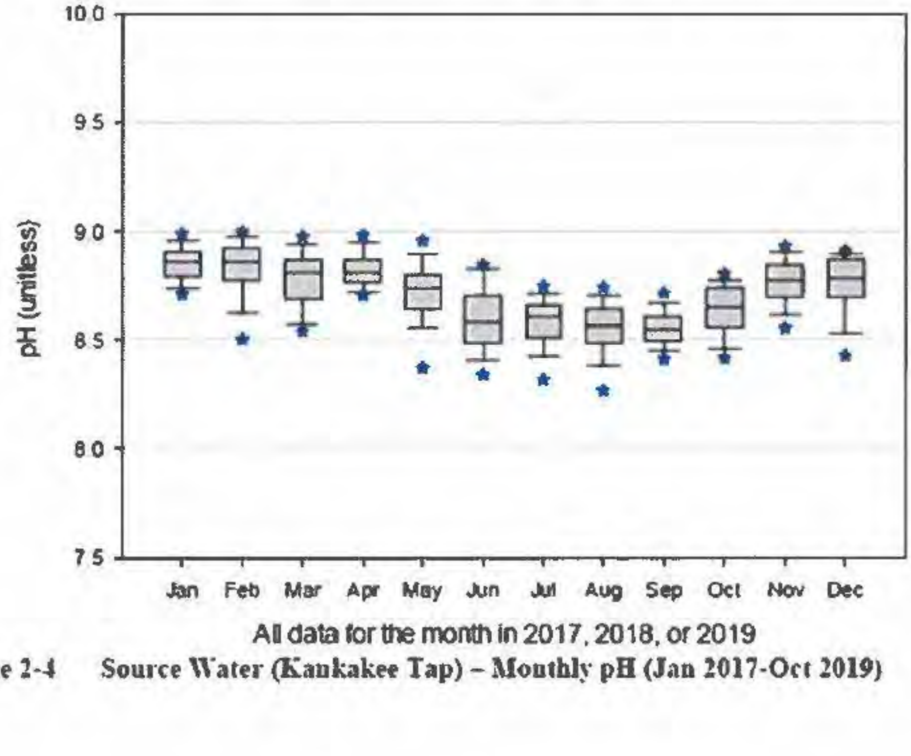


Figure 2-4 Source Water (Kankakee Tap) – Monthly pH (Jan 2017-Oct 2019)

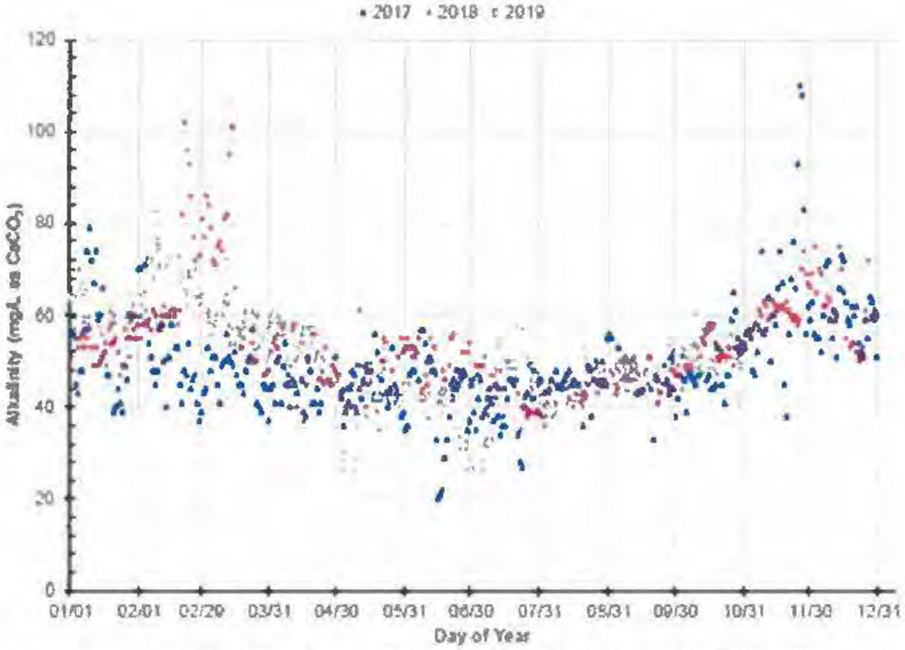


Figure 2-5 Source Water (Kankakee Tap) – Alkalinity (Jan 2017-Oct 2019)

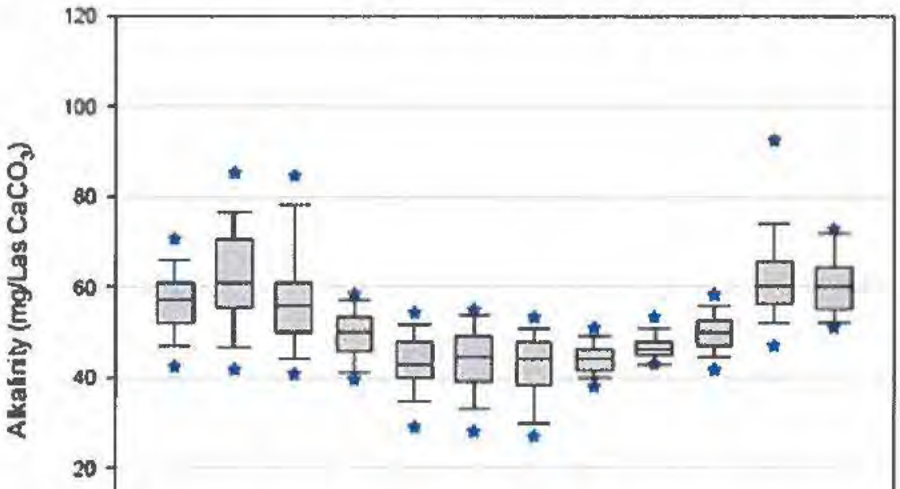


Figure 2-6 Source Water (Kankakee Tap) – Monthly Alkalinity (Jan 2017-Oct 2019)

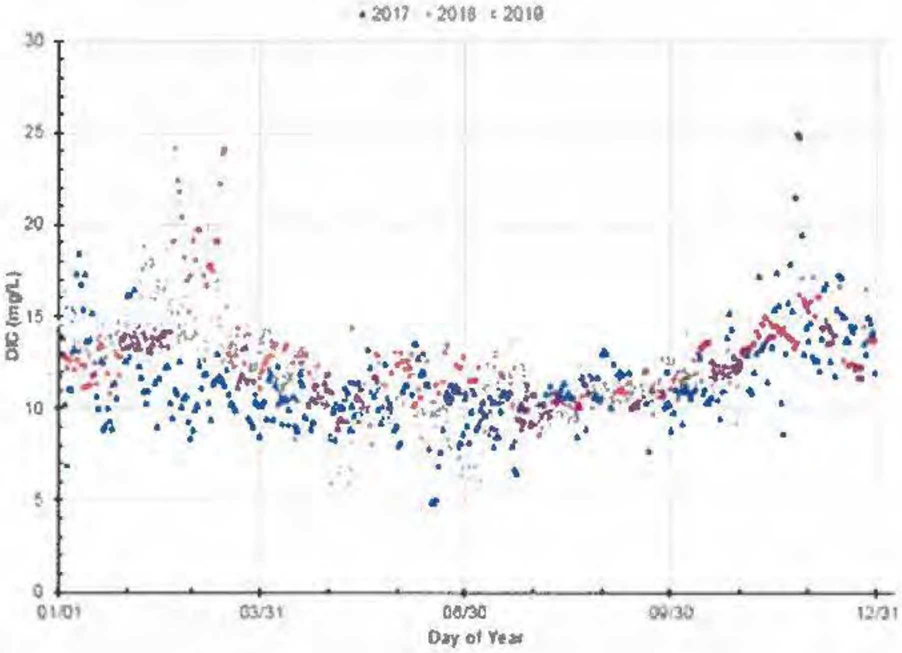
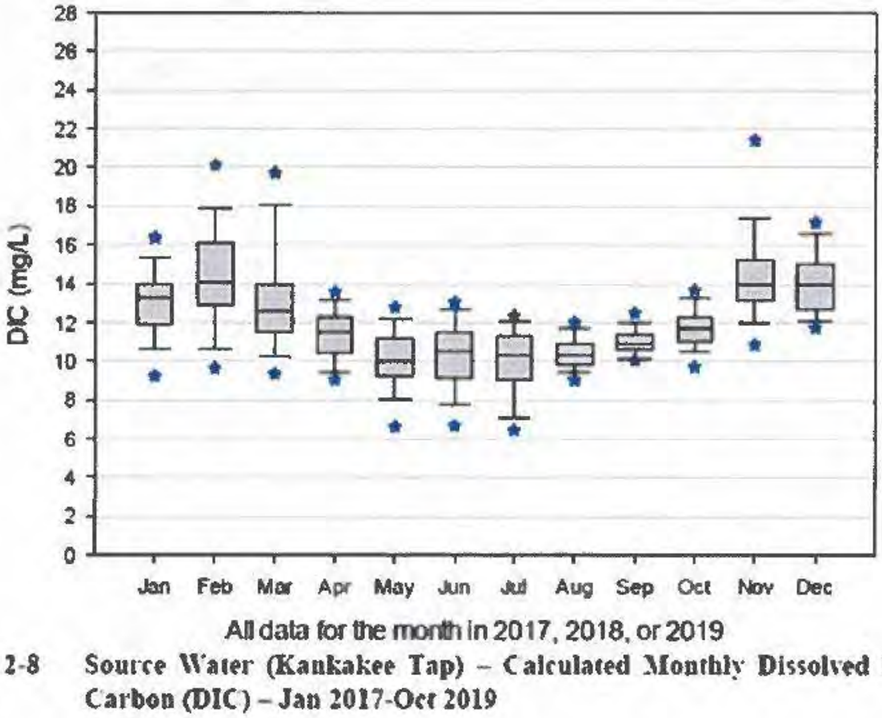


Figure 2-7 Source Water (Kankakee Tap) – Calculated Dissolved Inorganic Carbon (DIC) – Jan 2017-Oct 2019



All data for the month in 2017, 2018, or 2019

Figure 2-8 Source Water (Kankakee Tap) – Calculated Monthly Dissolved Inorganic Carbon (DIC) – Jan 2017-Oct 2019

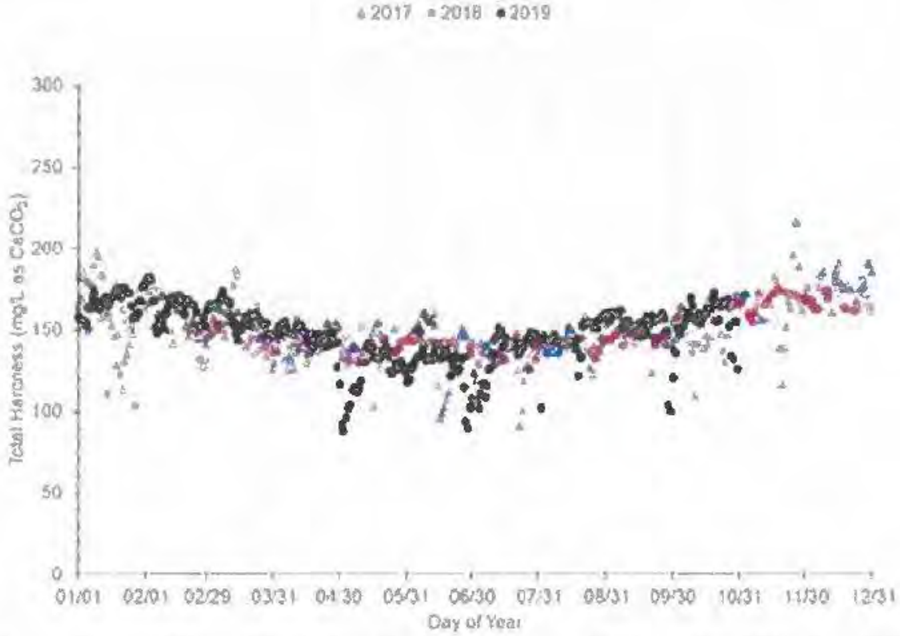


Figure 2-9 Source Water (Kankakee Tap) – Hardness (Total) – Jan 2017-Oct 2019

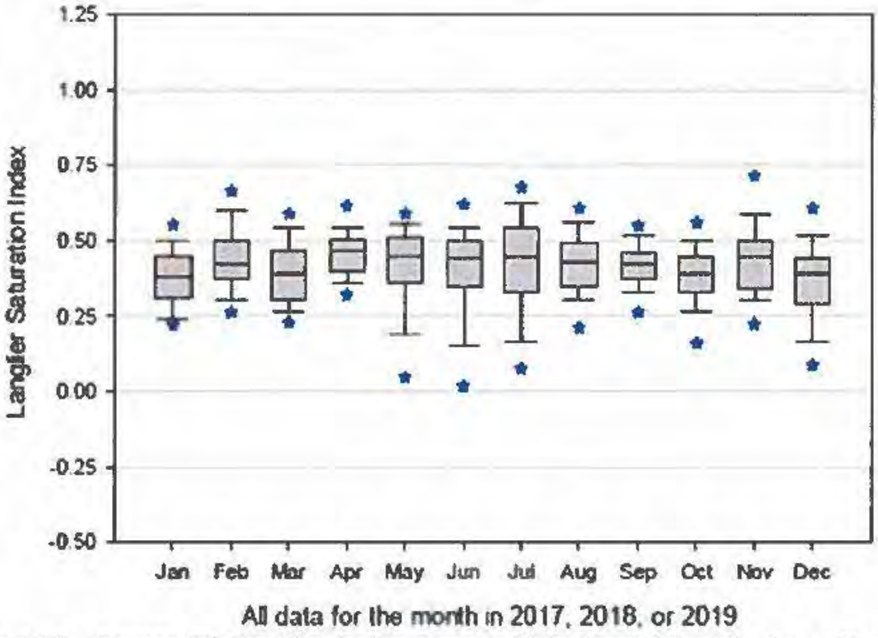


Figure 2-10 Source Water (Kankakee Tap) – Calculated Monthly Langelier Solubility Index (LSI) – Jan 2017-Oct 2019

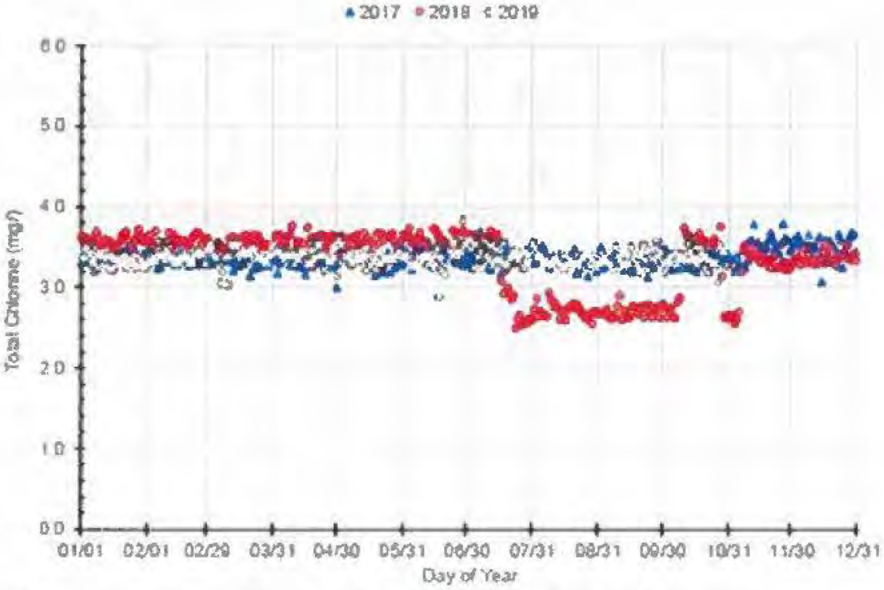


Figure 2-11 Source Water (Kankakee Tap) – Total Chlorine Residual – Jan 2017-Oct 2019

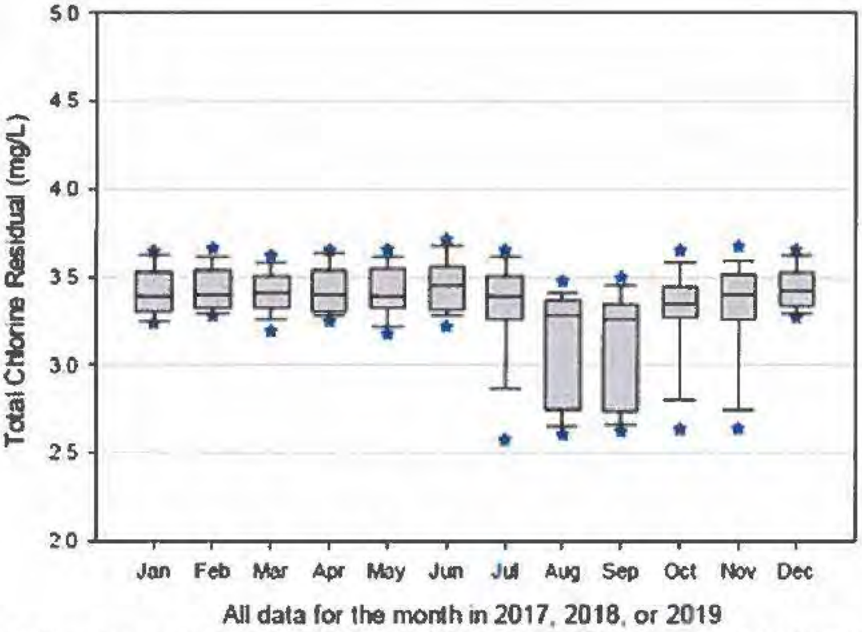


Figure 2-12 Source Water (Kankakee Tap) – Monthly Total Chlorine Residual – Jan 2017-Oct 2019

UP DISTRIBUTION SYSTEM WATER QUALITY

Table 2-1 and Figure 2-13 summarize water quality data in the UP system during June to November 2019. During this period, the UP system was receiving Kankakee treated water with the 90/10 blended phosphate added at the UP entry point prior to distribution. In the UP distribution system the pH is slightly lower than when the water leaves the Kankakee WTP (8.5 to 9.0 at the WTP (Figure 2-3) versus ~8.0 in the UP System (Figure 2-13a)). The DIC is about the same, as expected (10 to 14 mg/L (Figures 2-7 and 2-13d)). The total hardness is similar (140 to 150 mg/L as $CaCO_3$). The total chlorine residual decreased by about 1.5 mg/L, from 3 to 4 mg/L at the plant to 1.5 to 2.5 in the UP System. As shown in Figure 2-13b, the orthophosphate and total phosphate residuals in the distribution system were fairly steady during this period, about 1.4 mg/L as P (4.2 mg/L as PO4) for orthophosphate and 1.6 mg/L as P (4.8 mg/L as PO4) for total phosphate.

Table 2-2 summarizes data from the UP wells indicating the water quality entering the UP System prior to the conversion to the Kankakee treated water. The data suggest that groundwater quality prior to the conversion had a lower pH and a higher DIC, alkalinity, and hardness than the water currently supplied into the UP system.

Another potentially important factor that can impact lead CCT, as reported by Nguyen et al. (2011), is that a high chloride to sulfate ratio (CSMR) can increase galvanic corrosion when CSMR ratios >0.5 mg/mg are present, if lead or brass plumbing is also present. The CSMR for the UP wells is reported to be <0.1 mg/mg (Table 2-2), but for water in the UP system after conversion to Kankakee water source the CSMR increased, but was ~0.4 mg/mg, which is below the threshold referenced in Nguyen et al. (2011).

Table 2-1
Median water quality in the University Park (UP) distribution system
(June – November 2019)

Parameter †	Count	Median	Notes
General Characteristics, Including Carbonate Chemistry			
Field pH (unitless)	555	8.0	98% >7.5
Conductivity (µhmos/com or µS)	12	358	
Alkalinity (mg/L as $CaCO_3$)	541	46	
DIC (mg/L as C) *	541	11	
Total Hardness (mg/L as $CaCO_3$)	70	145	
Calcium Hardness (mg/L as $CaCO_3$) *	73	95	
Orthophosphate and Total Phosphate Residual			
Orthophosphate (mg as P)	615	1.4	99% >1.0 mg/L as P
Total Phosphate (mg as P)	71	1.6	100% >1.0 mg/L as P
Chloramine Residual, Nitrification, and Microbiological Activity			
Total Chlorine (mg/L as Cl_2)	598	2.0	98% >0.2 mg/L
Cellular ATP (pg/mL)	32	0.4	0 to 23 pg/mL
Ammonia (mg/L as N)	69	0.2	ND – 0.44 mg/L as N
Nitrate (mg/L as N)	74	1.3	1.0 – 2.7 mg/L as N
Nitrite (mg/L as N)	74	1.0	0.1 – 1.0 mg/L as N
Other Inorganic Chemical Characteristics			
Fluoride	74	0.8	
Chloride	74	34	
Sulfate	74	79	
CSMR (mg/mg) *	74	0.4	
Potassium	74	4.0	92% ≤ DL (0.01 mg/L)
Sodium	73	14	
Iron	67		Two detections, max 0.12 mg/L
Manganese	67		One detection, >3 mg/L
Aluminum	67	0.01	100% ≤DL (0.01 mg/L)

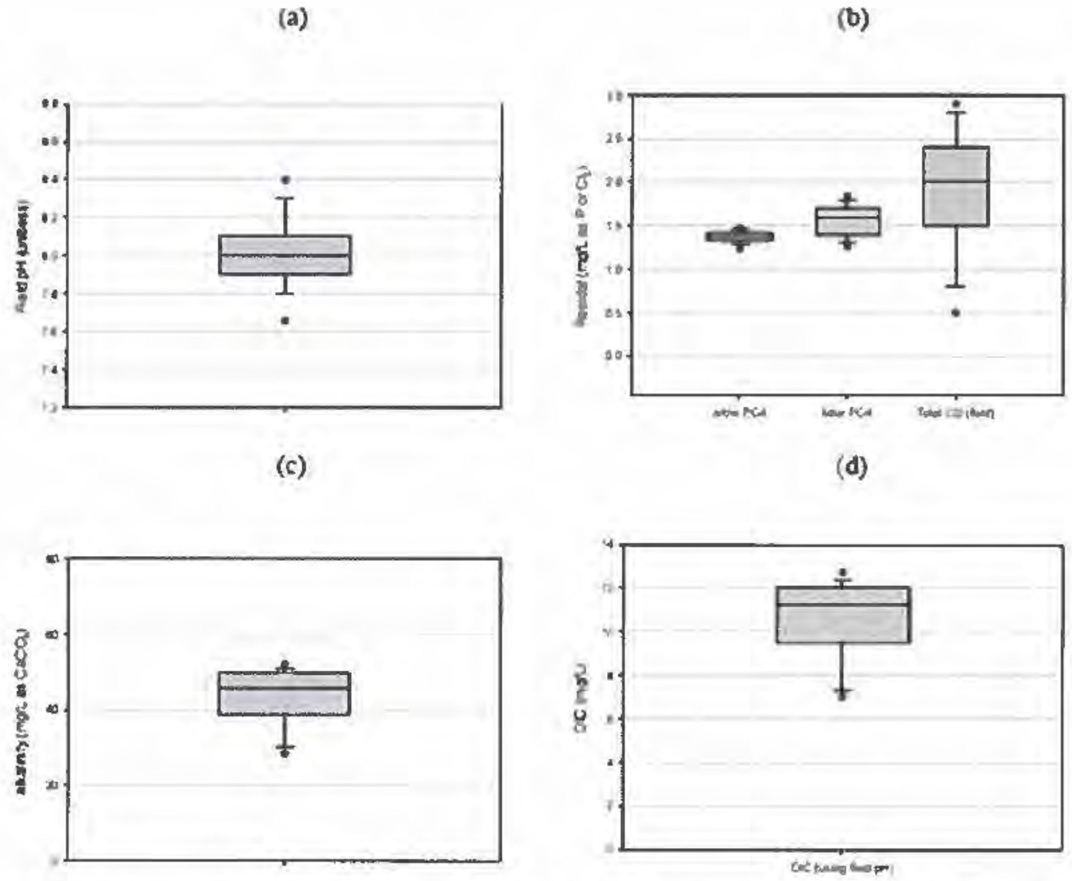


Figure 2-13 **UP Distribution System Water Quality: a) Field pH, b) Orthophosphate and Total Chlorine Residuals, c) Alkalinity, and d) DIC**

Note: Data was collected from >500 samples for each parameter/constituent during June through October 2019 for alkalinity, field pH, orthophosphate (o-PO_4) residual, and total chlorine residual. Total phosphate (total PO_4) was based on 71 samples submitted to the Aqua PA Laboratory (Bryn Mawr, PA). DIC was calculated for dates and locations with both recorded field pH and alkalinity data. Note that the reported data for o-PO_4 was in units of mg/L as PO_4. Data for o-PO_4 was plotted in units of mg/L as P by multiplying by a factor of 31/95.

Table 2-2
Historical water quality data from University Park (UP) wells

Parameter/Constituent †	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7
General Characteristics, Including Carbonate Chemistry							
pH (unitless)	7.2	7.2	6.4	7.1	7.1	7.2	7.3
Conductivity (µhmos/cm)	1,050	1,100	1,160	1,100	1,000	1,076	790
Alkalinity (mg/L as $CaCO_3$)	374	418	297	320	350	246	358
DIC (mg\L as C)	101	113	127	88	96	67	95
Hardness (mg/L as $CaCO_3$)	410	416	530	500	480	597	422
Calcium (mg/L as $CaCO_3$)	225	220	300	350	300	400	228
Nitrogen (mg/L as N)							
Ammonia-Nitrogen	0.13	<0.1	0.42	0.55	0.56	0.77	0.31
Nitrate-Nitrite	<0.1	<0.1	<0.1	<0.01	0.31	<0.01	0.30
Other Inorganic Chemical Characteristics							
Fluoride	1.2	0.9	0.4	0.8	0.7	0.5	0.3
Chloride	3.9	1.0	1.5	1.9	1.2	1.7	2.0
Sulfate	51	14	374	270	240	297	50
CSMR (mg/mg)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium	1.7	2.0	2.9	9.1	<0.01	5.8	2.1
Sodium	10	11	50	37	44	29	8
Iron	0.5	0.6	850.0	0.9	0.5	0.6	1.1
Manganese (µg/L)	21	<15	40	7	17	<15	29
Aluminum (µg/L)	<150	<100	<100	100	72	<100	

† units are mg/L unless noted otherwise

* Calculated from measured data (including calcium hardness calculated from measured calcium)

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CHAPTER 3
THEORETICAL COPPER SOLUBILITY

COPPER CORROSION

Over time, copper pipe naturally forms a scale of insoluble minerals such as malachite [$Cu_2CO_3(OH)_2(s)$] or tenorite [$CuO(s)$] (Schock & Sandvig, 2009; Grace et al., 2012). However, these scales form relatively slowly. While these minerals are forming, copper corrosion is controlled by the metastable cupric hydroxide [$Cu(OH)_2(s)$], which is much more soluble. This process of the pipe scaling thereby preventing further copper release is often referred to as "passivation". Therefore, under water quality conditions that are conducive to copper corrosion (i.e. "aggressive" water quality conditions), elevated copper levels would be more likely to be observed in new construction rather than at older homes, such as LCR monitoring sites. New copper pipes might never passivate in waters that are considered corrosive to copper. Furthermore, the presence of natural organic matter (NOM) can inhibit formation of these protective scales (Arnold et al. 2012).

NDWAC COPPER CORROSION SUSCEPTIBILITY

The National Drinking Water Advisory Committee (NDWAC) convened to address revisions to the LCR defined a range of water quality conditions deemed "corrosive" to copper as shown in the shaded areas of Figures 3-1 and 3-2 (NDWAC 2015 a&b). Water quality that falls in the unshaded region of each figure is considered to be non-corrosive to copper. For example, water quality with characteristics reflected in the unshaded region of Figure 3-1 are considered not aggressive (or non-corrosive to copper), whether o-PO_4 is present or not. However, water systems in the shaded region of Figure 3-1 are aggressive (corrosive) to copper, unless o-PO_4 is added under conditions consistent with unshaded regions of Figure 3-2. Although the shaded regions in these figures indicate potentially corrosive conditions, those conditions are only corrosive if the system adds an oxidant or aerates the water. Groundwater systems that are not chlorinated and are anoxic would not be corrosive even if they fall within the shaded region. Conversely, a water system that falls in the unshaded region of Figure 3-2 is considered not corrosive to copper, but only if the pH is within the effective range for control of copper corrosion with o-PO_4. For example, even if orthophosphate is present, if the pH is <7.0 the water would still be considered corrosive to copper due to the low pH.

Figure 3-1 compares the pH and alkalinity from the Kankakee WTP (January 1, 2017 through October 31, 2019) with data from the UP system (2019). The red symbols in this figure for Kankakee treated water indicates that the water leaving the Kankakee WTP is not conducive to copper corrosion. The water in the UP System (blue symbols) has a lower pH but these conditions are still not considered conducive to copper corrosion even without considering the impact of orthophosphate. Figure 3-2 depicts the orthophosphate residual and alkalinity data from the UP Distribution after adding orthophosphate with the current blended phosphate at the UP entry point. The data in this figure demonstrate that according to the water quality range identified by the

NDWAC, the conditions in the UP System measured on these dates is not considered corrosive to copper.

THEORETICAL SOLUBILITY RELATIONSHIPS

The copper solubility curves on which the above NDWAC diagrams were based have been updated based on research published by Lytle et al. (2018). Equation 3.1 below is the result of that research, which is based on an empirical evaluation ("curve fitting") of experimental data investigating soluble copper concentrations under controlled conditions after adding a copper-containing salt (copper perchlorate) that readily dissolves in water. Consequently, these studies start with dissolved copper under controlled conditions of pH, DIC, and orthophosphate and predict the soluble copper remaining at equilibrium after some of the copper precipitates. Readers should note the difference in this experimental approach versus corrosion monitored in a distribution system (solid copper pipe or copper-containing scales are present and we monitor the soluble copper that dissolves after stagnant contact with the solid forms of copper). Data from recent work by Cornwell indicates that for a variety of reasons, perhaps including this difference in how the solubility data were derived, the actual soluble copper levels for new copper are lower (as much as an order of magnitude lower) than predicted by the NDWAC figures or the data from Lytle et al. 2018.

Equation 3.1 **Copper solubility as function of pH, orthophosphate, and DIC as reported by Lytle et al. 2018**

$$Cu=56.68\times e^{-0.77\times pH}\times e^{-0.20\times PO4}\times DIC^{0.59}$$

Where:

Cu = predicted copper solubility (mg/L)

pH = pH (unitless)

PO_4 = orthophosphate residual in mg/L as PO_4

DIC = dissolved inorganic carbon (mg/L as C)

SUMMARY AND DISCUSSION

The data presented in this chapter and in the NDWAC and Lytle solubility graphs all suggest that the Kankakee treated water does not create conditions conducive to copper corrosion, and the addition of orthophosphate reduces the copper solubility still further. Consequently, the current use of Kankakee treated water, supplemented by orthophosphate, produces conditions that not only improve lead solubility control (see Chapter 4) but also copper solubility (see figures above).

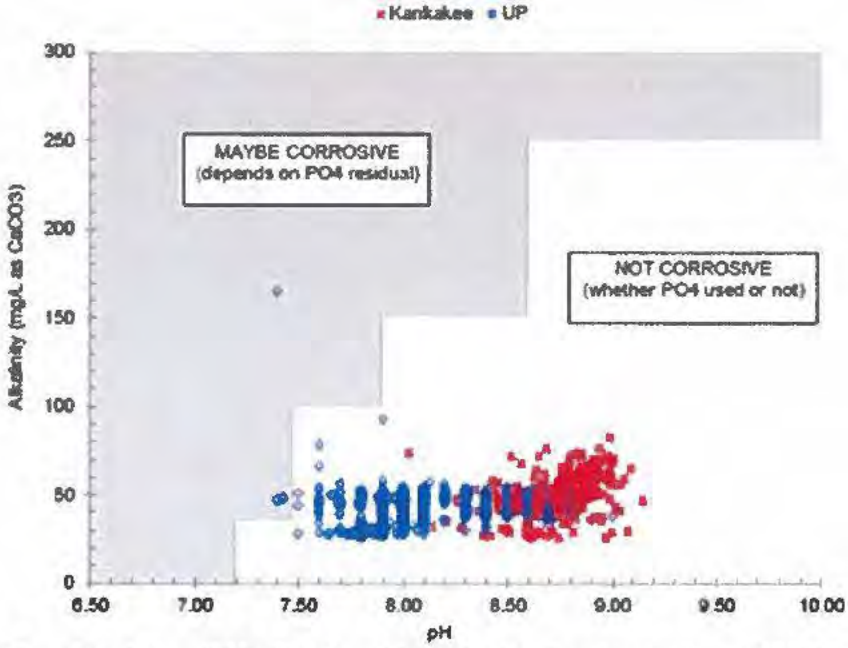

Figure 3-1 **Kankakee (2017-2019) and UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (without PO_4)**

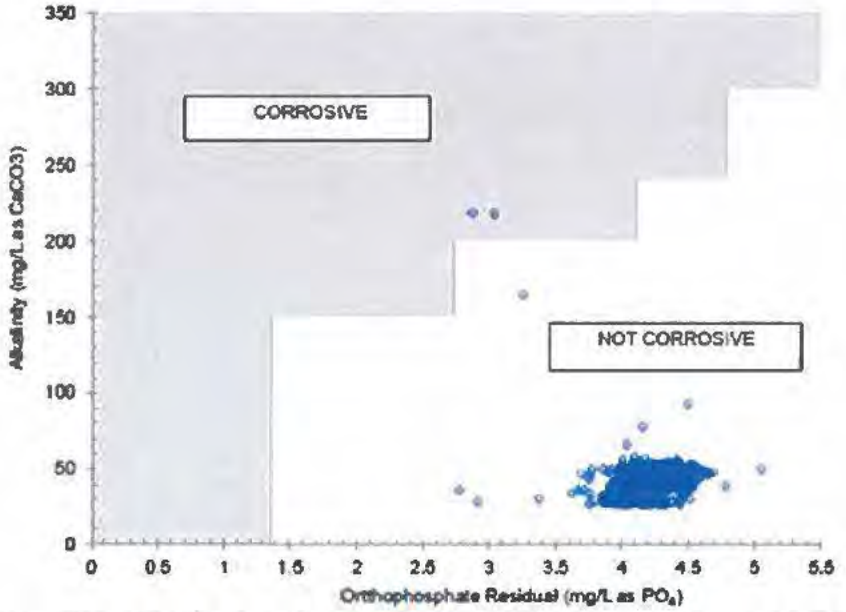

Figure 3-2 **UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (with PO_4)**

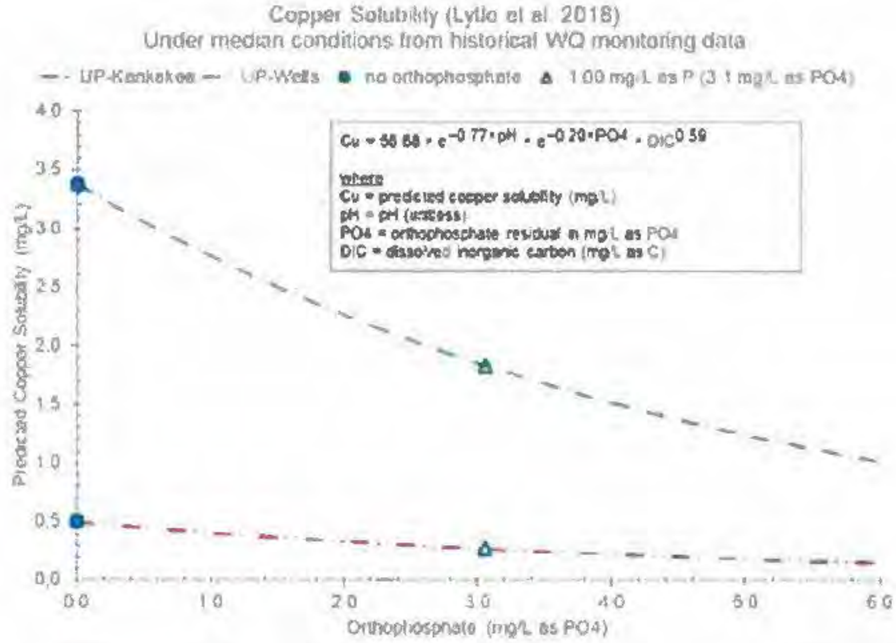

Figure 3-3 Theoretical Copper Solubility UP Distribution System Data (2019) Compared to NDWAC Copper Corrosivity Ranges (with PO_4)

CHAPTER 4
BENCH SCALE TESTING

This chapter presents a summary of bench scale testing methods including lead solubility tests with lead coupons, dump & fill studies conducted with harvested pipe and fittings containing either brass or copper with lead/tin solder, and pipe scale analysis of harvest copper pipe (containing lead/tin solder) performed by Cornwell (Cornwell Engineering Group, Newport News, VA). Also included in this chapter are the results of experiments conducted by researchers at Virginia Tech (Virginia Polytechnic Institute and State University, Blacksburg, VA) investigating the impact of phosphate-based corrosion inhibitors on galvanic corrosion of harvested copper pipe in contact with lead/tin solder.

LEAD SOLUBILITY TESTING

Background

Lead solubility testing as described in Cornwell and Wagner (2019) was conducted using treated water from the Kankakee WTP during 2018 and 2019 as discussed below.

Fall 2018

Treated surface water was collected by Aqua-IL staff from the Kankakee WTP, stored in 5-gallon plastic (HDPE) buckets, and shipped to Cornwell (Newport News, VA) for the Fall 2018 lead solubility testing conducted between November and December 2018. Figure 4-1 depicts a typical lead solubility study container, including a lead coupon suspended in a 500 mL HDPE bottle.

Figure 4-1 Typical Jar with Lead Coupon (500 mL HDPE Bottle)

The water in each 1.5 L beaker was first dosed with the target phosphoric acid (H_3PO_4) dose (1.8, 2.4, or 3.0 mg/L as PO_4). Ammonium chloride (NH_4Cl) was added to all beakers. A sodium hypochlorite (NaOCl) stock solution was also added to all beakers to achieve a target monochloramine residual of 3.2 mg/L. The targeted chlorine/ammonia ratio was 4.75 mg Cl_2 per mg N. The total chlorine or monochloramine residuals were measured and adjusted, as needed, before proceeding to the next step. The pH after adding these products was measured and adjusted to meet the pH target (8.2). Table 4-1 summarizes the test conditions.

Table 4-1
Lead solubility study test matrix – Kankakee WTP with added chloramines (in duplicate)

Description	Phosphoric Acid Dose		Target pH	Target Monochloramine Residual (mg/L)
	(mg/L as PO_4)	(mg/L as P)		
		Phosphoric acid only – pH 8.2		
1.8 mg/L as P	1.8	0.6	8.2	3.2
2.4 mg/L as P	2.4	0.8	8.2	3.2
3.0 mg/L as P	3.0	1.0	8.2	3.2

After preparing water in beakers, approximately 600 mL water for each sample was transferred into a new, pre-labeled, nominal 500 mL HDPE bottle as shown in Figure 4-1. The coupon and lid were carefully transferred from the old containers to the new freshly prepared containers, making sure that excess water was added to the bottles so that after placement of the lid the water in the container was headspace-free. The old containers were sealed and shipped to the Aqua PA Laboratory in Bryn Mawr (PA), where samples were acidified (pH <2), stored for at least 16 hr, and then analyzed for total lead by ICP-MS. Two replicate jars were prepared and used during this study for each condition noted in Table 4.1.

The Fall 2018 lead solubility study findings are depicted in Figure 4-2. In this figure replicate 1 ("rep. 1") for each test condition in Table 4-1 is shown as a solid line and replicate 2 ("rep. 2) is depicted as a dashed line. The 1.8 mg/L as PO_4 dose of H_3PO_4 (blue lines), 2.4 mg/L as PO_4 of H_3PO_4 (red lines), 3.0 mg/L as PO_4 of H_3PO_4 (green lines) and achieved steady-state at <5 µg/L-day after 14 to 21 days. These results suggest that using H_3PO_4 at any of these doses, under the conditions tested, would result in a low lead solubility.

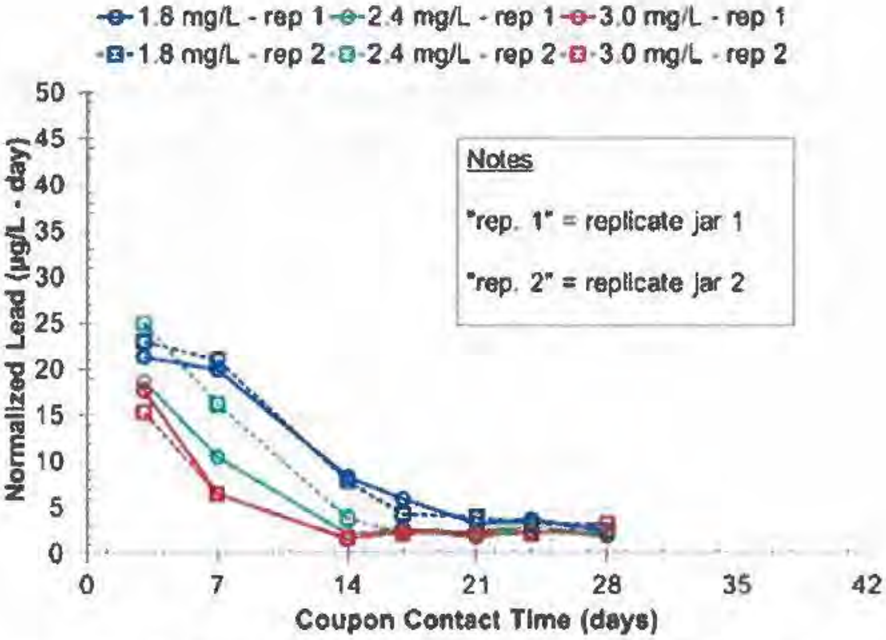

Figure 4-2 Fall 2018 Lead solubility Test Results – H_3PO_4 (Nov-Dec 2018)

Fall 2019

During Fall 2019 (September to November 2019) similar lead solubility studies were conducted using similar materials and similar procedures to those described above for Fall 2018. New 5-gal HDPE buckets of water from the Kankakee WTP were supplied. The Fall 2019 testing included 18 jars for nine test conditions (three phosphate products at three doses in duplicate). The three orthophosphate-containing products evaluated were:

a) Phosphoric acid (the same product used in Fall 2018),
b) Zinc orthophosphate (ZOP), SLI-321 from Shannon Chemical, containing 37% by weight as PO_4 (~12% as P) orthophosphate and a zinc-to-orthophosphate ratio of about 1:3.
c) Blended phosphate (LPC132) from Hawkins Inc. (Roseville, MN) with 90 percent by weight orthophosphate and 10% polyphosphate.

The three doses tested were 1, 2, and 3 mg/L as PO_4 for the orthophosphate fraction of each of these products. The average results for the duplicate jars for each test condition are summarized in Figure 4-3 for H_3PO_4 at the three doses tested, and results are similarly depicted in Figure 4-4 for ZOP and Figure 4-4 for LPC132 (90/10 blended phosphate). The studies at these three doses were completed in November 2019.

Figure 4-6[6] compares the steady-state results (days 39 to 49) for both replicates at all doses with each product tested. Review of Figures 4-3, 4-4, and 4-5 indicates 6 sample dates within this time period, so each box in Figure 4-6 summarizes 12 data points (6 dates in duplicate)[7]

Interpretation of Figures 4-3 to 4-6 reveals the following:

- The 2 and 3 mg/L as PO_4 doses of ZOP and H_3PO_4 all leveled off at <5 µg/L-day
- The 3 as PO4 dose for the 90/10 blended phosphate appears to be achieving steady-state at <5 µg/L-day
- As often occurs, the orthophosphate dose needed for lowest lead solubility is higher in a blended phosphate due to the presence of polyphosphate in the blended product.

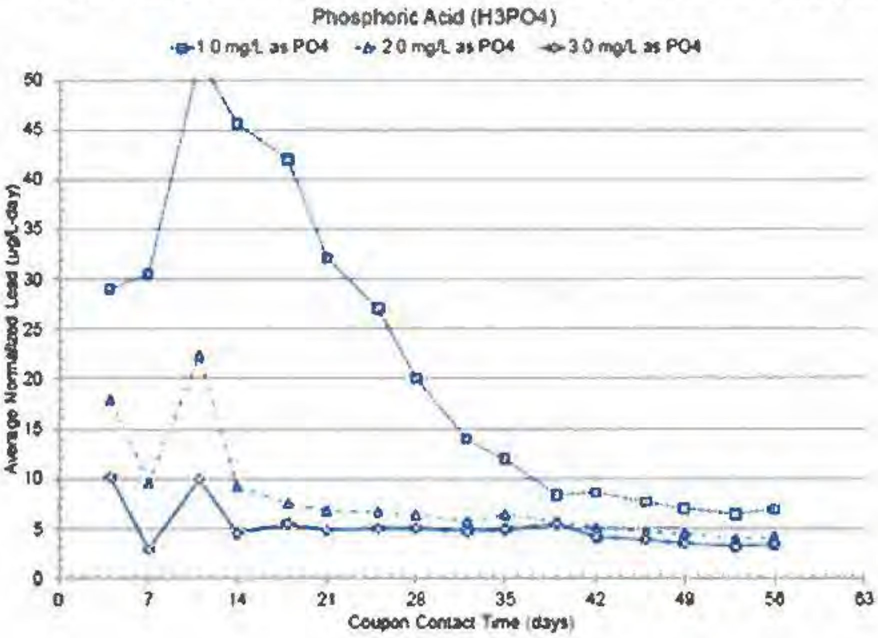

Figure 4-3 Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – H_3PO_4 Phosphate (Sep-Nov 2019)

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[6] For a review of interpretation of "box and whisker" plots in Figure 2-2).

[7] With 12 data points, it is possible to calculate the 10th and 90th percentile

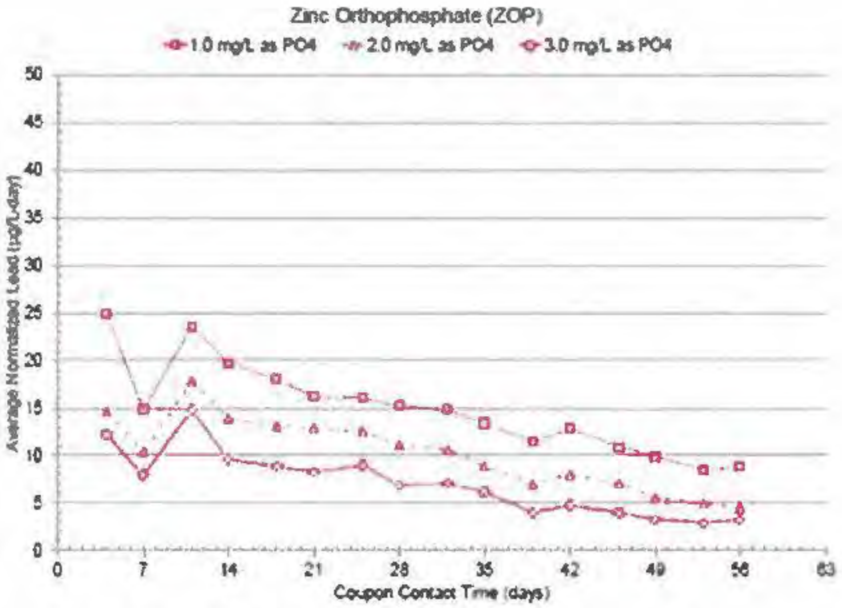

Figure 4-4 Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – ZOP (Sep-Nov 2019)

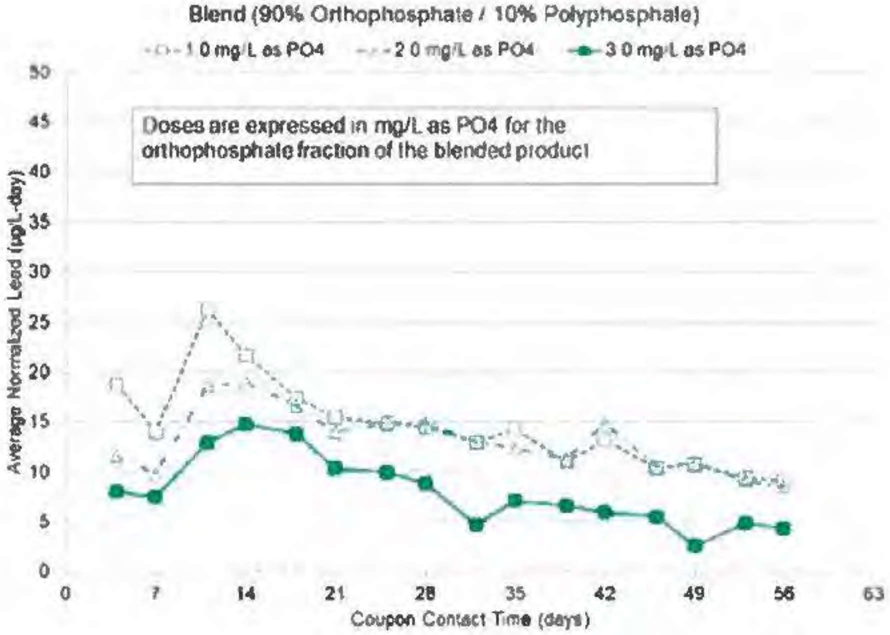

Figure 4-5 Summer/Fall 2019 Average Lead Solubility Test Results (Two Replicates) – Blended Phosphate (Sep-Nov 2019)

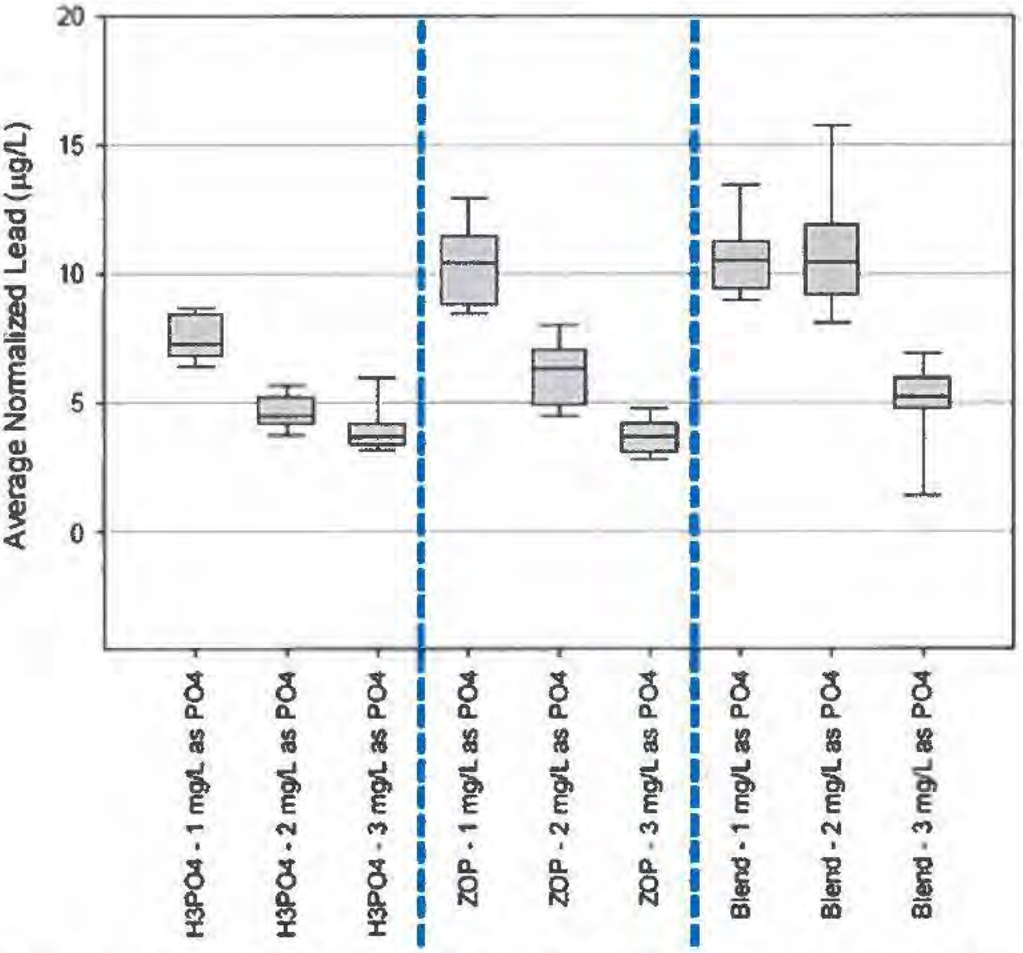

Figure 4-6 Summer/Fall 2019 Steady-State Lead Solubility Test Results (Day 39 to 49, Two Replicates) – H_3PO_4 vs. ZOP vs. Blended Phosphate (Sep-Nov 2019)

Summary of Fall 2018 and 2019 Lead Solubility Studies

These studies demonstrated that, under the conditions tested, when orthophosphate alone was used the lead solubility could be reduced to <5 µg/L-day with either 1.8, 2.0, 2.4, or 3.0 mg/L as PO_4 using either H_3PO_4, or at 2 and 3 mg/L as PO_4 with ZOP. When polyphosphate was present along with orthophosphate, using the 90/10 blended phosphate product tested, lead solubility comparable to orthophosphate alone could be achieved (<5 µg/L-day), but only at the 3 mg/L dose.

EXPERIMENTS WITH HARVESTED COPPER PIPE WITH LEAD SOLDER

Bench-scale dump-fill experiments were conducted on harvested copper pipe with lead solder in order to screen the potential impact of varying corrosion inhibitors and doses to existing University Park pipe scales. Eleven pipes were tested between late-June 2019 and mid-November 2019 during four main test phases, as shown in Table 4-2. As with the lead solubility (coupon) studies described earlier, the water prepared for the studies outlined below started with treated surface water from the Kankakee WTP.

Table 4-2
Copper pipe testing and sample information

Testing Phase	Pipe Number	Test Start Date	Test End Date
1		07/23/2019	08/22/2019
2	1 2 3 4	07/19/2019	08/07/2019
3	5 6A 6B	08/7/2019	09/12/2019
4	8 10 14	09/24/2019	11/13/2019

Testing Procedures

All pipes utilized for testing were harvested copper pipes containing a fitting with leaded solder. Pipes were prepared by sealing one end using parafilm and tape, and then suspending the pipe via a stand and burette clamp. Table 4-3 summarizes the test conditions for studies in Phases 1 through 4 below. Water was first prepared by dosing the appropriate corrosion inhibitor to the treated Kankakee water. If needed (see final column in Table 4-3), pH was manually adjusted prior to phosphate dosage using an HI902 titrator with 0.1N sodium hydroxide and/or 1.0N sulfuric acid. Once water was prepared, the previous sample stagnating in the pipe was collected by gently tipping the pipe over. The freshly prepared water was then poured into the re-clamped pipe, and the previous sample was acidified using 1:1 HNO_3 to achieve a pH of less than 2. Details of the individual products tested and other test conditions are summarized in Table 4-3 and in the discussion of the results for each "phase".

Table 4-3
Bench scale test matrix

Testing Phase	Pipe Number	Inhibitor	Orthophosphate Target Dose (mg/L PO_4)	pH Target (pre-Inhibitor)
1		Sodium o-PO_4	3.0	8.1
2a	1	Sodium o-PO_4	3.0	No Adjustment
	2			
	3			
	4			
2b	1	Sodium o-PO_4	3.0	8.4
	2	90/10 Blend		
	3	ZOP		
3a	5	90/10 Blend	3.0	8.4
	6	ZOP		
3b	5	90/10 Blend	3.0	8.4
	6A	ZOP		
	6B	90/10 Blend		
3c	6A	90/10 Blend	3.0	8.4
	6B	ZOP		
4	8	90/10 Blend	3.0	8.4
	10			
	14			

Results

Phase 1

The pipe in Phase 1 was the only pipe tested that had not been exposed to the 90/10 product prior to harvesting. This pipe was extracted from a home before the change of CCT occurred. Therefore, this pipe contained scales representative of conditions during the peak lead release event. It was dosed with sodium orthophosphate (Sodium o-PO_4), trade name SLI-5179 (Shannon Chemical Corporation, Malvern, PA). Results for this phase of testing are shown in Figure 4-7.

The results in Figure 4-7 suggest that the orthophosphate dose did result in stabilizing the total lead at <10 µg/L after about 4 weeks of daily water exchanges. Paired filtered and total lead samples were occasionally collected. The median filtered lead was 11 µg/L, ranging from 4 to 18 µg/L. These data measured for filtered lead and the trend for total lead presented in Figure 4-7 suggest that the filtered lead was ~10 µg/L during this contact period and the remainder of the total lead measured was particulate lead. Consequently, the improvement indicated in Figure 4-7 may have been exclusively due to a decrease in particulate lead, and therefore stabilization of the scales.

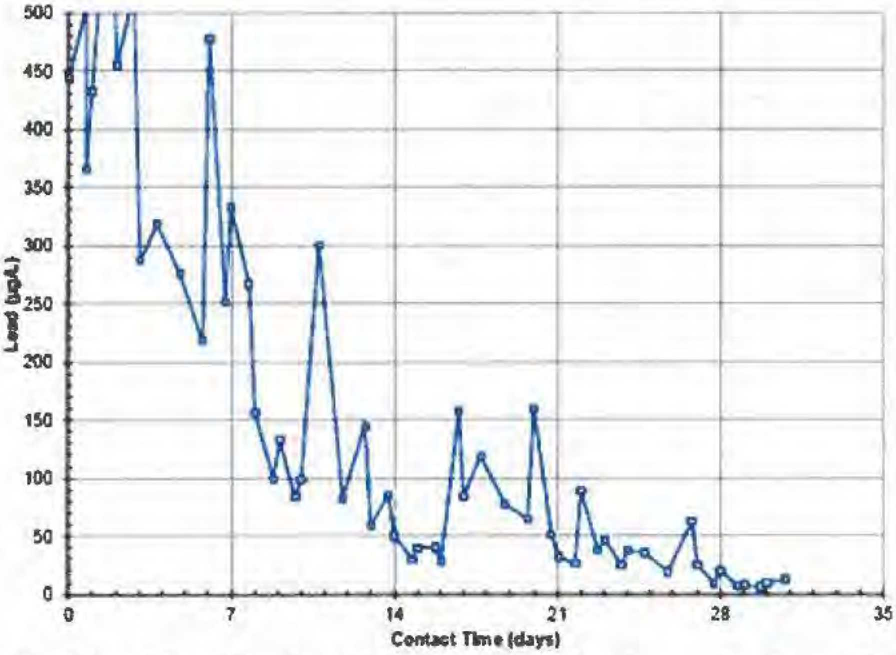

Figure 4-7 Phase 1 Lead Results with Sodium Orthophosphate at 3 mg/L as PO_4

Phase 2

Phase 2 originally consisted of four harvested copper pipes with small copper elbows. These were tested in a similar once-a-day complete fill and dump sampling, with pH adjustment to 8.4 before the addition of phosphate product. The pipes were first acclimated to 3 mg/L as PO_4 sodium o-PO_4 without pH adjustment (see Table 4-3). During this period, one pipe was dropped from the study due to an accident causing a partial loss of the first layer of scale in this pipe specimen. The remaining three pipe specimens were then evaluated in pH adjusted water (pH 8.4) for about 3 weeks using 3 mg/L as PO_4 for sodium o-PO_4 in one pipe, ZOP, in one pipe, and the 90/10 blended phosphate currently used in UP (LPC132) in the third pipe. The three products are the same as listed above for Phase 1 of the harvested pipe studies, or in the lead solubility (coupon) studies described earlier in this chapter. Results from these three pipes are depicted in Figure 4-8.

Results in Figure 4-8, coupled with observations from studies described earlier in this chapter, suggest that within 3 weeks the steady-state lead was < 10 µg/L with orthophosphate alone (ZOP or sodium o-PO_4) or with the LPC132. There were a few high total lead variations within this first 3 weeks of water contact, which may have been variable releases of particulate lead.

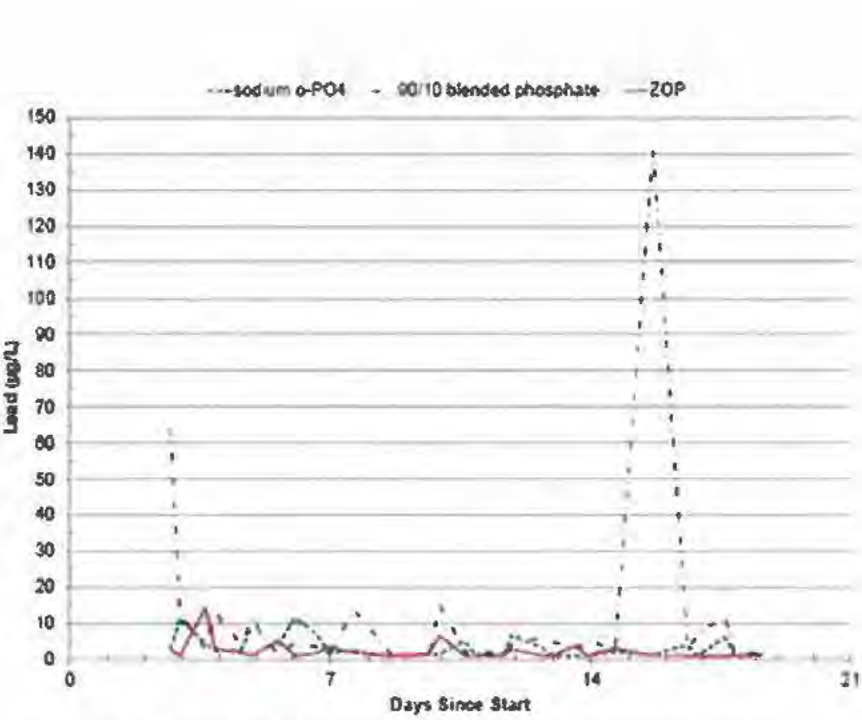

Figure 4-8 Phase 2 Lead with 3.0 mg/L as PO_4 Sodium Orthophosphate

Phase 3

A harvested copper pipe from Pipe 5 with a lead solder joint was evaluated in Phase 3 with a 3.0 mg/L as PO_4 dose and the same 90/10 blended phosphate discussed previously (LCP-132). A different copper pipe with two lead solder joints was harvested from another house and cut in half (one lead solder joint in the middle of each). After the pipe was split, one part (called 6B) was dosed with 3 mg/L of 90/10 blended phosphate. Pipe 6A was dosed with 3 mg/L as PO_4 of ZOP.

The monitoring results for these three pipe segments are summarized in Figure 4-9 for dates prior to Day 38. Prior to this time, the results in the pipe 5 (dosed with the 90/10 blended phosphate) had leveled off below 5 µg/L so testing of this pipe was halted. After Day 38, the corrosion control products in the 6A and 6B pipe segments were switched, so that before Day 38 pipe 6A was dosed with ZOP and after Day 38 with the blended phosphate, and for pipe 6B the switch on Day 38 was from blended phosphate to ZOP. The results in Figure 4-9 suggest the following:

- Pipe 5 leveled off at <5 µg/L after Day 6 and remained at this level until the study was terminated
- Pipe 6A also leveled off at <5 µg/L after ~3 weeks (with one spike >200 µg/L at Day 34), while dosed with ZOP, then leveled off at <4 µg/L after being switched to the blended phosphate after Day 38
- Pipe 6B released much higher lead then 6A, the lead was starting to come down around day 25. When switched to ZOP after Day 38, the decreasing trend in total lead

continued from the previous week of contact with blended phosphate (Days 32 to 38) with no apparent change in lead trend due to the inhibitor change.

Overall, the results in Figure 4-9 show that the 90/10 blend was successful in reducing lead solubility over time.

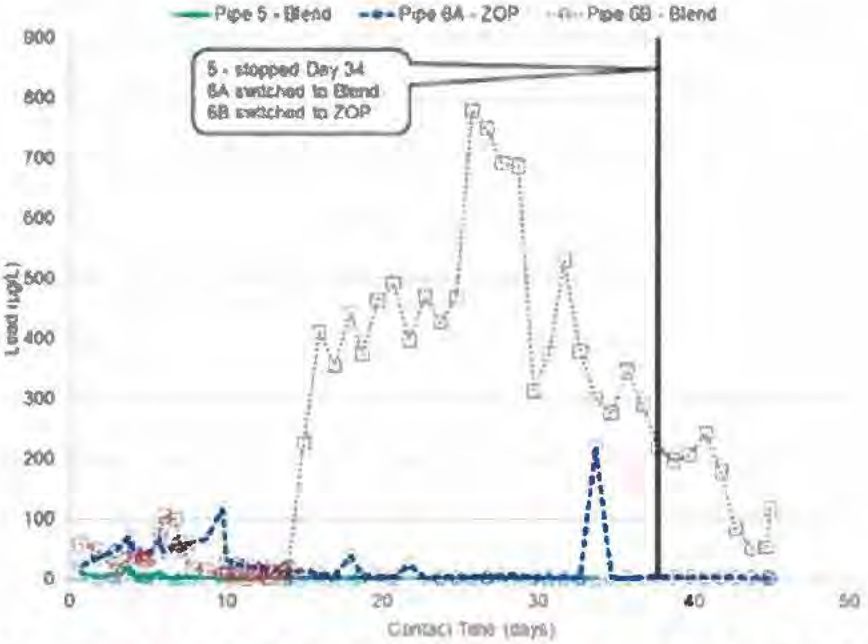

Figure 4-9 **Phase 3 Lead – 3 mg/L as PO_4 Blended Phosphate and ZOP, Including Two Adjacent Segments of Copper Pipe (Each with a Lead Solder Joint)**

Phase 4

Three additional pipes (copper with lead solder) were evaluated. All three received 3 mg/L as PO_4 of the LPC-132 blended phosphate described above, with pH adjusted to 8.4.

Lead data from these pipes (Pipes 8,10,14) are shown in Figure 4-10. Results from all three pipes leveled off within 3 weeks to < 5 µg/L with the 3 mg/L as PO_4 blended phosphate dose (there was a spike at day ~33 for pipe 14 due to a random release of particulate lead in harvested pipe segment tested). These results, in comparison to other results presented in this chapter, suggest that lead solubility using copper pipes with lead solder harvested from several University Park locations all achieved steady-state within a few weeks when exposed to LPC-132.

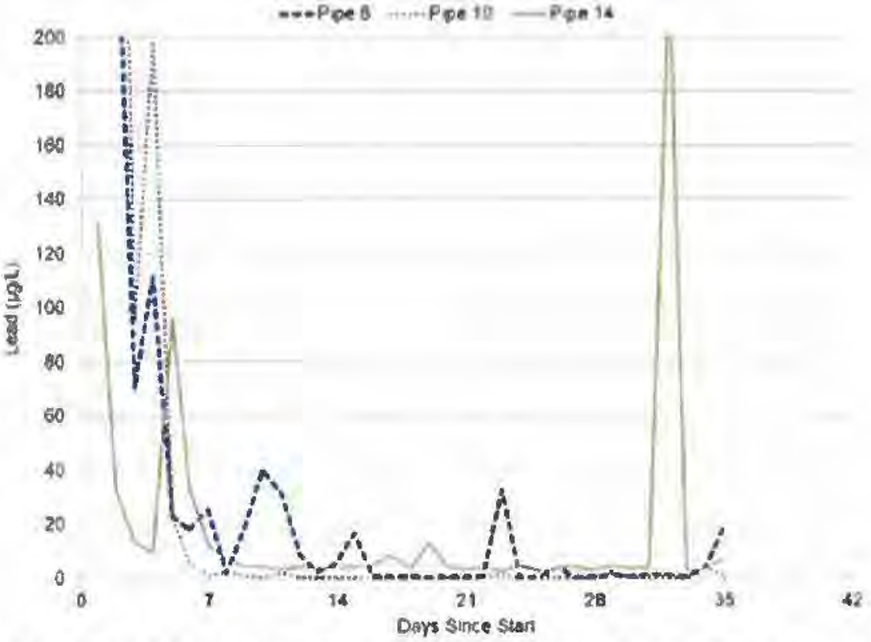

Figure 4-10 **Phase 4 Lead – 3 mg/L as PO_4 Blended Phosphate in Pipe Segments (Copper with Lead Solder) at Three Houses**

Summary of Stagnant Pipe Studies

The four phases of dump and fill studies described above all used harvested pipe with an elbow or joint containing lead solder. The results of these studies demonstrated that low lead could occur as fast as a few days and at least within 3 to 4 weeks. The same low levels (typically <10 µg/L and often <5 µg/L) could be achieved with either sodium orthophosphate, zinc orthophosphate (ZOP), phosphoric acid (H_3PO_4), or the 90/10 blended phosphate product. In particular, the results in Phase 1 and 4 demonstrated that higher lead levels (>100 µg/L) were present initially when water was placed in contact with the harvested materials, and then these leveled off to the lower levels described above after sufficient contact time.

PIPE SCALE ANALYSIS

Pipe Harvested from UP Prior to Switch to LPC-132

This pipe was received on June 15th, 2019 and had been harvested from a home located in UP prior to the use of the LPC-132 product. Therefore, it represented pipe scales that were last exposed to Kankakee treated water containing a polyphosphate and low orthophosphate blend. Extracted and prepared pipe scales were analyzed by x-ray diffraction (XRD) and scanning electron microscope / energy dispersive spectroscopy (SEM/EDS). Pipes were delivered to Cornwell where they were visually inspected. Cornwell laboratory then removed and separated three layers of scale and sent them to the University of Florida for analyses. Testing at UF was overseen by Dr. Cornwell. Figure

4-11 is a picture of the copper pipe as received. Figure 4-12 show more detail after cutting and splitting open the pipe prior to removing any scales. Figure 4-13 shows each of the layers.

Figure 4-11 Original Condition of Pipe Received

Figure 4-12 Pipe Prior to Scale Removal

Figure 4-13 Layers of Scale Removed from Harvested Pipe

Layer 1 was characterized as being very loose and easy to brush off. Layers 2 and 3 were more stable and had to be scraped off.

XRD analysis showed the presence in all three layers of cuprite and malachite. Both of these are fairly insoluble compounds and high copper levels would not be expected unless there is amorphous copper in layer 1 which has the loose scales. No lead compounds were identified.

The SEM/EDS results did show the presence of lead, although low quantities, as shown in Figure 4-14. The brighter dots are lead, but the dots are relatively dim so lead is present but not at high levels. The lead was highly associated with phosphorus and oxygen as was found by overlaying scans of those elements.

Figure 4-14 SEM Image Map of Lead in Layer 1 of Pipe

The semiquantitative results by SEM/EDS also showed large amounts of iron and significant calcium. Those elements are likely latent from when the well water was used. Layer 1 was also acid dissolved and analyzed by ICP MS. The following weight to weight concentrations were found:

Cu—21 %

Fe—14%

Pb---0.2%

The pipe was also inspected inside for the presence of visible solder at or near the solder joint. No solder was found. This indicates that the lead that was originally present as solder, had dissolved and some portion of that lead was trapped in the scales. The presence of lead in layer 1 and the loose nature of the scale are the likely contributors of lead to the water in this pipe. Some water chemistry changes likely disrupted the scale, releasing lead. The presence of high iron in layer 1 also is an indicator that if this scale was disturbed in some fashion it would be easy for loosely associated lead in the scale to be released in particulate form.

Pipes 6A and 6B

These pipes were both harvested from the same house around August 5th, 2019. Therefore, these pipes had been exposed to Kankakee water with 90/10 phosphate for about two months. These two pipes came from a single pipe in the home that had two lead solder joints with the joints located about 18 inches apart. Once the pipe was received at Cornwell, it was divided into two segments –6A and 6B. As discussed earlier, Pipe 6A was releasing very little lead into the water while 6B was releasing higher quantities in the laboratory testing.

As with the above pipe, after cleaning off the scales, there was no visible lead solder found on either pipe. Therefore, it was unlikely that intact solder was the lead source in pipe 6B. Figure 4-15 shows a close up of 6B at the joint. There is some visible lead in the copper seam where the pipe was cut, but none inside the pipe.

Figure 4-15 Close Up of Pipe 6B

There was also not a loose layer 1 like in the previous pipe. This lack of a loose layer could be because of the exposure for about 2 months to the 90/10 phosphate. Figure 4-16 shows the pipes before removing any scales. Three layers were removed from each pipe for analysis, but there was not enough material for any XRD tests. Some limited material was available for SEM microprobe, WDS, and EDS analysis.

Figure 4-16 Pipes 6A (top 2) and 6B (bottom 2) Prior to Scale Removal

Using a WDS (wavelength-dispersive spectroscopy) scan, it is interesting that for pipe 6A (Figure 4-17) there was little to no lead found in the scales. Recall that this is the pipe that was not releasing lead into the water in the laboratory tests (Phase 3 – see earlier discusion).

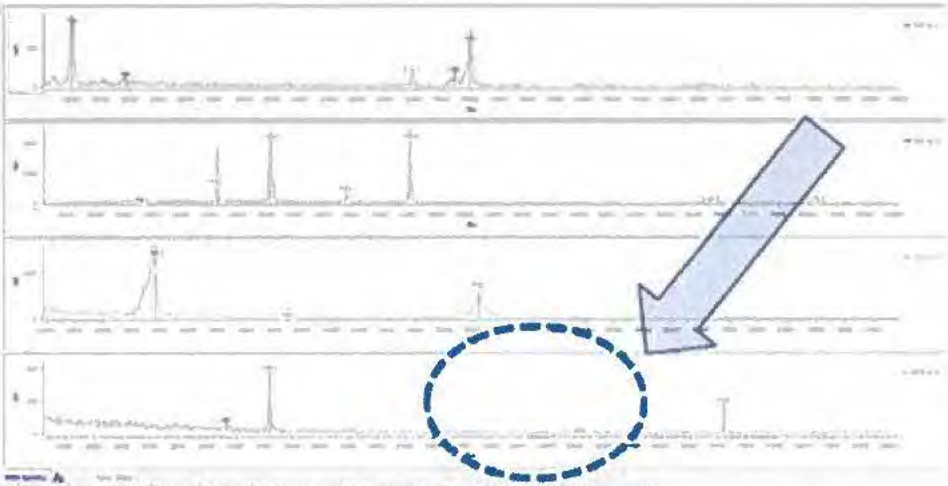

Figure 4-17 WDS Scan of Pipe 6A-lead would have spiked in the circle area if present

If lead were present a spike would have appeared in the circled area highlighted in Figure 4-17 In contrast, in pipe 6B lead was found in the scales as indicted by the spikes noted by the circle in Figure 4-18

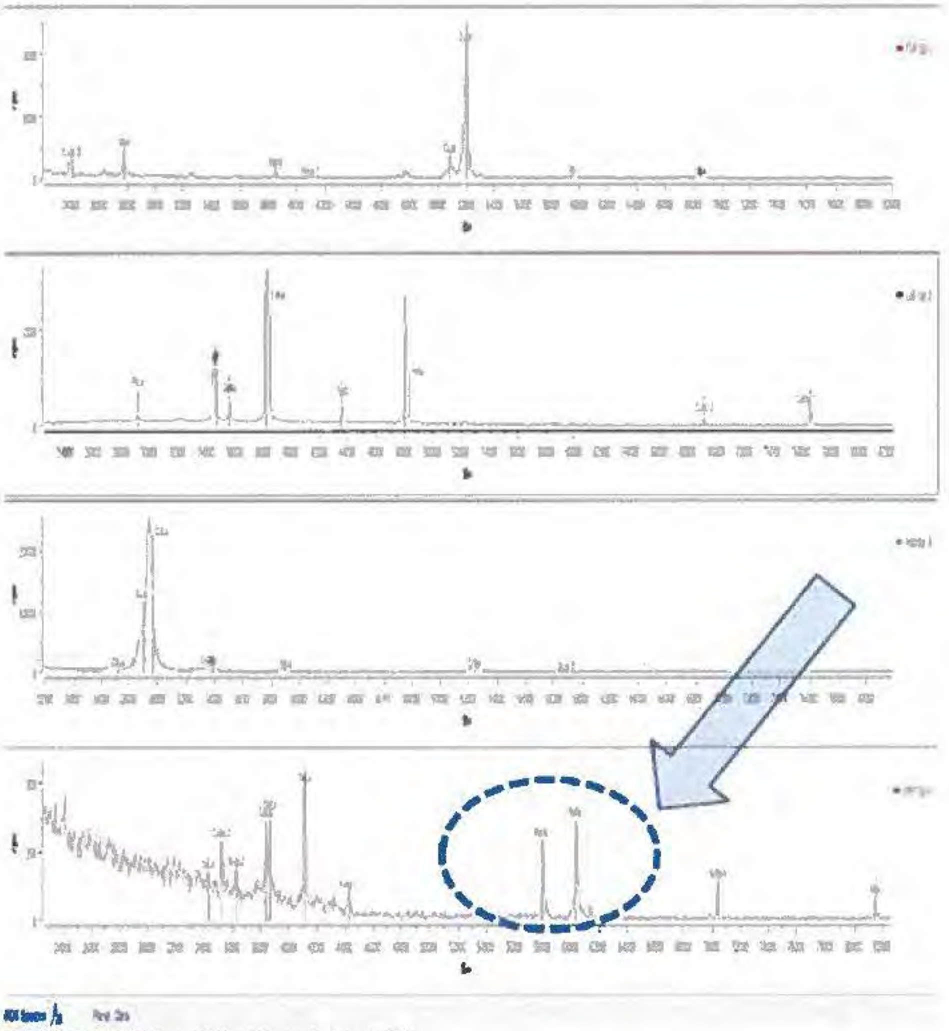

Figure 4-18 WDS Scan of Pipe 6B – peaks are circled

In Figure 4-19, zoomed at about a 300-micron scale, all of the bright spots were confirmed as lead using the microprobe feature scanning for lead.

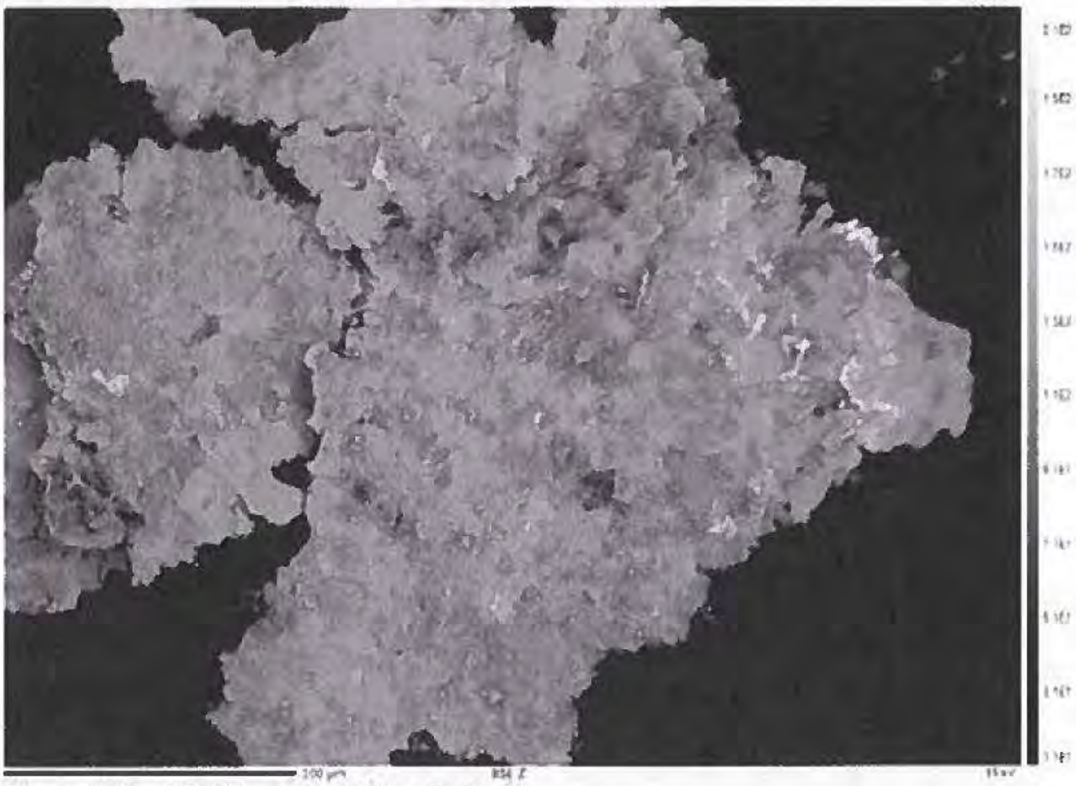

Figure 4-19 SEM Capture of Pipe 6B Scale

The scale results agree with the laboratory testing on lead leaching. Pipe 6A had little lead in the scales while 6B did have lead present in the scales, even though these two pipe segments are from the same house and same pipe within the house. The original lead present as solder in pipe 6A had apparently dissolved and not collected in the scales near that couple. The lead had either been flushed out or collected in downstream scales.

INVESTIGATING CORROSION INHIBITOR EFFECTIVENESS FOR GALVANIC COPPER AND SOLDER[‡]

Background

Analysis of samples shipped from homes with elevated lead to Virginia Tech, were subjected to strong acid (2% nitric) digestion and metals analysis. The results from a number of homes indicated a very strong correlation (R^2= 0.93) between lead and tin in water, demonstrating that the lead was somehow derived from lead:tin (Pb:Sn) solder corrosion.

The water lead from solder in 2019 could come from legacy corrosion issues decades ago when the pipes were new in the groundwater, if the switch to surface water somehow triggered sudden detachment of old rust layers on home plumbing. It is also possible that the high lead from solder could come from sudden corrosion of the lead solder joints starting in 2019. It is also possible that a combination of these two mechanisms was involved.

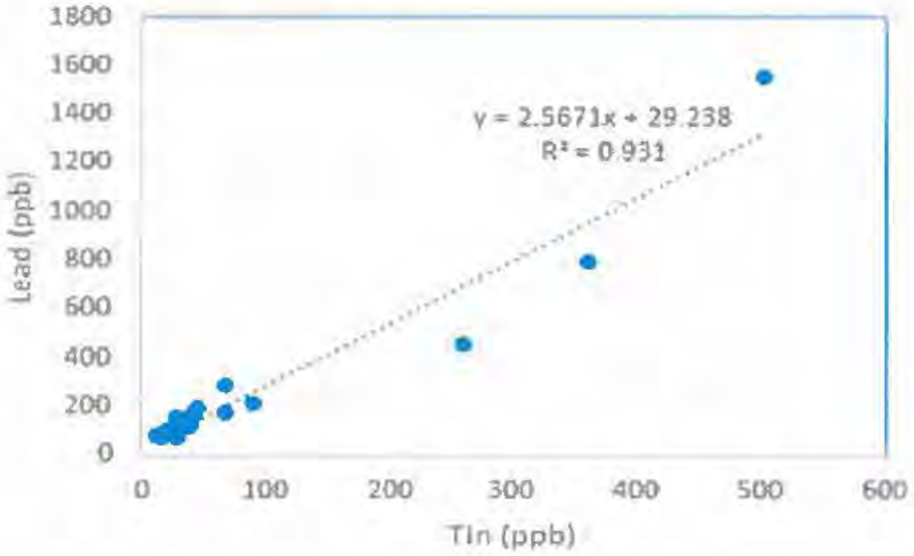

Figure 4-20 Lead Versus Tin in Water of University Park Homes Demonstrates a Strong Correlation and a Lead:Tin Solder Source

The goal of this research was to study trends in lead release from new lead solder galvanically connected to copper, in University Park water with a range of corrosion inhibitors. These tests had

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[‡] Marc Edwards, Christian Lytle, Rusty Rouillier, and Jeff Parks

no legacy lead in the rust of the new pipe samples. Consequently, the results reveal the galvanic lead solder corrosion potential of the water with each inhibitor type.

Testing Protocol

Seven water chemistries were tested to evaluate the relative effectiveness of corrosion control methods in University Park water derived from the Kankakee River (Table 4-5). The control water was treated Kankakee River without inhibitor. Conditions with polyphosphate, zinc orthophosphate, orthophosphate, ortho-poly 90:10 blend, polyphosphate + nitrate were also tested. The first phase of experiments was 2 weeks duration (Phase 1), after which time it was deemed desirable to try and test a more aggressive water condition in a second phase of experiments (Phase 2). Testing was conducted with 50:50 lead:tin solder galvanically connected to copper pipe (Figure 4-21).

The Phase 2 water involved mixing treated Kankakee water with a lower sulfate, lower alkalinity and similar chloride water in a ratio of 2/3 to 1/3, to obtain a water chemistry with a higher chloride to sulfate mass (CSMR) ratio (Figure 4-22). The Phase 2 water was designed to represent a future water quality if existing trends in Kankakee River alkalinity, chloride and sulfate were to continue for a period of years, and/or to test speculation about "worst-case" conditions during a very high rainfall event that occurred during 2019. In Phase 2 a higher dose of polyphosphate was also tested (Table 4-5). Another control condition without any inhibitors using Kankakee water in the 2/3 to 1/3 ratio was also tested in Phase 2.

Table 4-4

Water test conditions in terms of added (amended) total phosphorus (mg/L as P), total Zn+2 and nitrate (mg/L as N) in Kankakee River water

	Phase 1			Phase 2		
Name	P	Zn^{+2}	Nitrate	P	Zn^{+2}	Nitrate
Poly	0.5			1.4		
Zn Ortho	1	0.5		1	0.5	
Ortho P	1			1		
Ortho Poly	1			1		
Poly +Nitrate	1		3	1		3
*Phase 2 Control						
Control						

*1/3 Synthetic Water – 2/3 Kankakee

Figure 4-21 Apparatus Used for Testing. Solder Coupons in Glass Jars (Left) and 5 Replicates for Each Inhibitor Condition (Right)

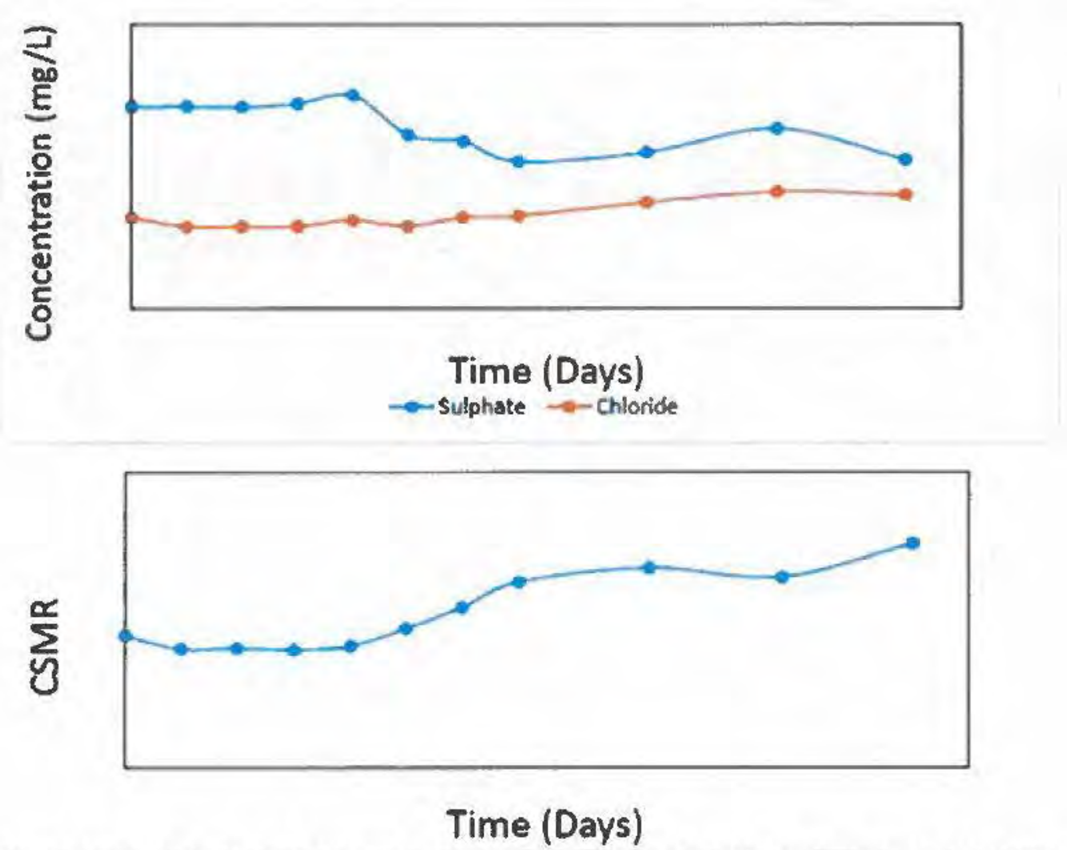

Figure 4-22 Sulfate and Chloride Levels During Phase 1 from Day 1 to 14 (100% Kankakee) and During Phase 2 from Day 15-42 with 2/3 Kankakee and 1/3 Synthesized Water (Upper). CSMR During the Study (Lower)

A 'dump-and-fill' testing procedure was used to simulate worst-case leaching conditions in service lines or buildings. Due to the long stagnation time and relatively new age of the plumbing, values reported in this work are not representative of those expected at the tap. They are "worst case" values which tend to be higher than those found in a typical potable water system, and results are suitable for rendering relative judgments in effectiveness of corrosion control for a galvanic couple. For the lead:tin solder galvanically connected to copper testing, the coupons were stored in glass vials. Five replicates were used for each water quality condition. The vials were manually filled and dumped every day. Compositive samples combining all 5 replicates were collected and analyzed for routine analysis, whereas at the end of each phase, each bottle replicate was sampled 3 days in a row to generate a dataset (typically n = 15, due to 5 replicates sampled 3 times). Samples were analyzed via inductively coupled plasma with mass spectroscopy (ICP-MS). Phosphorus, zinc, sulfate and chloride concentrations were also evaluated by ICP-MS. During Phase 2 water samples were occasionally allowed to stagnate for 72-96 hours, allowing comparison to results after 24 hours stagnation.

Results and Discussion

After discussing Phase 1 and Phase 2 results, the relative corrosivity and effects of stagnation time are evaluated.

Phase 1 composite trends and statistical results

During the initial two-week exposure (upper Figure 4-22) lead levels dropped rapidly as the pipe surfaces formed protective scales, before leveling off in this very short-term test. The zinc orthophosphate condition always had the lowest lead in Phase 1, whereas the 90:10 ortho:poly blend eventually produced very low lead results. For the final analysis both zinc orthophosphate and the ortho:poly blend had the lowest lead results and were statistically similar. Both of these conditions were statistically lower than any other condition tested. Relative to the Kankakee treated water with polyphosphate, lead levels with the zinc orthophosphate and ortho:poly blend were about 6 times lower.

Phase 2 composite trends and statistical analysis

During Phase 2 testing lead levels continued to drop, even though the water was altered in a manner deemed likely to increase corrosivity to lead:tin solder (upper Figure 4-23). The net result was the same ranking of inhibitor effectiveness as in Phase 1, with both zinc ortho and the ortho:poly blend producing the best performance (lower Figure 4-23). Both of these conditions were superior to any other condition tested.

Relative Effect of Phase 1 versus Phase 2 water

Ironically, lead levels were lower in the higher CSMR water (i.e., ratio Phase 2 concentration divided by Phase 1 concentration < 1.0), presumably because of the dominant effect of forming protective scale layers during this short-term test (Figure 4-24). The control condition with 100% Kankakee water showed the least improvement in Phase 2 versus Phase 1.

Relative Effect of Longer Stagnation Time

Contrary to expectations, lead levels with a longer 72-96 hour stagnation event, did not always indicate higher lead relative to results with a 24 hour stagnation event. Specifically, the ratio of the longer term stagnation lead concentration to the 24 hour stagnation result, was only 0.3 for the zinc ortho condition, and 0.9 for the poly and the ortho:poly blend (Figure 4-25). In other words, the concentration of lead after the longer stagnation was lower for these conditions versus the result after 24-hour stagnation. In contrast, all of the other conditions tested, demonstrated a 20-90% increase in lead after the longer term stagnation event compared to the 24 hour stagnation event.

Conclusion

Both zinc orthophosphate and a 90:10 ortho:poly blend, provided superior control of lead:tin solder galvanic corrosion for new pipes without pre-existing scale, compared to conditions with polyphosphate or no inhibitor. This was the case in both existing treated Kankakee water and in Kankakee water with higher CSMR.

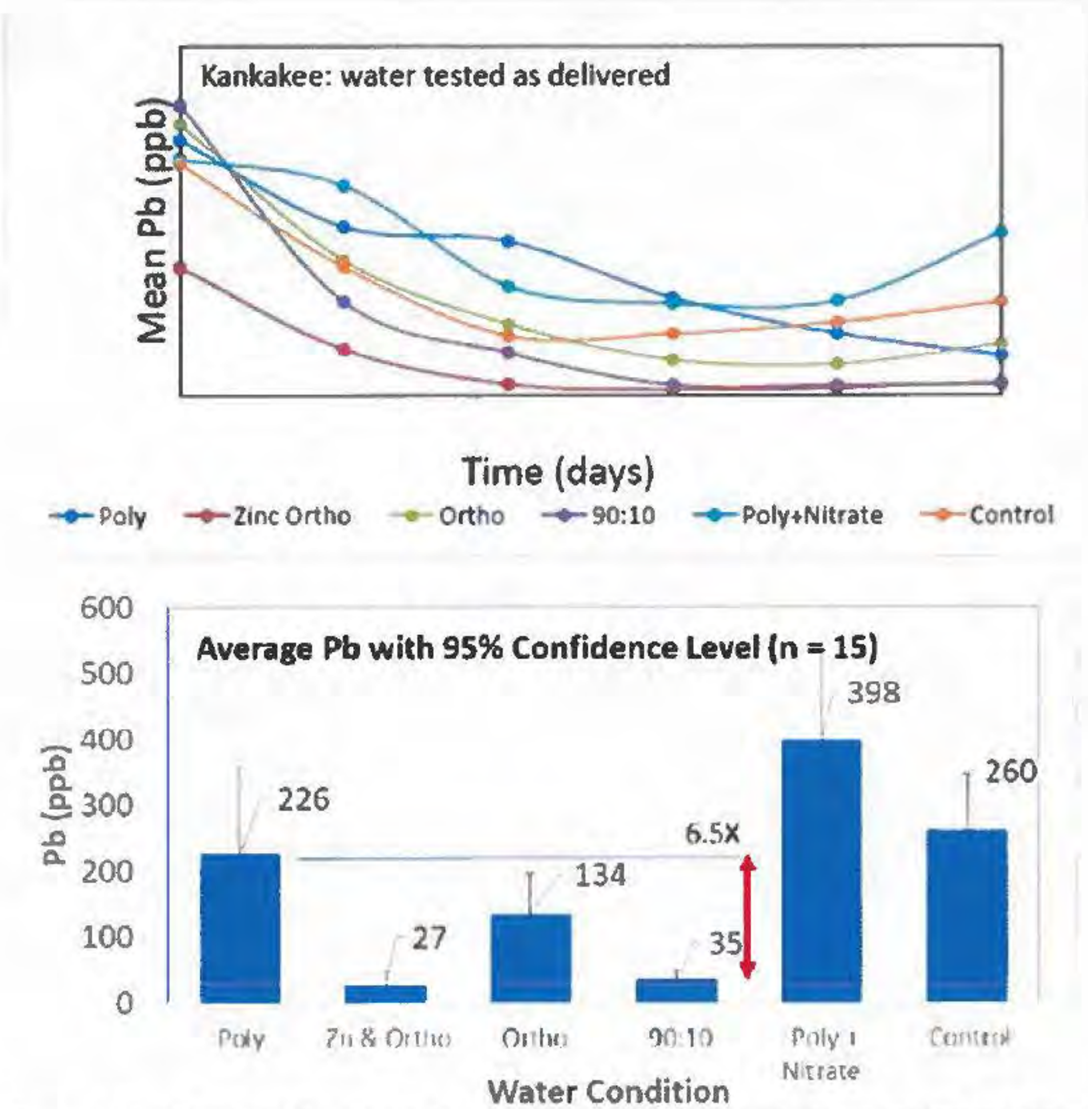

Figure 4-23 **Results of Composite Samples from All Replicates, Indicating Trends in Lead Release Using 100% Kankakee Water with Different Types of Corrosion Control (Upper)**

During the last three days of sampling, each of the five replicates was sampled on three sequential days (n=15) to create final results with 95% confidence intervals (lower).

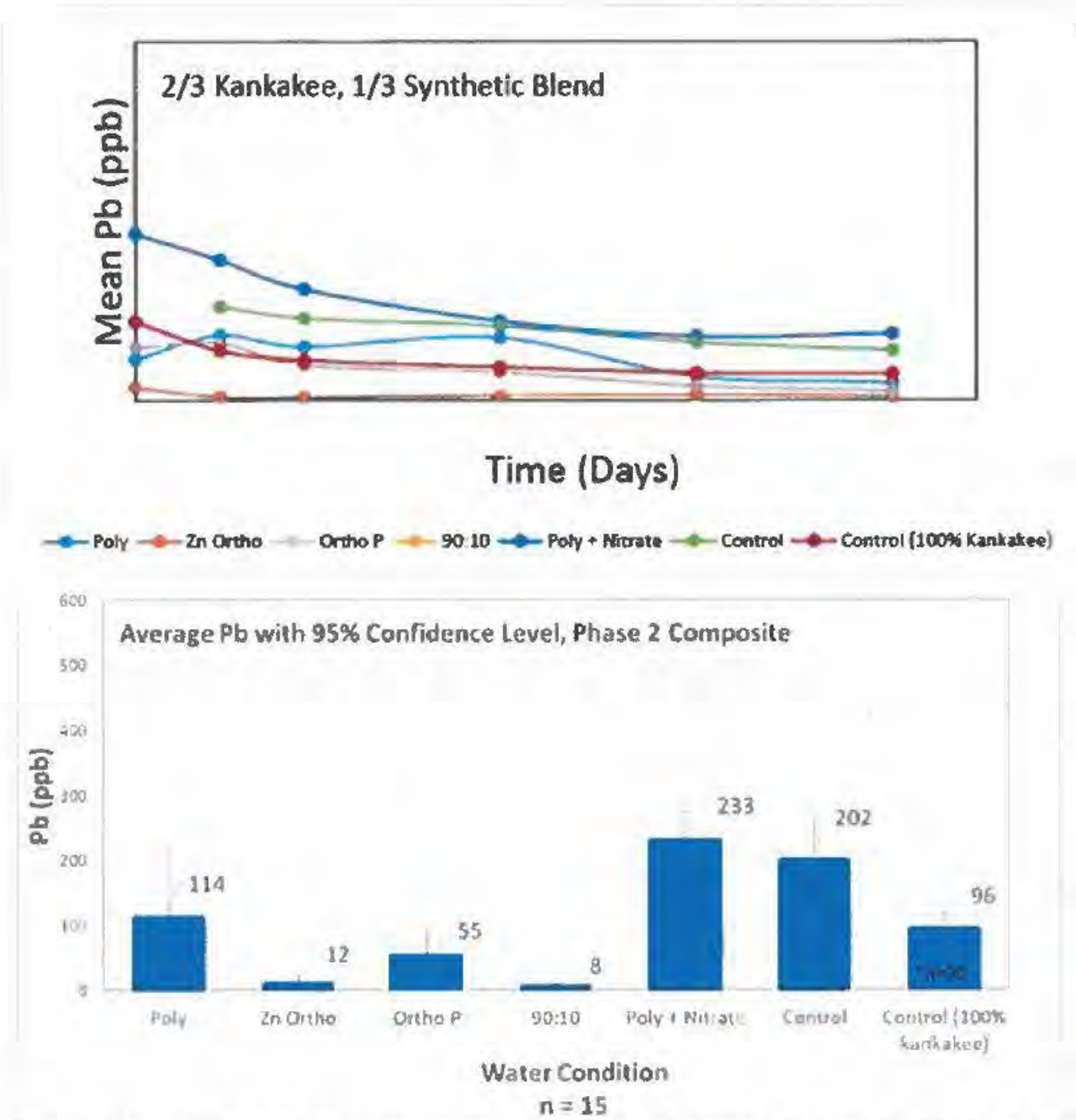

Figure 4-24 **Results of composite samples from all replicates, indicating trends in lead release using a blend of 2/3 Kankakee and 1/3 synthetic water, designed to replicate hypothesized conditions that are more aggressive in terms of lower sulfate and alkalinity during runoff events or in a decade (upper)**

Control sample in red is 100% Kankakee whereas all other samples represent the more aggressive conditions. The first data point is still using 100% Kankakee (Figure 4-20), whereas later dates are those representing the more aggressive water. After sampling on 3 sequential days with 5 replicates per condition (n = 15), final results are indicated with 95% confidence intervals (lower). The control with 100% Kankakee had n = 30 due to 10 replicates.

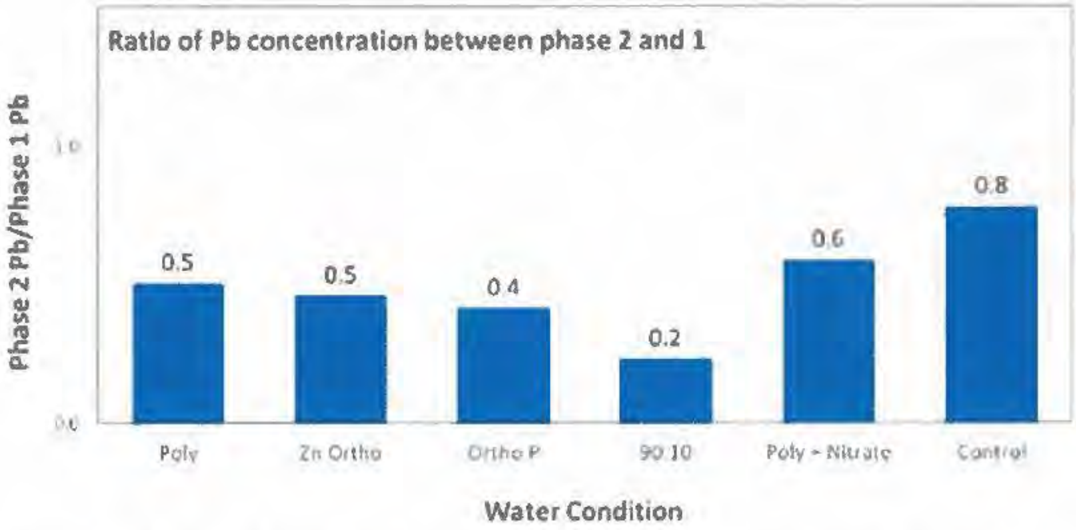

Figure 4-25 Relative Lead Leaching Under More Corrosive Conditions of Phase 2 (2/3 Kankakee and 1/3 Synthesized Water) Divided by Results of Phase 1 (100% Kankakee)

Surprisingly, the dominant effect was that a more protective scale continued to form during the experiment, which continued a downtrend in lead leaching in Phase 2 versus Phase 1, creating a ratio less than 1. The net result is that less lead was leached in the Phase 2 testing, despite the hypothesized more aggressive water.

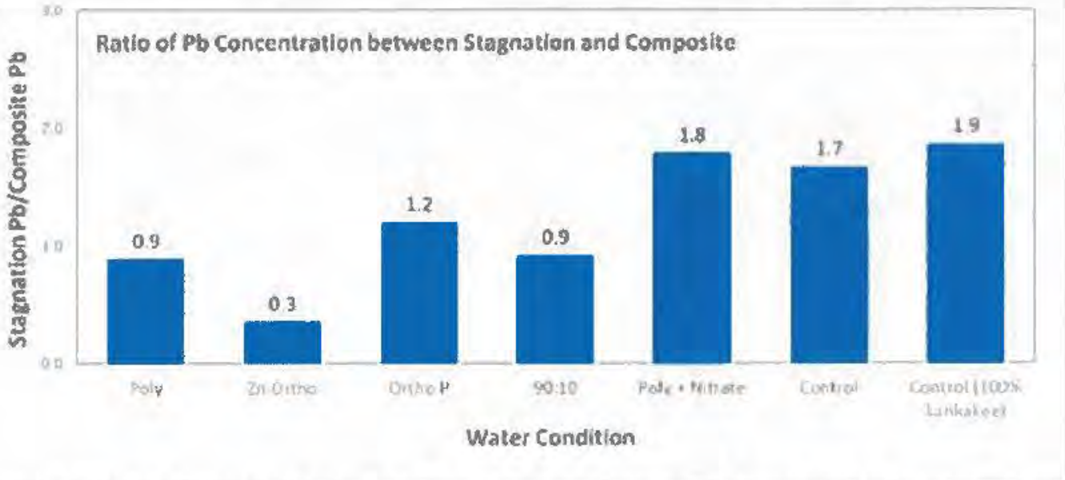

Figure 4-26 **Relative Level of Lead Under Long Stagnation Times (72-96 hours) Versus That Obtained During 24 Hour Composite Sampling (24 Hours)**
In the conditions with good corrosion control using zinc ortho and 90:10 blend, the lead level was slightly lower in the very long stagnation times (ratio < 1.0), where with conditions with the control water or with poly + extra nitrate, lead levels were higher with stagnation.

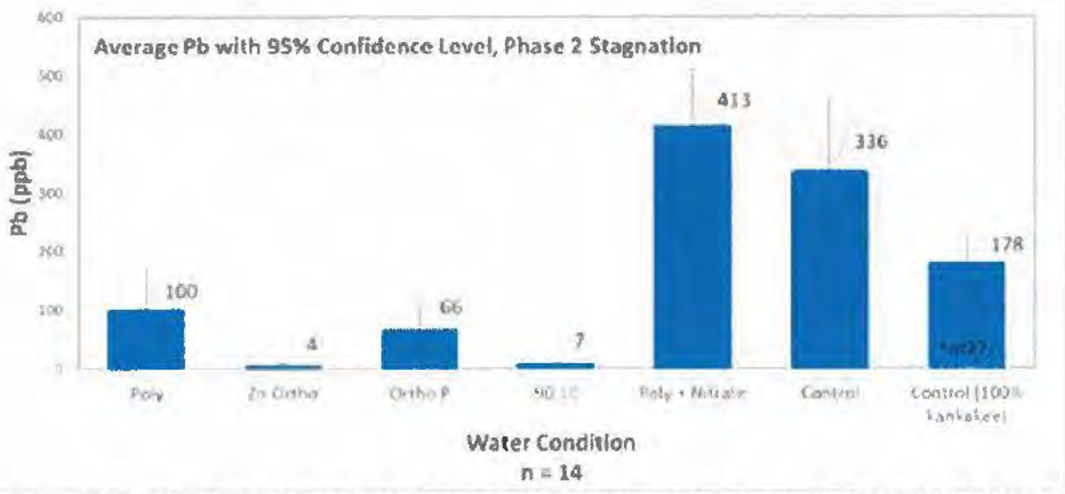

Figure 4-27 **Results with 95% Confidence Intervals for Samples Collected with Either 72 or 96 Hours Stagnation**

SUMMARY AND CONCLUSIONS (ALL BENCH-SCALE STUDIES)

The bench-scale testing results presented in this chapter demonstrate that low lead solubility can be achieved in the UP System, in the presence of copper pipe with lead solder and other lead-containing plumbing, applying a dose of 3 mg/L as PO_4 (1 mg/L as P) of the 90/10 blended phosphate currently used in University Park.

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CHAPTER 5
SUMMARY AND RECOMMENDATIONS

Based on the studies completed by Cornwell and Virginia Tech, and the results to date in University Park shown in Figure 5-1, it is recommended that the CCT be achieved in this system by targeting a dose of >3 mg/L as PO_4 using the current 90/10 blended phosphate (LC-132 by Hawkins, Inc.). Distribution system monitoring should target maintenance of an orthophosphate residual in representative locations in the University Park System of >3 mg/L as PO_4.

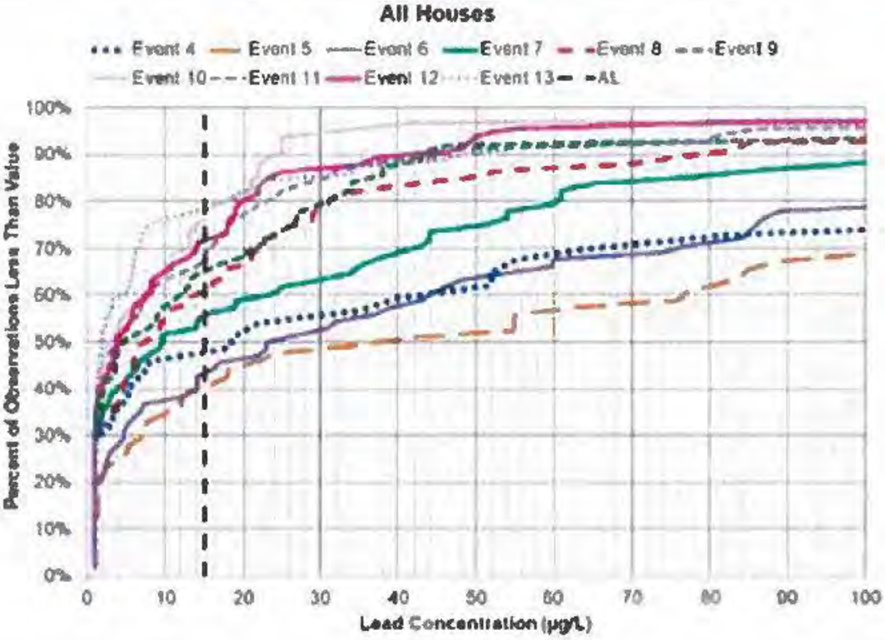

Figure 5-1 LCR Monitoring Data in University Park in 2019

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REFERENCES

Cornwell, D., and J. Wagner. 2019. "Coupon Procedures for Evaluating Lead and Copper Solubility." *Jour AWWA*, 111 (10):12-24.

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NDWAC (National Drinking Water Advisory Committee) 2015b. "Report of the Lead and Copper Working Group to the National Drinking Water Advisory Council – Final." Accessed September 30, 2018). https://19january2017snapshot.epa.gov/sites/production/ files/2017-01/documents/ndwacrecommtoadmin121515_0.pdf

APPENDIX B

April 2020 application for special permit by Aqua IL, and approval from ILEPA

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue, East; Post Office Box 19276; Springfield, IL 62794-9276

Division of Public Water Supplies Telephone 217/782-1724

PUBLIC WATER SUPPLY CONSTRUCTION PERMIT

SUBJECT: AQUA IL – UNIVERSITY PARK (IL1975030)

Permit Issued to:
Aqua Illinois
1000 S. Schuyler
Kankakee, IL 60901

PERMIT NUMBER: 1020-FY2020

DATE ISSUED: April 17, 2020
PERMIT TYPE: Plant Improvement

The issuance of this permit is based on plans and specifications prepared by the engineers/architects indicated and are identified as follows. This permit is issued for the construction and/or installation of the public water supply improvements described in this document, in accordance with the provisions of the "Environmental Protection Act", Title IV, Sections 14 through 17, and Title X, Sections 39 and 40, and is subject to the conditions printed on the last page of this permit and the ADDITIONAL CONDITIONS listed below.

FIRM: Cornwell Engineering Group
NUMBER OF PLAN SHEETS: na
TITLE OF PLANS: "Chemical Change Description"

PROPOSED IMPROVEMENTS:

Switch to a phosphoric acid corrosion control chemical

ADDITIONAL CONDITIONS:

1. An operating permit is required before feeding phosphoric acid.

2. The product must be NSF/ANSI 60 approved.

3. The minimum orthophosphate dose is 3 mg/L as PO_4. The expected pH range is 7.4 to 8.0 at the Central Avenue Booster Station. Optimal Water Quality Parameter ranges will be set at a later date through a Special Exception Permit after meeting the lead action level in two six month monitoring periods. Based upon all the orthophosphate tests and pH readings collected throughout the service area, notify the Illinois EPA if more than 10 percent of values for either parameter in any single month are outside of the expected ranges.

4. Monitor total chlorine, orthophosphate, pH, and alkalinity from at least nine locations at least once per week. The results must be sent to the Elgin Regional Office with the monthly operating reports.

5. During April 2020 monitor for lead and copper from at least one location on a weekly basis. The wastewater treatment plant is an acceptable location for this special condition.

IL 532-0168/PWS 065 Rev. 04-2007

6. Collect at least 40 lead and copper samples from approved sample site locations twice during May 2020, twice during June 2020, and monthly beginning in July 2020 until modified by a Special Exception Permit. The two sets May and June samples shall be divided by the 15th day of each month. Samples should be collected based upon highest past lead results and geographic representation.

7. The Illinois EPA may alter any of these additional conditions at a later date through issuance of a Special Exception Permit.

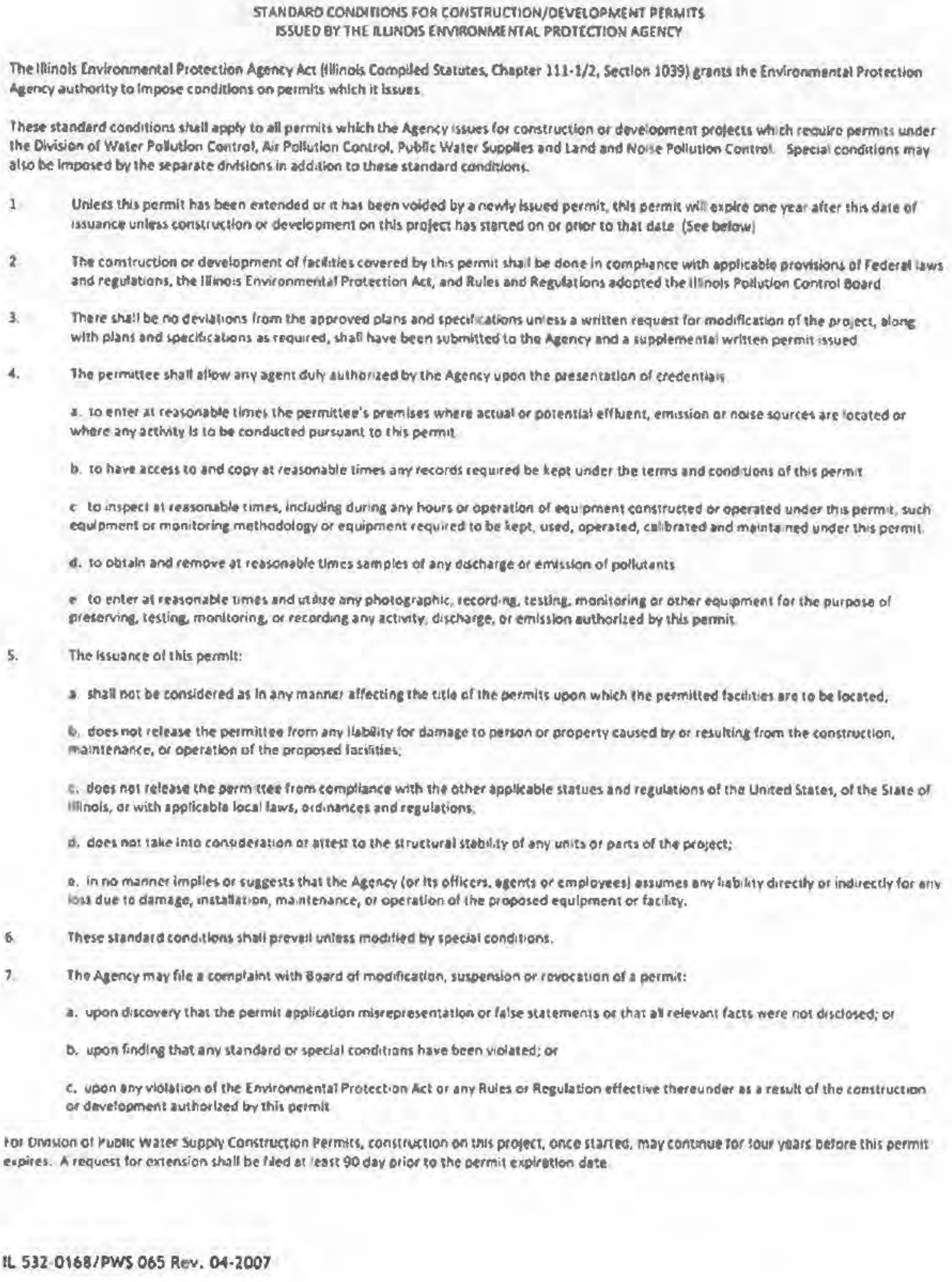
8. There are no further conditions to this permit.

DCC:

cc: Cornwell Engineering Group
DPWS/FOS – Elgin Regional Office

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

IL 532-0168/PWS 065 Rev. 04-2007



STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS
ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The Illinois Environmental Protection Agency Act (Illinois Compiled Statutes, Chapter 111-1/2, Section 1039) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

These standard conditions shall apply to all permits which the Agency issues for construction or development projects which require permits under the Division of Water Pollution Control, Air Pollution Control, Public Water Supplies and Land and Noise Pollution Control. Special conditions may also be imposed by the separate divisions in addition to these standard conditions.

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire one year after this date of issuance unless construction or development on this project has started on or prior to that date (See below)

2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted the Illinois Pollution Control Board

3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued

4. The permittee shall allow any agent duly authorized by the Agency upon the presentation of credentials

    a. to enter at reasonable times the permittee's premises where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit

    b. to have access to and copy at reasonable times any records required be kept under the terms and conditions of this permit

    c. to inspect at reasonable times, including during any hours or operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit.

    d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants

    e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit

5. The issuance of this permit:

    a. shall not be considered as in any manner affecting the title of the permits upon which the permitted facilities are to be located,

    b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;

    c. does not release the permittee from compliance with the other applicable statues and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;

    d. does not take into consideration or attest to the structural stability of any units or parts of the project;

    e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability directly or indirectly for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.

6. These standard conditions shall prevail unless modified by special conditions.

7. The Agency may file a complaint with Board of modification, suspension or revocation of a permit:

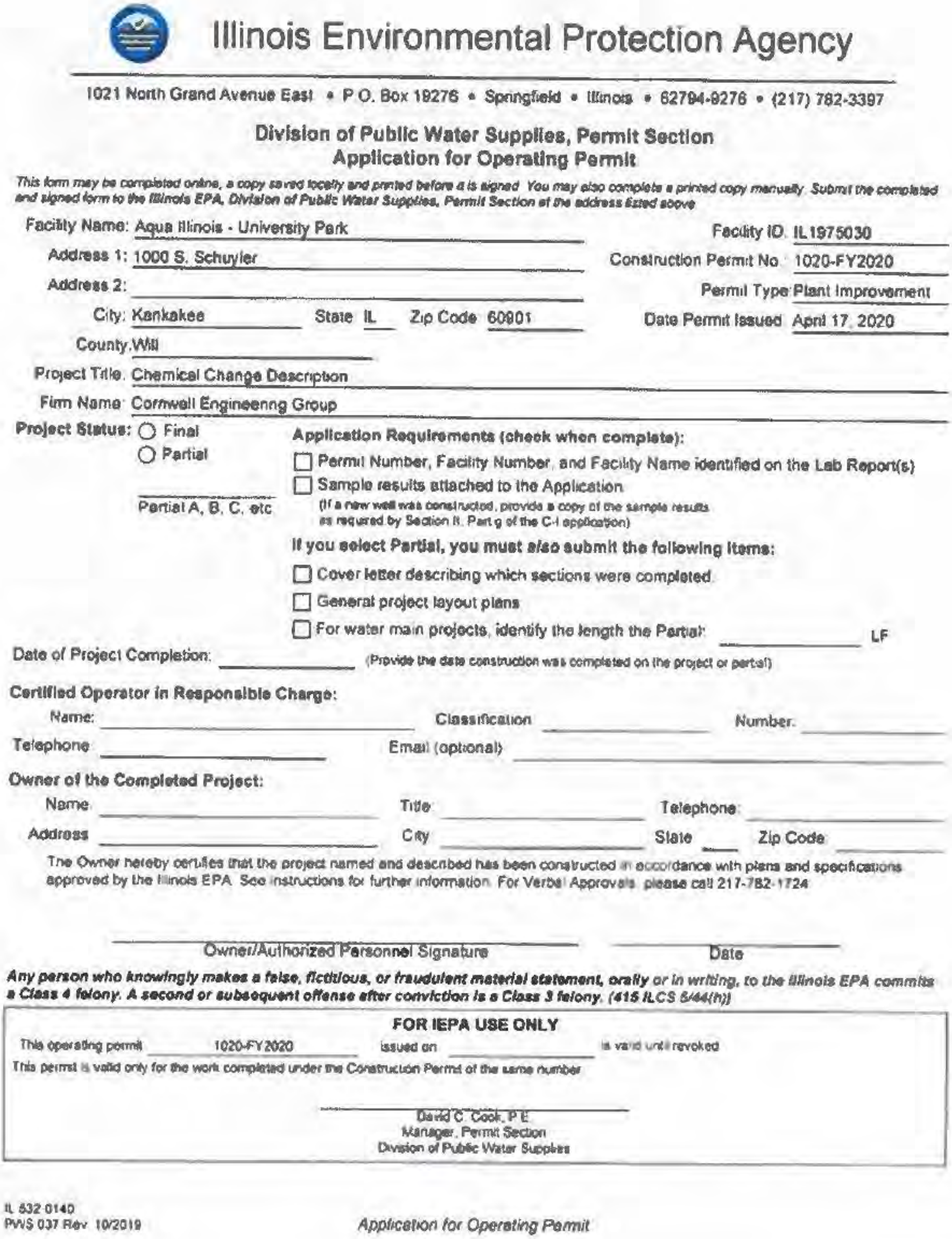
    a. upon discovery that the permit application misrepresentation or false statements or that all relevant facts were not disclosed; or

    b. upon finding that any standard or special conditions have been violated; or

    c. upon any violation of the Environmental Protection Act or any Rules or Regulation effective thereunder as a result of the construction or development authorized by this permit

For Division of Public Water Supply Construction Permits, construction on this project, once started, may continue for four years before this permit expires. A request for extension shall be filed at least 90 day prior to the permit expiration date

IL 532-0168/PWS 065 Rev. 04-2007



Illinois Environmental Protection Agency

1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276 • (217) 782-3397

Division of Public Water Supplies, Permit Section
Application for Operating Permit

This form may be completed online, a copy saved locally and printed before it is signed. You may also complete a printed copy manually. Submit the completed and signed form to the Illinois EPA, Division of Public Water Supplies, Permit Section at the address listed above

Facility Name: Aqua Illinois - University Park
Facility ID: IL1975030
Address 1: 1000 S. Schuyler
Construction Permit No.: 1020-FY2020
Address 2: ____
Permit Type: Plant Improvement
City: Kankakee State: IL Zip Code: 60901
Date Permit Issued: April 17, 2020
County: Will
Project Title: Chemical Change Description
Firm Name: Cornwell Engineering Group

Project Status: ○ Final
○ Partial
____
Partial A, B, C, etc

Application Requirements (check when complete):

☐ Permit Number, Facility Number, and Facility Name identified on the Lab Report(s)
☐ Sample results attached to the Application
(If a new well was constructed, provide a copy of the sample results as required by Section II, Part g of the C-I application)

If you select Partial, you must *also* submit the following items:

☐ Cover letter describing which sections were completed
☐ General project layout plans
☐ For water main projects, identify the length the Partial: ____ LF

Date of Project Completion: ____ (Provide the date construction was completed on the project or partial)

Certified Operator in Responsible Charge:

Name: ____ Classification: ____ Number: ____
Telephone: ____ Email (optional): ____

Owner of the Completed Project:

Name: ____ Title: ____ Telephone: ____
Address: ____ City: ____ State: ____ Zip Code: ____

The Owner hereby certifies that the project named and described has been constructed in accordance with plans and specifications approved by the Illinois EPA. See instructions for further information. For Verbal Approvals, please call 217-782-1724

Owner/Authorized Personnel Signature Date

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

FOR IEPA USE ONLY

This operating permit 1020-FY2020 issued on ____ is valid until revoked
This permit is valid only for the work completed under the Construction Permit of the same number

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

IL 532 0140
PWS 037 Rev. 10/2019

Application for Operating Permit

Instructions for Operating Permit Application

The Operating Permit Application must be submitted for all Public Water Supply projects that required a construction permit. The Operating Permit *must* be obtained before the project is placed in service.

Fill out the top section using the corresponding Construction Permit for reference.

- **Facility Name** is the name of the village, city or entity distributing community water supplies.
- **Facility ID Number** can be found on the Construction Permit. This number is specific to your facility.
- **Address** is the same as the address on the Construction Permit.
- **Construction Permit Number** is the assigned permit number of the corresponding Construction Permit. The Operating Permit and the corresponding Construction Permit will have the same permit number.
- **Permit Type** identifies whether the project involved is a Water Main, a Plant Improvement or Both.
- **Date Permit Issued** is the date the Construction Permit was granted.
- **Date of Project Completion** is the date construction was completed for the section of project you are requesting the Operating Permit for. If you are requesting an Operating Permit for a Partial project, the Date of Project Completion is the date construction was completed on that partial section. The Date of Project Completion will never be a date in the future, and must be a date *after* the issue date of the Construction Permit.
- **Title of Project** is the same title of project listed on the corresponding Construction Permit. The Operating Permit and the Construction Permit will have the same Title of Project.
- **Firm Name** is the engineering entity that designed the project.

Project Status will either be Final or Partial.

- **Final:** If construction on the project is complete, you will select **Final**.
- **Partial:** If construction on the total project is only *partially* complete, but you want to operate the completed section, you will select **Partial**. If this is the first partial, you will identify it as "Partial A", if this is the second partial, you will identify it as "Partial B" and so forth. Once the last partial section has been completed, identify it as such and also select Final in the Project Status.

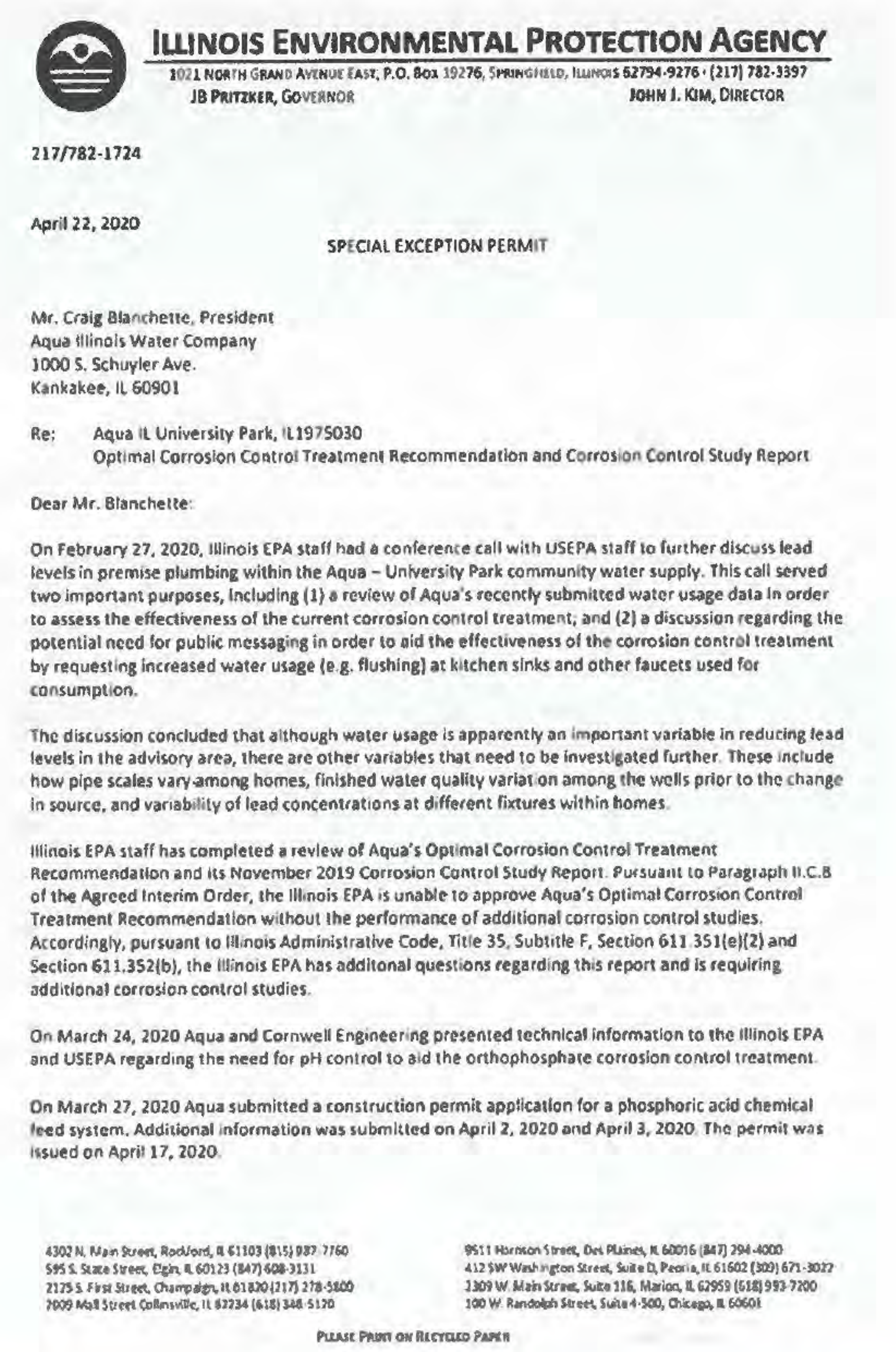
The **Certified Operator in Responsible Charge** and **Owner of the Completed Project** should fill out his/her respective section. Please print your name legibly and sign where appropriate. By signing the application, the owner hereby certifies that the project named and described has been constructed in accordance with plans and specifications approved by the Illinois EPA, including specifications for bacteriological samples, and that bacteriological samples (if required) were taken under the supervision of a representative from the Public Water Supply. The owner also certifies that the project will be operated in accordance with the provisions of the Illinois Environmental Protection Act and the Rules and Regulations adopted by the Illinois Pollution Control Board pursuant to provisions of the Act.

Requests for **Verbal Approval** and questions can be addressed at (217) 782-1724.

Disinfection and bacteriological analysis must be performed for the completed project in accordance with the requirements of AWWA C651, C652, C653 or C654. For projects requiring these procedures, the sample results must be attached to the application. The construction permit number should be clearly visible on the sample results. Samples are to be taken every 1,200 feet of new water main unless otherwise approved by the Illinois EPA. Samples must be measured using the Membrane Filter technique. Colilert/Colisure will not be accepted for new construction projects.

This form may be completed online, a copy saved locally and printed before it is signed. You may also complete a printed copy manually. Submit the completed form to the Illinois EPA, Bureau of Water, Permit Section at the following address:

Illinois Environmental Protection Agency
Division of Public Water Supplies, Permit Section #13
1021 North Grand Avenue East, PO Box 19276
Springfield, IL 62794-9276



ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR JOHN J. KIM, DIRECTOR

217/782-1724

April 22, 2020

SPECIAL EXCEPTION PERMIT

Mr. Craig Blanchette, President
Aqua Illinois Water Company
1000 S. Schuyler Ave.
Kankakee, IL 60901

Re: Aqua IL University Park, IL1975030
Optimal Corrosion Control Treatment Recommendation and Corrosion Control Study Report

Dear Mr. Blanchette:

On February 27, 2020, Illinois EPA staff had a conference call with USEPA staff to further discuss lead levels in premise plumbing within the Aqua – University Park community water supply. This call served two important purposes, including (1) a review of Aqua's recently submitted water usage data in order to assess the effectiveness of the current corrosion control treatment; and (2) a discussion regarding the potential need for public messaging in order to aid the effectiveness of the corrosion control treatment by requesting increased water usage (e.g. flushing) at kitchen sinks and other faucets used for consumption.

The discussion concluded that although water usage is apparently an important variable in reducing lead levels in the advisory area, there are other variables that need to be investigated further. These include how pipe scales vary among homes, finished water quality variation among the wells prior to the change in source, and variability of lead concentrations at different fixtures within homes.

Illinois EPA staff has completed a review of Aqua's Optimal Corrosion Control Treatment Recommendation and its November 2019 Corrosion Control Study Report. Pursuant to Paragraph II.C.8 of the Agreed Interim Order, the Illinois EPA is unable to approve Aqua's Optimal Corrosion Control Treatment Recommendation without the performance of additional corrosion control studies. Accordingly, pursuant to Illinois Administrative Code, Title 35, Subtitle F, Section 611.351(e)(2) and Section 611.352(b), the Illinois EPA has additonal questions regarding this report and is requiring additional corrosion control studies.

On March 24, 2020 Aqua and Cornwell Engineering presented technical information to the Illinois EPA and USEPA regarding the need for pH control to aid the orthophosphate corrosion control treatment.

On March 27, 2020 Aqua submitted a construction permit application for a phosphoric acid chemical feed system. Additional information was submitted on April 2, 2020 and April 3, 2020. The permit was issued on April 17, 2020.

4302 N. Main Street, Rockford, IL 61103 (815) 987-7760
595 S. State Street, Elgin, IL 60123 (847) 608-3131
2125 S. First Street, Champaign, IL 61820 (217) 278-5800
2009 Mall Street Collinsville, IL 62234 (618) 346-5120
9511 Harrison Street, Des Plaines, IL 60016 (847) 294-4000
412 SW Washington Street, Suite D, Peoria, IL 61602 (309) 671-3022
2309 W. Main Street, Suite 116, Marion, IL 62959 (618) 993-7200
100 W. Randolph Street, Suite 4-500, Chicago, IL 60601

For the November 2019 Corrosion Control Study Report, please respond to the following comments:

- Clarify what the "different" blended ortho/polyphosphate product mentioned in the System Description on page 1 (~75% polyphosphate / 25% orthophosphate based on the minimum wt% cited in the Aqua report) is referring to and update this information to reflect the chemical usage changes (90% polyphosphate/10% orthophosphate blend and phosphoric acid).

- The Fall 2018 Lead solubility results refer to lead coupons that appear to be new, solid Pb material, rather than Pb solder on Cu as is expected to be the main Pb source in UP. Please clarify whether the next section (Fall 2019 lead solubility) was still using new Pb coupons rather than Pb solder. (This is separate from the work by Edwards' group at VATech during this period using Pb solder on Cu, which is presented later in the report.)

- The dump-fill experiment appears to be a highly valuable test method and could be done with sections of pipes from diverse homes representing different past water quality history zones or represented by random representations of pipe ages and prior well zones. However, in the dump-fill experiment results, although the text indicates stabilization at relatively low Pb levels <10 or <5 ppb, the plotted data still shows particulate spikes at relatively low Pb levels.

For additional corrosion control studies, the following additional requests are made. Please provide:

- previous finished water quality of each of the wells prior to the change in source;

- depth, capacity, location, and usage information of each of the wells prior to the change in source;

- pipe scale analyses for a sufficient number of homes representative of Aqua's advisory area with low lead results;

- pipe scale analyses for a sufficient number of homes representative of Aqua's advisory area with high lead results;

- mini lead profiles at various fixtures through a sufficient number of representative homes with high results using 2 - 125ml and 1 – 500 ml samples;

- an evaluation for any differences, other than usage, between homes within Aqua's advisory area, such as location, age, pipe diameter, pipe configuration, distribution system pressure/flow and any effect on lead concentrations;

- a questionnaire for the current homes in the sampling pool to understand how water is used, i.e. is water use at the kitchen sink more or less than expected based upon meter readings (note: A good faith effort is sufficient. Based upon responses to other surveys, it is understood that a low response rate is anticipated) (Illinois EPA would like to review the questionnaire before it is sent),

- wastewater treatment plant restroom study results;

- The effectiveness of orthophosphate added as phosphoric acid treatment on existing pipe samples in the pH range of 7.2 to 8.5, to mitigate the release of lead from existing premise plumbing pipe scales. There should be four different pH points evaluated; the lowest probable pH (based on projected dosage of 3-3.5 mg/L as PO4); pH 7.6, pH 7.8, and a pH reflective of the maximum Kankakee-fed pH combined with estimated OCCT dosage of 3-3.5 mg/L as PO4. This is consistent with a note in the USEPA guidance manual in flowchart 1c that states that orthophosphate effectiveness is lowest in the pH range of 8 – 8.5. Systems should avoid this range because of inadequate buffering in the distribution system. However, because the flowcharts provided in the guidance manual are recommended for screening purposes only, they are not a suitable substitute for pilot studies and other site-specific investigations. Since the guidance does not include information on optimizing treatment, optimization of CCT for University Park needs to be empirically determined by testing.

Please submit the information as it becomes available. It is understood that parts of this will be difficult to do during the current COVID-19 health crisis. If you need to clarify any of this request, please schedule another technical call with Illinois EPA and USEPA staff.

Sincerely,

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

cc: DPWS/FOS – Elgin Region

APPENDIX C

July 2020 ILEPA form "OCCT Evaluation of Treatment Alternatives", including associated new ILEPA form 141-C and a UP schematic.

Illinois Environmental Protection Agency

1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276 • (217) 782-3397

Optimal Corrosion Control Treatment (OCCT) Recommendation

Public Water Supply Systems required to submit an OCCT Recommendation to the Illinois EPA need to provide this form and all the information required in the IEPA's Instructions for an OCCT Evaluation of Treatment Alternatives.

This form may be completed in Acrobat, a copy saved locally, and then printed before it is signed. You may also complete a printed copy normally. Submit the completed and signed form the the Illinois EPA, Division of Public Water Supplies.

System

System Number: IL1975030 County: WILL

System Name: Aqua Illinois - University Park

Street Address: 1000 S Schuyler Ave

City: Kankakee State: IL Zip: 60901

Contact Name: Melissa Kahoun

Phone: 815-614-2032

Email: makahoun@aquaamerica.com

Number of People Served:

○ ≤ 100 ○ 101 to 500 ○ 501 to 3,000 ● 3,001 to 10,000 ○ 10,001 to 100,000 ○ > 100,000

OCCT Recommendation

The following OCCT is recommended:

○ pH / Alkalinity / DIC Adjustment

● Orthophosphate

○ Blended phosphate (/ ortho / poly ratio)

○ Silicates

○ Remove iron and/or manganese and add ortho phosphate

○ No treatment or treatment change at this time **(Attach justification)**

Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Melissa Kahoun
Printed Name

Environmental Compliance Manager
Title

Melissa Kah
Signature

8 3-20
Date

Illinois Environmental Protection Agency

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Optimal Corrosion Control Treatment (OCCT) Evaluation of Treatment Alternatives

Print the Instructions

Go to the Form

Instructions

Introduction

Public Water Supply Systems (systems) serving a population of less than 50,000 are required to submit an Optimal Corrosion Control Treatment (OCCT) Recommendation to Illinois EPA if there is an action level exceedance for lead or copper in their distribution system.

Illinois EPA is using the guidance document developed by USEPA to assist public water supply systems and State Agencies in the selection and review of OCCT recommendations. USEPA's guidance document is titled:

> USEPA Guidance Document Optimal Corrosion Control Treatment (OCCT) Evaluation Technical Recommendations for Primacy Agencies and Public Water Supplies dated March 2016 (EPA 816-B-16-003).

This document is available on the following USEPA web page:

> www.epa.gov/dwreginfo/optimal-corrosion-control-treatment-evaluation-technical-recommendations

Purpose

The purpose of this IEPA document is to assist systems in demonstrating that they have followed the USEPA guidance when they are required to recommend an OCCT.

The process of selecting an OCCT that is described in Section 3 of the USEPA guidance follows these steps:

- **Step 1**: Summarize existing PWS information and water quality data
- **Step 2**: Evaluate the potential for Scaling
- **Step 3**: Use the flowcharts to determine a recommended OCCT
- **Step 4**: Identify possible limitations for the proposed OCCT
- **Step 5**: Evaluate the feasibility and cost for the proposed OCCT

Note: The timelines for selecting and implementing an OCCT is provided in Exhibit 4.1 of USEPA's guidance document.

Information Required for an OCCT Recommendation

Provide the following when submitting an OCCT Recommendation:

- A properly completed **Form 141-C**, and
- The information described below.

The following information needs to be provided in the tables and available space provided at the end of these instructions. Some information will need to be provided as an attachment. It is recommended that the applicant obtain an electronic copy of this document, save it electronically, and type the required information in the appropriate locations.

Step 1: Summary of water quality data and other PWS information (Section 3.2.1)

1.1 General Information: Provide the indicated general information about the public water supply in the table provided.

1.2 Description of Water Treatment System & Distribution:

1.2.1 Flowchart of Water System / Treatment. Attach a flowchart or schematic of the water system that shows the entry points, treatment and storage involved. Identify any additional / optional treatment that is performed within the distribution system.

1.2.2 Chemicals Used. Identify the chemicals used and their feed rates in the table.

1.2.3 Change in Treatment: Identify any chemical or physical changes in the treatment for system (e.g. chemicals used, physical treatment methods, etc.) that occurred 3 years prior to the date of the ALE to the present.

1.2.4 Change in Sampling Plan: Identify any change in the lead / copper sampling plan that occurred 3 years prior to the date of the ALE to the present.

1.3 Water Quality Data: Provide water quality data for the finished/treated water from each source (entry point) in the table provided. Use the analytical data from the most recent sampling events. If available, provide data from multiple sampling events and use the average values in subsequent steps. If there are multiple sources, create a new table for each source (entry point) in the system. Identify if the source is surface water or groundwater. Attach a copy of the laboratory reports used to complete the table.

1.4 Water Quality & Physical Factors: Using the information in Chapter 2 of USEPA's OCCT Guidance Document, identify the water quality factors and physical factors that may be contributing to the lead and/or copper release.

Step 2: Evaluate Potential for Scaling
(Section 3.2.2)

Evaluate the potential for scaling (precipitation of calcium carbonate) using the water quality data collected in Step 1 above for the finished water from each source. Use the averaged values of pH, alkalinity and calcium from Step 1 above.

2.1 Saturation pH & Potential for Scaling. Determine the Saturation pH for calcium carbonate in the system and potential for calcium carbonate precipitation (scaling). This information is used to better understand how adjusting the pH of the system as part of the OCCT could influence the formation of calcium carbonate scale in the pipes.

Perform the following steps using Appendix B and Exhibit 3.2 in the USEPA Guidance Document and provide the information in the table.

2.1.1 DIC: Use the alkalinity and pH of each source water to enter the table in Appendix B and determine (approximate) the dissolved inorganic carbon (DIC mg/l carbon).

2.1.2 Calcium: Use the average calcium concentration (mg/l) for each source in the finished water. If this is unknown, but total hardness is; the calcium concentration can be estimated by dividing the finished water hardness by 2.5.

2.1.3 Saturation pH Curve: On Exhibit 3.2 find the intersection of DIC on the x-axis (mg C/l) and calcium on y-axis (mg Ca/l). Find the pH curve closest to the intersection. This is the saturation pH for the system.

2.1.4 Indicate if potential for scaling is high or low: Compare the system pH to saturation pH. A system pH below the saturation pH indicates a low potential for precipitating calcium carbonate.

Step 3: Select One or More Treatment Options
(Section 3.2.3)

3.1 Identify the Appropriate Flowchart for Preliminary OCCT Selection: Use the information developed in Steps 1 & 2 above, apply it to Exhibit 3.3 in the USEPA Guidance Document, and to determine which flowchart (1a – 3b) in the OCCT Guidance to use. Provide the information in the table.

3.2 Identify the Recommended OCCT: Use the recommended flowchart and the estimated DIC for the system to identify the recommended optimal corrosion control treatment (OCCT) option. Identify the recommended OCCT in the space provided.

Step 4: Identifying Possible Limitations for Treatment Options (Section 3.2.4)

Once the treatment option(s) is/are selected from the flowcharts, the information in Section 3.2.4 of the USEPA Guidance Document should be reviewed to identify any possible treatment limitations to the recommended OCCT due to:

- The Adjustment of pH / Alkalinity / DIC, or the Addition of Silicate
- Phosphate-Based Corrosion Inhibitors

Note: Additional information on setting water quality parameters and dose for the treatment options is provided in Section 3.3 of the OCCT Guidance.

4.1 Possible Limitations of pH / Alkalinity / DIC Adjustment: Indicate if any of the following apply and how they are addressed if applicable. Provide this information in the space provided below.

4.1.1 Optimizing pH for other purposes: Treatment processes such as coagulation and disinfection have different target pH ranges. Adjusting any of these parameters needs to be considered in light of these other process objectives. (Refer to Section 3.2.4.)

In this situation, the recommended treatment option needs to address:

- The proper location for the addition of a pH / alkalinity adjustment chemical.
- The impact a pH / alkalinity will have on disinfection residual in the system.
- The formation of disinfection byproducts (DBPs) such as TTHM and HAA5.

4.1.2 Calcium Carbonate Precipitation: If the finished water has high hardness (specifically, the calcium portion of hardness), raising the pH and DIC may cause calcium carbonate to precipitate in the distribution system.

In this situation, the recommended treatment option can take one of the following approaches:

- Choose a different OCCT method such as using a phosphate-based corrosion inhibitor,
- Remove DIC with ion exchange or membrane filtration, or
- Add softening to remove calcium.

4.1.3 Oxidation of Iron and Manganese: Oxidized forms of iron and magnesium can result in black/red water complaints. Dissolved oxygen and oxidants like chlorine may oxidize iron and magnesium, and increasing the pH can increase the rate of oxidation. Sequestering agents such as polyphosphates may reduce black/red water complaints, but may also cause increases in lead and copper levels measured at the tap.

If the system is treating for iron and manganese, it needs to indicate how it will continue to do so while also treating for lead/copper.

Note: Blended polyphosphates (mixture of poly & ortho phosphates) should be used with caution. Refer to Section 3.3 for more information.

4.2 Possible Limitations of Phosphate-Based Corrosion Inhibitors: Indicate if any of the following apply and how they are addressed if applicable.

4.2.1 Reactions with Aluminum: Aluminum can occur in the distribution system as an impurity in lime, or when the system uses alum for coagulation. Aluminum can interfere with orthophosphate effectiveness by forming aluminum phosphate precipitate.

The system needs to indicate if aluminum is present in the finished water. If it is, and it proposes to use orthophosphate, the system needs to indicate how it will address this issue.

4.2.2 Impacts on Wastewater Treatment: Studies have shown that adding phosphate-based corrosion inhibitors can increase the phosphorus loading to the waste water treatment plant (WWTP) by 10 to 35 percent. Use of a zinc orthophosphate can increase the zinc load to the WWTP. Zinc can inhibit biological waste water treatment processes, particularly nitrification and denitrification.

Systems recommending the addition of a phosphate or zinc orthophosphate based corrosion inhibitor should also indicate that they have discussed this with their WWTP to estimate the additional amount of phosphorus, and/or zinc load to the WWTP, and assess if the additional loading could cause the plant to exceed permit limits or cause other operational problems.

Step 5: Technical Recommendations for Evaluating Feasibility and Cost (Section 3.2.5)

The PWS should consider operability, reliability, system configuration, and other site-specific factors when evaluating OCCT alternatives. Where more than one option can meet the OCCT definition of the rule, systems may want to consider cost of each option.

5.1 Feasibility and Cost: Provide discussion of the feasibility and cost of the selected OCCT.

Print the Instructions   Go to the Form

Illinois Environmental Protection Agency

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Optimal Corrosion Control Treatment (OCCT) Evaluation of Treatment Alternatives

Go to the Instructions

System

System Number: IL1975030 County: WILL

System Name: Aqua Illinois - University Park

Contact Name: Melissa Kahoun

Street Address: 1000 S. Schuyler Ave

City: Kankakee State: IL Zip: 60901

Phone: 815-614-2032

Email: makahoun@aquaamerica.com

Engineer (Optional)

Engineer Name: Dr. David Cornwell (Illinois PE 062071727)

Company: Cornwell Engineering Group, Inc.

Street Address: 712 Gum Rock Court

City: Newport News State: VA Zip: 23606

Phone: 757-873-1534 x227

Email: dcornwell@cornwellinc.com

Form 141-C: Optimal Corrosion Control Treatment Recommendation

Attach a copy of the properly completed Form 141-C.

Step 1: Summary of Water Quality Data and Other PWS Information

1.1 General PWS Information

Approximate Population Served: 7,052

Water Source: ● Surface Water ○ Groundwater ○ Both

Is water purchased?: ● Yes ○ No If yes, enter the name and ID number below.

Name: Aqua Illinois - Kankakee ID Number: IL0915030

Average Daily Usage: 1.3 ○ Gallons/Day ● MGD

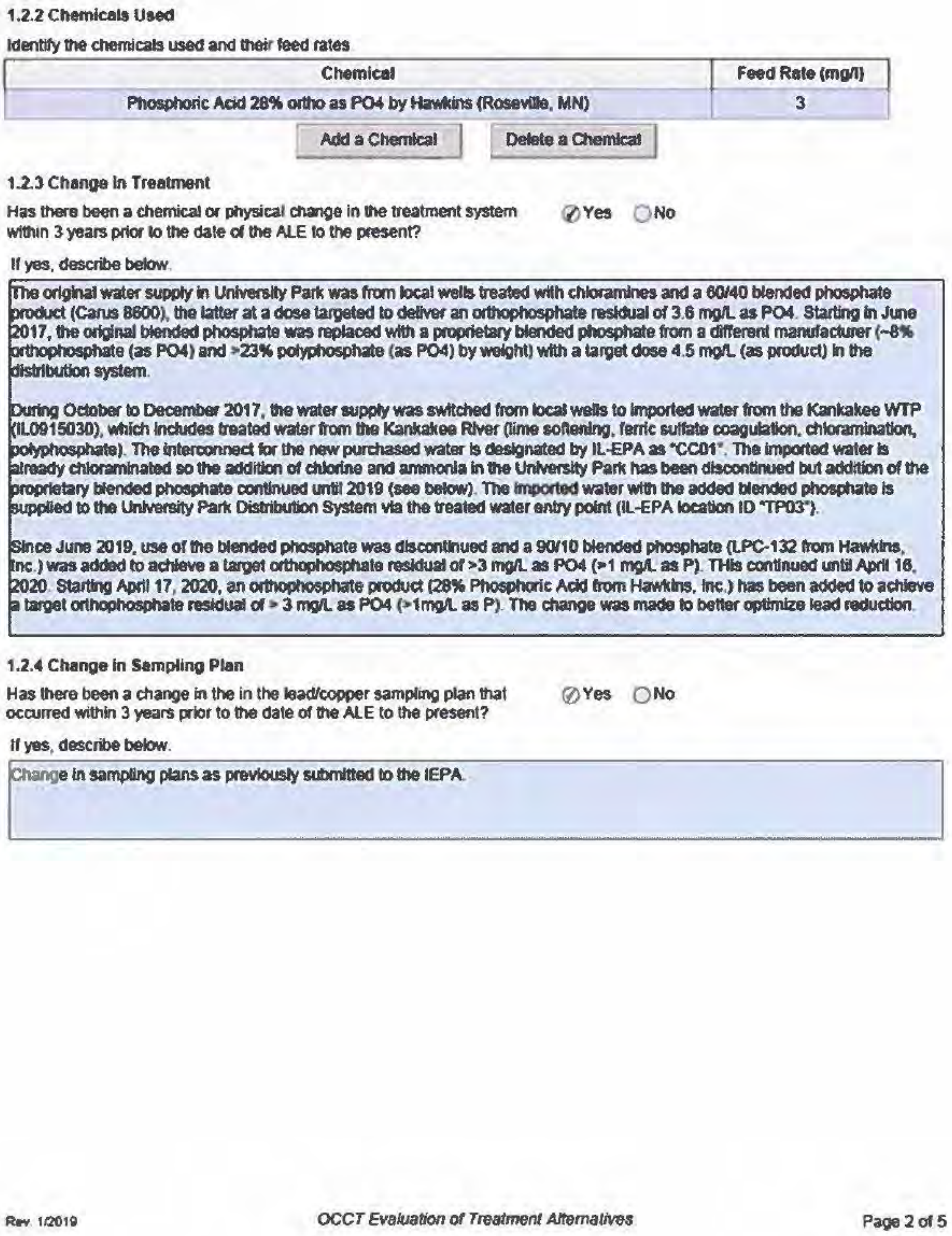
ALE for: ● Lead ○ Copper ○ Both

Does the system have lead service lines?: ○ Yes ● No If yes, approximately how many? ____________

1.2 Description of Water Treatment System

1.2.1 Flowchart of Water System / Treatment

Attach a flowchart or schematic of the water system.



1.2.2 Chemicals Used

Identify the chemicals used and their feed rates

Chemical	Feed Rate (mg/l)
Phosphoric Acid 28% ortho as PO4 by Hawkins (Roseville, MN)	3

1.2.3 Change in Treatment

Has there been a chemical or physical change in the treatment system within 3 years prior to the date of the ALE to the present? ☑ Yes ○ No

If yes, describe below.

The original water supply in University Park was from local wells treated with chloramines and a 60/40 blended phosphate product (Carus 8600), the latter at a dose targeted to deliver an orthophosphate residual of 3.6 mg/L as PO4. Starting in June 2017, the original blended phosphate was replaced with a proprietary blended phosphate from a different manufacturer (~8% orthophosphate (as PO4) and >23% polyphosphate (as PO4) by weight) with a target dose 4.5 mg/L (as product) in the distribution system.

During October to December 2017, the water supply was switched from local wells to imported water from the Kankakee WTP (IL0915030), which includes treated water from the Kankakee River (lime softening, ferric sulfate coagulation, chloramination, polyphosphate). The interconnect for the new purchased water is designated by IL-EPA as "CC01". The imported water is already chloraminated so the addition of chlorine and ammonia in the University Park has been discontinued but addition of the proprietary blended phosphate continued until 2019 (see below). The imported water with the added blended phosphate is supplied to the University Park Distribution System via the treated water entry point (IL-EPA location ID "TP03").

Since June 2019, use of the blended phosphate was discontinued and a 90/10 blended phosphate (LPC-132 from Hawkins, Inc.) was added to achieve a target orthophosphate residual of >3 mg/L as PO4 (>1 mg/L as P). THis continued until April 16, 2020. Starting April 17, 2020, an orthophosphate product (28% Phosphoric Acid from Hawkins, Inc.) has been added to achieve a target orthophosphate residual of > 3 mg/L as PO4 (>1mg/L as P). The change was made to better optimize lead reduction.

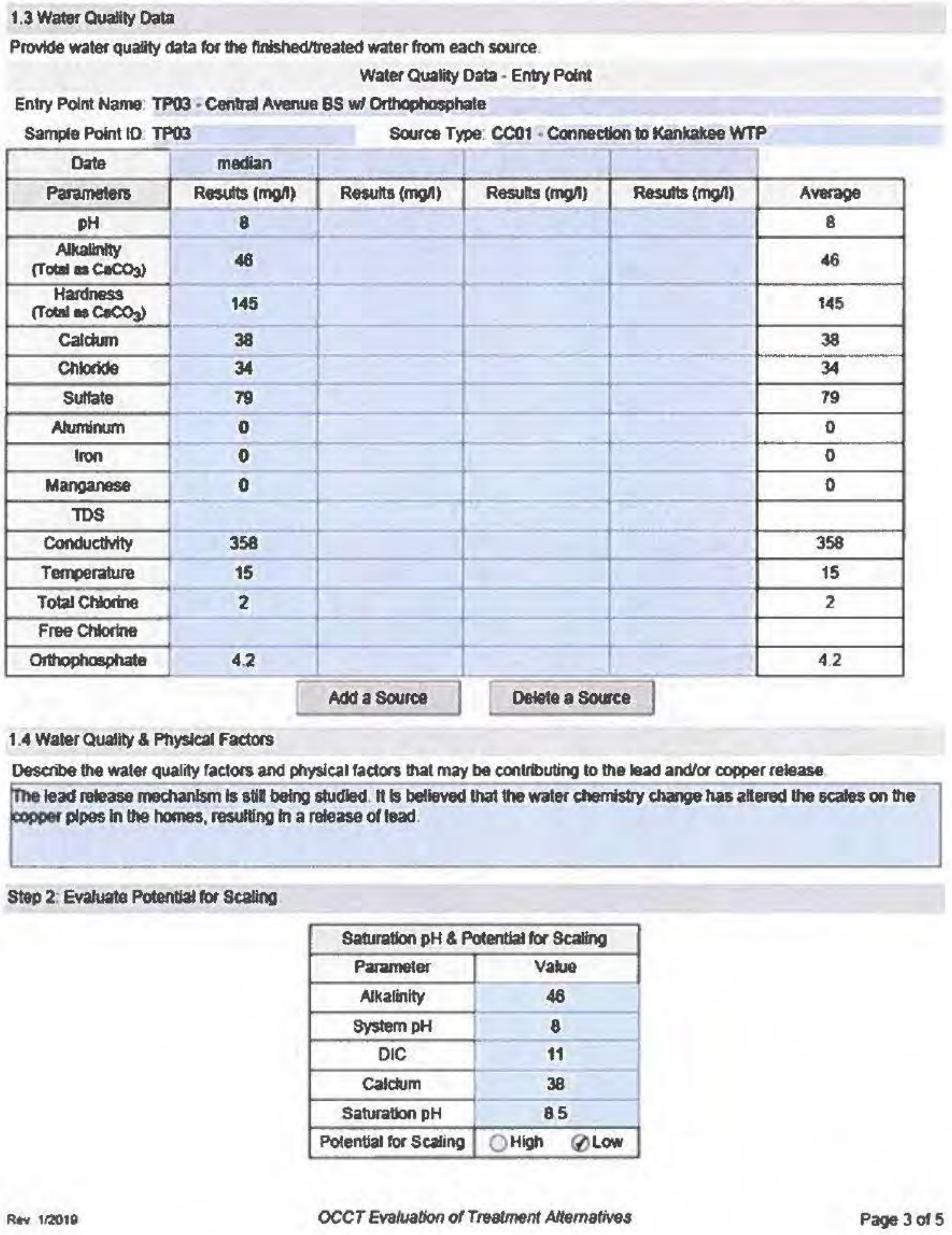
1.2.4 Change in Sampling Plan

Has there been a change in the in the lead/copper sampling plan that occurred within 3 years prior to the date of the ALE to the present? ☑ Yes ○ No

If yes, describe below.

Change in sampling plans as previously submitted to the IEPA.

Rev. 1/2019 *OCCT Evaluation of Treatment Alternatives* Page 2 of 5



1.3 Water Quality Data

Provide water quality data for the finished/treated water from each source.

Water Quality Data - Entry Point

Entry Point Name: TP03 - Central Avenue BS w/ Orthophosphate

Sample Point ID: TP03

Source Type: CC01 - Connection to Kankakee WTP

Date	median				
Parameters	**Results (mg/l)**	**Results (mg/l)**	**Results (mg/l)**	**Results (mg/l)**	**Average**
pH	8				8
Alkalinity (Total as $CaCO_3$)	46				46
Hardness (Total as $CaCO_3$)	145				145
Calcium	38				38
Chloride	34				34
Sulfate	79				79
Aluminum	0				0
Iron	0				0
Manganese	0				0
TDS					
Conductivity	358				358
Temperature	15				15
Total Chlorine	2				2
Free Chlorine					
Orthophosphate	4.2				4.2

1.4 Water Quality & Physical Factors

Describe the water quality factors and physical factors that may be contributing to the lead and/or copper release.

The lead release mechanism is still being studied. It is believed that the water chemistry change has altered the scales on the copper pipes in the homes, resulting in a release of lead.

Step 2: Evaluate Potential for Scaling

Saturation pH & Potential for Scaling	
Parameter	**Value**
Alkalinity	46
System pH	8
DIC	11
Calcium	38
Saturation pH	8.5
Potential for Scaling	○ High ☑ Low

Rev. 1/2019 *OCCT Evaluation of Treatment Alternatives* Page 3 of 5

Step 3: Technical Recommendations for Selecting One or More Treatment Options

3.1 Identify the Appropriate Flowchart for Preliminary OCCT Selection

Is iron or manganese present in finished water?	● Yes ○ No
The OCCT is designed to treat:	○ Lead ○ Copper ● Both
The pH of the finished water is:	8
Recommended Flowchart per Exhibit 3.3:	1c

3.2 Identify the Recommended OCCT

The Recommended OCCT is:

Addition of 28% Phosphoric Acid from Hawkins Inc. at a target dose >3 mg/L as PO4 or 1 mg/L as P.

Step 4: Identifying Possible Limitations for Treatment Options

4.1 Possible Limitations of pH / Alkalinity / DIC Adjustment

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.1.1 Optimizing pH for Other Purposes ○ Applicable ● Not Applicable

4.1.2 Calcium Carbonate Precipitation ○ Applicable ● Not Applicable

4.1.3 Oxidation of Iron and Manganese ○ Applicable ● Not Applicable

4.2 Possible Limitations of Phosphate-Based Corrosion Inhibitors

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.2.1 Reactions with Aluminum ○ Applicable ● Not Applicable

4.2.2 Impacts on Wastewater Treatment ○ Applicable ● Not Applicable

Step 5: Evaluation of Feasibility and Cost

5.1 Feasibility and Cost

Provide a discussion of the feasibility and cost of the selected OCCT.

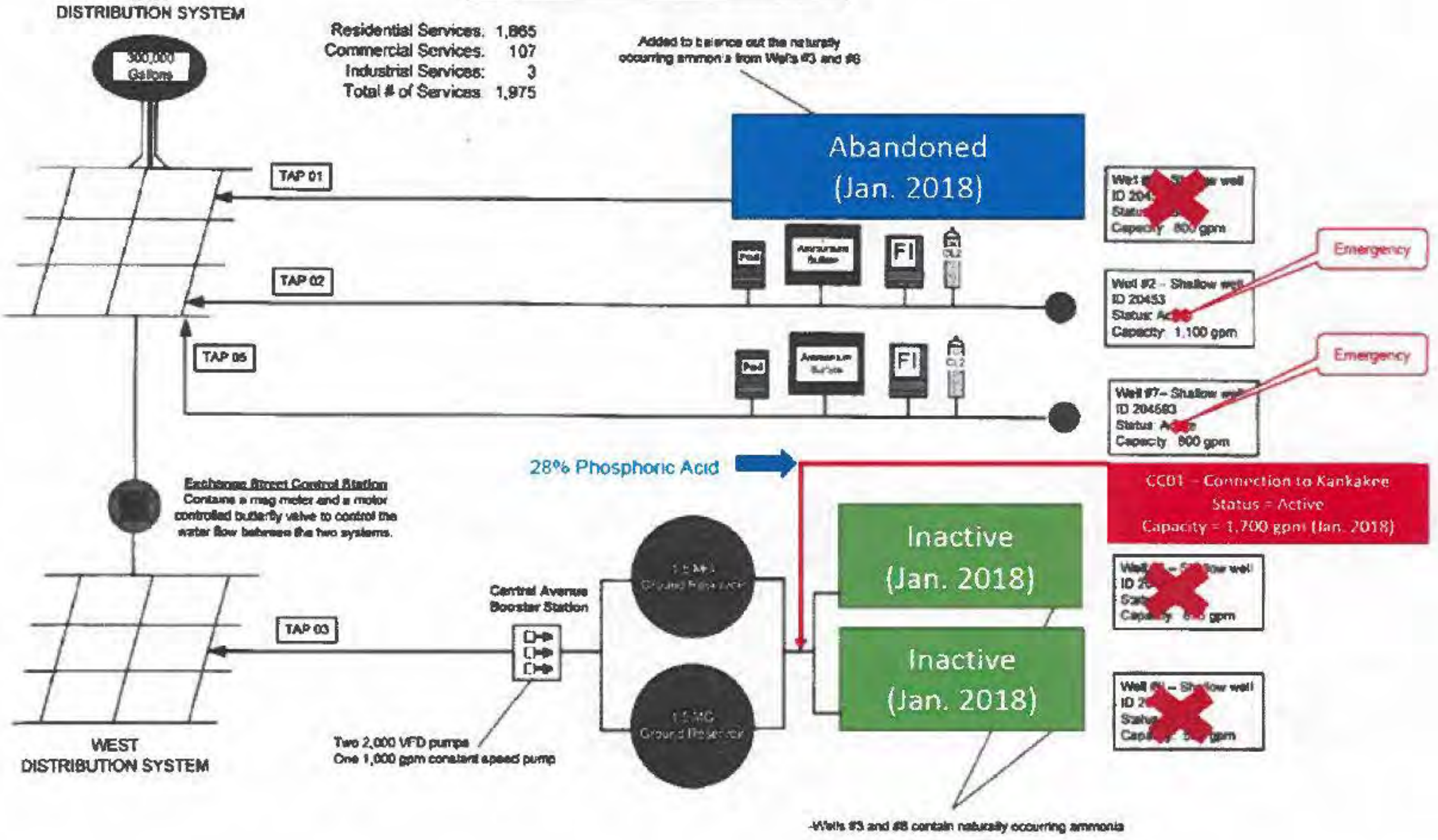
The water system has selected the best option for CCT, which we believe to be easy to operate and cost effective

Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Melissa Kahoun	Environmental Compliance Manager
Printed Name	Title
Melissa Kah	7-3-20
Signature	Date

University Park 2020



NO EMERGENCY INTERCONNECTIONS

APPENDIX D

Additional data from evaluation of 2017 to 2019 Kankakee WTP data versus water temperature

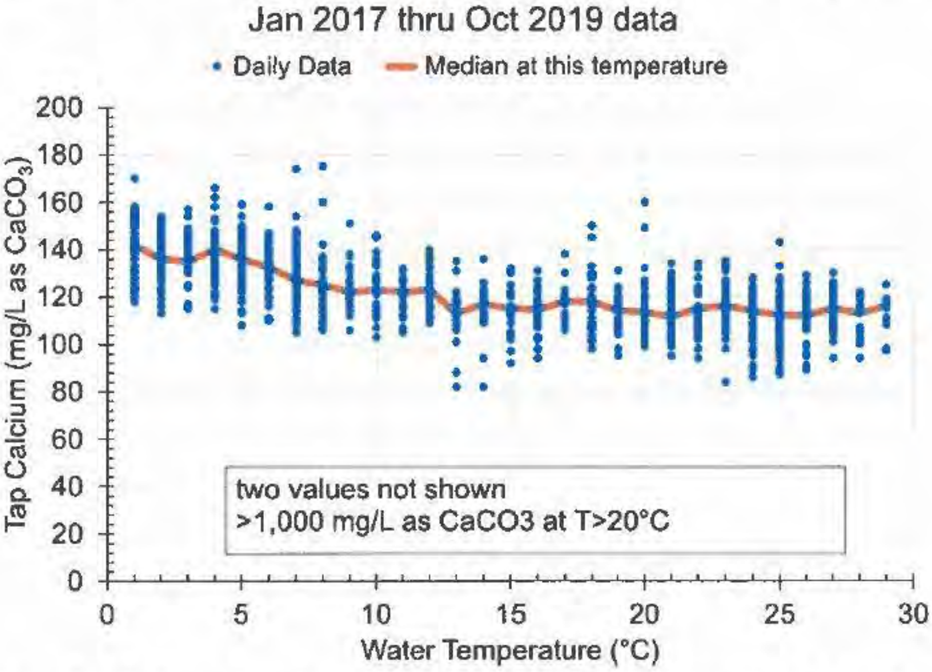


Figure 7 Daily and median calcium hardness data measured on dates from Jan 2017 through October 2019 with the same temperaure

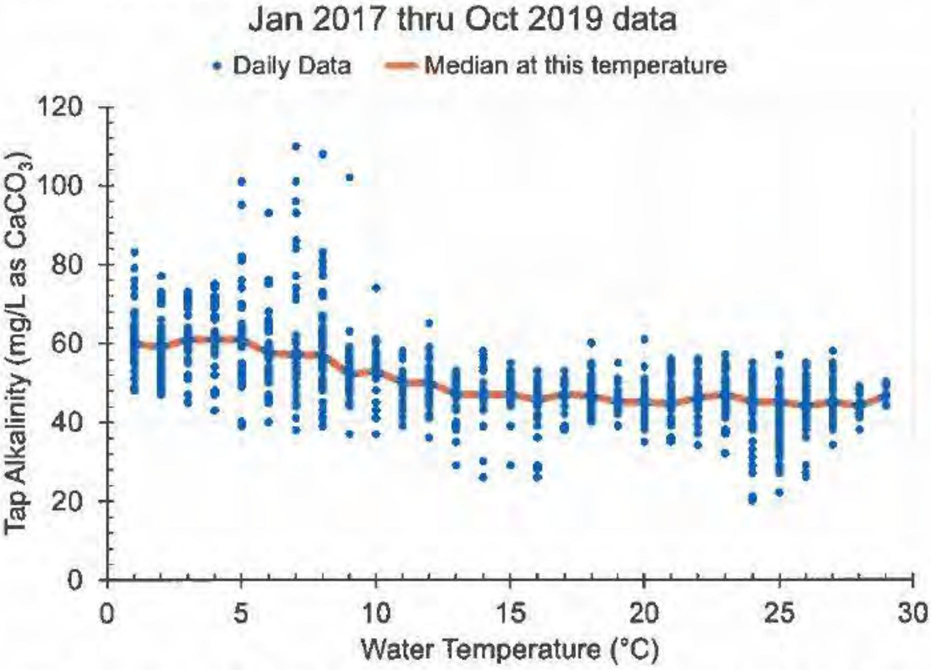


Figure 8 Daily and median alkalinity data measured on dates from Jan 2017 through October 2019 with the same temperaure

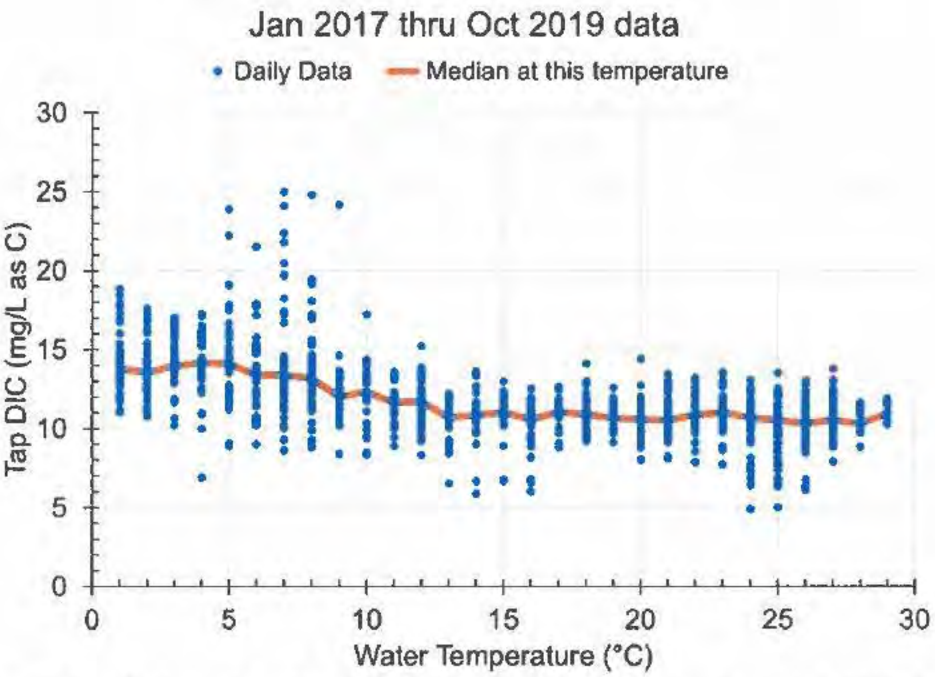


Figure 9 Daily and median DIC data calculated on dates from Jan 2017 through October 2019 with the same temperaure

APPENDIX E

NEW LABORATORY DATA

Figures 10 through 13 summarize laboratory solubility studies similar to those described in the November 2019 OCCT report submitted to ILEPA, except that these studies replaced new lead coupons with harvested plumbing from two homes in University Park. Figure 10 describes results using three segments from a kitchen faucet at one University Park house. Figure 11 is identical except the vertical scale is smaller. Similarly, Figure 12 includes data from solubility studies conducted with four plumbing segments harvested from a different University Park house, and Figure 13 depicts identical data but at smaller vertical scale. All 7 of these solubility tests were conducted with 3 mg/L as PO_4 does of orthophosphate and pH adjusted to 8.4. All were dosed with phosphoric acid (H_3PO_4) except for two of the tests in Figures 5 and 6 conducted with zinc orthophosphate (ZOP) instead of H_3PO_4.

The results in Figure 12 and Figure 13 show that all but one test (BLK – ortho) stabilized to <10 µg/L-day after about 40 to 50 days of contact with treated water. All three replicate conditions in Figure 10 and Figure 11 also stabilized after about 50 days, but (as shown in Figure 11) all three did not reach <10 µg/L-day until near the end of study (day 60 to 70).

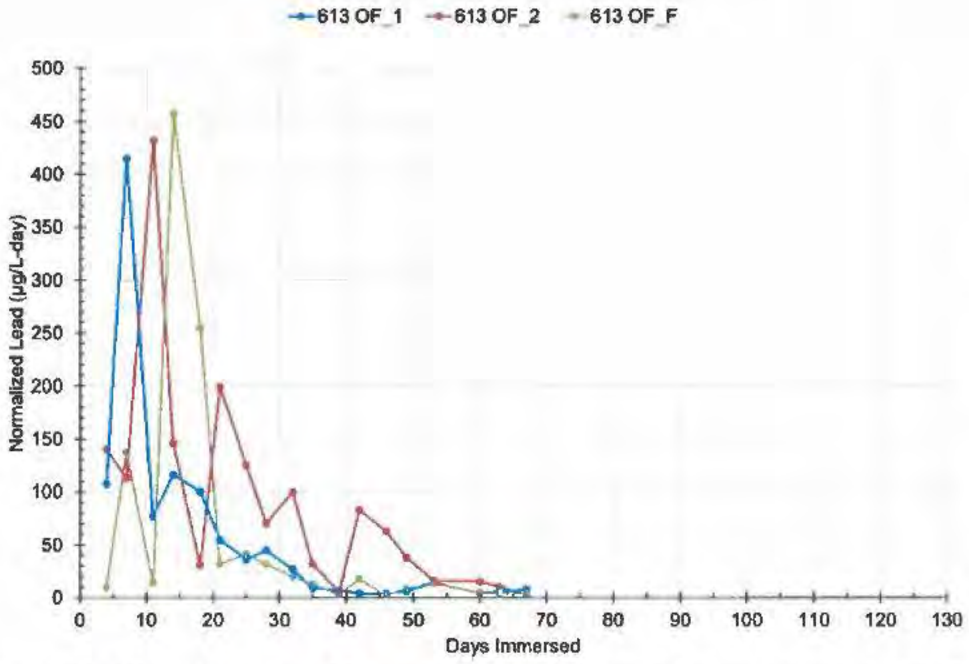


Figure 10 Three segments of faucet harvested from one UP house, treated with H_3PO_4 at 3 mg/L as PO_4 dose (0 to 500 µg/L-day scale)

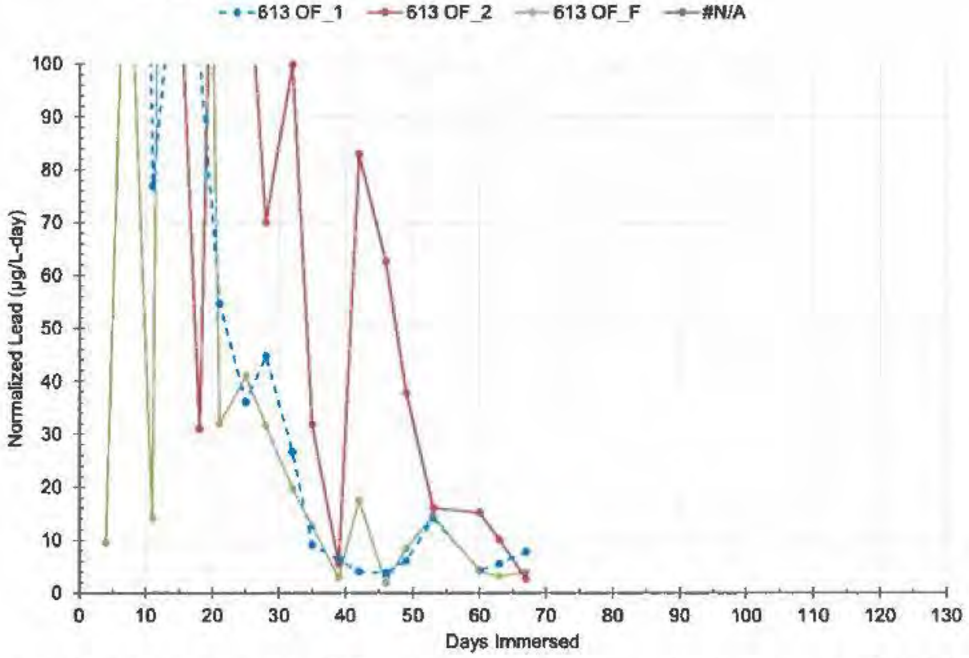


Figure 11 Three segments of faucet harvested from one UP house, treated with H_3PO_4 at 3 mg/L as PO_4 dose (0 to 100 µg/L-day scale)

redacted

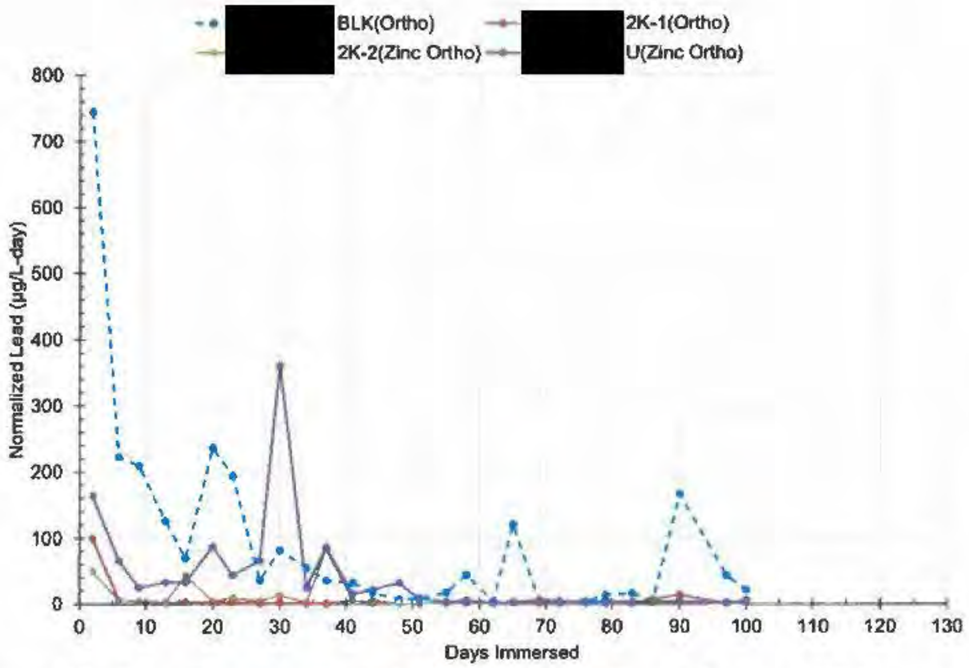


Figure 12 **Four segments of household plumbing harvested from one UP house, treated with 3 mg/L as PO4 dose, with either ZOP or H_3PO_4 – 0 to 800 µg/L-day scale**

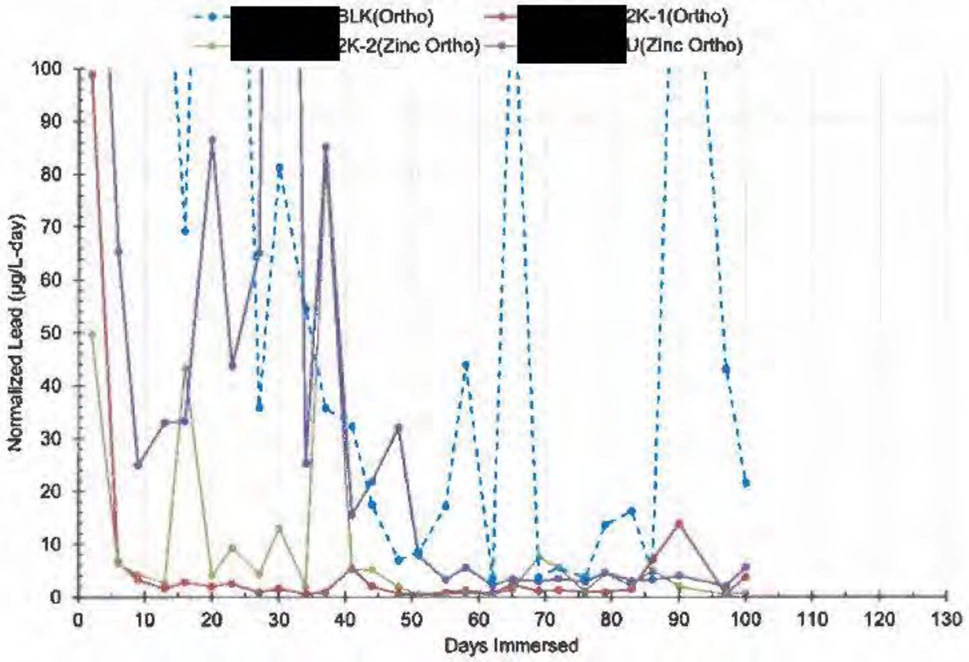


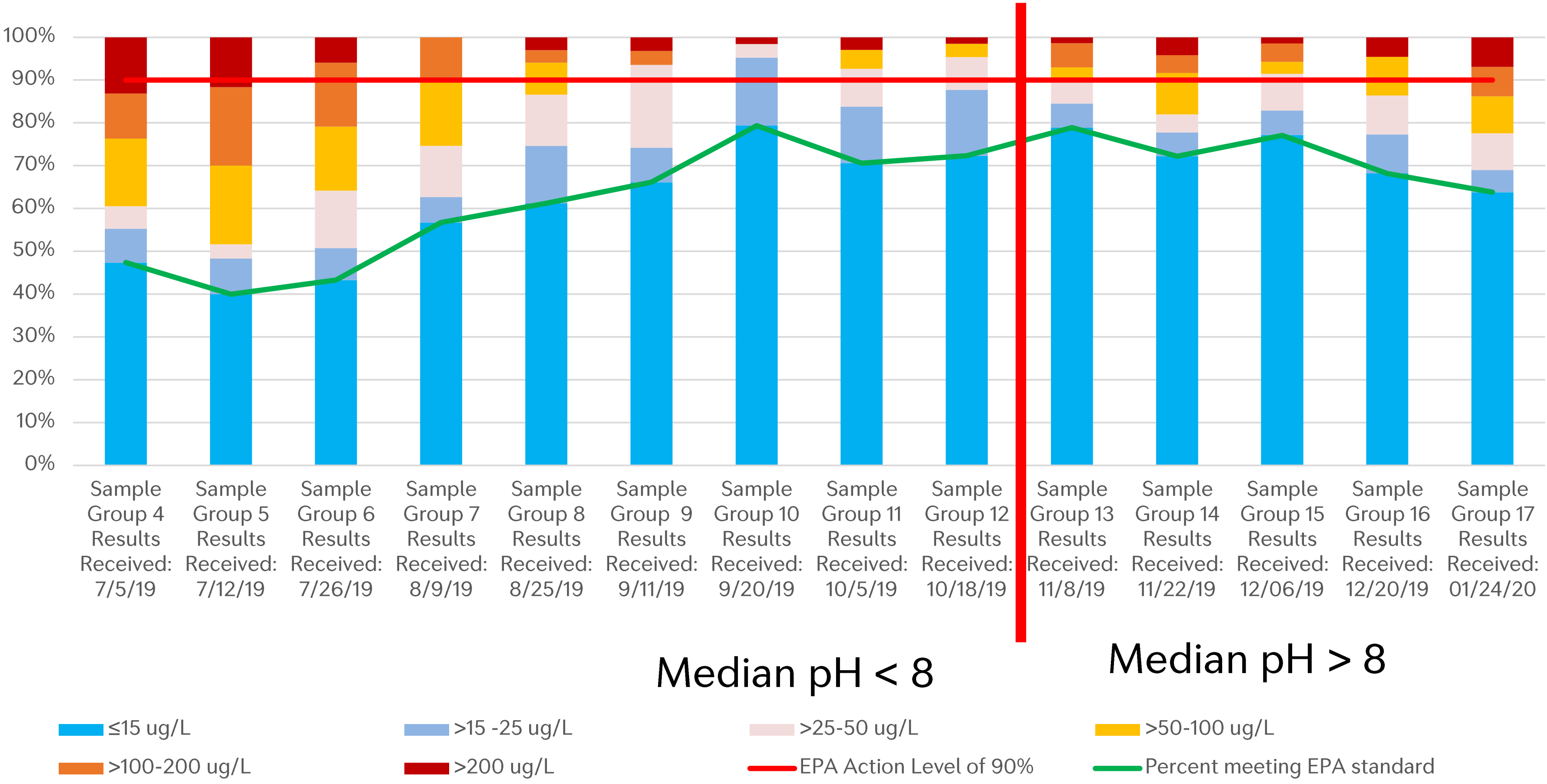
Figure 13 **Four segments of household plumbing harvested from one UP house, treated with 3 mg/L as PO4 dose, with either ZOP or H_3PO_4 – 0 to 100 µg/L-day scale**

UP Update & Technical Discussion

3/24/2020

Events 4 Through 17

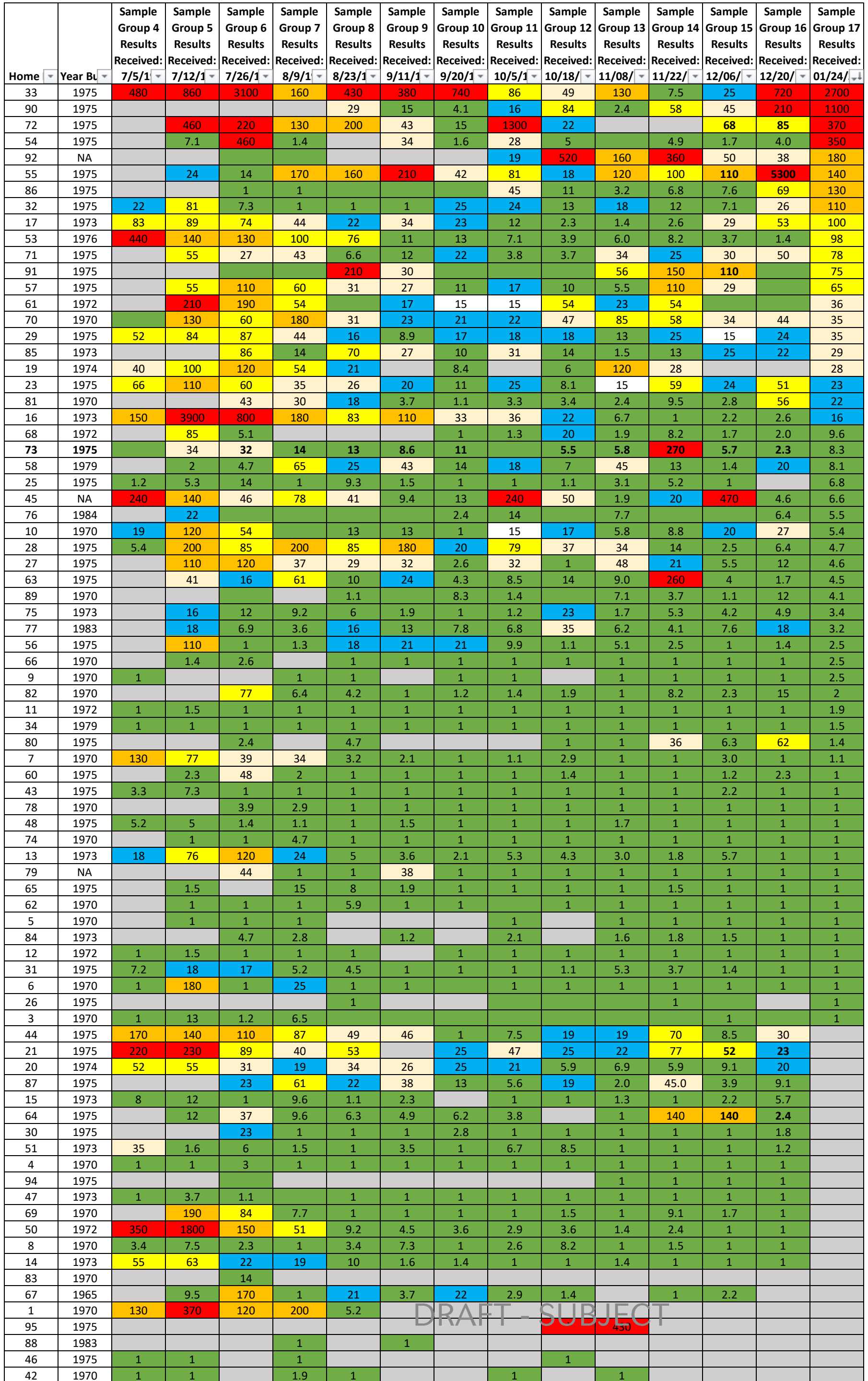
Homes with good results < 15ppb tend to drop out of sample pool participation over time



Median pH < 8

Median pH > 8

Notice higher houses stay in pool - Creates artificial bias



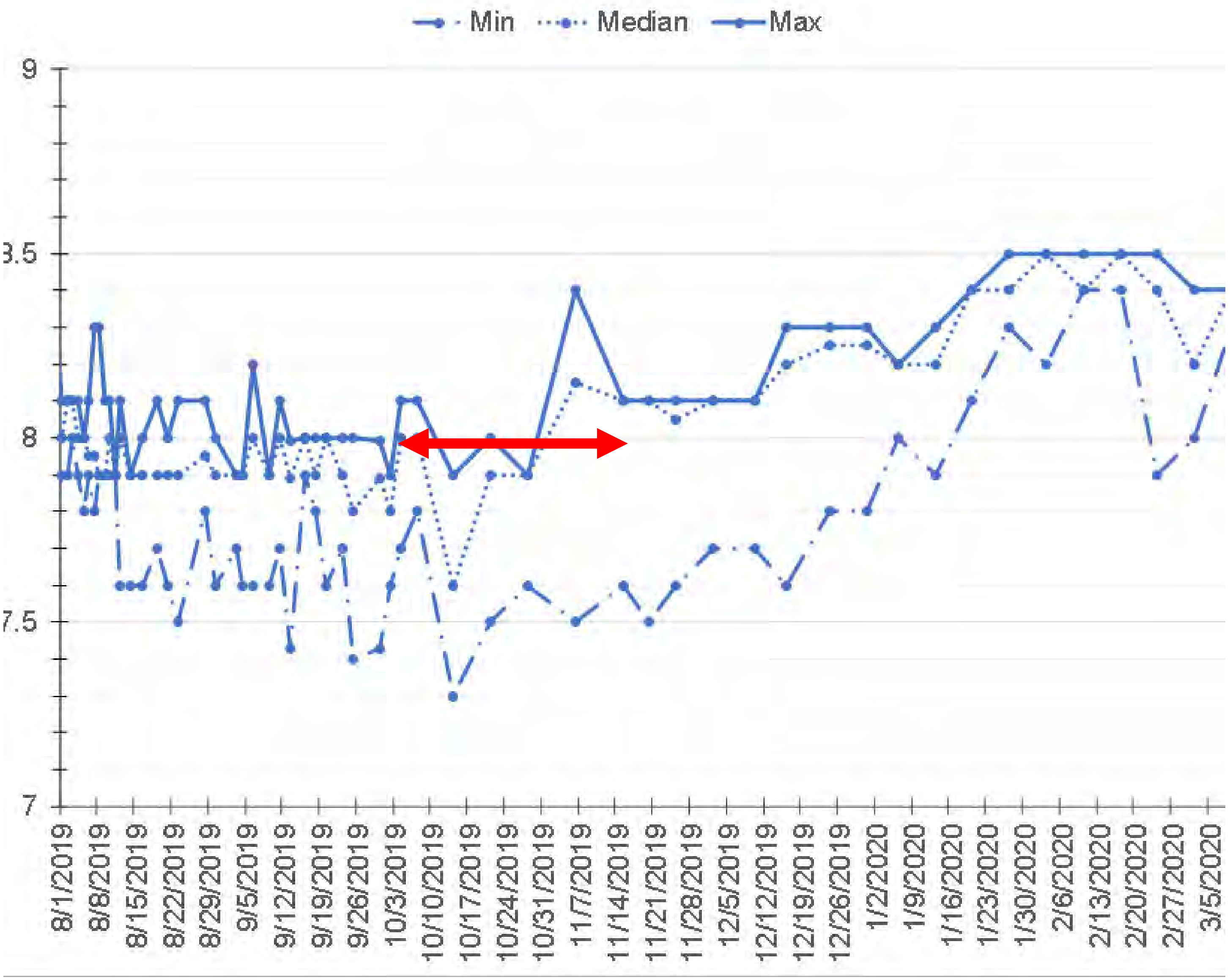
Home	Year Bu	Sample Group 4 Results Received: 7/5/1	Sample Group 5 Results Received: 7/12/1	Sample Group 6 Results Received: 7/26/1	Sample Group 7 Results Received: 8/9/1	Sample Group 8 Results Received: 8/23/1	Sample Group 9 Results Received: 9/11/1	Sample Group 10 Results Received: 9/20/1	Sample Group 11 Results Received: 10/5/1	Sample Group 12 Results Received: 10/18/	Sample Group 13 Results Received: 11/08/	Sample Group 14 Results Received: 11/22/	Sample Group 15 Results Received: 12/06/	Sample Group 16 Results Received: 12/20/	Sample Group 17 Results Received: 01/24/
33	1975	480	860	3100	160	430	380	740	86	49	130	7.5	25	720	2700
90	1975					29	15	4.1	16	84	2.4	58	45	210	1100
72	1975		460	220	130	200	43	15	1300	22			**68**	**85**	370
54	1975		7.1	460	1.4		34	1.6	28	5		4.9	1.7	4.0	350
92	NA								19	520	160	360	50	38	180
55	1975		24	14	170	160	210	42	81	18	120	100	**110**	**5300**	140
86	1975			1	1				45	11	3.2	6.8	7.6	69	130
32	1975	22	81	7.3	1	1	1	25	24	13	18	12	7.1	26	110
17	1973	83	89	74	44	22	34	23	12	2.3	1.4	2.6	29	53	100
53	1976	440	140	130	100	76	11	13	7.1	3.9	6.0	8.2	3.7	1.4	98
71	1975		55	27	43	6.6	12	22	3.8	3.7	34	25	30	50	78
91	1975					210	30				56	150	**110**		75
57	1975		55	110	60	31	27	11	17	10	5.5	110	29		65
61	1972		210	190	54		17	15	15	54	23	54			36
70	1970		130	60	180	31	23	21	22	47	85	58	34	44	35
29	1975	52	84	87	44	16	8.9	17	18	18	13	25	15	24	35
85	1973			86	14	70	27	10	31	14	1.5	13	25	22	29
19	1974	40	100	120	54	21		8.4		6	120	28			28
23	1975	66	110	60	35	26	20	11	25	8.1	15	59	24	51	23
81	1970			43	30	18	3.7	1.1	3.3	3.4	2.4	9.5	2.8	56	22
16	1973	150	3900	800	180	83	110	33	36	22	6.7	1	2.2	2.6	16
68	1972		85	5.1				1	1.3	20	1.9	8.2	1.7	2.0	9.6
73	**1975**		34	**32**	**14**	**13**	**8.6**	**11**		**5.5**	**5.8**	**270**	**5.7**	**2.3**	8.3
58	1979		2	4.7	65	25	43	14	18	7	45	13	1.4	20	8.1
25	1975	1.2	5.3	14	1	9.3	1.5	1	1	1.1	3.1	5.2	1		6.8
45	NA	240	140	46	78	41	9.4	13	240	50	1.9	20	470	4.6	6.6
76	1984		22					2.4	14		7.7			6.4	5.5
10	1970	19	120	54		13	13	1	15	17	5.8	8.8	20	27	5.4
28	1975	5.4	200	85	200	85	180	20	79	37	34	14	2.5	6.4	4.7
27	1975		110	120	37	29	32	2.6	32	1	48	21	5.5	12	4.6
63	1975		41	16	61	10	24	4.3	8.5	14	9.0	260	4	1.7	4.5
89	1970					1.1		8.3	1.4		7.1	3.7	1.1	12	4.1
75	1973		16	12	9.2	6	1.9	1	1.2	23	1.7	5.3	4.2	4.9	3.4
77	1983		18	6.9	3.6	16	13	7.8	6.8	35	6.2	4.1	7.6	18	3.2
56	1975		110	1	1.3	18	21	21	9.9	1.1	5.1	2.5	1	1.4	2.5
66	1970		1.4	2.6		1	1	1	1	1	1	1	1	1	2.5
9	1970	1			1	1		1	1		1	1	1	1	2.5
82	1970			77	6.4	4.2	1	1.2	1.4	1.9	1	8.2	2.3	15	2
11	1972	1	1.5	1	1	1	1	1	1	1	1	1	1	1	1.9
34	1979	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5
80	1975			2.4		4.7				1	1	36	6.3	62	1.4
7	1970	130	77	39	34	3.2	2.1	1	1.1	2.9	1	1	3.0	1	1.1
60	1975		2.3	48	2	1	1	1	1	1.4	1	1	1.2	2.3	1
43	1975	3.3	7.3	1	1	1	1	1	1	1	1	1	2.2	1	1
78	1970			3.9	2.9	1	1	1	1	1	1	1	1	1	1
48	1975	5.2	5	1.4	1.1	1	1.5	1	1	1	1.7	1	1	1	1
74	1970		1	1	4.7	1	1	1	1	1	1	1	1	1	1
13	1973	18	76	120	24	5	3.6	2.1	5.3	4.3	3.0	1.8	5.7	1	1
79	NA			44	1	1	38	1	1	1	1	1	1	1	1
65	1975		1.5		15	8	1.9	1	1	1	1	1.5	1	1	1
62	1970		1	1	1	5.9	1	1		1	1	1	1	1	1
5	1970		1	1	1				1		1	1	1	1	1
84	1973			4.7	2.8		1.2		2.1		1.6	1.8	1.5	1	1
12	1972	1	1.5	1	1	1		1	1	1	1	1	1	1	1
31	1975	7.2	18	17	5.2	4.5	1	1	1	1.1	5.3	3.7	1.4	1	1
6	1970	1	180	1	25	1	1		1	1	1	1	1	1	1
26	1975					1						1			1
3	1970	1	13	1.2	6.5								1		1
44	1975	170	140	110	87	49	46	1	7.5	19	19	70	8.5	30	
21	1975	220	230	89	40	53		25	47	25	22	77	**52**	**23**	
20	1974	52	55	31	19	34	26	25	21	5.9	6.9	5.9	9.1	20	
87	1975			23	61	22	38	13	5.6	19	2.0	45.0	3.9	9.1	
15	1973	8	12	1	9.6	1.1	2.3		1	1	1.3	1	2.2	5.7	
64	1975		12	37	9.6	6.3	4.9	6.2	3.8		1	140	**140**	**2.4**	
30	1975			23	1	1	1	2.8	1	1	1	1	1	1.8	
51	1973	35	1.6	6	1.5	1	3.5	1	6.7	8.5	1	1	1	1.2	
4	1970	1	1	3	1	1	1	1	1	1	1	1	1	1	
94	1975										1	1	1	1	
47	1973	1	3.7	1.1		1	1	1	1	1	1	1	1	1	
69	1970		190	84	7.7	1	1	1	1	1.5	1	9.1	1.7	1	
50	1972	350	1800	150	51	9.2	4.5	3.6	2.9	3.6	1.4	2.4	1	1	
8	1970	3.4	7.5	2.3	1	3.4	7.3	1	2.6	8.2	1	1.5	1	1	
14	1973	55	63	22	19	10	1.6	1.4	1	1	1.4	1	1	1	
83	1970			14											
67	1965		9.5	170	1	21	3.7	22	2.9	1.4		1	2.2		
1	1970	130	370	120	200	5.2									
95	1975									[illegible]	430				
88	1983				1		1								
46	1975	1	1		1					1					
42	1970	1	1		1.9	1			1		1				

Why are these homes > 15ppb ?

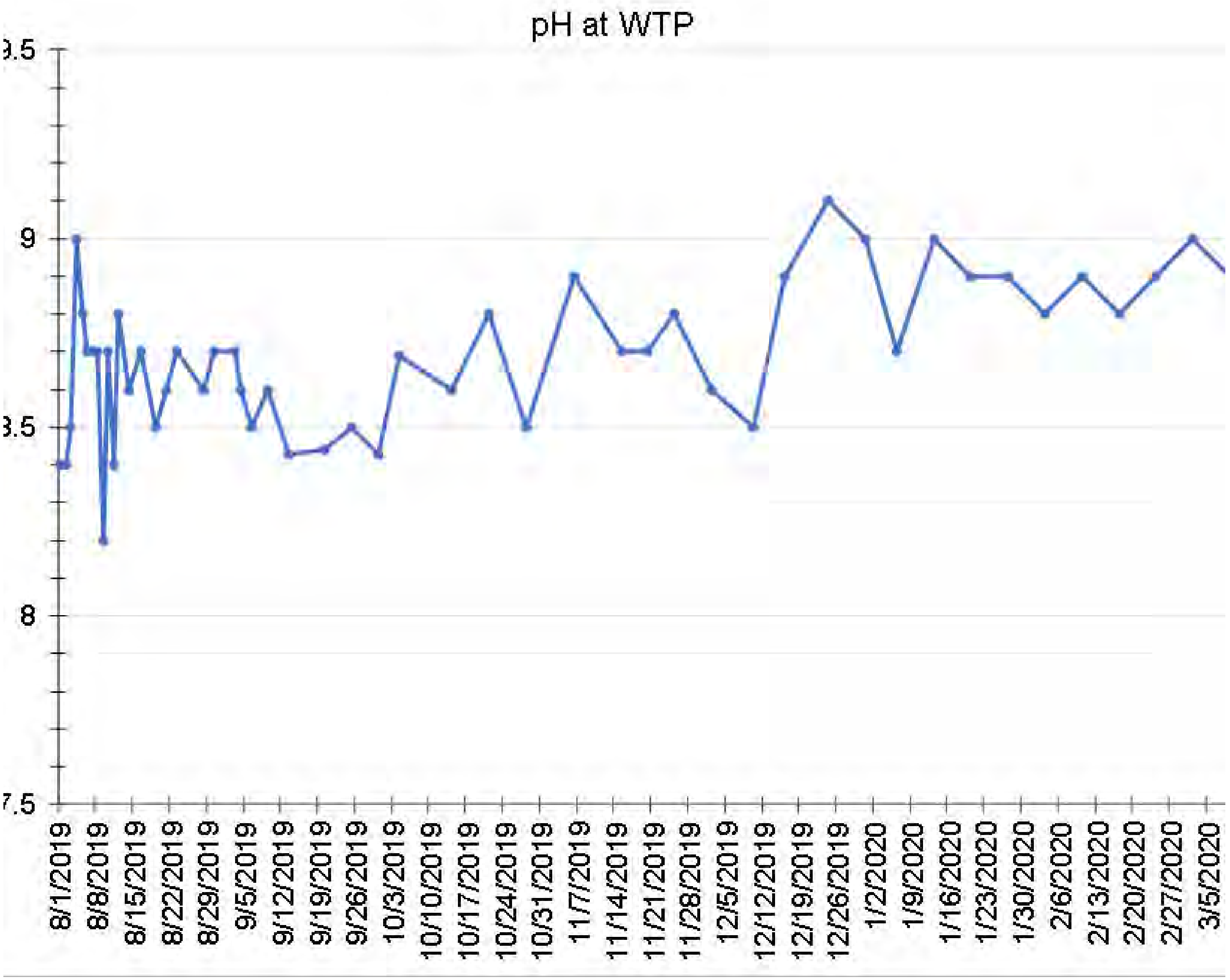
have lower water use

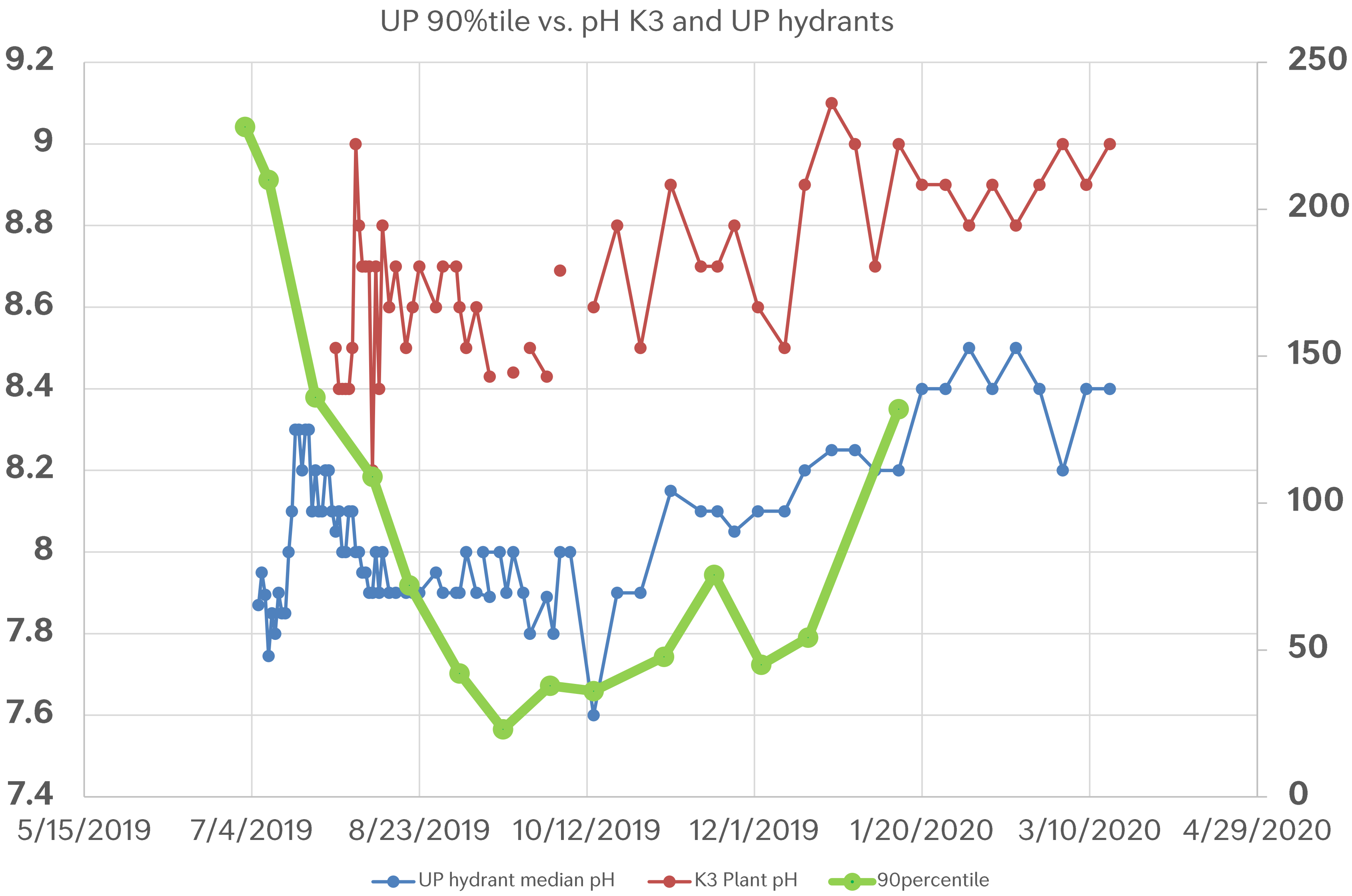
Notice lower houses drop out – 16 houses Creates artificial bias

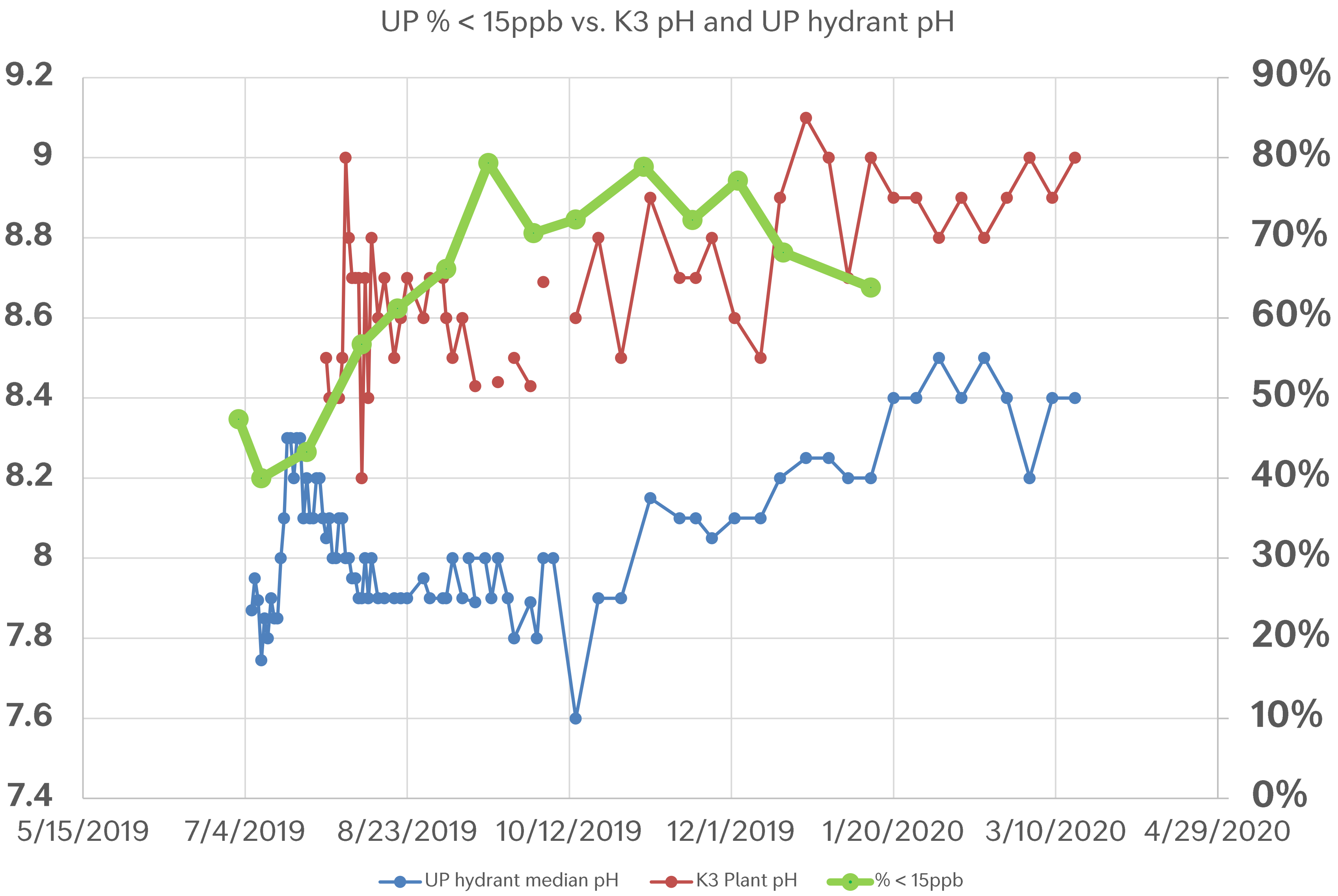
UP 9 Hydrants



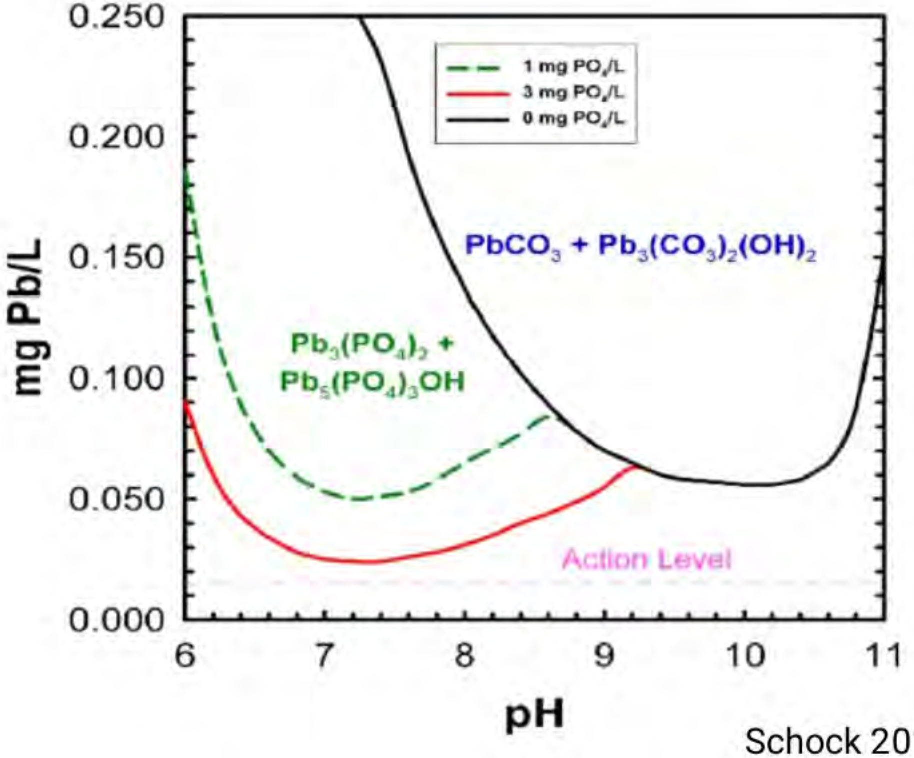
pH at Kankakee Plant




UP 90%tile vs. pH K3 and UP hydrants
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
250
200
150
100
50
0
5/15/2019
7/4/2019
8/23/2019
10/12/2019
12/1/2019
1/20/2020
3/10/2020
4/29/2020
UP hydrant median pH
K3 Plant pH
90percentile


UP % < 15ppb vs. K3 pH and UP hydrant pH
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5/15/2019
7/4/2019
8/23/2019
10/12/2019
12/1/2019
1/20/2020
3/10/2020
4/29/2020
UP hydrant median pH
K3 Plant pH
% < 15ppb

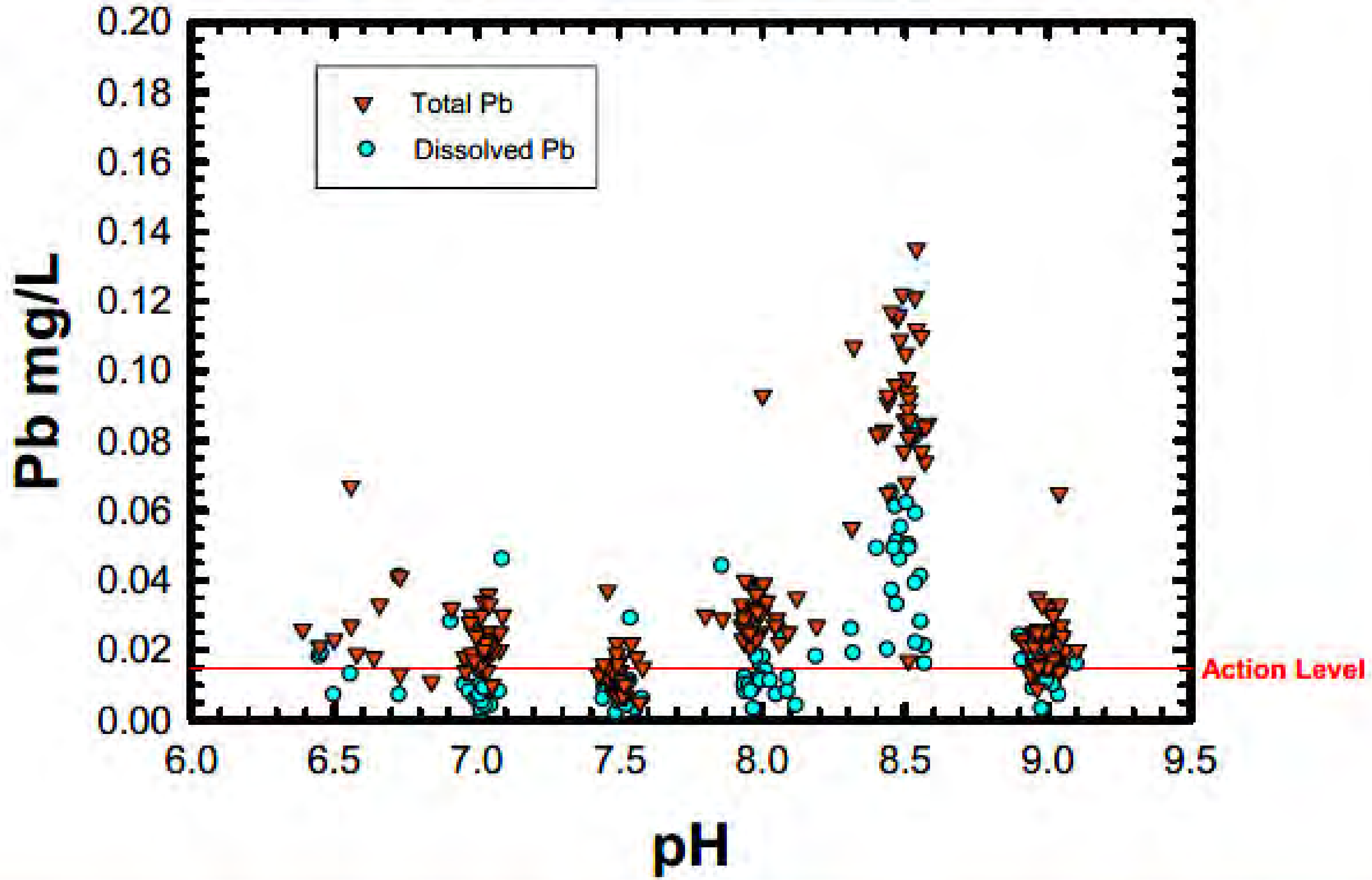
LEAD(II) PHOSPHATE SCALES ARE CONSISTENTLY LESS SOLUBLE THAN CARBONATE SCALES



Schock 2016

- Orthophosphate produces least soluble Pb(II) scale in pH 7-8 range
- Less effective above pH 8

Results for 1 mg PO_4/L @ DIC = 5



Langliers Index & Kankakee

- Kankakee has lead service lines
- Kankakee does not add a corrosion inhibitor
- Corrosion control for decades has been adjusting pH to maintain a positive LSI
- At LSI > 0
  - Water is supersaturated with respect to calcium carbonate ($CaCO_3$) and scale forming may occur.

Next Steps

- The 90:10 is optimal for corrosion control at the proper pH of near or < 8
- 90:10 is 90% ortho and pH stable product that does not impact pH in UP.
- However, the Kankakee system has always maintained a positive LSI to maintain corrosion control causing pH to go above 8 during cold water temps impacting UP pH.
- The most feasible method to have orthophosphate and optimal pH is to switch to phosphoric acid (AKA straight orthophosphate)

Mechanisms/Experiment review

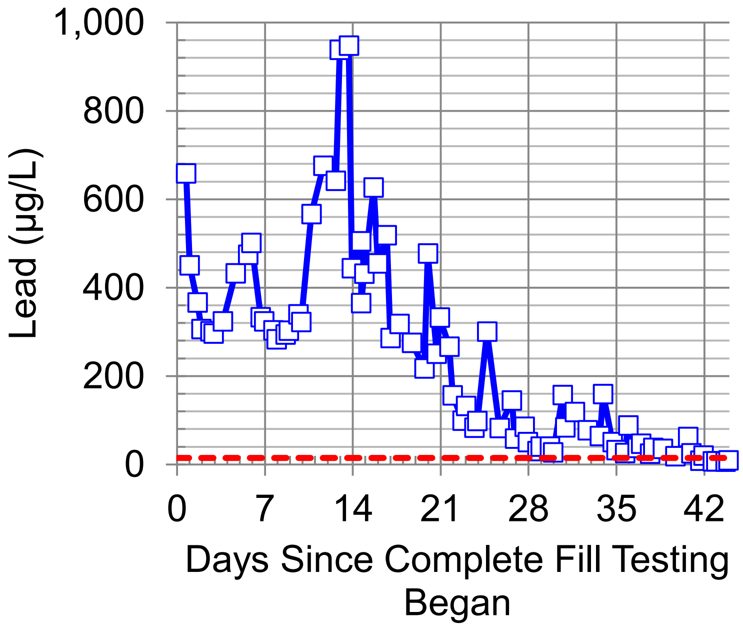
- Experiments show Ortho worked as well as 90:10 for fill draw experiments by Cornwell
- Edwards examined different inhibitors for galvanic corrosion which is not believed to be occurring at this time
- Consensus suggests a scale stability issue.

Prior Fill and Draw Tests on UP Pipes using o-PO4

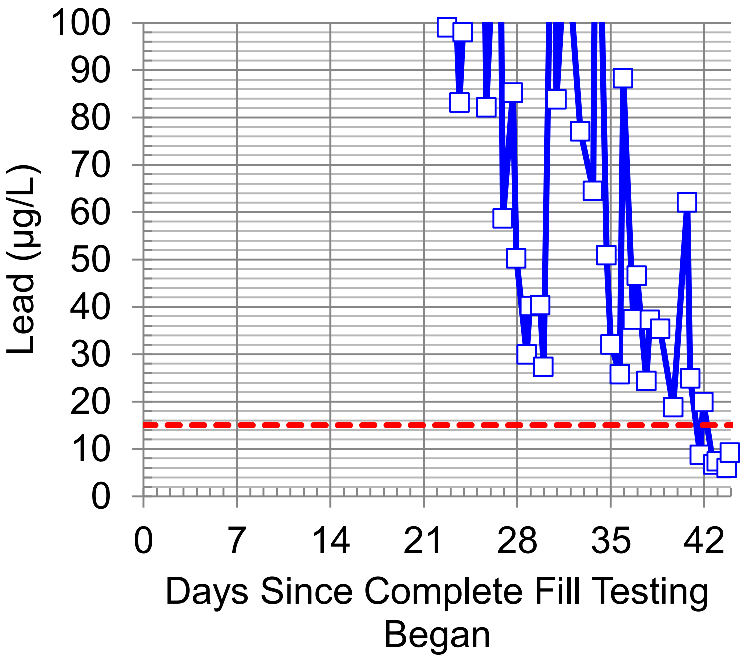
Cornwell

Original 455 Doral Pipe: 3 mg/L O-PO4 (straight ortho) pH pre-stagnation = 8.1 pH post stagnation = 7.7

Zoomed out

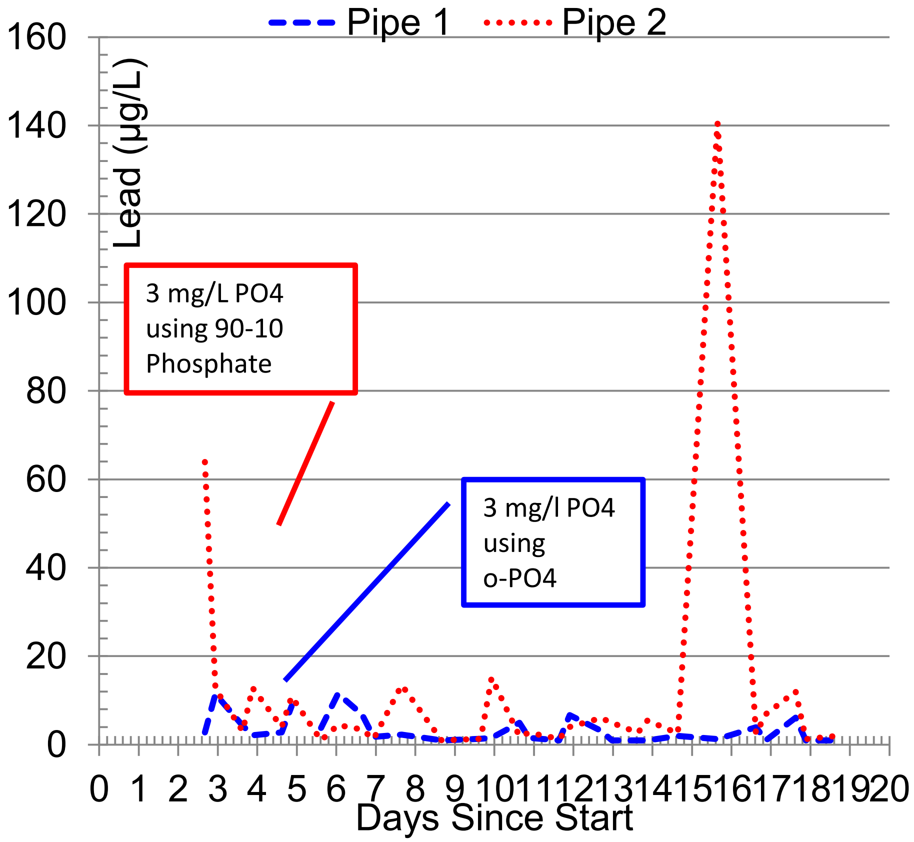


Zoomed in at end



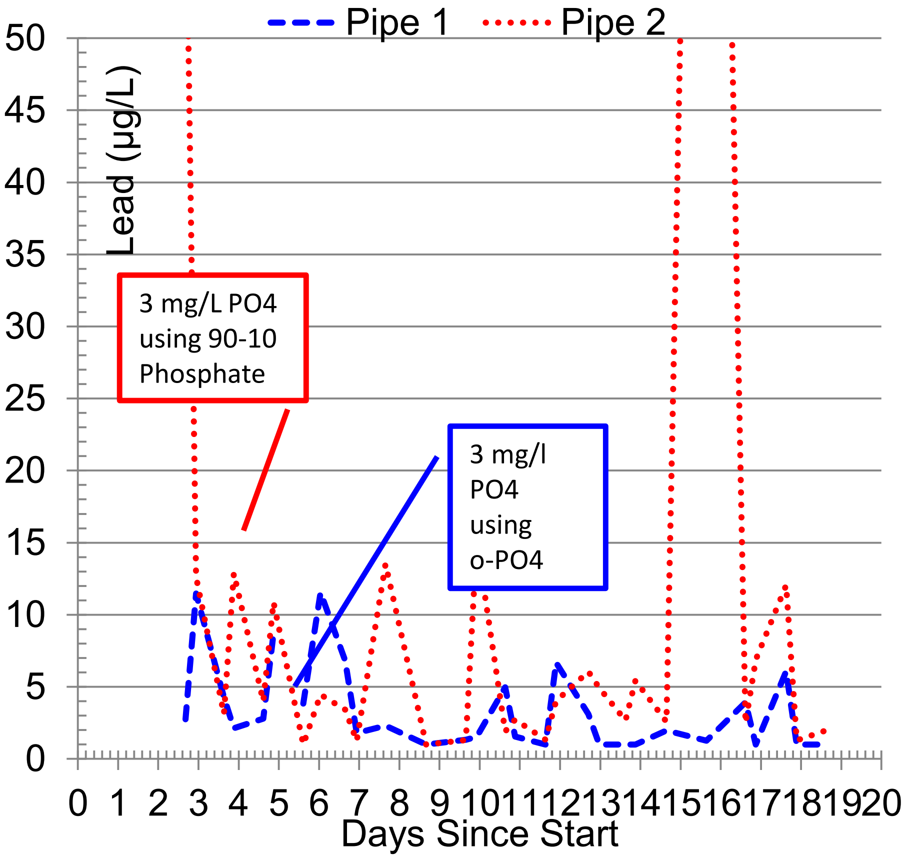
90:10 and Straight Ortho Performance Is Similar in Fill/Draw Tests

W/W plant pipes 1,2
pH pre-stagnation= 8.4
pH post-post stagnation = 7.9



3 mg/L PO4 using 90-10 Phosphate

3 mg/l PO4 using o-PO4

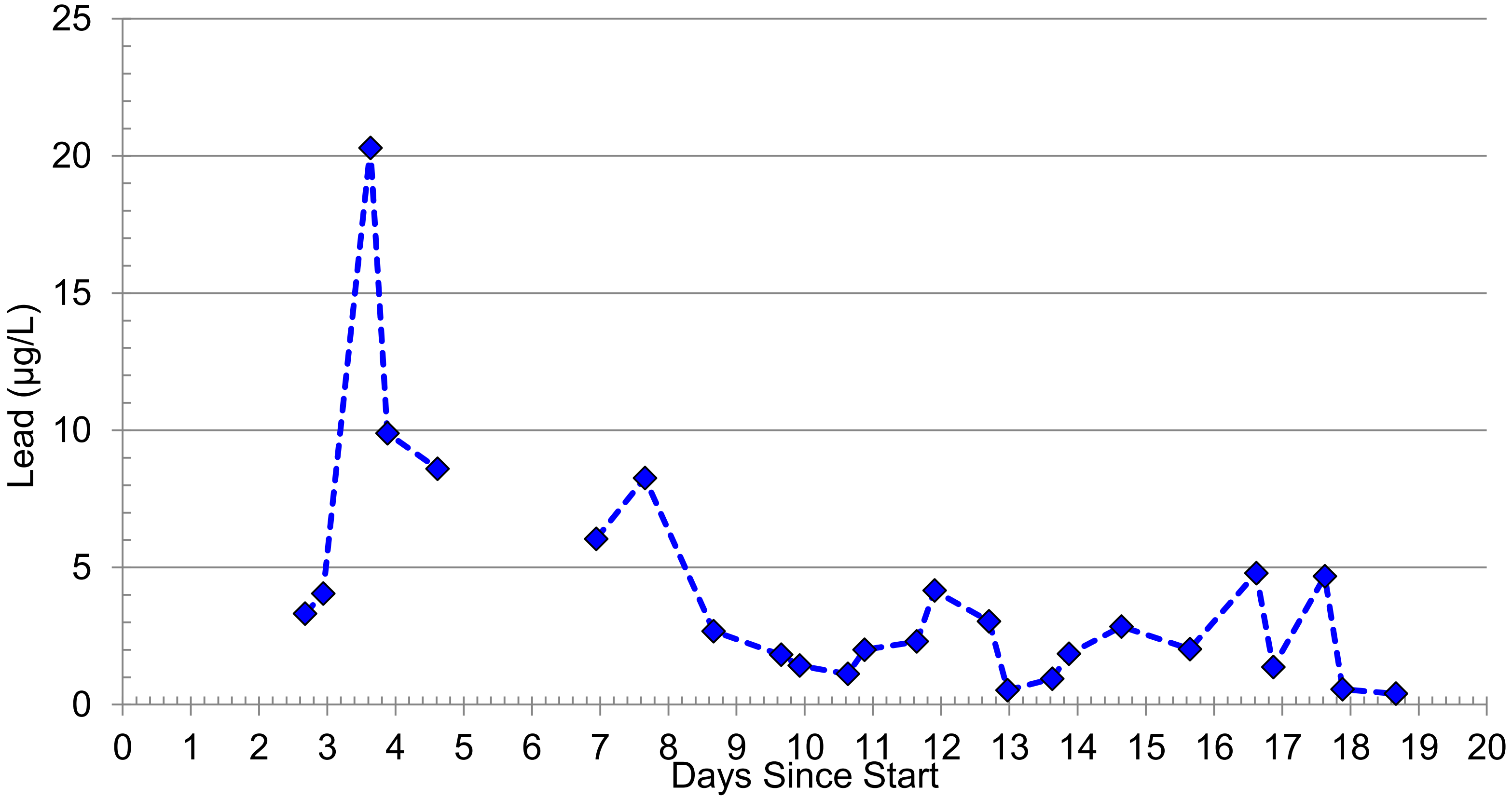


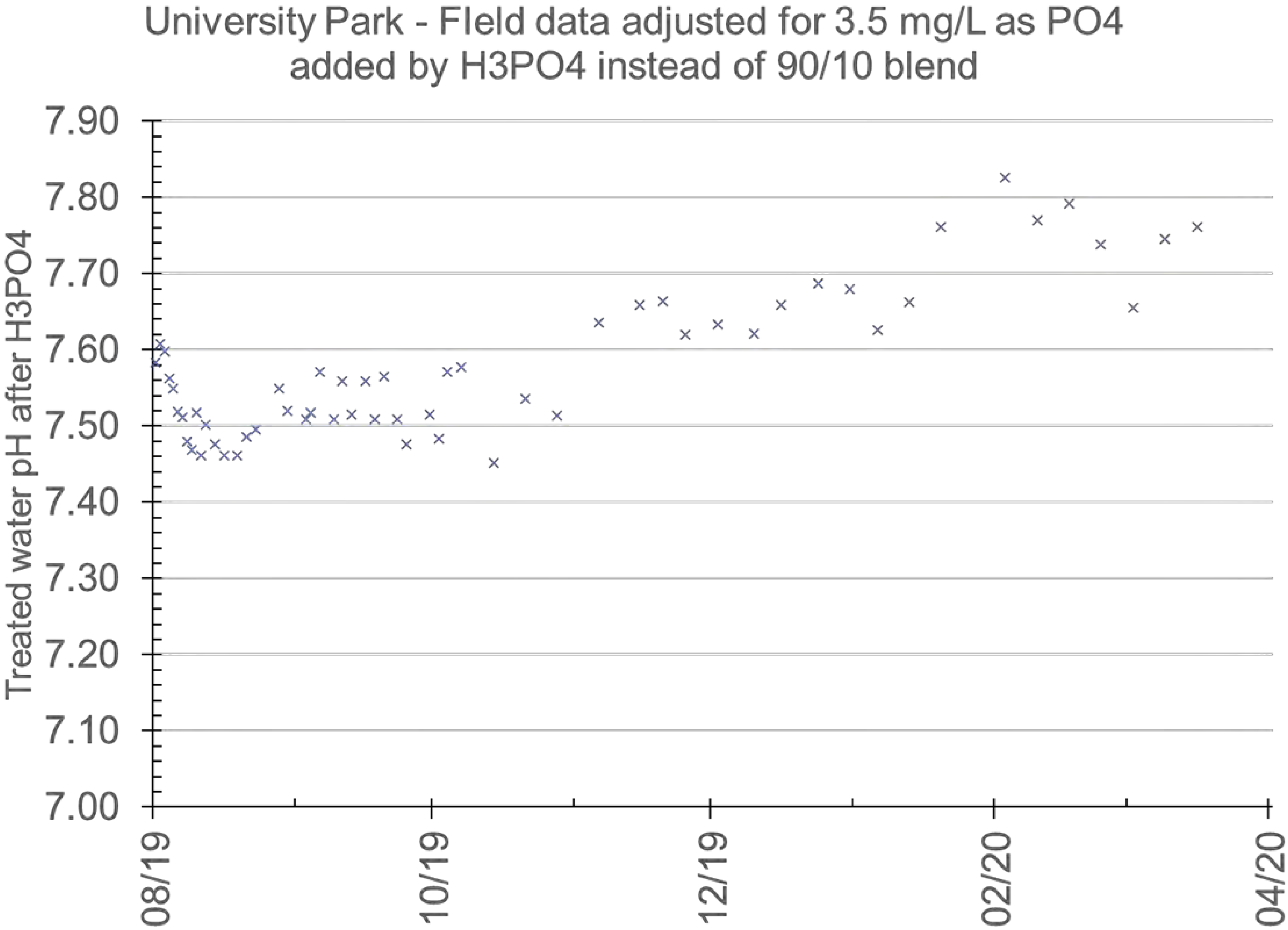
3 mg/L PO4 using 90-10 Phosphate

3 mg/l PO4 using o-PO4

Straight Ortho Works in Fill/Draw Tests from Summer 2019

w/w Plant Pipe 4: 3 mg/L PO4 using o-PO4
pH pre-stagnation= 8.4
pH post-post stagnation = 7.9




University Park - FIeld data adjusted for 3.5 mg/L as PO4 added by H3PO4 instead of 90/10 blend
Treated water pH after H3PO4
7.90
7.80
7.70
7.60
7.50
7.40
7.30
7.20
7.10
7.00
08/19
10/19
12/19
02/20
04/20

Next steps

- Request to switch to straight orthophosphate from 90:10 product at UP booster station
- Phosphoric acid will allow us to lower and control pH in most stable way to maintain best pH for corrosion control
- Experiments show straight ortho works for scale stability
- Avoids adjustments in the larger Kankakee system that is stable

Water Use Is Still A Factor

- High lead homes did not use enough water to stabilize scale during original Fall 2019 window before pH moved from optimal range
- These homes will still need to increase water use in order to stabilize scales and recover

Experts Opinion/Discussion

- Cornwell
- Edwards
- Schock
- Lytle
- Cook

R 000342

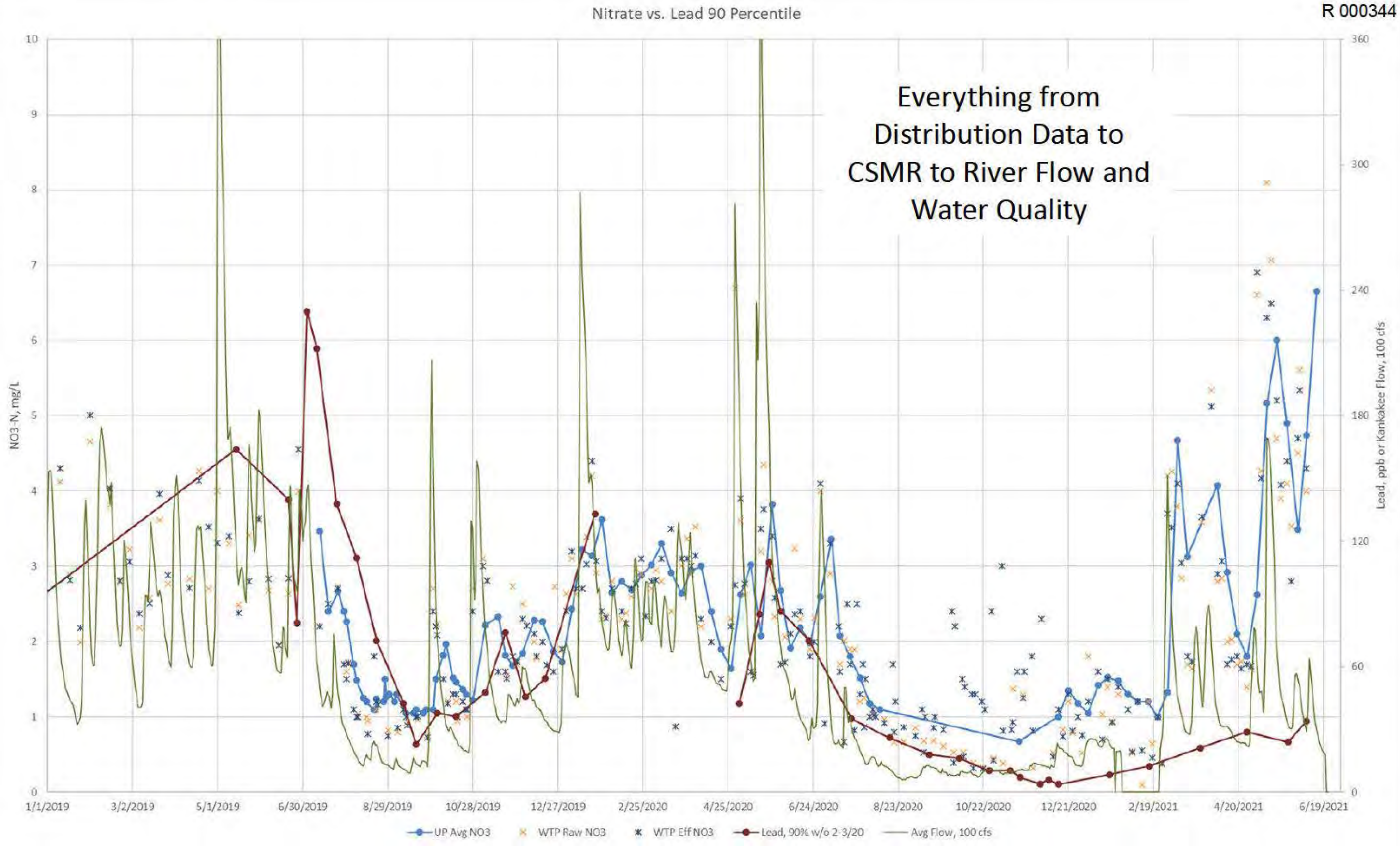
Aqua UP: Technical Response Team Presentation

07/1/2021

Overview

R 000343

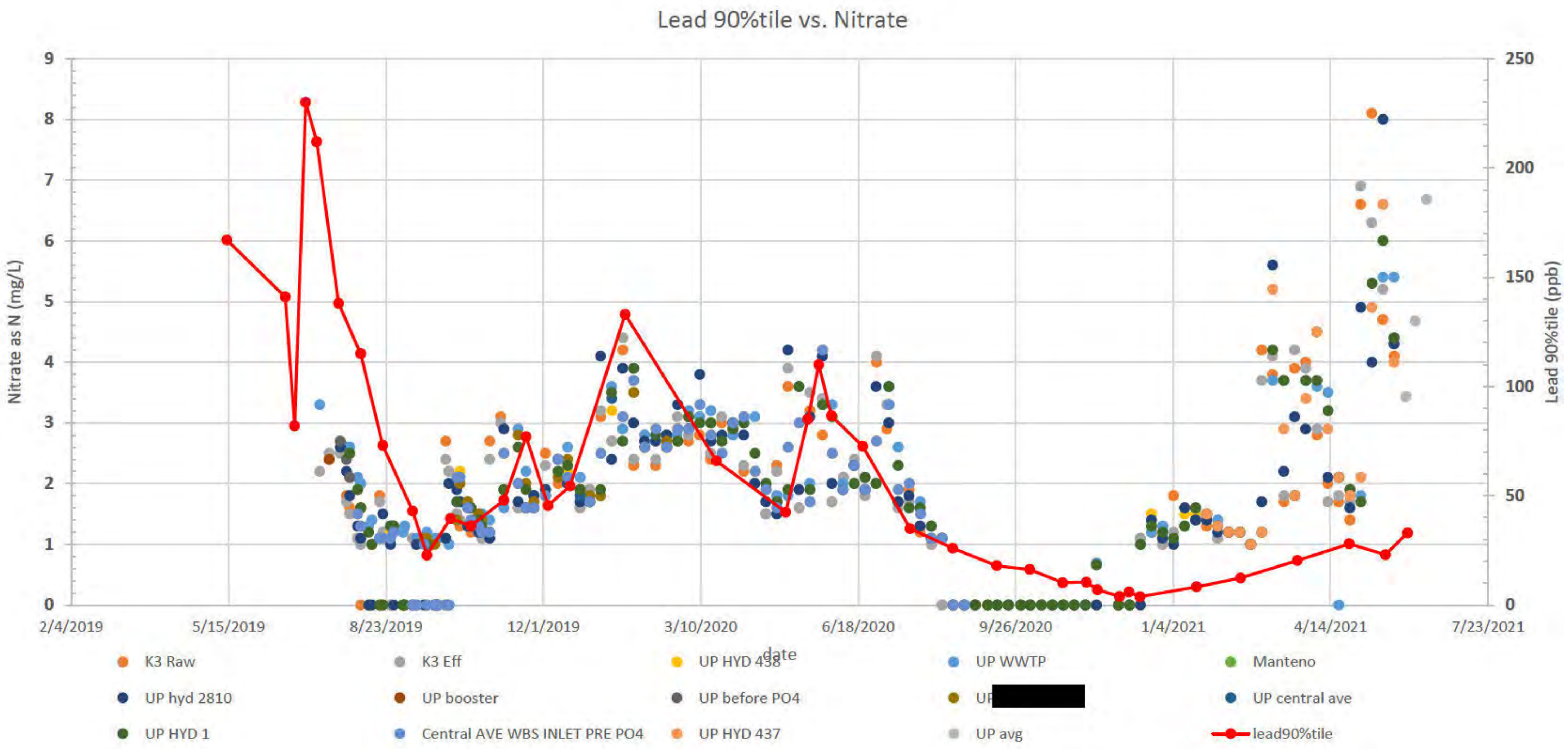
- Aqua has continuously investigated numerous causes, conditions, and factors that could cause elevated lead in the tap water of certain homes in UP with experiments and field studies.
    - This work has continued despite the improvement trends we have seen in home recovery across the UP-compliance sampling pool after roughly 2 years of monthly compliance sampling
- Recently observed elevated river nitrate levels from farm runoff is coinciding with lead level increases in certain homes that have not recovered. Recent river nitrate levels were extremely high making the trend more apparent.
- Prior in-lab experiments looking at nitrate did not reproduce the lead levels previously observed in tap water collected from certain homes in UP.
- Dr. Marc Edwards and Virginia Tech have recently run new experiments and will update the technical team today on new scientific findings.
- Based on this new and unprecedented information and the recent lead data/trend, Aqua anticipates requesting a switch to ZnPO4 as a further protective measure targeting nitrate galvanic attack.



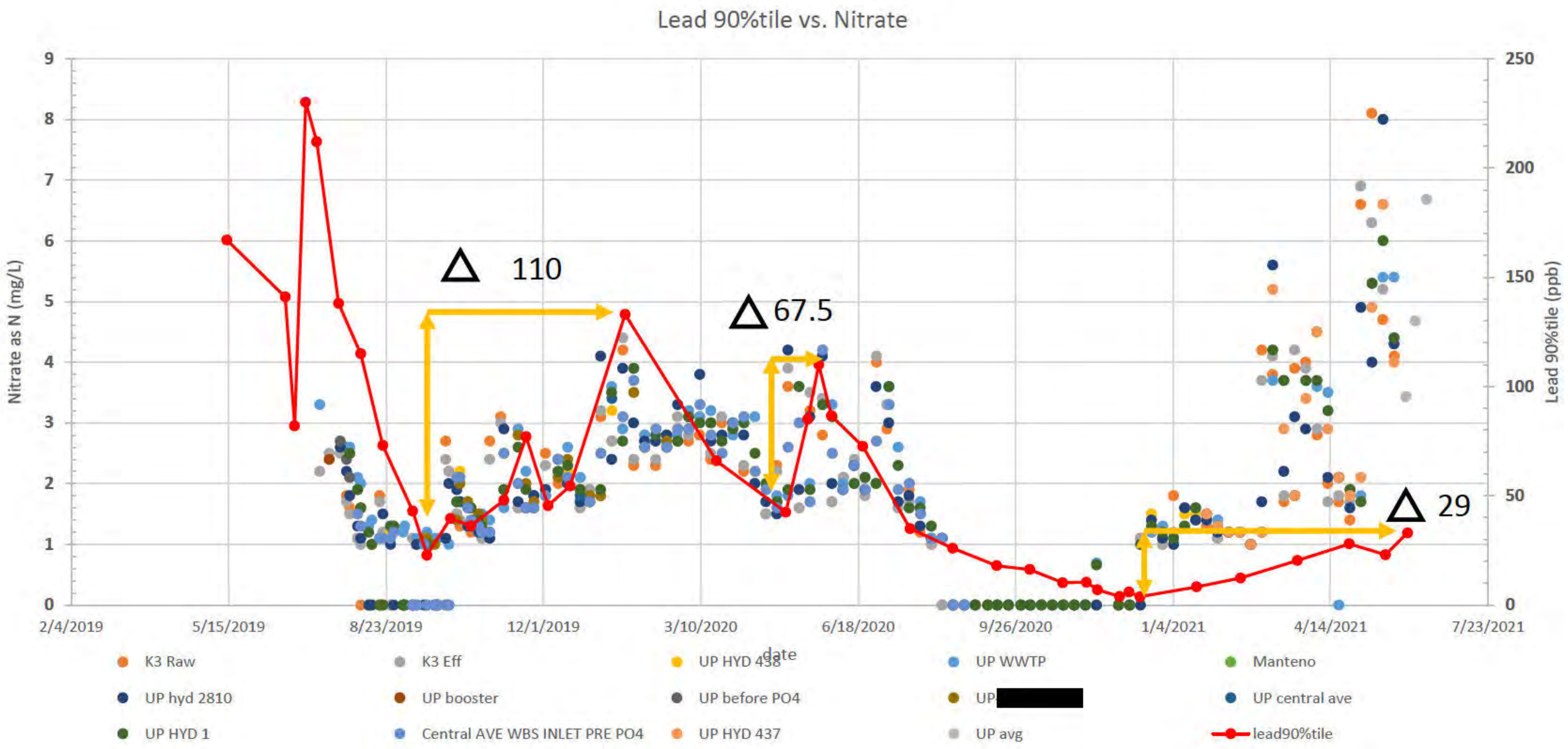
Nitrate vs. Lead 90 Percentile

Everything from Distribution Data to CSMR to River Flow and Water Quality

redacted


Lead 90%tile vs. Nitrate
Nitrate as N (mg/L)
Lead 90%tile (ppb)
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
2/4/2019
5/15/2019
8/23/2019
12/1/2019
3/10/2020
6/18/2020
9/26/2020
1/4/2021
4/14/2021
7/23/2021
date
K3 Raw
K3 Eff
UP HYD 438
UP WWTP
Manteno
UP hyd 2810
UP booster
UP before PO4
UP [redacted]
UP central ave
UP HYD 1
Central AVE WBS INLET PRE PO4
UP HYD 437
UP avg
lead90%tile

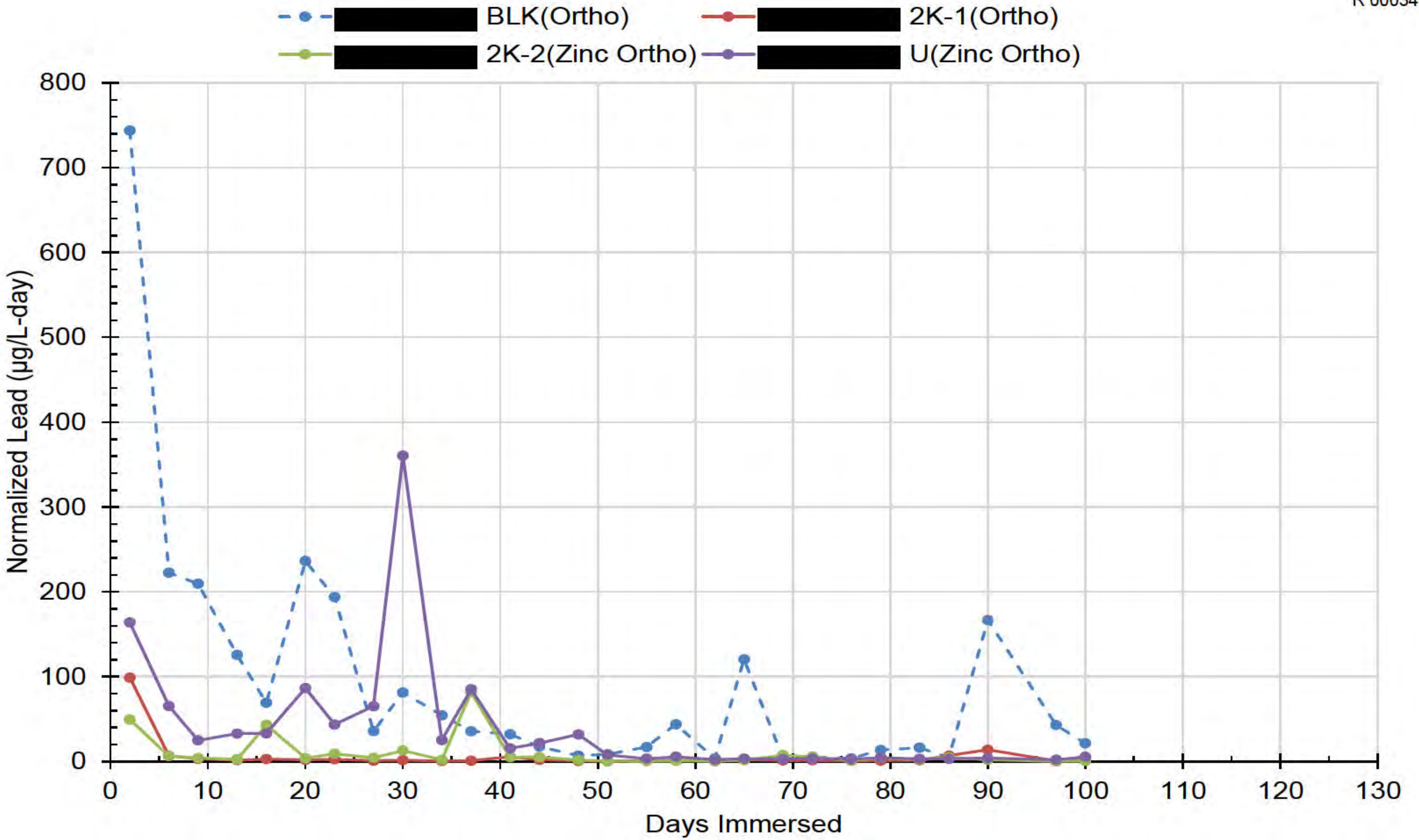
Redacted


Lead 90%tile vs. Nitrate
Nitrate as N (mg/L)
0
1
2
3
4
5
6
7
8
9
Lead 90%tile (ppb)
0
50
100
150
200
250
2/4/2019
5/15/2019
8/23/2019
12/1/2019
3/10/2020
6/18/2020
9/26/2020
1/4/2021
4/14/2021
7/23/2021
date
△ 110
△ 67.5
△ 29
● K3 Raw
● K3 Eff
● UP HYD 438
● UP WWTP
● Manteno
● UP hyd 2810
● UP booster
● UP before PO4
● UP [redacted]
● UP central ave
● UP HYD 1
● Central AVE WBS INLET PRE PO4
● UP HYD 437
● UP avg
lead90%tile

redacted

Dr. Marc Edwards and Virginia Tech Experiment Presentation

- Coupon Tests with High Nitrate Water
- [redacted] Harvested Pipe – Fill and Draw


[redacted] BLK(Ortho)
[redacted] 2K-1(Ortho)
[redacted] 2K-2(Zinc Ortho)
[redacted] U(Zinc Ortho)
Normalized Lead (µg/L-day)
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Days Immersed

Next Steps

- Pending results next week, we anticipate making a request to switch to Zinc Orthophosphate to provide added and accelerated protection for certain homes that are not yet responding, to address the impacts of nitrates
- We request that the State work with us on our anticipated request in an expedited fashion
- If we request a switch to Zinc Orthophosphate to address the impacts of seasonal nitrates on the recovery of certain homes, monthly compliance sampling should be replaced, beginning in July and for two additional months after permit issuance approving the treatment, with sentinel non-compliance sampling:
  - Sentinel non-compliance sampling at locations focusing on homes with higher lead (subject to customer participation)
  - Customer sampling will still be offered free of charge to any customer requesting

Questions

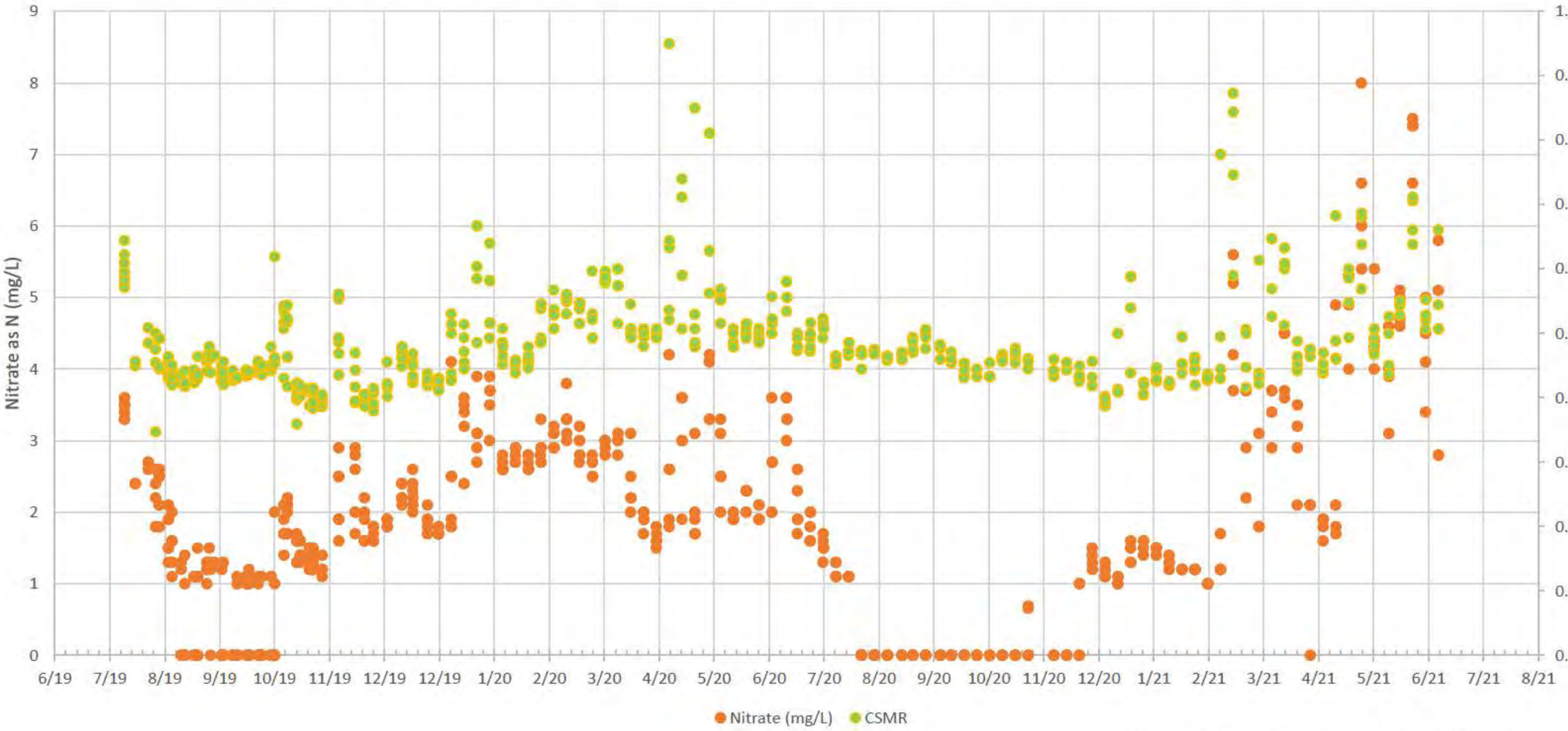
Aqua UP: Technical Response Team Presentation

07/14/2021

Overview

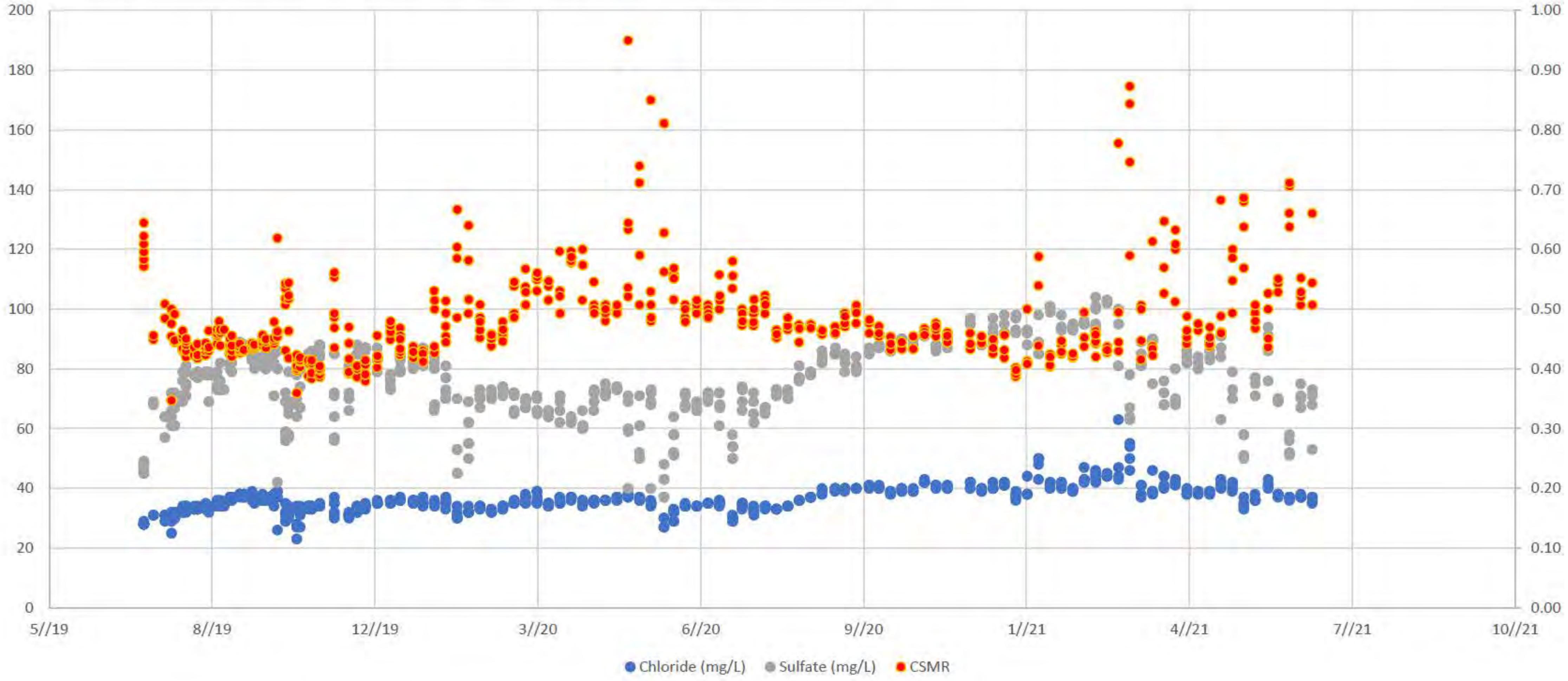
- Recently observed elevated river nitrate levels from farm runoff is coinciding with lead level increases in certain homes that have not recovered. Recent river nitrate levels were extremely high making the trend more apparent.
- Dr. Marc Edwards and Virginia Tech continue to run new experiments and will update the technical team today on most recent results.
- Work is occurring in parallel by Dr. David Cornwell shows a 10:1 zinc sulfate supplemented orthophosphate product can achieve the same seasonal pH control as the existing orthophosphate
- Based on this new and unprecedented information and the recent lead data/trend, Aqua will request to supplement the current orthophosphate to a zinc orthophosphate inhibitor as a further protective measure targeting nitrate galvanic attack.

Nitrate vs. CSMR



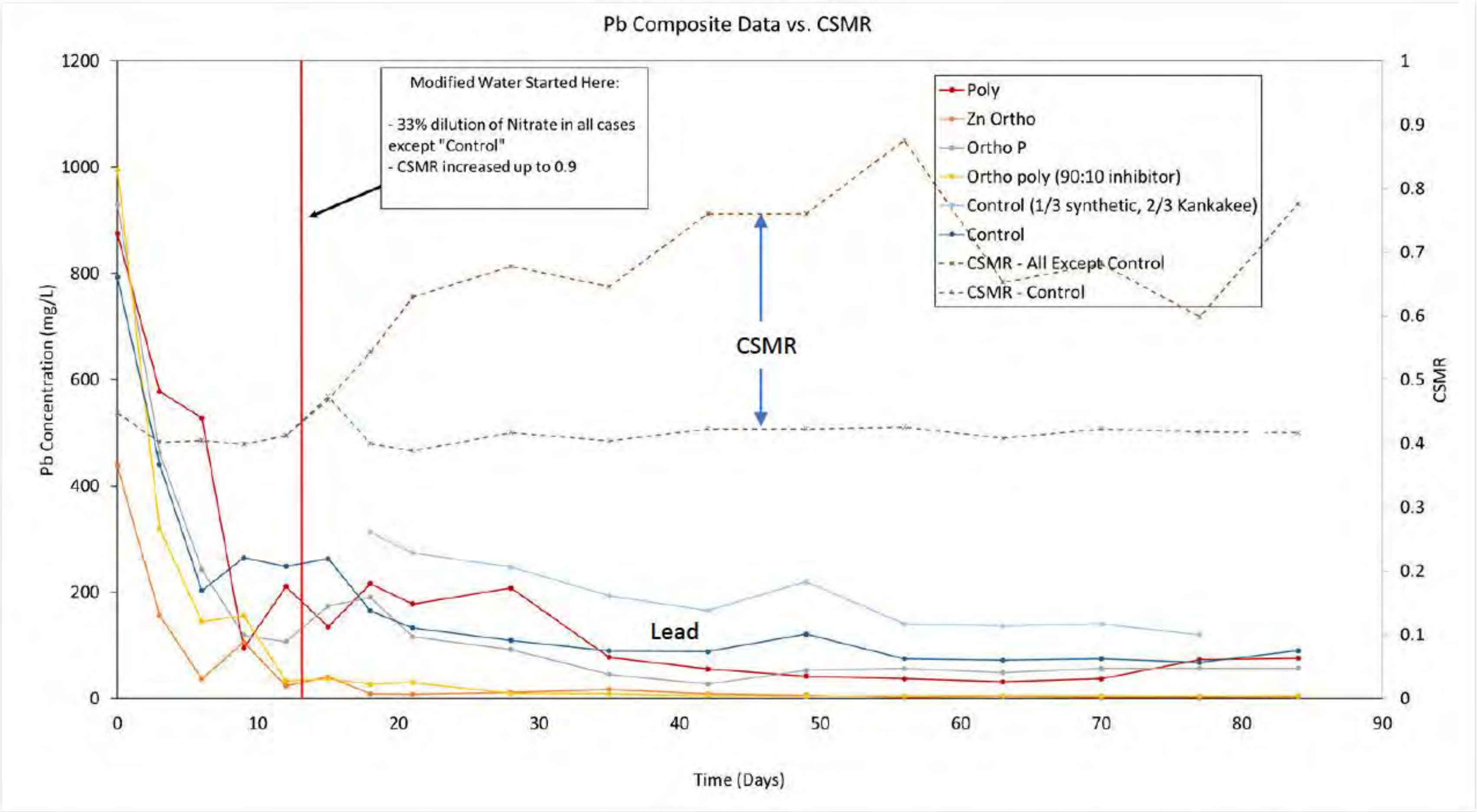
Presentation Contains Results Still Under Review

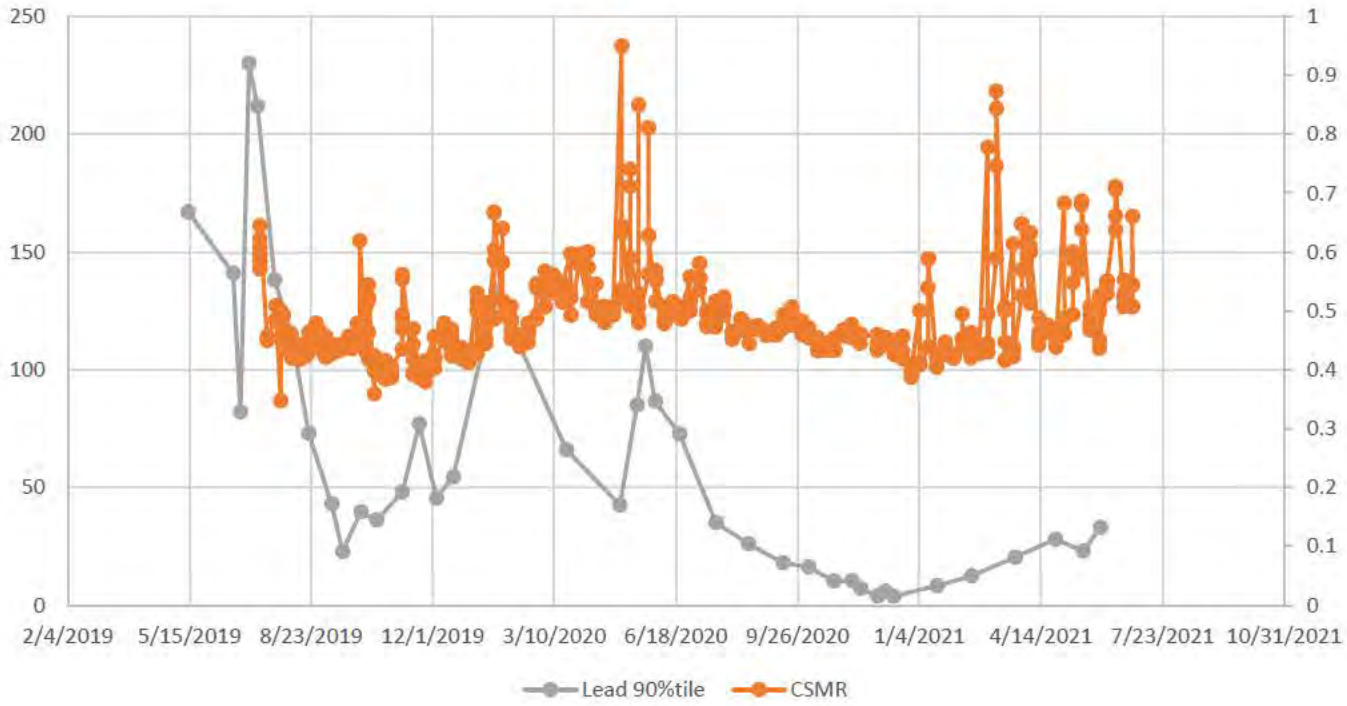
Chloride, Sulfate, & CSMR

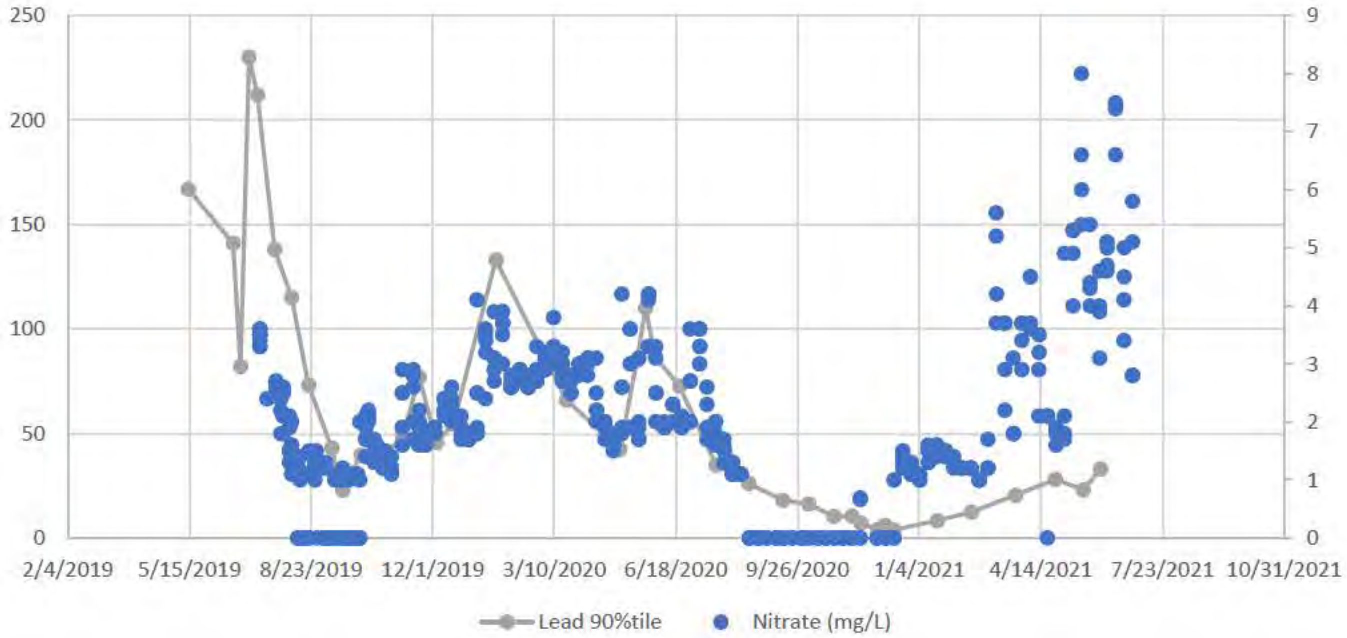


Chloride stable, sulfate fluctuates driving CSMR

High CSMR in Prior Experiments by Virginia Tech Had No Impact on Lead Release (2019)





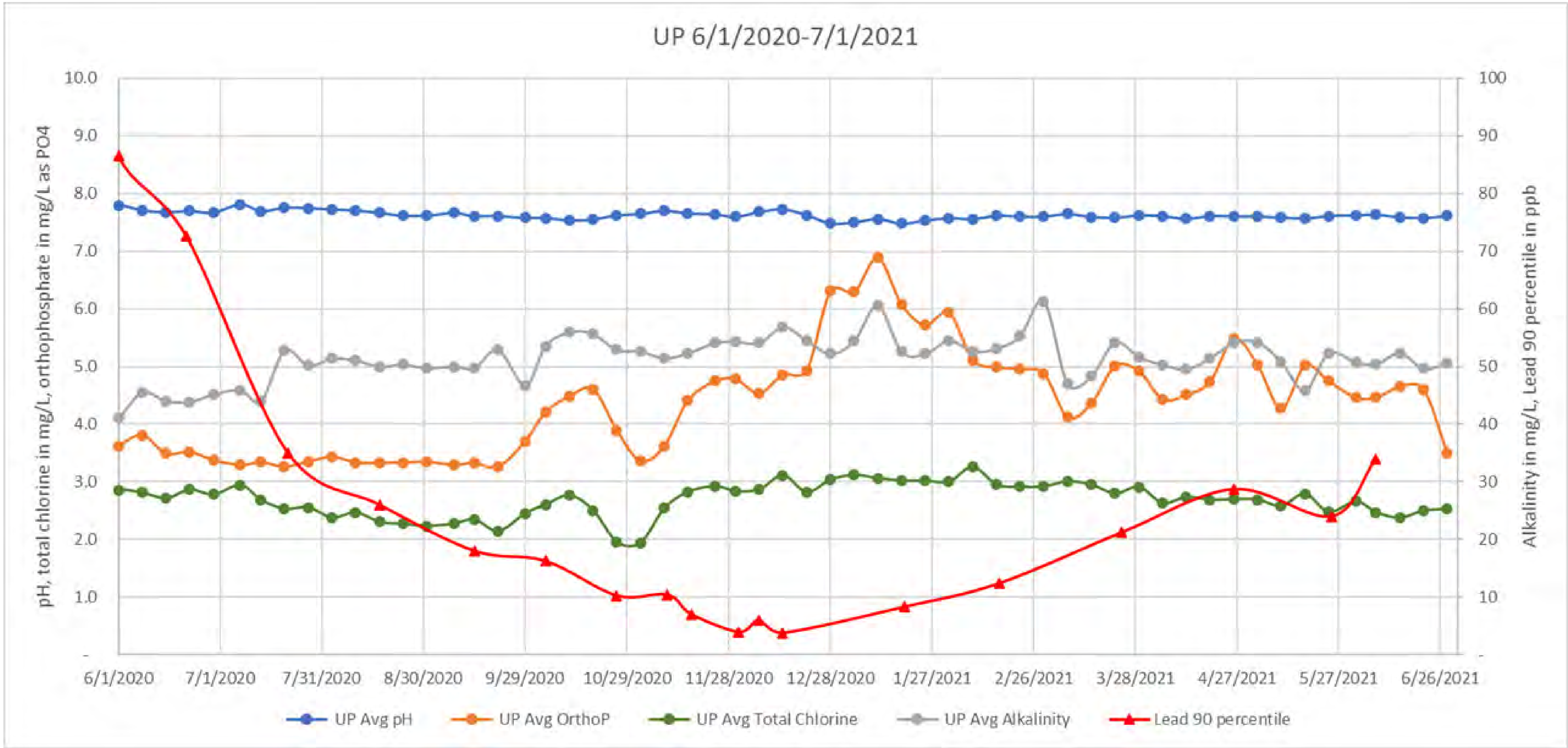


Chloride levels generally stable
Sulfate declines during high flow/runoff events
Nitrate increases during runoff events

Presentation Contains Results Still Under Review

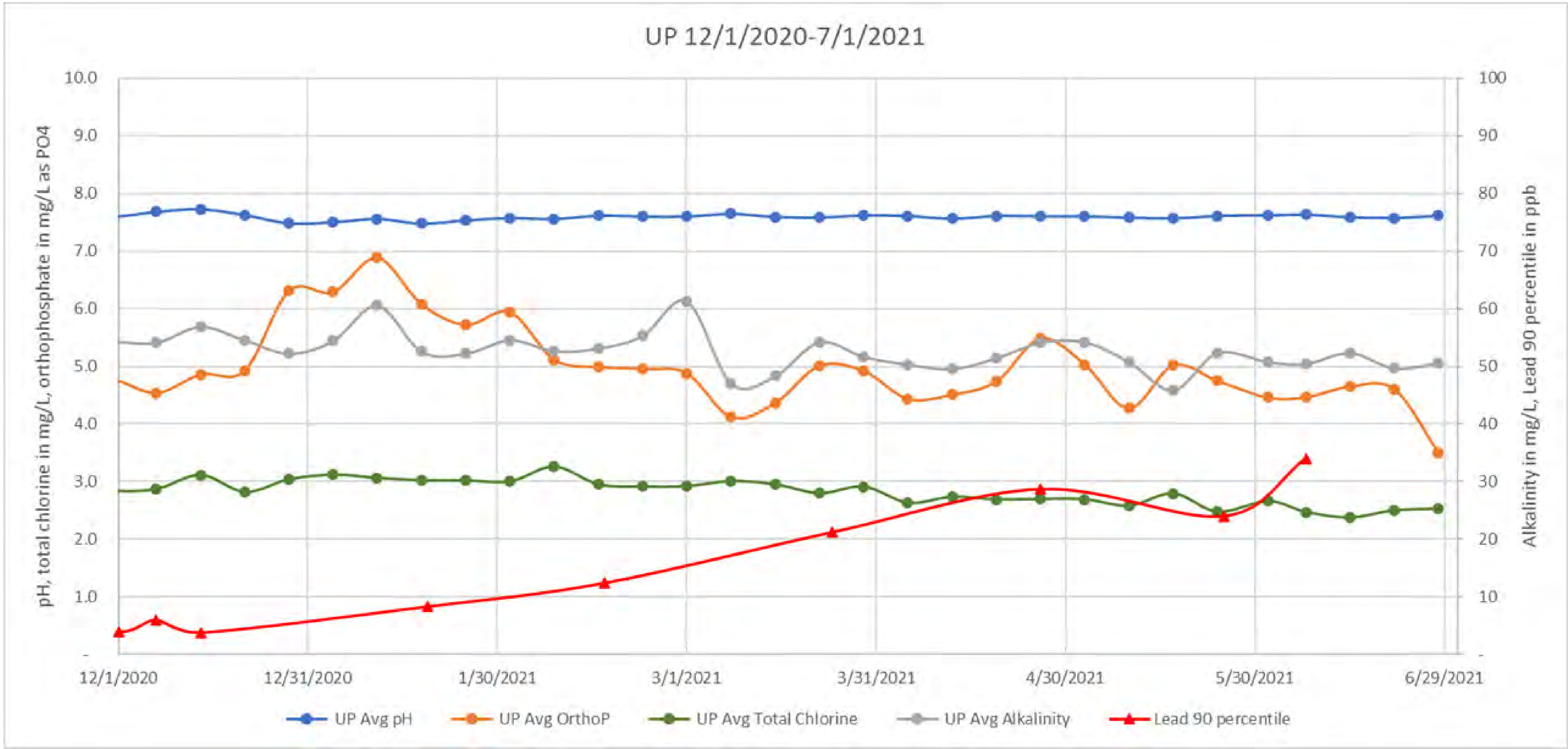
Chlorine, Alkalinity, and pH Were Stable the Past Year

Presentation Contains Results Still Under Review



Reminder: Orthophosphate fluctuates with seasons to maintain steady pH (orthophosphoric acid product) in UP as water from Kankakee pH increases in winter due to LSI targets in original Kankakee system

Chlorine, Alkalinity, and pH Were Stable the Past Year

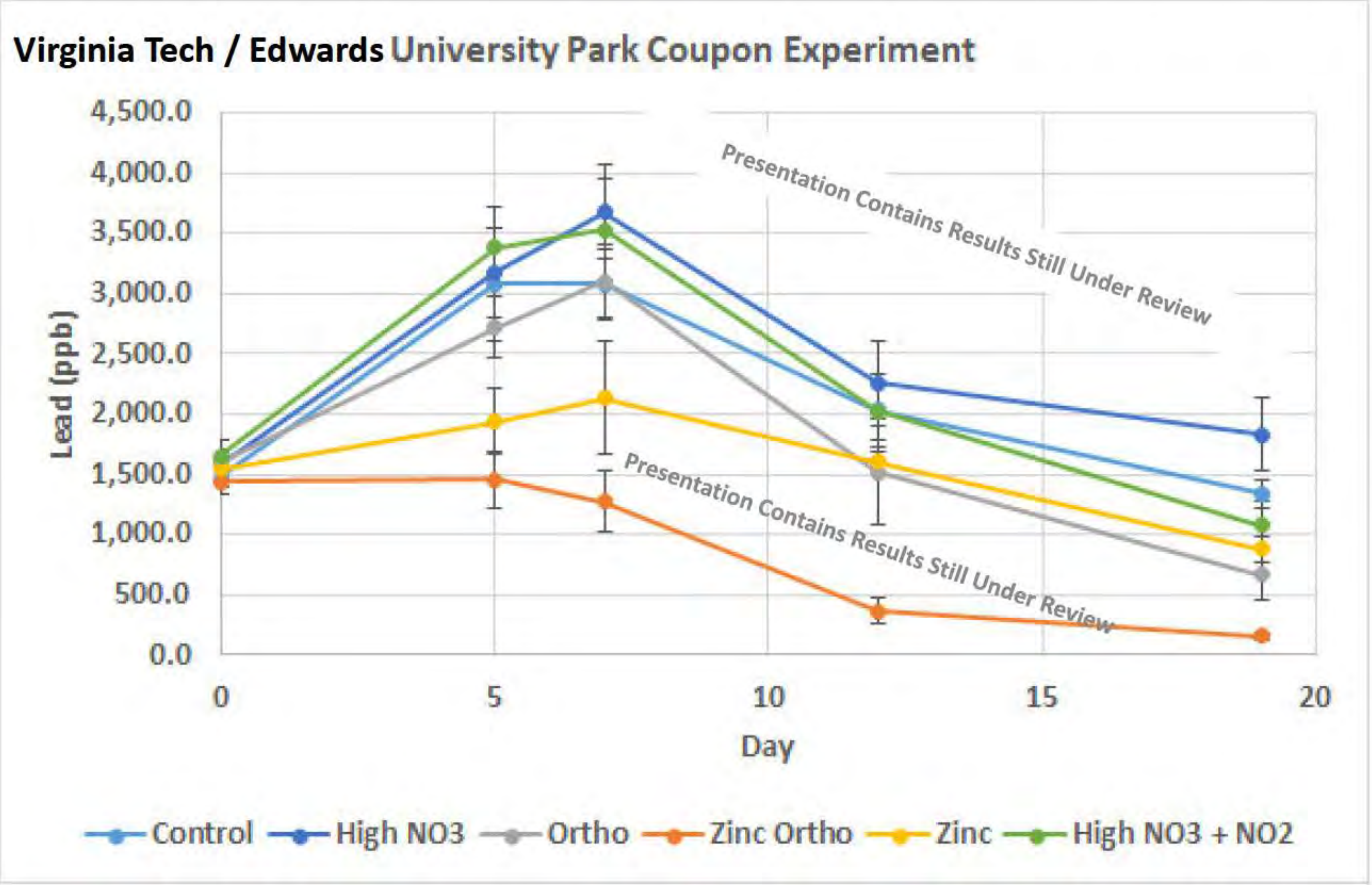


Reminder: Orthophosphate fluctuates with seasons to maintain steady pH (orthophosphoric acid product) in UP as water from Kankakee pH increases in winter due to LSI targets in original Kankakee system

Dr. Marc Edwards and Virginia Tech Experiment Presentation

- Coupon Tests with High Nitrate Water
- [redacted] Harvested Pipe – Fill and Draw

Recap - Zinc Ortho Worked Better In Higher Nitrate Situations



Next Steps

- Aqua will make request to switch to Zinc Orthophosphate to provide added and accelerated protection for certain homes that are not yet responding
  - Request likely within 1 week
  - We respectfully seek State expedited review
- When Aqua requests the switch to supplement the existing treatment, Aqua will also be seeking a modification to the permit sampling regime consistent with the recognition that treatment can take several months before lead levels stabilize. Monthly compliance sampling for the remainder of the 6 month period will begin 30 days after the supplemented treatment is installed. During the period of time prior to installation, Aqua will collect non-compliance samples at 25 sentinel sites monthly within the compliance pool and customer requested sampling will continue.

Questions

University Park Nitrate Experiments

July 14th, 2021

Current Study

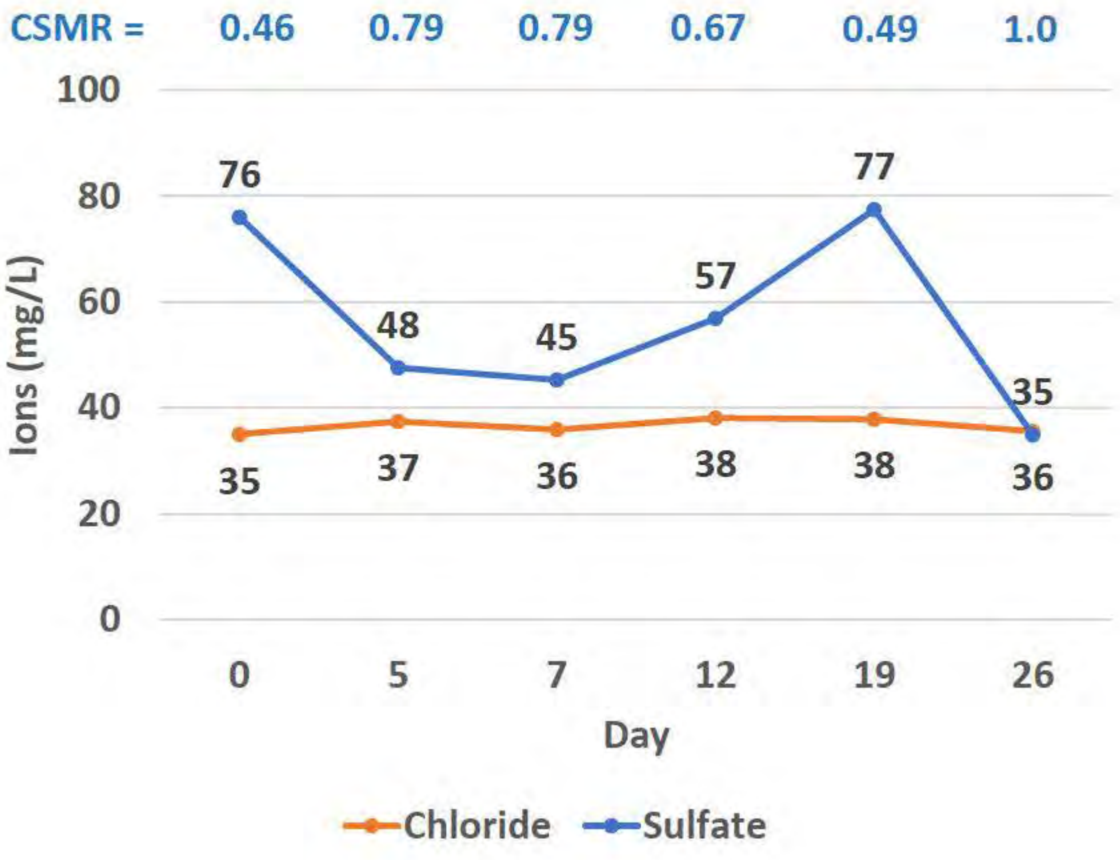
- New copper coupons with 50:50 lead-tin solder
- Conditioned for 1 week with groundwater, then 1 week with Kankakee
  - Coupons tested, selected to minimize relative standard deviation and sorted into 6 statistically similar groupings
- Changed water to create 6 different conditions (n=15)

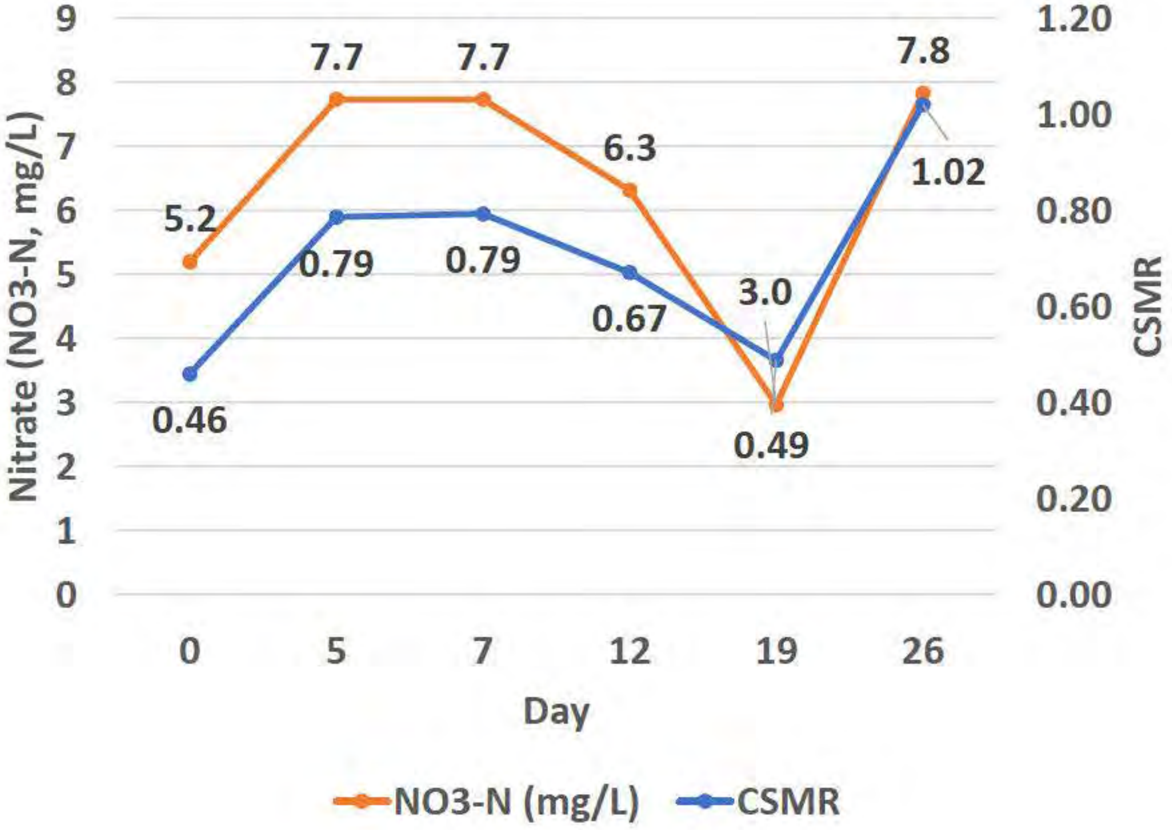
Water Conditions	Phosphate	Zinc	NO3	NO2
Control				
High NO3			+5 mg/L N	
Ortho	0.10-2 mg/L P		+5 mg/L N	
Zinc Ortho	0.10-2 mg/L P	0.33-4 mg/L	+5 mg/L N	
Zinc		0.33-4 mg/L	+5 mg/L N	
High NO3 + NO2			+5 mg/L N	0.5 mg/L N

*Phosphate was 0.10 mg/L P for the 1st 5 days, then 2 mg/L for a week. Final target dose was 1 mg/L P.

**Zn was a conditioning dose of 4 mg/L for the 1st 5 days, then 0.5 mg/L for a week, and the final maintenance dose was 0.33 mg/L.

Water Quality

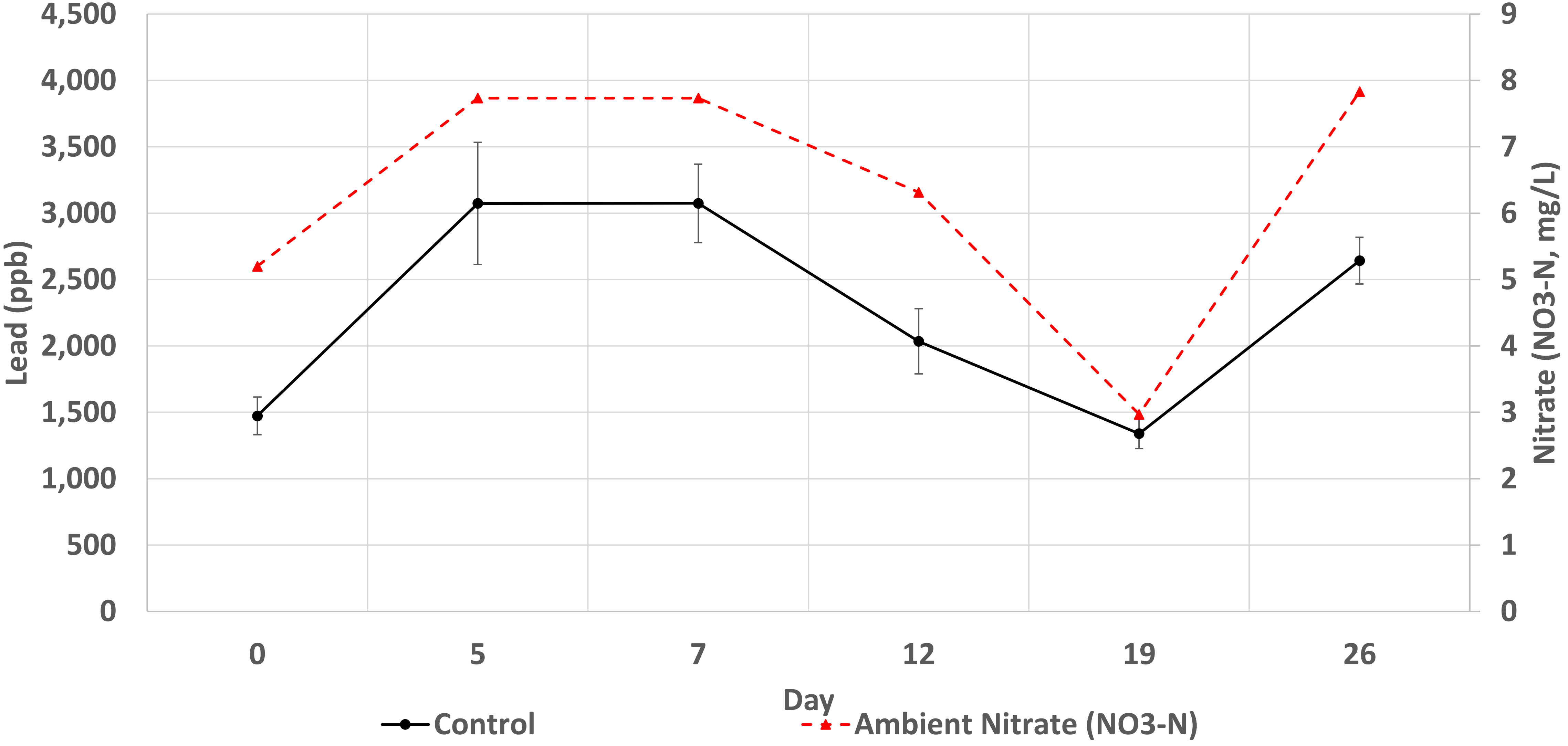




*Time 0 data estimated from AQUA monitoring data from May 17, 2021

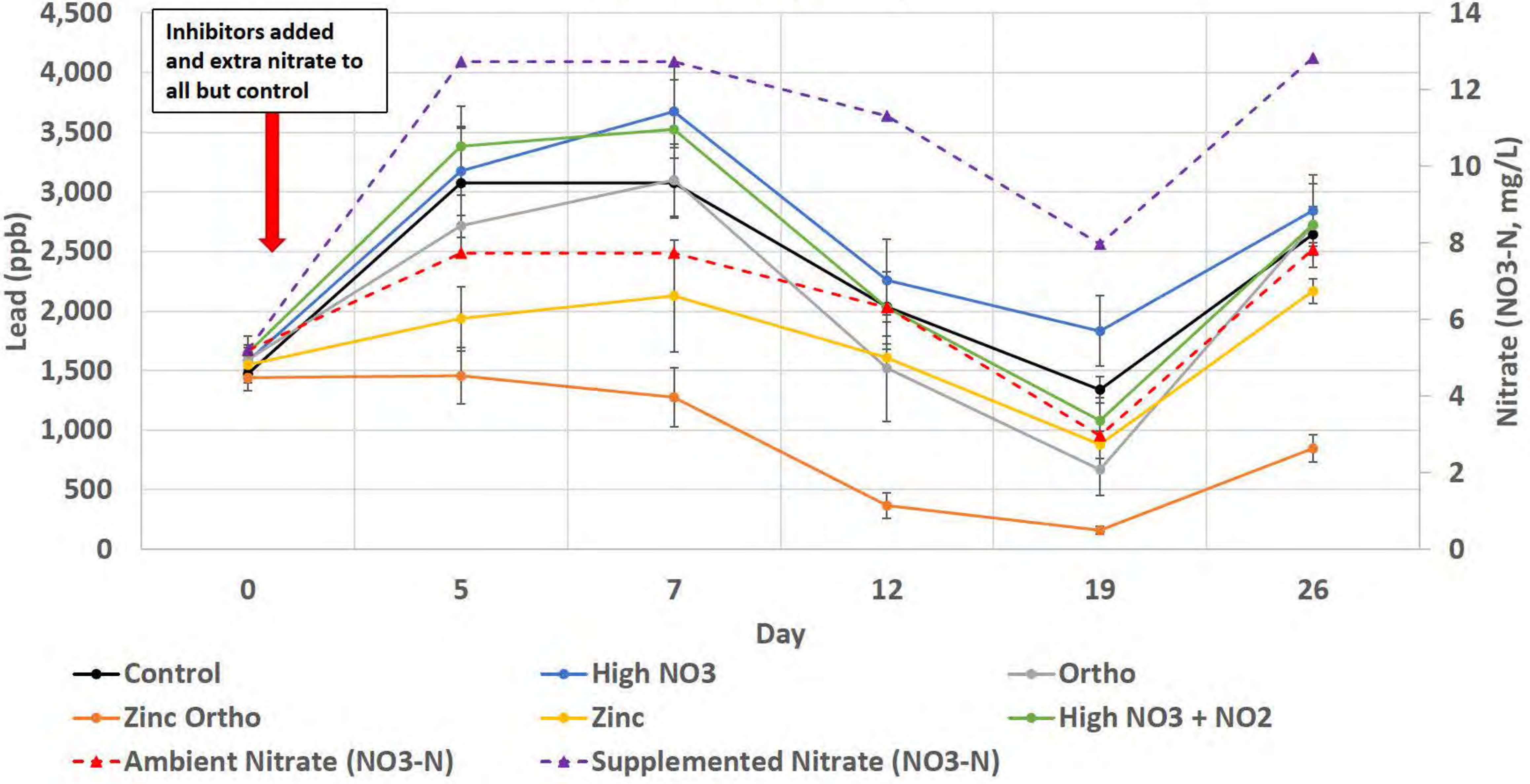
Presentation Contains Data/Results Still Under Review

University Park Coupon Experiment



Error bars represent 95% confidence intervals

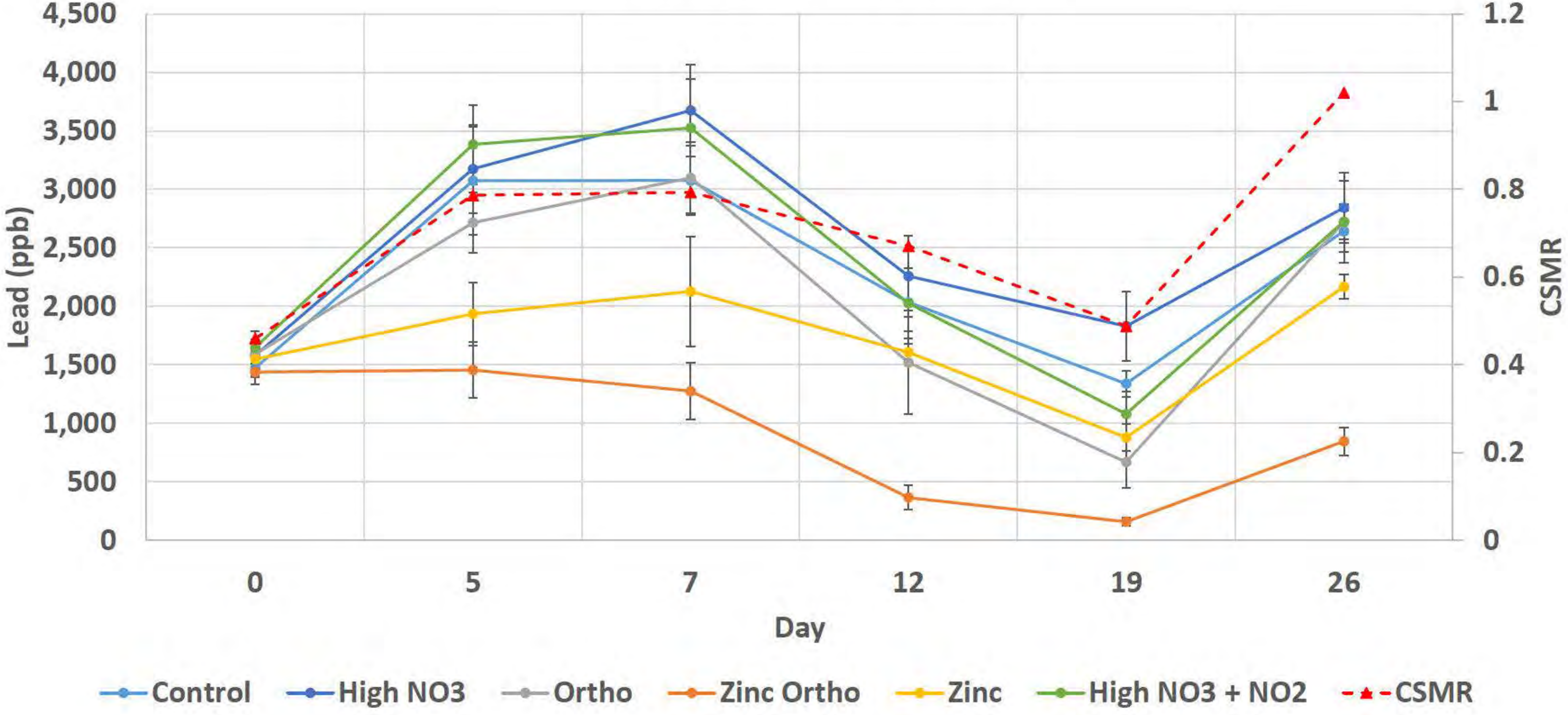
University Park Coupon Experiment



Error bars represent 95% confidence intervals

Presentation Contains Data/Results Still Under Review

University Park Coupon Experiment

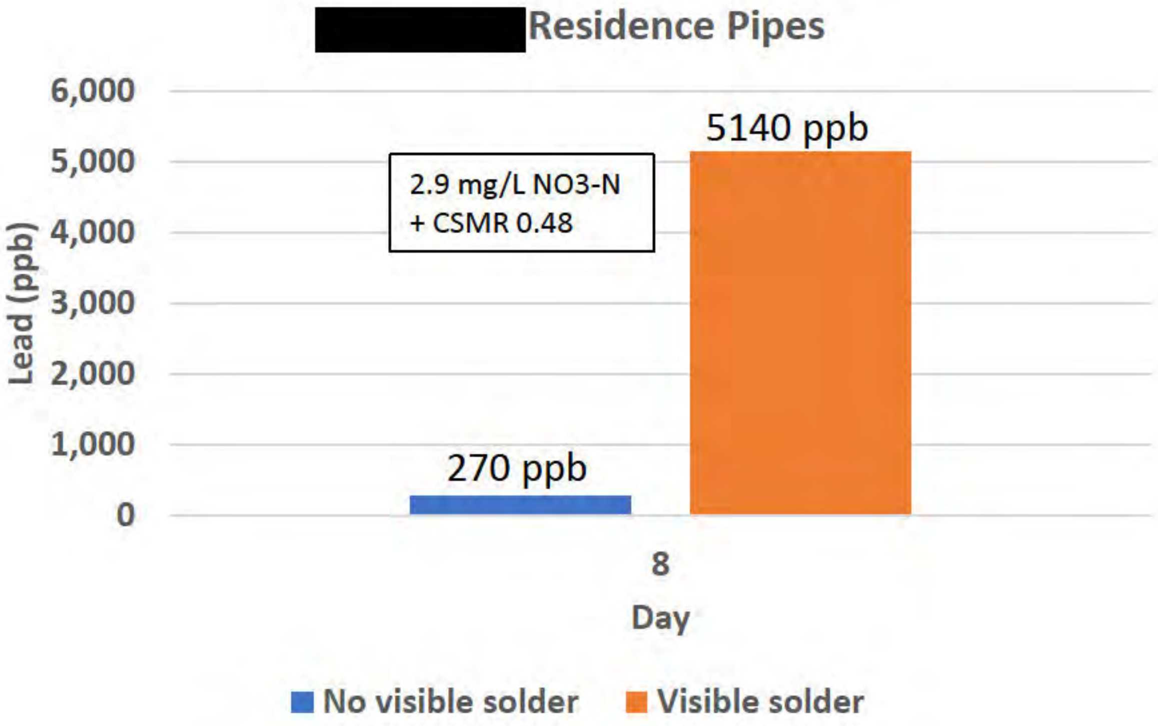


Error bars represent 95% confidence intervals

Presentation Contains Data/Results Still Under Review

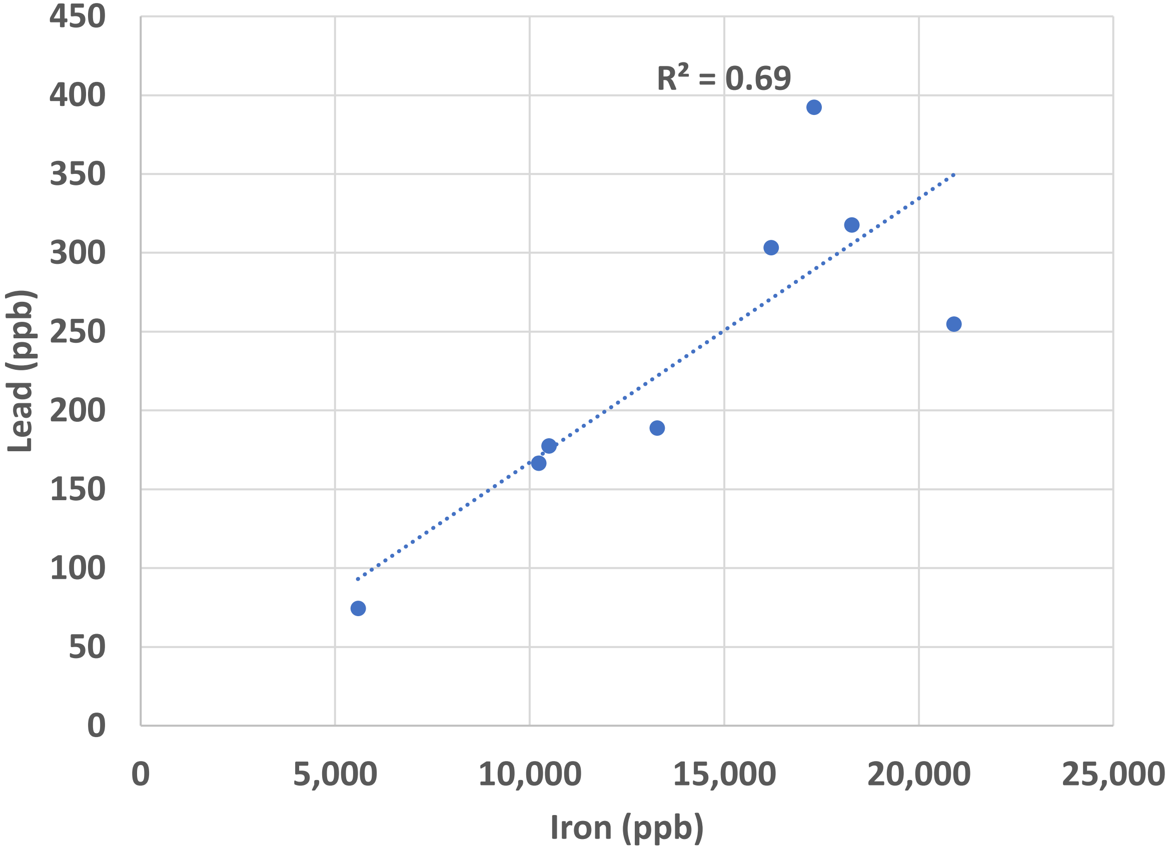
[redacted] Residence Pipe Experiment

- 13 old copper pipes split into 2 groups:
    - No visible lead solder (n=8)
    - Visible lead solder (n=5
- Pipes conditioning in Kankakee water + 1 mg/L P
- Running most recent data w/ aggressive 20% acid digestion

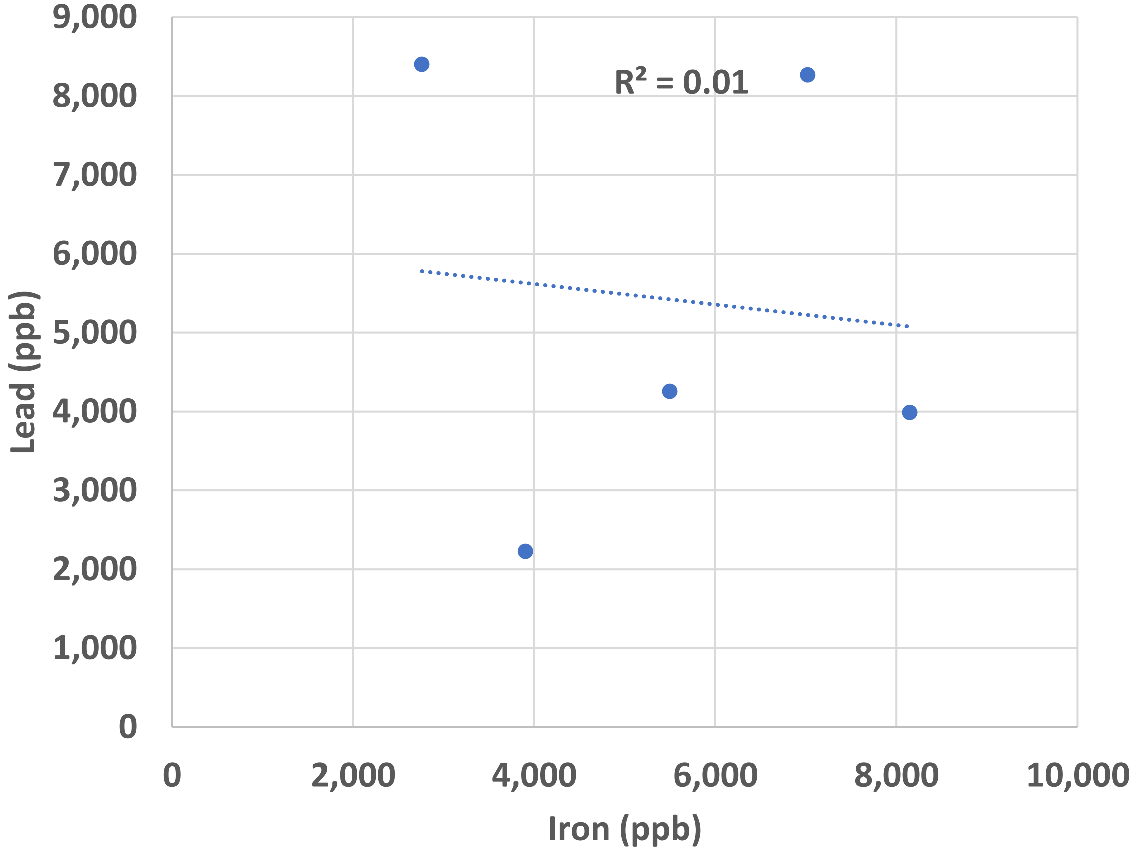


Presentation Contains Data/Results Still Under Review

Redacted



[redacted] Pipes: No visible solder



[redacted] Pipes: Visible solder

Experiment Plan Going Forward

- Coupons will continue receiving treatment
- Testing pipes from [redacted] residence
  - Digestion with 2% nitric acid (more than EPA protocol) did not fully dissolve particles
  - More aggressive digestion with 20% nitric acid and 20 hrs heat
  - If remaining particles have lead, the actual lead may be greater than preliminary data shown

Summary

- This case is the first of its kind
    - Relatively short-term changes in nitrate and sulfate are hypothesized to be exacerbating corrosion
    - Possible interaction between nitrate + CSMR
    - Large chunks of solder detaching are contributing to high lead
- Zinc orthophosphate looks promising based on preliminary data

University Park (IL1975030) Construction Permit Application

Chemical Change Description

July 15, 2021

Sealed by:

David Cornwell

Cornwell Engineering Group, Inc.

712 Gum Rock Court

Newport News, VA 23606

(757) 873-1534

LICENSED PROFESSIONAL ENGINEER
DAVID A. CORNWELL
062-071727
OF ILLINOIS

7/15/21
exp 11-30-21

OVERVIEW

Aqua Illinois (Aqua IL) currently feeds phosphoric acid (H_3PO_4) as a corrosion inhibitor for the University Park distribution system. The current product is supplied by Hawkins, Inc. (Roseville, MN) and contains 28 percent (by weight) of orthophosphate as PO_4, which is equivalent to 8.9 percent as P. The product is fed into the distribution system at the Central Avenue Booster Station.

The current feed system consists of a tank containing the H_3PO_4 product. The tank is on a scale for daily weight measurements. The product is pumped using a Grundfos pump into the pipeline entering the distribution system. The pump feed rate is controlled by SCADA based on a water flow meter and feedback loop to maintain the set dose of product ("flow pacing").

Aqua IL plans to switch from H_3PO_4 to zinc orthophosphate (ZOP). The ZOP product is ANSI/NSF Standard 60 approved and is available from many suppliers. The current plan is to obtain a product from Sterling Water Technologies, LLC (Columbia, TN), product CP 330S which can be described as a "1:10 Zn to PO_4 ratio" product, containing 34 to 36 percent orthophosphate as PO_4 (11.1 to 11.7 percent as P) and 2.5 to 4.0 percent zinc (Zn). However, any vendor providing a similar product may be used. There will be no change to the tank, scale, pump, or feed system located at Central Avenue Booster Station.

DISCUSSION

The proposed future target conditions (pH and ZOP dose), laboratory study results, and other related information is summarized below.

Target pH and orthophosphate residual

The current target orthophosphate residual is ≥3 mg/L as PO_4. Aqua IL proposes to continue the same ≥3 mg/L as PO_4 limit. Tests are ongoing to evaluate zinc affects on harvested pipe.

The current pH target for water distributed in University Park is 7.4 to 8.0, as currently permitted by IEPA. The proposed future pH limits are identical. Theoretical pH calculated using RTW indicates similar predicted pH from adding H_3PO_4 as from adding 1:10 ZOP (modeled as H_3PO_4 and 1:10 doses of zinc sulfate ($ZnSO_4$)). So, pH results may be similar with ZOP as with H_3PO_4. However, under conditions where ZOP doses above 4 mg/L as PO_4 are needed to keep pH under 8.0, then pH adjustment with acid may needed (see discussion below).

Table 1 show results of laboratory studies using Kankakee treated surface water with alkalinity and pH adjusted with a combination of $NaHCO_3$, NaOH, and H_2SO_4 to achieve the pH and alkalinity targets noted in the table, and pH measured after adding either 3 or 4 mg/L as PO_4 using the ZOP product outlined earlier (CP330S from Sterling). These results suggest that some acid feed may be needed if the ZOP dose is limited to 4 mg/L. If that is the case, Aqua IL will submit a future revised permit request to IEPA, as needed.

Table 1
Measured pH change in the laboratory for Kankakee treated surface water samples adjusted to alkalinity and pH and then dosed with 3 and 4 mg/L as PO_4 doses of ZOP

Date (2021)	Alkalinity† mg/L as $CaCO_3$	Measured pH† before ZOP	Measured pH† after ZOP (3 mg/L)	Measured pH† after ZOP (4 mg/L)	Notes
7/8	46.6	8	7.5	7.4	
7/9	60	8.3	7.6	7.6	High alkalinity condition
7/9	55	8.3	7.6	7.6	
7/8	50	8.4	7.6	7.5	Typical condition
7/9	60	**8.8**	**8.1**	**8**	**Highest observed pH/alkalinity in UP**
7/8	61	9.1	8.7	8.6	Highest pH/alkalinity in Manteno

† Kankakee treated surface water was adjusted to pre-ZOP pH and alkalinity values indicated in the table, and then dosed with ZOP. The alkalinity was adjusted with $NaHCO_3$, the pH with H_2SO_4 and NaOH, and the ZOP product was CP330S. The ZOP doses are in mg/L as PO_4

Justification for switch from H_3PO_4 to ZOP

Figure 1 compares the current pH before and after H_3PO_4 addition as well as orthophosphate residual, average NO_3^-, and 90th percentile lead. Aqua IL has postulated that fluctuations in 90th percentile lead, especially periods when lead appears not to be stable in certain homes, is related to the presence of nitrate (NO_3^-) and that adding zinc (Zn) can attenuate these conditions. After switching to phosphoric acid in April 2020, the pH and orthophosphate residual have been maintained within target levels.

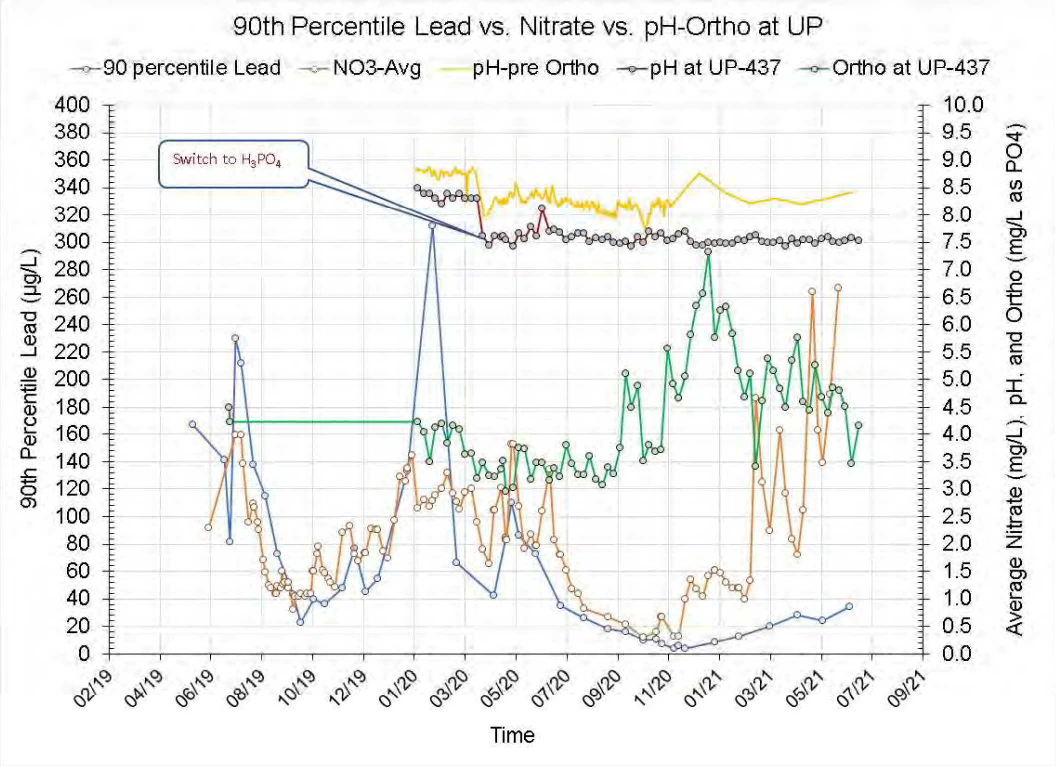


Figure 1 pH before H_3PO_4 addition, orthophosphate residual and pH after H_3PO_4, and 90th percentile lead and average nitrate (NO_3^-) in University Park

Note: This graph shows some nitrate data <3 mg/L as N, and this level of nitrate addition did not cause significant lead release compared to the control in the 2019 Virginia Tech study (see below).

In July 2019, Dr. Edwards from Virginia Tech conducted a laboratory coupon experiment to study galvanic corrosion on new lead solder using Kankakee WTP water. The results were summarized and submitted as a part of the OCCT study in 2019. The experiment mainly focused on testing the effects of chloride to sulfate mass ratio (CSMR) and various corrosion inhibitors. It is concluded that the short duration of CSMR increase up to 0.9 in Kankakee water should not cause significant galvanic corrosion on new lead solders. A scenario was designed to test the effect of nitrate on galvanic corrosion of new lead solder by adding additional 3 mg/L of nitrate as N. This level of nitrate addition did not cause significant lead release compared to the Control.

It is important to note that there is very little research on the subject of nitrate induced galvanic corrosion of leaded solders. (Oliphant 1983, Nguyen 2011) In the Spring of 2021, nitrate as high as 8.1 mg/L was observed at the Kankakee WTP and nitrate up to 6.7 mg/L was measured at hydrants within the UP distribution system. After review of all available data of the UP system and the testing conditions of the 2019 experiment, Aqua IL and Dr. Edwards decided to study the short-term effect of higher levels of nitrate on corrosion of leaded solder.

The experiment is a dump and fill lead solubility test using new copper coupons connected with a 50:50 mixture of lead (Pb) and tin (Sn) solder. The goal was to: (1) examine if high nitrate in Kankakee water could cause galvanic corrosion on new lead solders; and (2) test if adding Zn and PO_4, could mitigate the galvanically induced lead corrosion on new materials from the presence of spiked NO_3^-.

The new coupons were first acclimated for one week with University Park local groundwater, then one more week with treated surface water from Kankakee. These acclimated coupons were then exposed to the conditions listed in Table 2 using treated surface water from Kankakee. The target pH prior to exposure for all these coupons was adjusted to 7.6. The chloramine residual was not adjusted from the levels as received from Kankakee. All coupons, except the Control, were dosed with 5 mg/L as N additional NO_3^-. The NO_3^- in the water shipped to Virginia Tech changed naturally over time as follows: a) day 1-7 = 7.7 mg/L as N, b) day 8-12 = 6.3 mg/L as N, and c) day 13-19 = 2.9 mg/L as N. As noted in Table 2, all conditions studied, except the control, were spiked with additional nitrate (5 mg/L as N), resulting in total (spike + background) nitrate from 7.9 to 12.7 mg/L as N. Lead results from these studies to date are shown in Figure 2. Dr. Edwards reports that zinc orthophosphate looks promising. These studies are still in progress, and tests on harvested pipes with spiked nitrate were also initiated.

Table 2
Conditions for testing of new coupons with Pb/Sn solder – June 2021

Label	Additives (and dose)			
	Orthophosphate (PO_4^{-3})	Zinc (Zn)	Nitrate (NO_3^-)	Nitrite (NO_2^-)
	(mg/L as P)	(mg/L)	(mg/L as N)	(mg/L as N)
Day 1 to 5				
Control				
NO_3^- only			5	
NO_3^- and PO_4	0.1		5	
NO_3^-, Zn, and PO_4	0.1	4	5	
NO_3^- and Zn		4	5	
NO_3^- and NO_2^-			5	0.5
Day 6 to 12				
Control				
NO_3^- only			5	
NO_3^- and PO_4	2		5	
NO_3^-, Zn, and PO_4	2	0.5	5	
NO_3^- and Zn		0.5	5	
NO_3^- and NO_2^-			5	0.5
Day 13 onward				
Control				
NO_3^- only			5	
NO_3^- and PO_4	1		5	
NO_3^-, Zn, and PO_4	1	0.33	5	
NO_3^- and Zn		0.33	5	
NO_3^- and NO_2^-			5	0.5

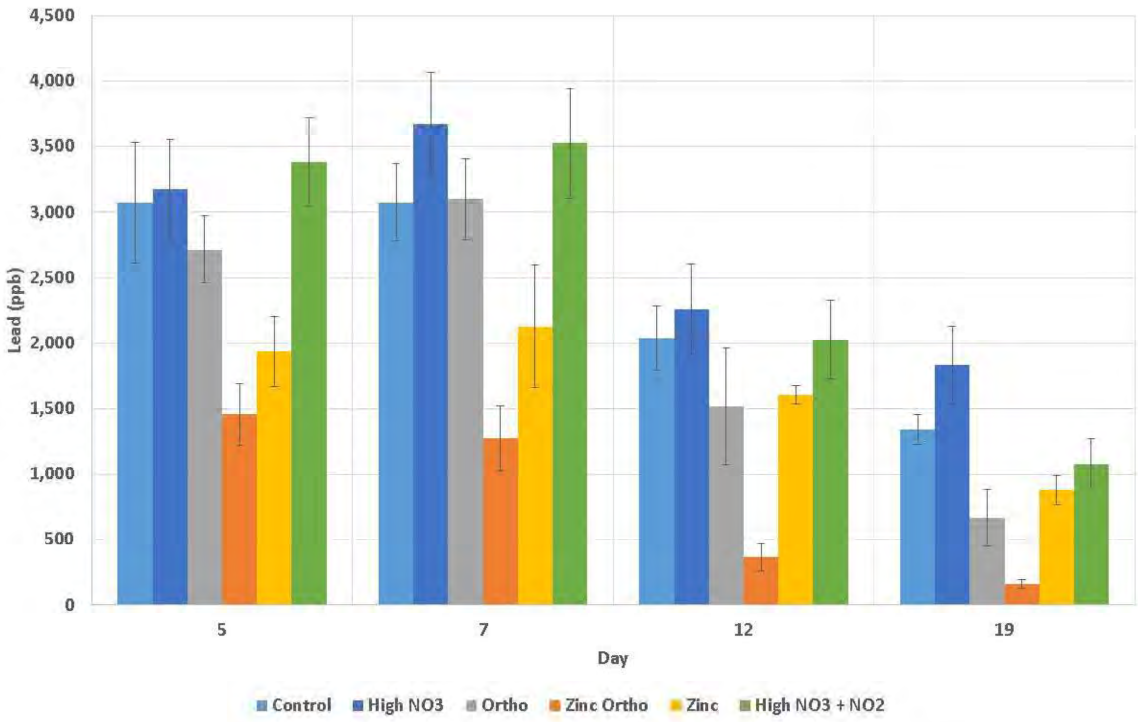


Figure 2 Lead results from testing of new copper coupons with Pb/Sn solder – in progress

Studies conducted by the Cornwell Engineering Group (Cornwell) comparing ZOP to other orthophosphate-containing products are shown in Figure 3 (H_3PO_4) and Figure 4 (ZOP) using lead coupons. Dump/fill studies are shown in Figure 5 through Figure 8. The results were similar for all studies no matter what orthophosphate source was used, except for a couple pipes on ZOP (Figures 7 and 9). Especially Figure 8 showed high lead results with ZOP. It isn't known if that is due to ZOP or a function of the pipe tested.

Cornwell is in the process of starting additional harvested pipe studies targeted to investigate lead solubility in University Park harvested materials with and without spiked nitrate. These will be tested with the CP330S 1:10 ZOP proposed for University Park above. The tests will include ZOP doses of 3 mg/L as PO_4. Four conditions will be tested, including ZOP with no spiked nitrate to see if Zn upsets scales, and the same doses spiked with 8 mg/L as N nitrate to see if Zn has a beneficial affect at high nitrate. Straight orthophosphate will also be tested with spiked nitrate as a comparison. Finally straight orthophosphate will be tested at 8 mg/L to see if the high PO_4 affected scales.

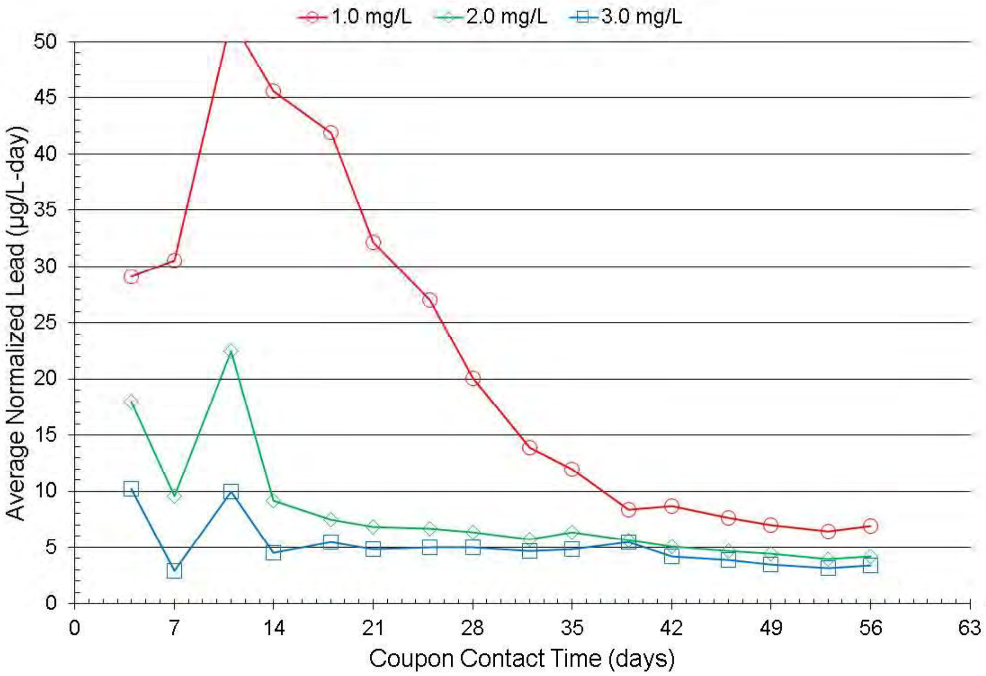


Figure 3 Coupon results from testing of new lead coupons with H_3PO_4 (doses are mg/L as PO_4)

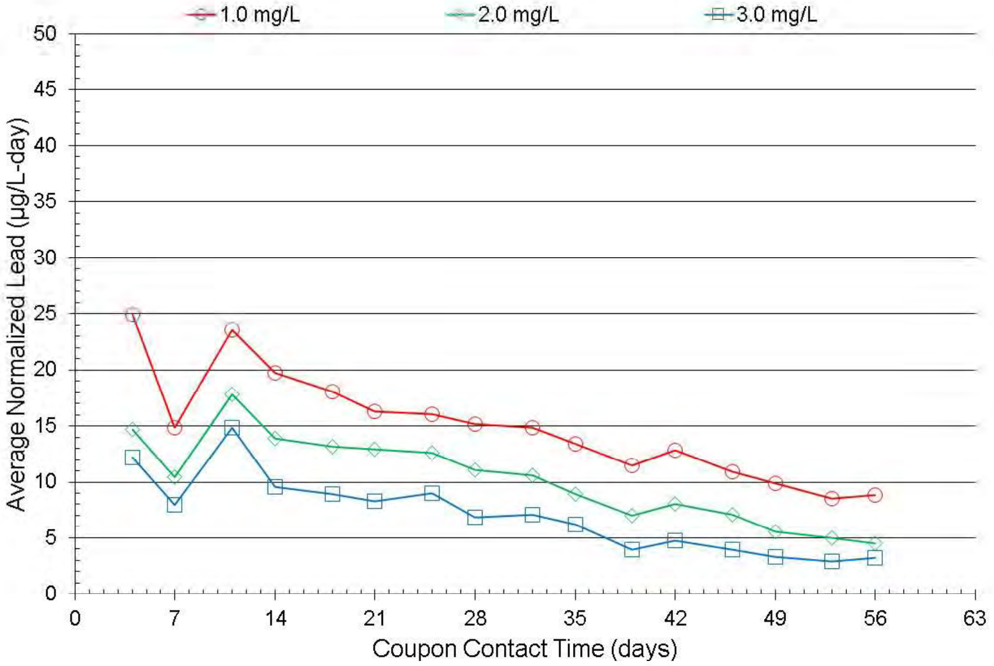


Figure 4 Coupon results from testing of new lead coupons with ZOP (doses are mg/L as PO_4)

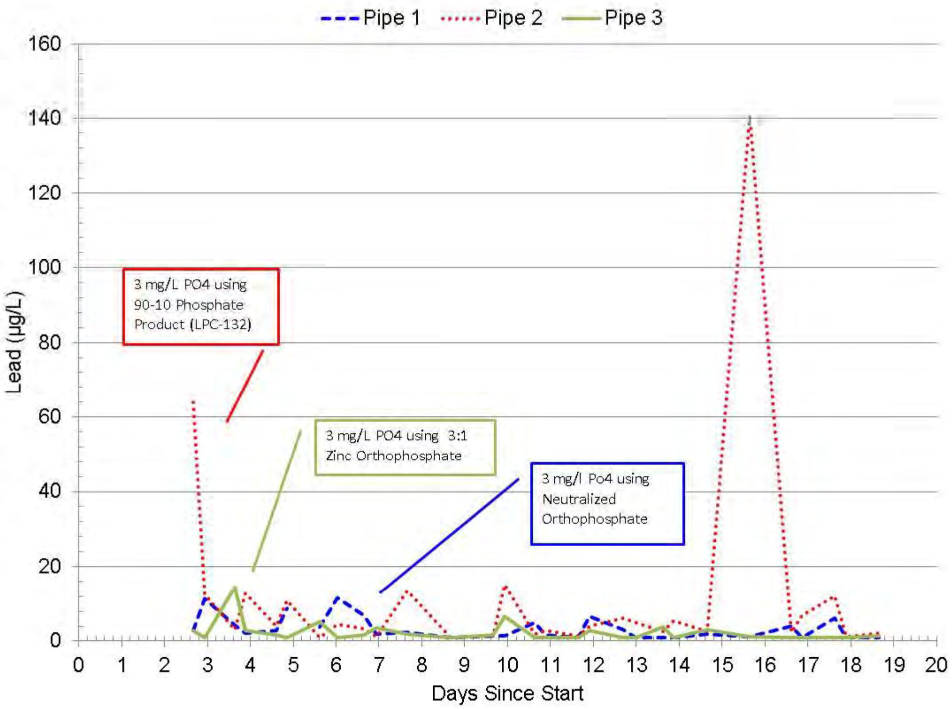


Figure 5 Lead solubility dump/fill studies with harvested pipe comparing 3 mg/L as PO_4 doses of a 90/10 ortho/poly blend, ZOP, and neutralized orthophosphate (NaH_2PO_4)

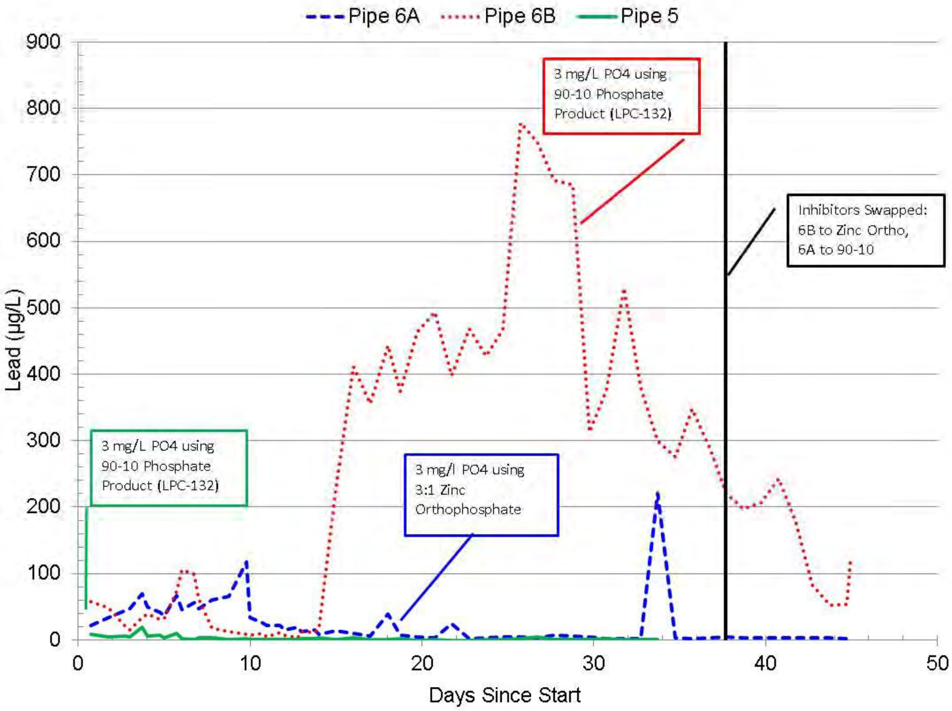


Figure 6 Lead solubility dump/fill studies with harvested pipe comparing 3 mg/L as PO_4 doses of a 90/10 ortho/poly blend to ZOP

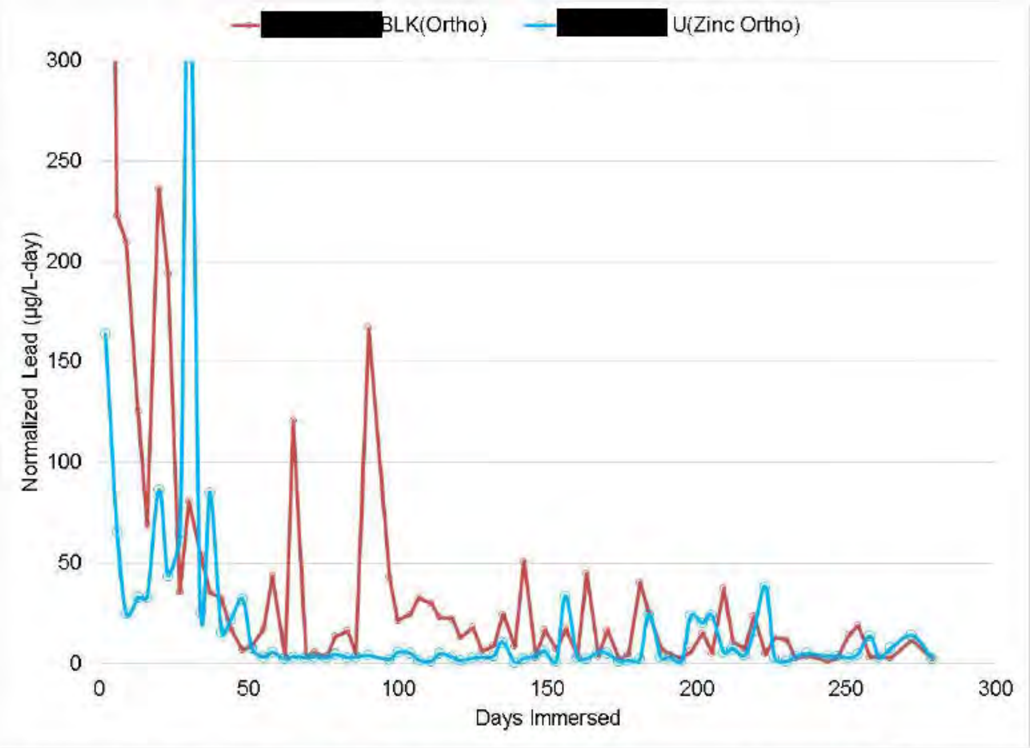


Figure 7 Lead solubility in dump and fill harvested pipe from [redacted] in University Park – Ortho (H_3PO_4) versus Zinc ortho (ZOP) at 3 mg/L as PO_4 doses

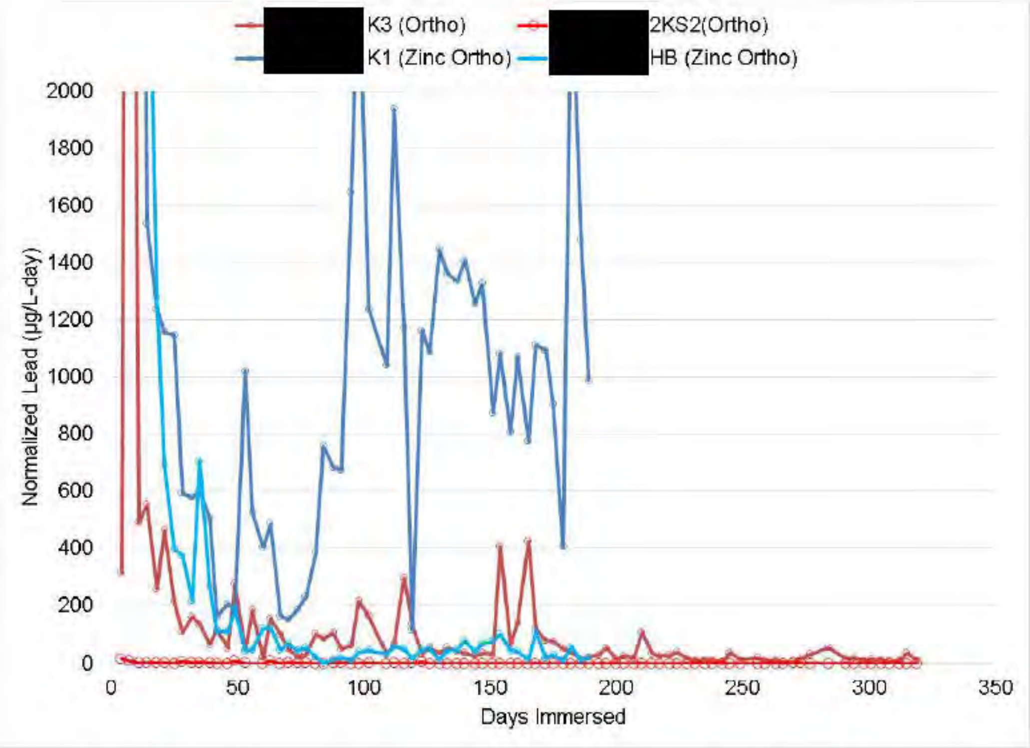


Figure 8 Lead solubility in dump and fill harvested pipe from [redacted] in University Park – Ortho (H_3PO_4) versus Zinc ortho (ZOP) at 3 mg/L as PO_4 doses

WQP Monitoring

After the switch to ZOP, the WQP monitoring is expected to be maintained as under present conditions, including the following:

- Orthophosphate will continue to be monitored daily at the Central Avenue Booster Station at or near the point of entry. Pump Station pump flow data are continuously recorded in SCADA.
- One day per week the following parameters will continue to be monitored at nine locations in University Park:
    - Free Chlorine
    - Total Chlorine
    - Monochloramine
    - Free ammonia
    - Orthophosphate
    - pH
    - Alkalinity
- These are monitored as part of the WQPs for lead and copper CCT. These and other University Park monitoring locations will continue to be monitored to fulfill other requirements, including RTCR, DBPR, LCR (lead and copper), etc. as outlined in previous Aqua IL sampling plans for University Park. In addition, a Nitrification Action Plan, including routine monthly, weekly, and daily monitoring will be submitted for IEPA review. This will include monitoring for monochloramine and total chlorine residuals, free ammonia, etc.

SUMMARY

Aqua IL is requesting IEPA approval of the switch to the 1:10 ZOP product noted above (CP330S from Sterling) to be fed at ≥ 3 mg/L as PO_4, with pH to be targeted between 7.4 and 8.0.

Tests are ongoing to evaluate zinc affects on harvested pipe.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue, East; Post Office Box 19276; Springfield, IL 62794-9276

Division of Public Water Supplies Telephone 217/782-1724

PUBLIC WATER SUPPLY CONSTRUCTION PERMIT

SUBJECT: AQUA IL – UNIVERSITY PARK (IL1975030)

Permit Issued to:
Aqua Illinois
1000 S. Schuyler
Kankakee, IL 60901

PERMIT NUMBER: 0071-FY2022

DATE ISSUED: July 30, 2021
PERMIT TYPE: Plant Improvement

The issuance of this permit is based on the Application for Construction Permit and supporting documents prepared by the engineers/architects indicated and are identified in the ADDITIONAL CONDITIONS. This permit is issued for the construction and/or installation of the public water supply improvements described, in accordance with the provisions of the "Environmental Protection Act (Act)", Title IV, Sections 14 through 17, and Title X, Sections 39 and 40, and is subject to the conditions printed on the last page of this permit and the ADDITIONAL CONDITIONS listed below.

FIRM: Cornwell Engineering Group
NUMBER OF PLAN SHEETS: na
TITLE OF PLANS: "University Park Booster Station – Chemical Feed Change"

PROPOSED IMPROVEMENTS:

Switch to a zinc orthophosphate corrosion control chemical

IEPA-DIVISION OF RECORDS MANAGEMENT
RELEASABLE
NOV 15 2021
REVIEWER: EMI

ADDITIONAL CONDITIONS:

1. An operating permit is required before feeding zinc orthophosphate. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.300) The issuance of an operating permit 0071-FY2022 for zinc orthophosphate replaces the additional conditions in construction permit 1020-FY2020.

2. The product must be NSF/ANSI 60 approved and contain a 1:10 Zn to PO_4 ratio. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 604.105(g) and Chemical Change Description dated July 15, 2021)

3. Optimal Water Quality Parameter (OWQP) ranges will be set after the community water supply meets the lead action level in two consecutive six-month monitoring periods.The orthophosphate dose and residual shall be a minimum of 3 mg/L as PO_4. The pH range shall be 7.4 to 8.0 at the Central Avenue Booster Station. The zinc range shall be 0.3 - 0.4 mg/L. Notify the Division of Public Water Supplies, Permit Section staff if results are outside of these ranges in two consecutive weeks of water quality monitoring. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 611.351(e) and the Chemical Change Description dated July 15, 2021)

4. Water quality monitoring must be conducted for the Aqua Illinois - University Park community water supply as described below and results submitted for each month to david.cook@illinois.gov within 10 days after the last day of the month. The submissions must include all water quality parameter monitoring done during the month including any monitoring not mentioned here.

The minimum water quality monitoring parameters, locations, and frequencies are as described in the Chemical Change Description dated July 15, 2021. The Chemical Change Description includes daily monitoring for flow and orthophosphate at the Central Avenue Booster Pump Station and weekly monitoring at nine locations for free chlorine, total chlorine, monochloramine, free ammonia, orthophosphate, pH, and alkalinity. In addition, weekly monitoring at nine locations is required for chloride, sulfate, CSMR (calculated value), nitrite, nitrate, iron, manganese, zinc, and Total Organic Carbon (TOC).

Any water quality parameter monitoring conducted must be reported in a spreadsheet. The data are needed to set Optimal Water Quality Parameter (OWQP) ranges. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 604.140, 611.352(f) and the Chemical Change Description dated July 15, 2021)

5. Water quality monitoring must be conducted for the Aqua Illinois - Kankakee entry point to the distribution system as described below and results submitted to david.cook@illinois.gov within 10 days after the last day of the month. The submissions shall be limited to these parameters at this location: pH, alkalinity, chloride, sulfate, CSMR (calculated), nitrite, nitrate, and TOC. The specified water quality parameters that are monitored must be reported in a spreadsheet. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114 and 611.352(f))

6. Collect between 40 and 60 lead compliance samples from approved individual sample site locations each month beginning 30 days after the issuance of the operating permit for this project. Consideration should be given based upon highest past lead results and geographic representation. Consideration should also be given to sampling when CSMR and nitrate results are the highest for the month, typically following rain events. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 601.101. 611.352(f) and the Chemical Change Description dated July 15, 2021)

7. The permit approval is for the Application, Schedule D, and the Chemical Change Description sealed by David Cornwell, PhD, P.E. that were received on July 16, 2021. The Aqua University Park Technical Response Team PowerPoint® presentation dated July 14, 2021and the University Park Nitrate Experiments presentation dated July 14, 2021 were also reviewed.

cc: Cornwell Engineering Group
DPWS/FOS – Elgin Regional Office
DWPC/Permit Section
DWPC/Standards Section

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The Illinois Environmental Protection Agency Act (415 ILCS 5/39) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

These standard conditions shall apply to all permits which the Agency issues for construction or development projects which require permits under the Division of Water Pollution Control, Air Pollution Control, Public Water Supplies and Land Pollution Control. Special conditions may also be imposed by the separate divisions in addition to these standard conditions.

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire one year after this date of issuance unless construction or development on this project has started on or prior to that date.

2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted the Illinois Pollution Control Board.

3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.

4. The permittee shall allow any agent duly authorized by the Agency upon the presentation of credentials:

   a. to enter at reasonable times the permittee's premises where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit.

   b. to have access to and copy at reasonable times any records required be kept under the terms and conditions of this permit.

   c. to inspect at reasonable times, including during any hours or operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit.

   d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants.

   e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.

5. The issuance of this permit:

   a. shall not be considered as in any manner affecting the title of the permits upon which the permitted facilities are to be located;

   b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;

   c. does not release the permittee from compliance with the other applicable statues and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;

   d. does not take into consideration or attest to the structural stability of any units or parts of the project;

   e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability directly or indirectly for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.

6. These standard conditions shall prevail unless modified by special conditions.

7. The Agency may file a complaint with the Board for modification, suspension or revocation of a permit:

   a. upon discovery that the permit application misrepresentation or false statements or that all relevant facts were not disclosed; or

   b. upon finding that any standard or special conditions have been violated; or

   c. upon any violation of the Environmental Protection Act or any Rules or Regulation effective thereunder as a result of the construction or development authorized by this permit.

Illinois Environmental Protection Agency

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Division of Public Water Supplies 2022-0071
Application for Construction Permit 1975030

The regulations referenced in this application are taken from the Illinois Environmental Protection Act, 2007. All subsequent rules, regulations, and violations listed in this document can be found within the Act. This application may be completed online, a copy saved locally, and printed before it is signed and mailed to the Illinois EPA.

1. Name of Public Water Supply: Aqua Illinois - University Park
2. Facility ID: IL1975030 County: Will
3. Location of Project: University Park Booster Station - 1125 Central Ave, University Park, IL 60484
4. Title of Plans: University Park Booster Station - Chemical Feed Change

   Number of Construction Drawings: ______

5. Documents being Submitted:
   - ☑ Application for Construction Permit
   - ☐ Schedule A - Cost Estimate
   - ☐ Schedule B - Water Main Construction
   - ☐ Specifications
   - ☐ Construction Drawings
   - ☐ Engineer's Design Summary
   - ☐ Schedule C-I Well Drilling Only
   - ☐ Schedule C-II Well Completion
   - ☐ Permit Fee (Applicable Water Main Only)
6. Scope of Project:

   Change in corrosion control treatment for University Park. Change from 28% Phosphoric Acid to Zinc orthophosphate. See attached Schedule D - Water Stability and Corrosion Control.

7. Illinois Commerce Commission: Are you a privately owned water company subject to Illinois Commerce Commission rules? ● Yes ○ No
8. Infringement on **Other Public Water Supplies:** Will any part of this project be located within the boundaries of an area served by another PWS? ○ Yes ● No

RECEIVED
JUL 16 2021
Div. of Public Water Supplies
Illinois EPA

9. Certifications

NOTE: Each person signing this application certifies that the information in the application is complete and accurate, and that the text of the application has not been changed from the Agency's official construction permit application form.

9.1) Certificate by Design Engineer

I hereby certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate.

Name Dr. David Cornwell
Registration Number IL PE 062071727
Firm Cornwell Engineering Group, Inc.
Address 712 Gum Rock Court
City Newport News State VA Zip 23606
Phone Number (757) 873-1534 Email (optional) dcornwell@cornwellinc.com

D Cornwell
Signature

7/15/21
Date

9.2) Certificate by Applicant(s) to Construct

I hereby certify that I have read and thoroughly understand the conditions and requirements of this submittal. I/the representative company hereby agree to conform with the Standard Conditions and any Special Conditions made part of this Construction Permit.

Name Aqua Illinois - University Park / Melissa Kahoun
Address 1000 S. Schuyler Ave
City Kankakee State IL Zip 60901 Phone Number (815) 614-2032

Melissa Kah
Signature

7-15-21
Date

9.3) Water Main Fees

Section 16.1 of the Illinois Environmental Protection Act (Act) requires the Agency to collect a fee for certain applications for the installation or extension of water mains. There are no permit fees for other improvements (for example, treatment facilities) to public water supply systems and only certain water main projects are affected. The Agency will not approve any construction application without the required fee. Except for the conditions listed in Section 9.4, the following fee schedule applies per Section 16.1(d) of the Act:

Fee : Total Length of Water Main

○ $ 0 : 200 feet or less
○ $ 240 : Greater than 200 feet but not more than 1,000 feet
○ $ 720 : Greater than 1,000 feet, but not more than 5,000 feet
○ $1200 : Greater than 5,000 feet

Please check the appropriate fee; make check or money order payable to: *Treasurer, State of Illinois* and submit along with this application. Any fee remitted to the Agency <u>shall not</u> be refunded at any time or for any reason, either in whole or in part.

9.4) Water Main Fee Exceptions - READ CAREFULLY BEFORE SIGNING THE FOLLOWING

The Water Main Permit fee does not apply to:

a. Any Department, Agency or Unit of State Government.

b. Any unit of local government where all of the following conditions are met:

   i. The cost of the installation or extension is paid wholly from monies of the unit of local government, state grants or loans, federal grants or loans, or any combination thereof.

   ii. The unit of local government is not given monies, reimbursed or paid, either in whole or in part, by another person (except for State grants or loans or federal grants or loans.

I, ______________________________ hereby certify that this project meets the above criteria.
(Unit of local government & signature of authorized official)

DO NOT SIGN HERE UNLESS PROJECT MEETS FEE EXCEPTION CRITERIA.

9.5) Agreement to Furnish Water (this section must be completed if applicable)

The ______________________________ has agreed to furnish water to the area in which
(City, Town, Village, Water Company or Water Authority)

water main extensions are proposed by Aqua Illinois - University Park / Melissa Kahoun
(Applicant to construct)

according to plans titled University Park Booster Station - Chemical Feed Change

prepared by Cornwell Engineering Group, Inc.
(Engineering Firm)

The undersigned acknowledges the public water supply's responsibility for examining the plans and specifications to determine the proposed extensions meet local laws, regulations, and ordinances.

Signature of authorized public water supply official	Title	Date

9.6) Certification by Owner(s) of Completed Public Water Supply Improvement(s)

I hereby certify that I have read and thoroughly understand the conditions and requirements of this submittal. I hereby agree to accept ownership of the project upon satisfactory completion.

Name of Public Water Supply: Aqua Illinois - University Park
Facility ID: IL1975030

Address: 1000 S. Schuyler Ave
City: Kankakee
State: IL
Zip: 60901

Signature of authorized public water supply official: Melissa Kah
Date: 7-15-21

Printed name of authorized public water supply official: Melissa Kahoun
Printed title of authorized public water supply official: Environmental Compliance Manager

NOTE: Applications signed by a person other than a responsible municipal official, corporation officer, or owner, must be accompanied by evidence of authority to sign the applications, unless documentation of such authority is on file with the Division of Public Water Supplies.

Felony Warning: Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony (415 ILCS 5/44(h)).

This Agency is authorized to require this information under Illinois Compiled Statutes, 415 ILCS 5/39 (2000) Disclosure of this information is required under that Section. Failure to do so may prevent this form from being processed and could result in your application being denied.

Illinois Environmental Protection Agency

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Division of Public Water Supplies, Permit Section
Schedule D - Water Stability and Corrosion Control

This form must be submitted for all proposed community water supply construction projects that involve a new source or treatment process or a change in treatment. This form is needed to comply with the Lead and Copper Rule requirements including USEPA's November 3, 2015 memorandum.

Name of the Community Water Supply: Aqua Illinois - University Park ID: IL1975030

1. Check all that apply:
   - ☐ New Source - Raw Water
   - ☐ New Source - Purchased Water
   - ☒ Treatment Change
   - ☐ Treatment Addition

2. Scope of Project:

maintain orthophosphate CCT by meeting the current treatment targets for: PO4 residual (≥3 mg/L as PO4) and pH (7.4 to 8.0), but change the PO4-based treatment chemical from H3PO4 to a zinc orthophosphate (ZOP) containing a mass ratio of 1 mg Zn per 10 mg PO4. The new product is a ZOP formulation from Sterling Chemical (Columbia, TN) with a product name of CP330S.

If there will be a change in finished water quality as a result of this project, the community water supply must begin standard monitoring for lead and copper after the issuance of the operating permit.

3. Have water quality parameter ranges been set for this water supply? ● Yes ○ No

4. If water quality parameter ranges have been set, will the proposed improvements adversely impact the established ranges? ○ N/A ○ Yes ● No

5. Do optimal corrosion control treatment or water quality parameters need to be designated as a result of this project to minimize lead and copper concentrations in household plumbing? ○ Yes ● No

If the answer to either #4 or #5 is yes, please include a discussion on lead and copper control along with a specific treatment recommendation in an Engineer's Report. The Agency will review and issue a Special Exception Permit designating interim water quality parameter ranges. Another Special Exception Permit will be issued after implementation and collection of lead and copper samples to verify effectiveness of the water quality parameters. Use of a water stability model is recommended. Two examples are the Tetra Tech (RTW) Model for Water Process and Corrosion Chemistry from the American Water Works Association or the free download from Trussell Technologies, www.trusselltech.com.

6. Will any satellite community water supplies be receiving different finished water quality as a result of this project? ○ Yes ● No

7. Has the anticipated water quality been evaluated for stability and/or corrosiveness? If so, please include a discussion of the model or index used and the results in the Engineer's Design Summary. ● Yes* ○ No

* Current water quality parameters are not changing. M.Kahn 7-15-21

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This Agency is authorized to request this information under 415 ILCS 5/4(b)(2012). Disclosure of this information is voluntary and no penalties will result from the failure to provide the information. However, the absence of the information could prevent your application from being processed or could result in denial of your application. This form has been approved by the Forms Management Center.

8. Finished Water Quality Data Table: Indicate the ranges and unit of measurement of each parameter based upon existing water quality data and expected range after the change is implemented.

Parameter	Current Range	Proposed Range
Hardness	145 (127-242) as CaCO3	145 (127-242) as CaCO3
Calcium	40 (34-69) as Ca	40 (34-69) as Ca
Alkalinity	50 (37-61) as CaCO3	50 (37-61) as CaCO3
pH	7.4-8.0	7.4-8.0
Orthophosphate	≥3 mg/L PO4	3-4 mg/L PO4
Silicate	NA	NA
Total Dissolved Solids	see conductivity	see conductivity
Oxidation-Reduction Potential (ORP)	NA	NA
Temperature	1-29 C	1-29 C
Chloride	23-39 mg/L Cl	23-39 mg/L Cl
Sulfate	56-88 mg/L SO4	56-88 mg/L SO4
Iron	0-0.12 mg/L	0-0.12 mg/L
Manganese	0-0.01 mg/L	0-0.01 mg/L
Chlorine residual (total)	2.0 mg/L (0-3.6 mg/L)	2.0 mg/L (0-3.6 mg/L)
Chlorine residual (free)	none	none
Zinc	<0.05 mg/L	0.3-0.4 mg/L
conductivity	360 µmhos/cm	360 µmhos/cm

Reminder: Because you answered "Yes" to #7, remember to include a discussion of the model or index used and the results in the Engineer's Design Summary.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR **JOHN J. KIM**, DIRECTOR

MEMORANDUM

DATE: July 26, 2021

TO: Log Number 2022-0071 Application File

FROM: David Cook, P.E., DPWS/Permit Section Manager

SUBJECT: Aqua Illinois University Park, IL1975030
Zinc Orthophosphate Chemical Feed System

This memorandum serves as an explanation of the Additional Conditions added to the construction permit.

Additional Conditions Explanation

1. All construction permits require an operating permit before being placed into service. The regulation is 35 Ill. Adm. Code 602.300. Since the zinc orthophosphate will replace phosphoric acid (permit 1020-FY2020), the additional conditions in permit 1020-FY2020 also need to be replaced in the new permit. Zinc orthophosphate also replaces phosphoric acid as the proposed Optimal Corrosion Control Treatment (OCCT). Previously, the proposed OCCT was orthophosphate greater than 3.0 mg/L (as PO4). Now, the proposed OCCT is expected to be orthophosphate plus zinc. Due to the increasing monthly 90th percentile values starting in March 2021, the Agency sent a Special Exception Permit letter dated June 14, 2021 with a due date of October 31, 2021 requiring additional corrosion control studies.

2. All chemicals added to a community water supply must be third-party approved for safety. The standard is NSF/ANSI Standard 60. The regulation is 35 Ill. Adm. Code 604.105(g). Aqua plans to feed a zinc orthophosphate product from Sterling Water Technologies, LLC (Columbia, TN). The product name is CP 330S. Any vendor with a zinc orthophosphate product that is NSF/ANSI Standard 60 approved may be substituted. For consistency in treatment, the required ratio 1:10 Zn to PO4 is being added to the permit.

3. The proposed ranges for pH, orthophosphate, and zinc are listed in the Chemical Change Description dated July 15, 2021. These ranges are listed in the permit and effective until an OWQP SEP is issued. The consultant acknowledges that to meet both pH and zinc, a permit for an acid feed needs to be obtained. This is based upon last year's phosphoric acid feed. The range was 3 – 7 mg/L. If that happened again, the zinc range would be 0.3 – 0.7 mg/L. Excess chemical feed could cause precipitation of zinc in the distribution system.

Since an Excursion report won't be provided until an OWQP SEP is issued, the condition states to notify the Agency if not meeting the ranges in two consecutive weeks.

Also, there will be wastewater water quality concerns for any zinc level. Copies of the DPWS permit will be sent to the Division of Water Pollution Control.

4. Traditional water quality parameter monitoring in the University Park distribution system was a condition on the phosphoric acid chemical feed permit. These parameters included pH, alkalinity, orthophosphate, and chlorine residual. Lead results increased beginning in March 2021. Water quality monitoring is necessary to troubleshoot potential causes for lead action level exceedances. Aqua is currently testing a theory in a laboratory at Virginia Tech University that nitrate concentrations may be contributing to recent increases in lead results. There could also be a correlation between other water quality parameters such as CSMR or TOC. The Chemical Change Description outlines several other water quality parameters related to Aqua's nitrification action plan. Aqua is already testing for most, if not all, of these parameters in their sentinel network of 9 hydrants. If necessary, the Agency may establish OWQP ranges for water quality parameters other than pH and orthophosphate according to 35 Ill. Adm. Code 611.352(f).

5. Aqua Illinois University Park is supplied from the Aqua Kankakee water treatment plant. This water plant uses LSI as an indicator for water stability. As part of the routine monitoring for the Aqua Kankakee community water supply, water quality parameters are being monitoring. These specific parameters may have an impact on Aqua Illinois University Park – pH, alkalinity, chloride, sulfate, nitrate, nitrite, and TOC. This permit condition requires that the data be reported to the Permit Section but does not specify monitoring frequencies. Any data collected needs to be reported.

6. Since January 2021, Aqua has collected between 40 and 60 lead samples each month. The lead monitoring results showed an increase beginning in March 2021. To assure that the water quality is assuredly safe, the monthly monitoring needs to continue. The monthly lead monitoring accounts for any seasonal impacts to water quality. For example, Aqua is testing a theory that variability in nitrate concentrations have contributed to an increase in lead results. Reportedly, nitrate is fluctuating in the source water from less than 1 mg/L to as high as 8 mg/L. Aqua is testing a theory that higher nitrate concentrations increases lead results. Lead sampling should be done during the month after rain events when the nitrate levels are higher.

AQUA℠
An Essential Utilities Company

July 15, 2021

Mr. David Cook
Illinois EPA
Division of Public Water Supplies, Permit Section
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

RE: Aqua Illinois-University Park-Facility ID: IL 1975030-Construction and Operating Permits 1020-FY2020

Dear Mr Cook:

On April 17, 2020, the Illinois Environmental Protection Agency ("Illinois EPA') issued Construction Permit 1020-FY2020 to Aqua Illinois authorizing a chemical change for the University Park Water Supply System ("Construction Permit"). On April 17 and again on April 28, 2020, (we believe just in duplication) the Illinois EPA signed the Application for Operating Permit submitted by Aqua Illinois ("Aqua") authorizing operation of the chemical change project ("Operating Permit"). The Construction Permit contains several special conditions, including Special Condition 6, which provides:

> **Collect at least 40 lead and copper samples from approved sampling site locations twice during May 2020, twice during June 2020, and monthly beginning in July 2020 until modified by Special Exemption Permit. The two sets May and June samples shall be divided by the 15th day of each month. Samples should be collected based upon the highest past lead result and geographical representation.**

Aqua Illinois has been working around the clock to ensure it is providing the best water possible to University Park customers. Based on its ongoing analysis of factors such as water quality parameters, home plumbing characteristics, water use and based on Aqua's work with its national experts, Aqua is submitting with this letter a construction permit application requesting authorization to supplement the orthophosphate currently in use in the University Park System. The current orthophosphate treatment has resulted in a very positive trend of recovery by improving the water quality for University Park customers. But because the lead that is entering the tap water in certain homes in University Park is due to lead present in the internal customer plumbing, many factors such as water use,

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plumbing configuration, excess lead solder to name a few, can impact how quickly the treatment is adhering to provide the protection needed. Additionally, seasonal influence like heavy rain events appear to be adding spiking levels of nitrates to the water entering the System in a way that further challenges the speed at which the orthophosphate alone can do its job in certain homes with plumbing and/or water use challenges. Aqua is committed to helping those homes recover. Aqua's permit application presents a request to supplement the orthophosphate treatment with zinc. The zinc attacks and thereby "cuts off" any negative effect the seasonal nitrates may be having on the recovery process in those homes that might need this extra protection. Since any treatment used is introduced by suppliers into the System as a whole, all customers in UP will receive zinc orthophosphate with the added protection provided by the zinc component of the treatment blend.

Pursuant to Section 602.600(d) of the Board's Public Water Supply Regulations, 35 Ill. Adm Code 602.600(d), a Special Exemption Permit ("SEP") may be initiated by either a written request from the community water supply or by the Agency. As part of its request to authorize the treatment change to zinc orthophosphate, Aqua also, by this letter requests that the Agency issue a SEP modifying Special Condition 6 of the Construction Permit, as follows:

Collect at least 20 lead tap water non-compliance samples from the kitchen tap of approved compliance sampling pool sites in July, August and September, 2021, with priority to the past month's highest results, subject to customer cooperation. The samples shall be collected in 2 500 mL sampling bottles after 6 hour stagnation and shall only be analyzed for lead. Aerator cleaning shall not be performed by Aqua at any time prior to the July or August, 2021 sampling events. In September, 2021, Aqua shall perform aerator cleaning of the kitchen faucet in all compliance sampling pool sites, subject to customer cooperation. All debris of sufficient quantity shall be collected and analyzed. If performed, the September, 2021, sampling event shall not occur sooner than 4 days after aerator cleaning. Aqua shall collect at least 40 lead and copper compliance samples from the approved sampling pool no sooner than thirty (30) days after the zinc orthophosphate treatment has been introduced to the UP System pursuant to Illinois EPA construction and operating permits. Every month thereafter during the July-December 2021 compliance monitoring period, Aqua shall perform monthly compliance sampling by collecting at least 20 compliance samples each month. Once compliance sampling resumes, the requirement that at least 20 lead tap water non-compliance samples be collected from the approved compliance sampling pool sites shall cease. Upon meeting the lead action level for the six-month monitoring period (July-December, 2021), Aqua shall continue monitoring for lead and copper every six months by performing one compliance sampling event of at least 40 compliance samples each six month compliance monitoring period.

In support of our SEP request, we also incorporate by reference in full the attached construction permit application.

Aqua believes issuance of this SEP is appropriate and consistent with Section 39 of the Illinois Environmental Protection Act, 415 ILCS 5/1 *et seq*, applicable Illinois Pollution Control Board regulations and the LCR. As the Agency is aware, Aqua has been performing heightened sampling since detecting a lead action level exceedance in the University Park Water Supply System in June, 2019. During this period of time, Aqua has determined that the source of the lead is from customer-owned plumbing and/or fixture in certain homes served by the System. The lead is not from Aqua owned infrastructure or service lines. As a result of exceeding the lead action level, Aqua began performing the corrosion control treatment requirements of the LCR for the UP System. Aqua is in the process of installing the optimal corrosion control treatment and is seeking an adjustment to the treatment to address a subset of homes in the UP System where the lead has not stabilized. As EPA has recognized in the promulgation of the LCR, experience has shown that it generally takes several months after treatment has been installed and adjusted for the lead levels to stabilize. In fact, suppliers completing corrosion control treatment requirements are allowed to cease monitoring until after the System has installed the optimal corrosion control treatment specified by the State. This is because the main purpose of compliance sampling is to determine if the treatment is working and in this case, we already know an adjustment is needed. Requiring compliance sampling prior to and immediately after installing the adjusted treatment does not further the purpose of the LCR' s treatment and compliance pool monitoring scheme. Aqua does see value in collecting samples and has proposed an approach that recognizes the value of sampling but at the same time allows for a period of time (30 days) for the treatment to stabilize the lead sources in the remaining homes before compliance sampling resumes.

We respectfully request that the Agency consider the issuance of a SEP by no later than July 23, 2021. Monthly compliance sampling for the month of July must be collected no later than the week of July 23, 2021, if Aqua is to meet the mandate of the current Special Condition 6. We stand ready to work with the Agency on this request as needed to advance the Agency's consideration of this request. As always, we remain available at any time to discuss any aspect of our sampling and work in University Park.

Sincerely,

Melissa Kah

Melissa Kahoun
Environmental Compliance Manager

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR **JOHN J. KIM**, DIRECTOR

217/782-1724

June 14, 2021

SPECIAL EXCEPTION PERMIT

Ms. Melissa Kahoun
Environmental Compliance Manager
Aqua Illinois Water Company
1000 S. Schuyler Ave.
Kankakee, IL 60901

Re: Aqua IL University Park, IL1975030
Optimal Corrosion Control Treatment Recommendation and Corrosion Control Study Report

Dear Ms. Kahoun:

On April 22, 2020, a Special Exception Permit was issued by the Illinois Environmental Protection Agency (Agency) that required additional information for purposes of reviewing the Optimal Corrosion Control Treatment (OCCT) recommendation for the Aqua Illinois - University Park community water supply. Aqua's final submittal in response to the Agency's April 2020 Special Exception Permit was received by the Agency on December 14, 2020.

Pursuant to 35 Ill. Adm. Code 611.351(e), the Agency has six months after a supplier completes corrosion control studies to make a determination on optimal corrosion control treatment. Accordingly, pursuant to 35 Ill. Adm. Code 611.351(c) and (e), the Agency has determined that additional studies, information and data are required before it can approve OCCT.

Based upon the March 2021, April 2021, and May 2021 lead compliance sampling results, the Agency requests that Aqua investigate potential causes of elevated lead results in the compliance sampling pool during the current January – June 2021 monitoring period as compared to the July – December 2020 monitoring period. The Agency requests that Aqua investigate the following issues in order to confirm the current corrosion control treatment under current water quality conditions, which include, but are not limited to:

1. A comparison of water qualities since April 2020. What water quality variables have remained stable? What water quality variables have fluctuated? What are the effects of fluctuating water quality variables, such as nitrate, on lead release?
2. Is water temperature, or other non-traditional water quality parameter variables, playing an important role in lead release or current corrosion control treatment?
3. How do the corrosion control studies conducted by Aqua in 2019 need to be updated based on current water quality characteristics, as well as to assess any seasonal variability?

4. Is Aqua, or its retained expert, planning to conduct additional scale analysis to determine if the scales are changing? If not, please provide justification.
5. What are Aqua's plans for collecting and analyzing debris from aerators both inside and outside of the compliance sampling pool?
6. What are Aqua's plan to investigate differences in plumbing configuration for homes with elevated lead sample results?
7. What other corrosion control studies/tests is Aqua, or its retained expert, currently performing or planning to perform?
8. What are Aqua's plans to study whether a higher dose of orthophosphate or tighter limits on ranges for pH and orthophosphate is beneficial?
9. The Agency requests that Aqua provide a spreadsheet of water quality hydrant network data for review on a quarterly basis in order to review water quality parameters in the distribution system.

Please submit results from the requested investigations when available, but no later than October 31, 2021. If additional time is necessary, Aqua may submit a written request for an extension of time to respond.

Sincerely,

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

cc: DPWS/FOS – Elgin Region

copy

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue, East; Post Office Box 19276; Springfield, IL 62794-9276
Division of Public Water Supplies Telephone 217/782-1724

PUBLIC WATER SUPPLY CONSTRUCTION PERMIT

SUBJECT: AQUA IL – UNIVERSITY PARK (IL1975030)

Permit Issued to:
Aqua Illinois
1000 S. Schuyler
Kankakee, IL 60901

PERMIT NUMBER: 1020-FY2020

DATE ISSUED: April 17, 2020
PERMIT TYPE: Plant Improvement

The issuance of this permit is based on plans and specifications prepared by the engineers/architects indicated and are identified as follows. This permit is issued for the construction and/or installation of the public water supply improvements described in this document, in accordance with the provisions of the "Environmental Protection Act", Title IV, Sections 14 through 17, and Title X, Sections 39 and 40, and is subject to the conditions printed on the last page of this permit and the ADDITIONAL CONDITIONS listed below.

FIRM: Cornwell Engineering Group
NUMBER OF PLAN SHEETS: na
TITLE OF PLANS: "Chemical Change Description"

PROPOSED IMPROVEMENTS:

Switch to a phosphoric acid corrosion control chemical

ADDITIONAL CONDITIONS:

1. An operating permit is required before feeding phosphoric acid.

2. The product must be NSF/ANSI 60 approved.

3. The minimum orthophosphate dose is 3 mg/L as PO_4. The expected pH range is 7.4 to 8.0 at the Central Avenue Booster Station. Optimal Water Quality Parameter ranges will be set at a later date through a Special Exception Permit after meeting the lead action level in two six month monitoring periods. Based upon all the orthophosphate tests and pH readings collected throughout the service area, notify the Illinois EPA if more than 10 percent of values for either parameter in any single month are outside of the expected ranges.

4. Monitor total chlorine, orthophosphate, pH, and alkalinity from at least nine locations at least once per week. The results must be sent to the Elgin Regional Office with the monthly operating reports.

5. During April 2020 monitor for lead and copper from at least one location on a weekly basis. The wastewater treatment plant is an acceptable location for this special condition.

6. Collect at least 40 lead and copper samples from approved sample site locations twice during May 2020, twice during June 2020, and monthly beginning in July 2020 until modified by a Special Exception Permit. The two sets May and June samples shall be divided by the 15th day of each month. Samples should be collected based upon highest past lead results and geographic representation.

7. The Illinois EPA may alter any of these additional conditions at a later date through issuance of a Special Exception Permit.

8. There are no further conditions to this permit.

DCC:

cc: Cornwell Engineering Group
DPWS/FOS – Elgin Regional Office

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The Illinois Environmental Protection Agency Act (Illinois Compiled Statutes, Chapter 111-1/2, Section 1039) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

These standard conditions shall apply to all permits which the Agency issues for construction or development projects which require permits under the Division of Water Pollution Control, Air Pollution Control, Public Water Supplies and Land and Noise Pollution Control. Special conditions may also be imposed by the separate divisions in addition to these standard conditions.

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire one year after this date of issuance unless construction or development on this project has started on or prior to that date. (See below)

2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted the Illinois Pollution Control Board.

3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.

4. The permittee shall allow any agent duly authorized by the Agency upon the presentation of credentials:

   a. to enter at reasonable times the permittee's premises where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit.

   b. to have access to and copy at reasonable times any records required be kept under the terms and conditions of this permit.

   c. to inspect at reasonable times, including during any hours or operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit.

   d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants.

   e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.

5. The issuance of this permit:

   a. shall not be considered as in any manner affecting the title of the permits upon which the permitted facilities are to be located;

   b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;

   c. does not release the permittee from compliance with the other applicable statues and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;

   d. does not take into consideration or attest to the structural stability of any units or parts of the project;

   e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability directly or indirectly for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.

6. These standard conditions shall prevail unless modified by special conditions.

7. The Agency may file a complaint with Board of modification, suspension or revocation of a permit:

   a. upon discovery that the permit application misrepresentation or false statements or that all relevant facts were not disclosed; or

   b. upon finding that any standard or special conditions have been violated; or

   c. upon any violation of the Environmental Protection Act or any Rules or Regulation effective thereunder as a result of the construction or development authorized by this permit.

For Division of Public Water Supply Construction Permits, construction on this project, once started, may continue for four years before this permit expires. A request for extension shall be filed at least 90 day prior to the permit expiration date.

University Park (IL1975030) Construction Permit Application

Chemical Change Description

July 15, 2021

Sealed by:

David Cornwell
Cornwell Engineering Group, Inc.
712 Gum Rock Court
Newport News, VA 23606
(757) 873-1534

LICENSED PROFESSIONAL ENGINEER
DAVID A. CORNWELL
062-071727
OF ILLINOIS

7/15/21
EXPIRES
11/30/21

OVERVIEW

Aqua Illinois (Aqua IL) currently feeds phosphoric acid (H_3PO_4) as a corrosion inhibitor for the University Park distribution system. The current product is supplied by Hawkins, Inc. (Roseville, MN) and contains 28 percent (by weight) of orthophosphate as PO_4, which is equivalent to 8.9 percent as P. The product is fed into the distribution system at the Central Avenue Booster Station.

The current feed system consists of a tank containing the H_3PO_4 product. The tank is on a scale for daily weight measurements. The product is pumped using a Grundfos pump into the pipeline entering the distribution system. The pump feed rate is controlled by SCADA based on a water flow meter and feedback loop to maintain the set dose of product ("flow pacing").

Aqua IL plans to switch from H_3PO_4 to zinc orthophosphate (ZOP). The ZOP product is ANSI/NSF Standard 60 approved and is available from many suppliers. The current plan is to obtain a product from Sterling Water Technologies, LLC (Columbia, TN), product CP 330S which can be described as a "1:10 Zn to PO_4 ratio" product, containing 34 to 36 percent orthophosphate as PO_4 (11.1 to 11.7 percent as P) and 2.5 to 4.0 percent zinc (Zn). However, any vendor providing a similar product may be used. There will be no change to the tank, scale, pump, or feed system located at Central Avenue Booster Station.

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DISCUSSION

The proposed future target conditions (pH and ZOP dose), laboratory study results, and other related information is summarized below.

Target pH and orthophosphate residual

The current target orthophosphate residual is ≥3 mg/L as PO_4. Aqua IL proposes to continue the same ≥3 mg/L as PO_4 limit. Tests are ongoing to evaluate zinc affects on harvested pipe.

The current pH target for water distributed in University Park is 7.4 to 8.0, as currently permitted by IEPA. The proposed future pH limits are identical. Theoretical pH calculated using RTW indicates similar predicted pH from adding H_3PO_4 as from adding 1:10 ZOP (modeled as H_3PO_4 and 1:10 doses of zinc sulfate ($ZnSO_4$)). So, pH results may be similar with ZOP as with H_3PO_4. However, under conditions where ZOP doses above 4 mg/L as PO_4 are needed to keep pH under 8.0, then pH adjustment with acid may needed (see discussion below).

Table 1 show results of laboratory studies using Kankakee treated surface water with alkalinity and pH adjusted with a combination of $NaHCO_3$, NaOH, and H_2SO_4 to achieve the pH and alkalinity targets noted in the table, and pH measured after adding either 3 or 4 mg/L as PO_4 using the ZOP product outlined earlier (CP330S from Sterling). These results suggest that some acid feed may be needed if the ZOP dose is limited to 4 mg/L. If that is the case, Aqua IL will submit a future revised permit request to IEPA, as needed.

Table 1

Measured pH change in the laboratory for Kankakee treated surface water samples adjusted to alkalinity and pH and then dosed with 3 and 4 mg/L as PO_4 doses of ZOP

Date	Alkalinity†	Measured pH†			
(2021)	mg/L as $CaCO_3$	before ZOP	after ZOP (3 mg/L)	after ZOP (4 mg/L)	Notes
7/8	46.6	8	7.5	7.4	
7/9	60	8.3	7.6	7.6	High alkalinity condition
7/9	55	8.3	7.6	7.6	
7/8	50	8.4	7.6	7.5	Typical condition
7/9	60	**8.8**	**8.1**	**8**	**Highest observed pH/alkalinity in UP**
7/8	61	9.1	8.7	8.6	Highest pH/alkalinity in Manteno

† Kankakee treated surface water was adjusted to pre-ZOP pH and alkalinity values indicated in the table, and then dosed with ZOP. The alkalinity was adjusted with $NaHCO_3$, the pH with H_2SO_4 and NaOH, and the ZOP product was CP330S. The ZOP doses are in mg/L as PO_4

Justification for switch from H_3PO_4 to ZOP

Figure 1 compares the current pH before and after H_3PO_4 addition as well as orthophosphate residual, average NO_3^-, and 90th percentile lead. Aqua IL has postulated that fluctuations in 90th percentile lead, especially periods when lead appears not to be stable in certain homes, is related to the presence of nitrate (NO_3^-) and that adding zinc (Zn) can attenuate these conditions. After switching to phosphoric acid in April 2020, the pH and orthophosphate residual have been maintained within target levels.

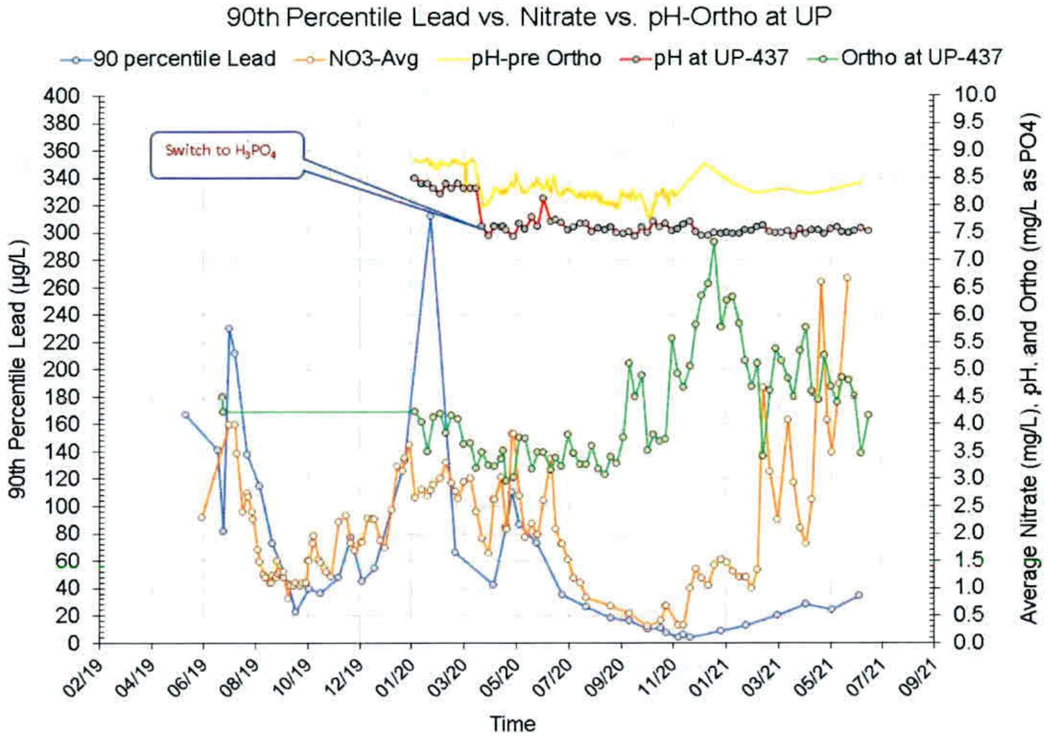


Figure 1 pH before H_3PO_4 addition, orthophosphate residual and pH after H_3PO_4, and 90th percentile lead and average nitrate (NO_3^-) in University Park

Note: This graph shows some nitrate data <3 mg/L as N, and this level of nitrate addition did not cause significant lead release compared to the control in the 2019 Virginia Tech study (see below).

In July 2019, Dr. Edwards from Virginia Tech conducted a laboratory coupon experiment to study galvanic corrosion on new lead solder using Kankakee WTP water. The results were summarized and submitted as a part of the OCCT study in 2019. The experiment mainly focused on testing the effects of chloride to sulfate mass ratio (CSMR) and various corrosion inhibitors. It is concluded that the short duration of CSMR increase up to 0.9 in Kankakee water should not cause significant galvanic corrosion on new lead solders. A scenario was designed to test the effect of nitrate on galvanic corrosion of new lead solder by adding additional 3 mg/L of nitrate as N. This level of nitrate addition did not cause significant lead release compared to the Control.

It is important to note that there is very little research on the subject of nitrate induced galvanic corrosion of leaded solders. (Oliphant 1983, Nguyen 2011) In the Spring of 2021, nitrate as high as 8.1 mg/L was observed at the Kankakee WTP and nitrate up to 6.7 mg/L was measured at hydrants within the UP distribution system. After review of all available data of the UP system and the testing conditions of the 2019 experiment, Aqua IL and Dr. Edwards decided to study the short-term effect of higher levels of nitrate on corrosion of leaded solder.

The experiment is a dump and fill lead solubility test using new copper coupons connected with a 50:50 mixture of lead (Pb) and tin (Sn) solder. The goal was to: (1) examine if high nitrate in Kankakee water could cause galvanic corrosion on new lead solders; and (2) test if adding Zn and PO_4, could mitigate the galvanically induced lead corrosion on new materials from the presence of spiked NO_3^-.

The new coupons were first acclimated for one week with University Park local groundwater, then one more week with treated surface water from Kankakee. These acclimated coupons were then exposed to the conditions listed in Table 2 using treated surface water from Kankakee. The target pH prior to exposure for all these coupons was adjusted to 7.6. The chloramine residual was not adjusted from the levels as received from Kankakee. All coupons, except the Control, were dosed with 5 mg/L as N additional NO_3^-. The NO_3^- in the water shipped to Virginia Tech changed naturally over time as follows: a) day 1-7 = 7.7 mg/L as N, b) day 8-12 = 6.3 mg/L as N, and c) day 13-19 = 2.9 mg/L as N. As noted in Table 2, all conditions studied, except the control, were spiked with additional nitrate (5 mg/L as N), resulting in total (spike + background) nitrate from 7.9 to 12.7 mg/L as N. Lead results from these studies to date are shown in Figure 2. Dr. Edwards reports that zinc orthophosphate looks promising. These studies are still in progress, and tests on harvested pipes with spiked nitrate were also initiated.

Table 2
Conditions for testing of new coupons with Pb/Sn solder – June 2021

Label	Additives (and dose)			
	Orthophosphate (PO_4^{-3}) (mg/L as P)	Zinc (Zn) (mg/L)	Nitrate (NO_3^-) (mg/L as N)	Nitrite (NO_2^-) (mg/L as N)
Day 1 to 5				
Control				
NO_3^- only			5	
NO_3^- and PO_4	0.1		5	
NO_3^-, Zn, and PO_4	0.1	4	5	
NO_3^- and Zn		4	5	
NO_3^- and NO_2^-			5	0.5
Day 6 to 12				
Control				
NO_3^- only			5	
NO_3^- and PO_4	2		5	
NO_3^-, Zn, and PO_4	2	0.5	5	
NO_3^- and Zn		0.5	5	
NO_3^- and NO_2^-			5	0.5
Day 13 onward				
Control				
NO_3^- only			5	
NO_3^- and PO_4	1		5	
NO_3^-, Zn, and PO_4	1	0.33	5	
NO_3^- and Zn		0.33	5	
NO_3^- and NO_2^-			5	0.5

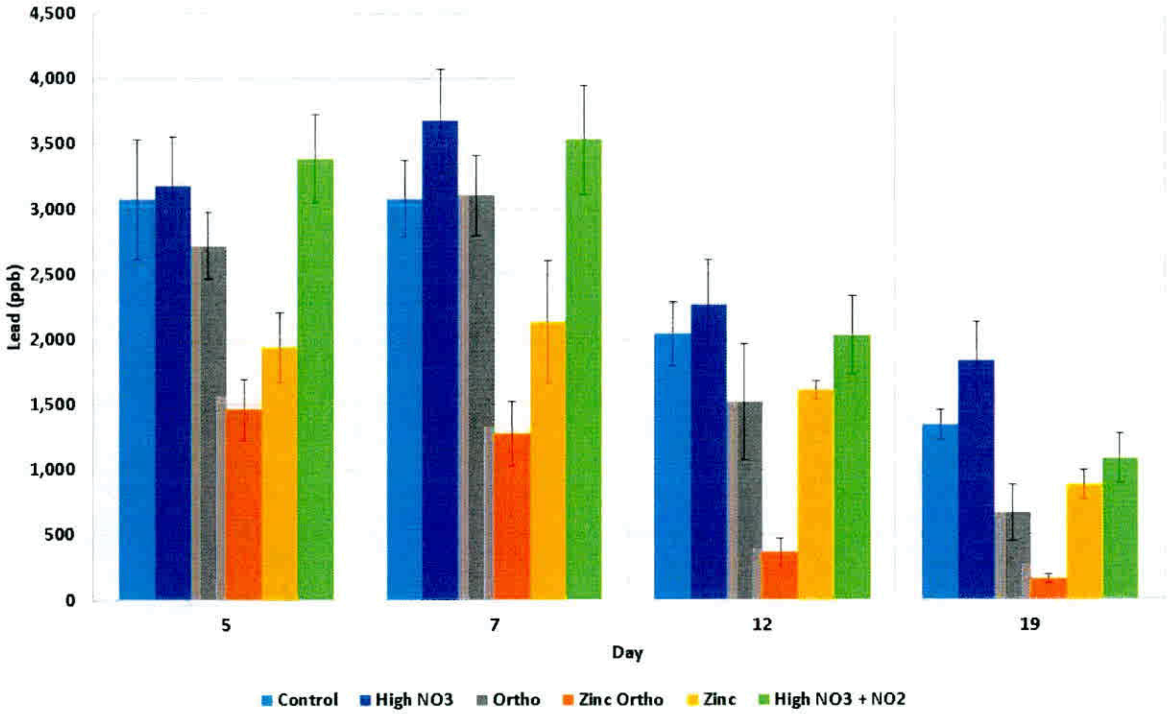


Figure 2 Lead results from testing of new copper coupons with Pb/Sn solder – in progress

Studies conducted by the Cornwell Engineering Group (Cornwell) comparing ZOP to other orthophosphate-containing products are shown in Figure 3 (H_3PO_4) and Figure 4 (ZOP) using lead coupons. Dump/fill studies are shown in Figure 5 through Figure 8. The results were similar for all studies no matter what orthophosphate source was used, except for a couple pipes on ZOP (Figures 7 and 9). Especially Figure 8 showed high lead results with ZOP. It isn't known if that is due to ZOP or a function of the pipe tested.

Cornwell is in the process of starting additional harvested pipe studies targeted to investigate lead solubility in University Park harvested materials with and without spiked nitrate. These will be tested with the CP330S 1:10 ZOP proposed for University Park above. The tests will include ZOP doses of 3 mg/L as PO_4. Four conditions will be tested, including ZOP with no spiked nitrate to see if Zn upsets scales, and the same doses spiked with 8 mg/L as N nitrate to see if Zn has a beneficial affect at high nitrate. Straight orthophosphate will also be tested with spiked nitrate as a comparison. Finally straight orthophosphate will be tested at 8 mg/L to see if the high PO_4 affected scales.

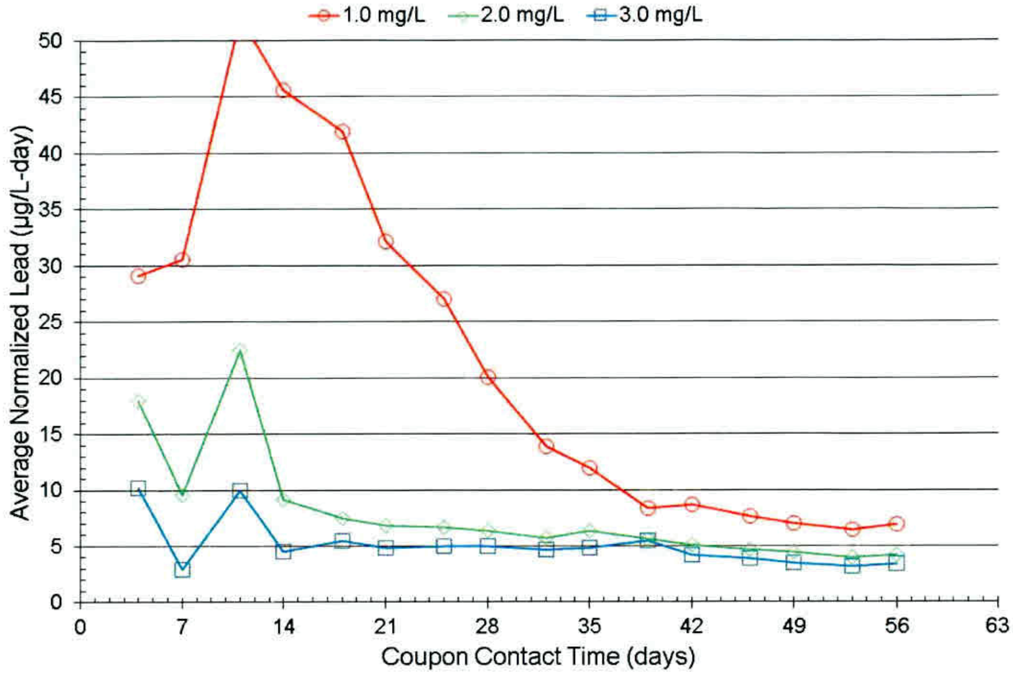


Figure 3 **Coupon results from testing of new lead coupons with H_3PO_4 (doses are mg/L as PO_4)**

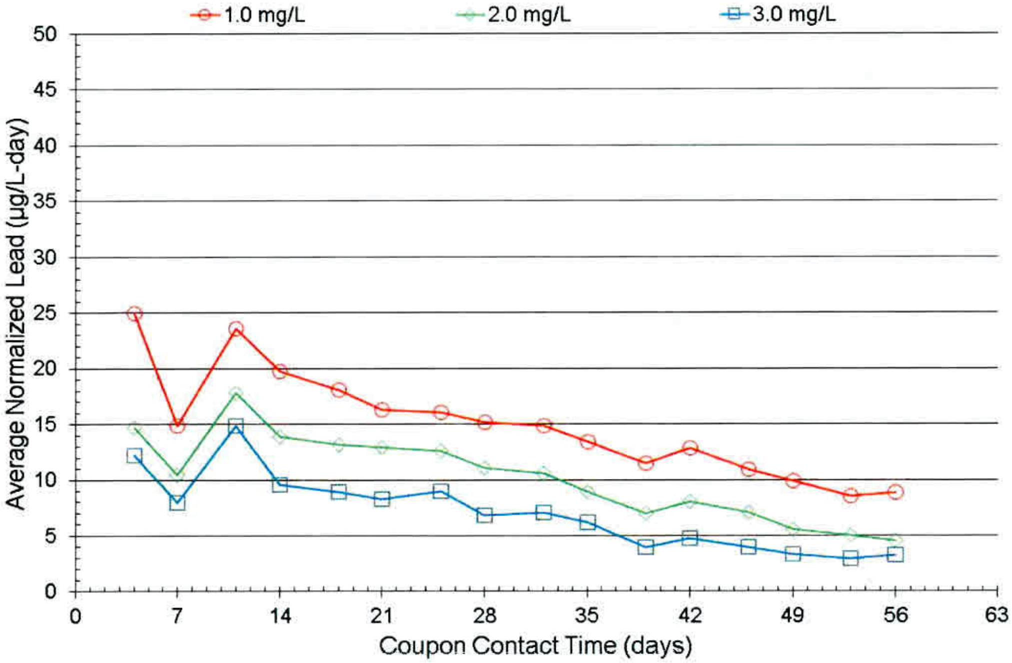


Figure 4 **Coupon results from testing of new lead coupons with ZOP (doses are mg/L as PO_4)**

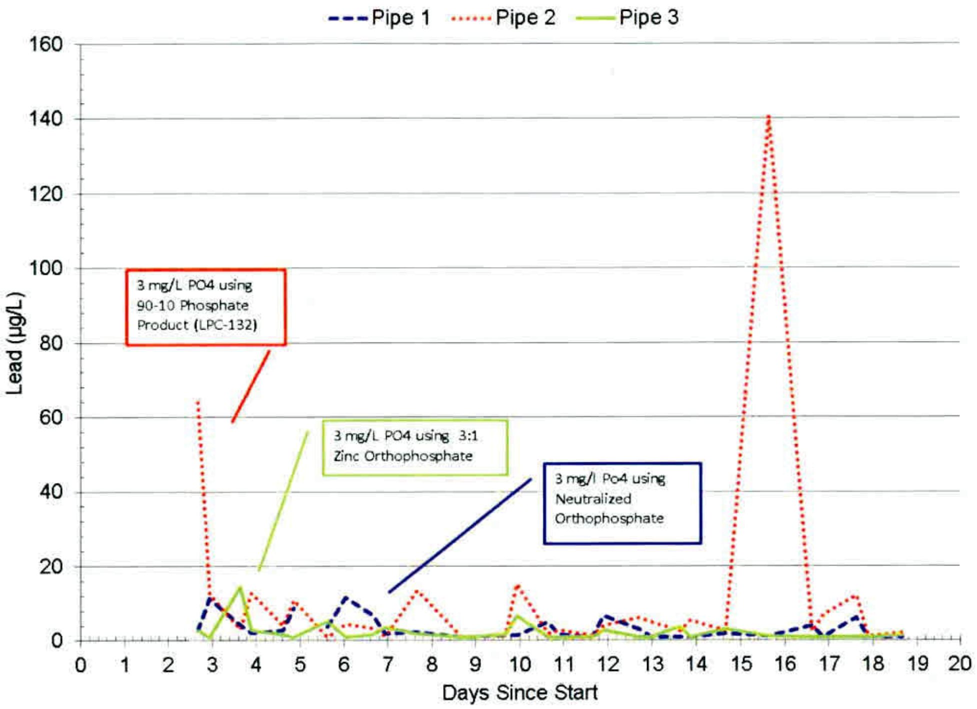


Figure 5 Lead solubility dump/fill studies with harvested pipe comparing 3 mg/L as PO_4 doses of a 90/10 ortho/poly blend, ZOP, and neutralized orthophosphate (NaH_2PO_4)

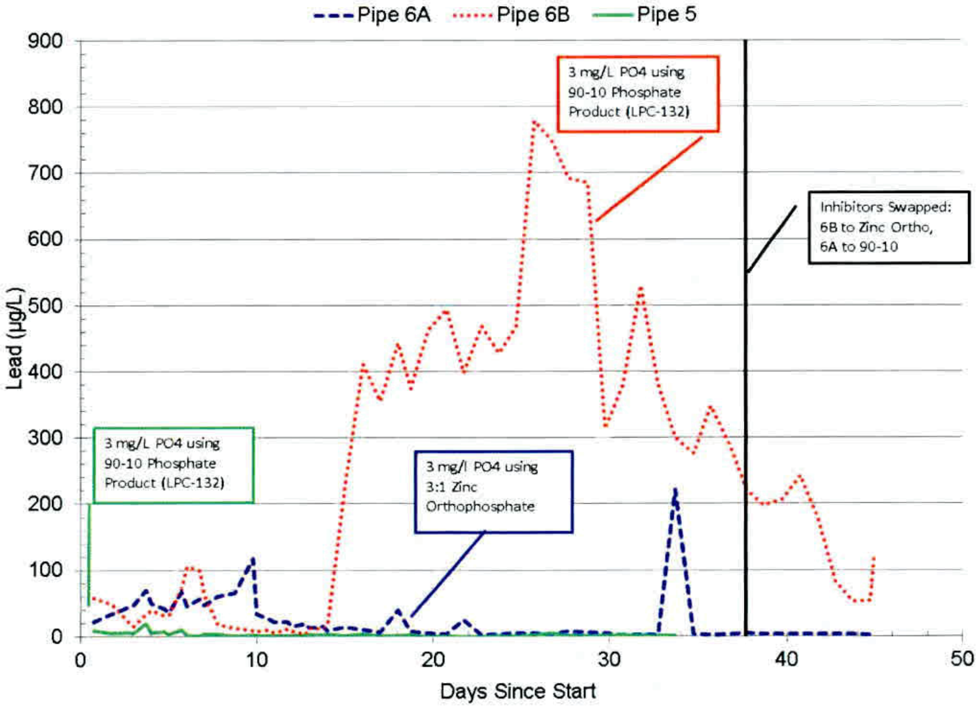


Figure 6 Lead solubility dump/fill studies with harvested pipe comparing 3 mg/L as PO_4 doses of a 90/10 ortho/poly blend to ZOP

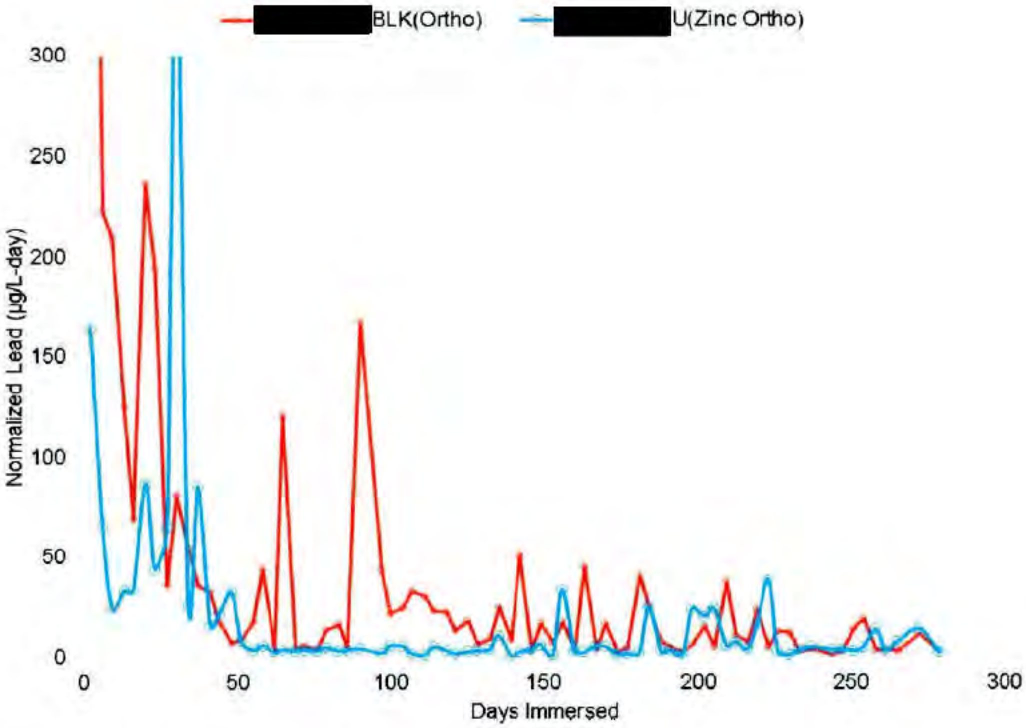


Figure 7 Lead solubility in dump and fill harvested pipe from [redacted] in University Park – Ortho (H_3PO_4) versus Zinc ortho (ZOP) at 3 mg/L as PO_4 doses

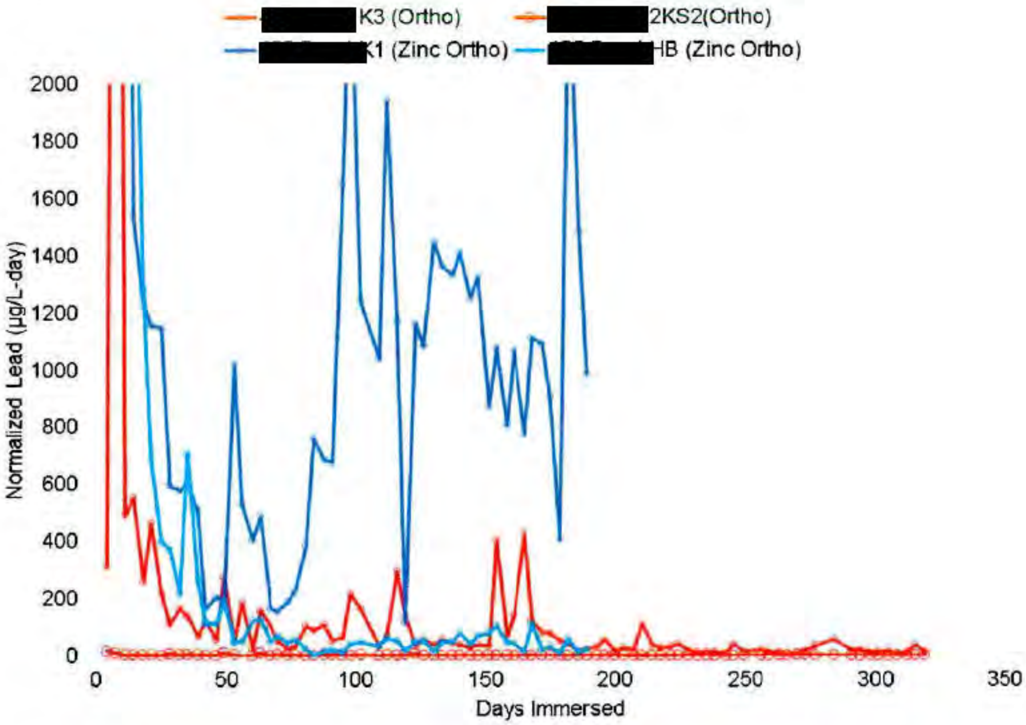


Figure 8 Lead solubility in dump and fill harvested pipe from [redacted] in University Park – Ortho (H_3PO_4) versus Zinc ortho (ZOP) at 3 mg/L as PO_4 doses

WQP Monitoring

After the switch to ZOP, the WQP monitoring is expected to be maintained as under present conditions, including the following:

- Orthophosphate will continue to be monitored daily at the Central Avenue Booster Station at or near the point of entry. Pump Station pump flow data are continuously recorded in SCADA.
- One day per week the following parameters will continue to be monitored at nine locations in University Park:
    - Free Chlorine
    - Total Chlorine
    - Monochloramine
    - Free ammonia
    - Orthophosphate
    - pH
    - Alkalinity
- These are monitored as part of the WQPs for lead and copper CCT. These and other University Park monitoring locations will continue to be monitored to fulfill other requirements, including RTCR, DBPR, LCR (lead and copper), etc. as outlined in previous Aqua IL sampling plans for University Park. In addition, a Nitrification Action Plan, including routine monthly, weekly, and daily monitoring will be submitted for IEPA review. This will include monitoring for monochloramine and total chlorine residuals, free ammonia, etc.

SUMMARY

Aqua IL is requesting IEPA approval of the switch to the 1:10 ZOP product noted above (CP330S from Sterling) to be fed at ≥3 mg/L as PO_4, with pH to be targeted between 7.4 and 8.0.

Tests are ongoing to evaluate zinc affects on harvested pipe.

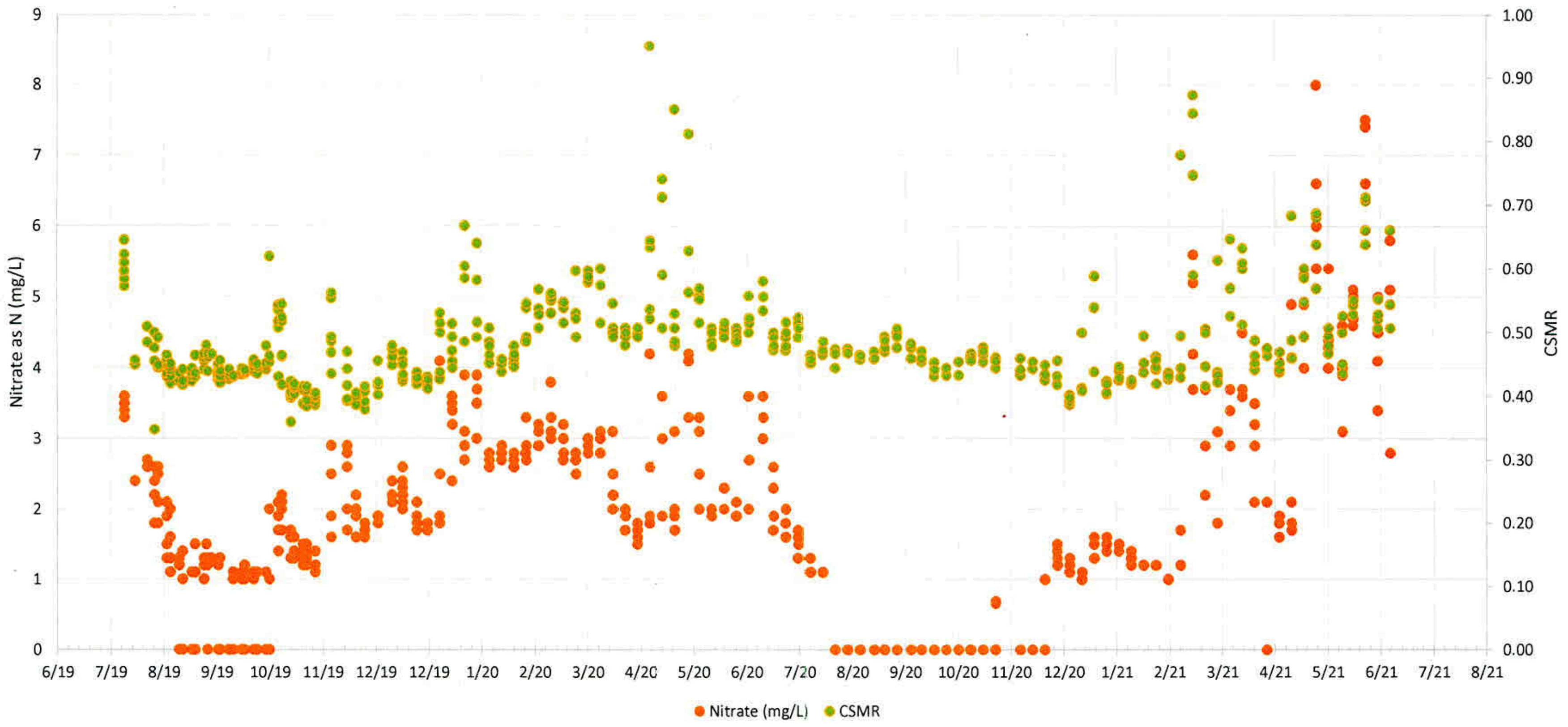
Aqua UP: Technical Response Team Presentation

07/14/2021

Overview

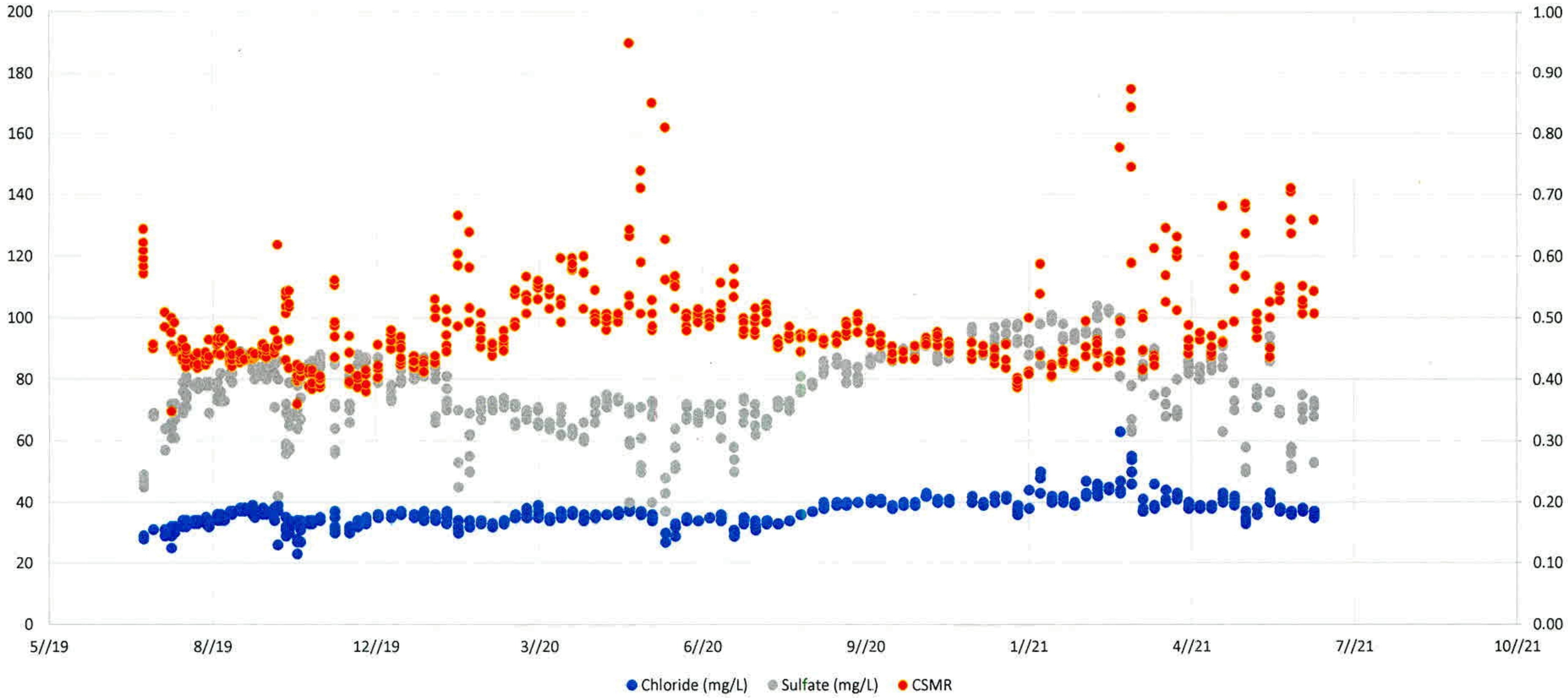
- Recently observed elevated river nitrate levels from farm runoff is coinciding with lead level increases in certain homes that have not recovered. Recent river nitrate levels were extremely high making the trend more apparent.
- Dr. Marc Edwards and Virginia Tech continue to run new experiments and will update the technical team today on most recent results.
- Work is occurring in parallel by Dr. David Cornwell shows a 10:1 zinc sulfate supplemented orthophosphate product can achieve the same seasonal pH control as the existing orthophosphate
- Based on this new and unprecedented information and the recent lead data/trend, Aqua will request to supplement the current orthophosphate to a zinc orthophosphate inhibitor as a further protective measure targeting nitrate galvanic attack.

Nitrate vs. CSMR



Presentation Contains Results Still Under Review

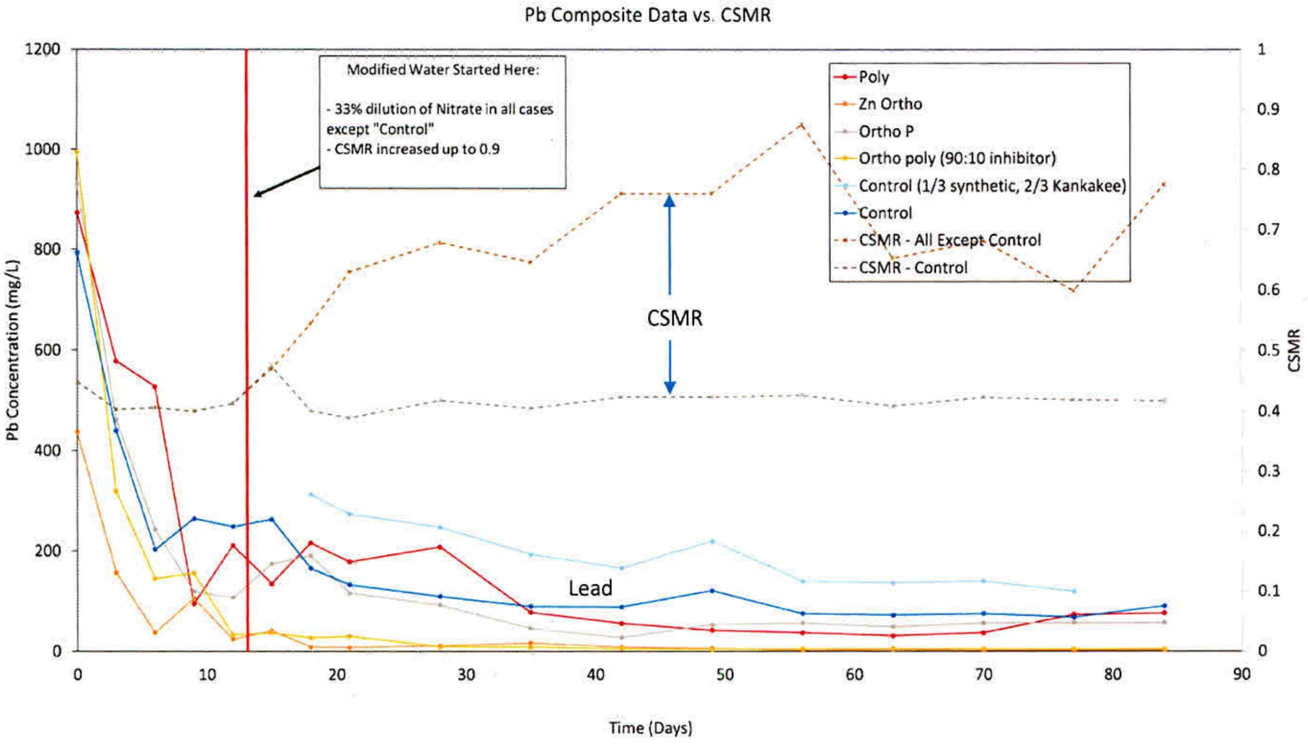
Chloride, Sulfate, & CSMR



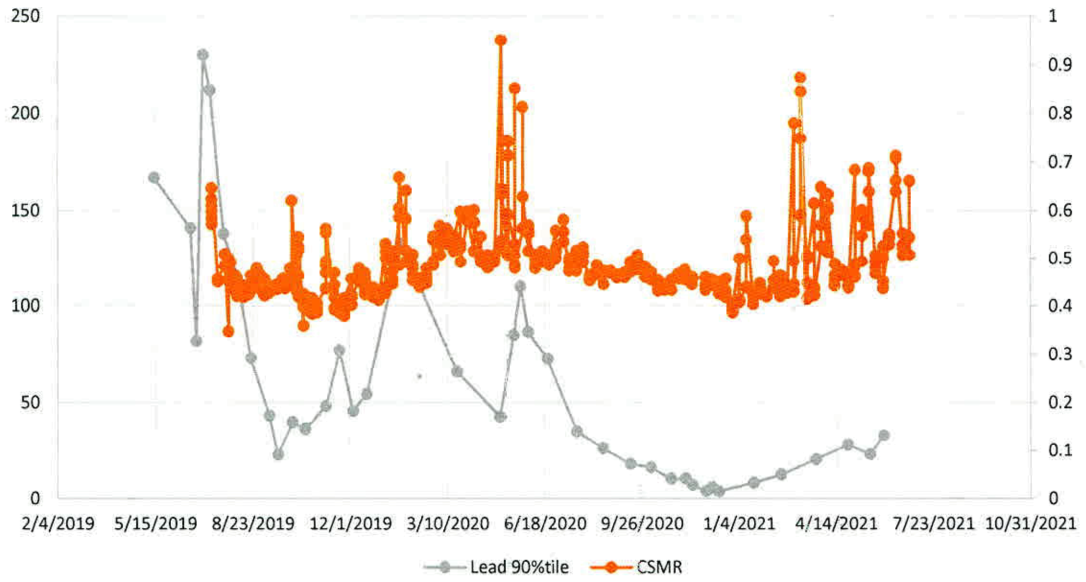
Chloride stable, sulfate fluctuates driving CSMR

Presentation Contains Results Still Under Review

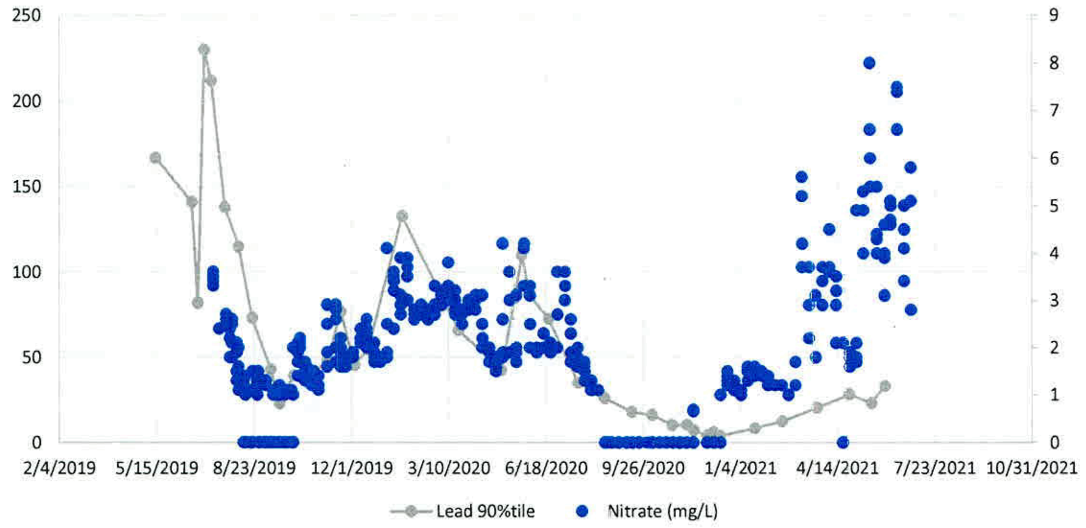
High CSMR in Prior Experiments by Virginia Tech Had No Impact on Lead Release (2019)



Presentation Contains Results Still Under Review



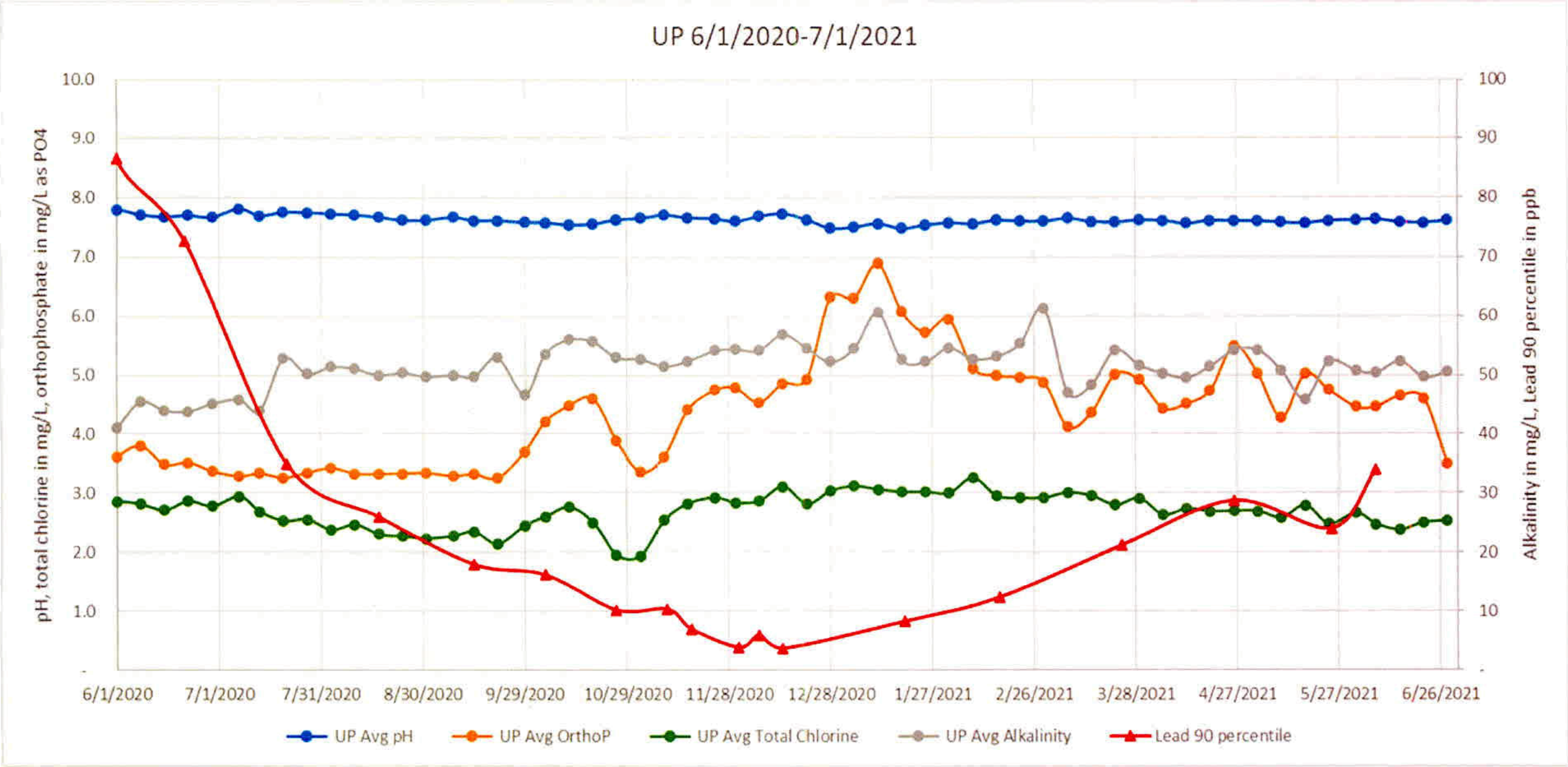
Chloride levels generally stable
Sulfate declines during high flow/runoff events
Nitrate increases during runoff events



Presentation Contains Results Still Under Review

Chlorine, Alkalinity, and pH Were Stable the Past Year

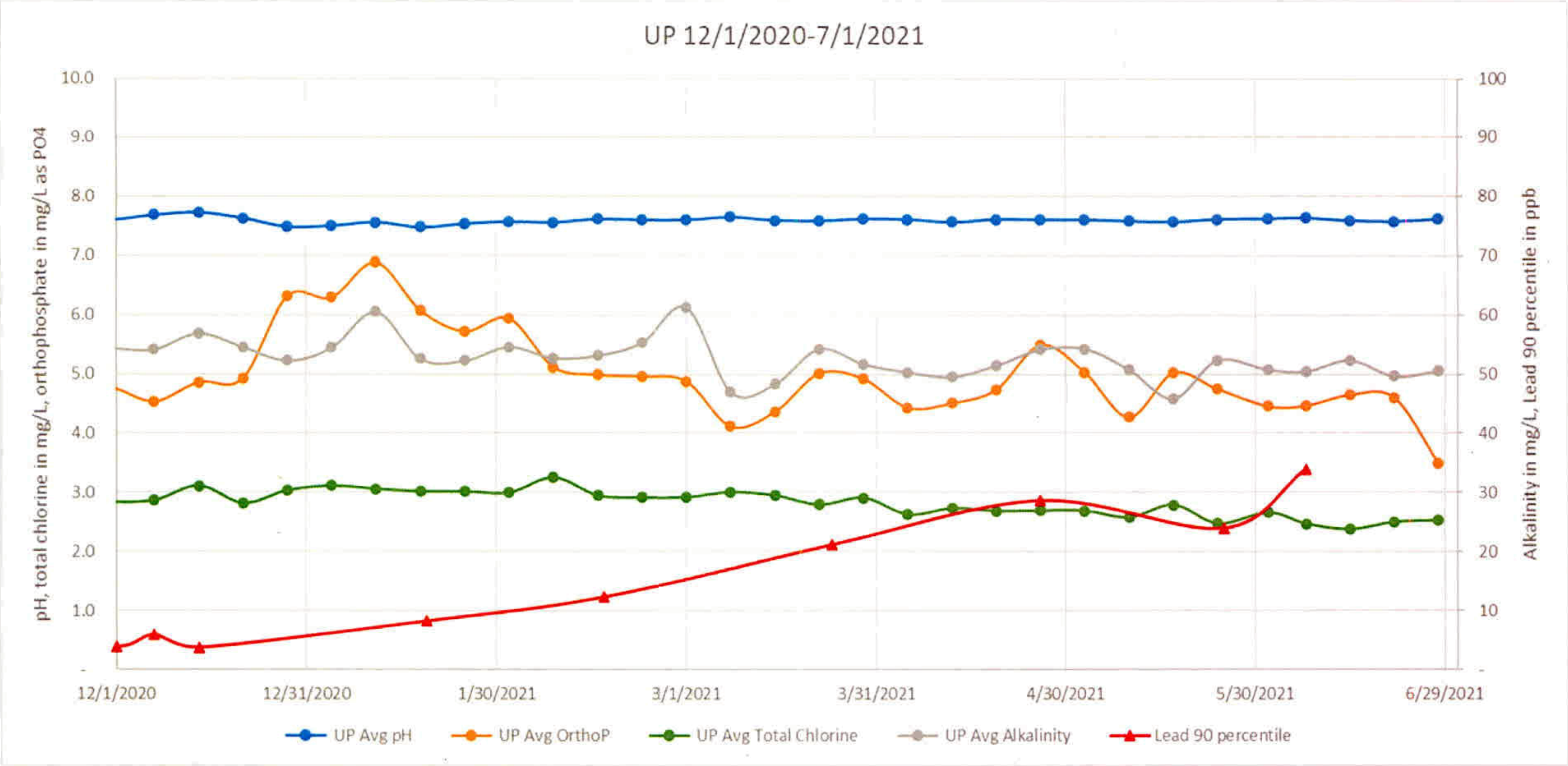
Presentation Contains Results Still Under Review



Reminder: Orthophosphate fluctuates with seasons to maintain steady pH (orthophosphoric acid product) in UP as water from Kankakee pH increases in winter due to LSI targets in original Kankakee system

Chlorine, Alkalinity, and pH Were Stable the Past Year

Presentation Contains Results Still Under Review



Reminder: Orthophosphate fluctuates with seasons to maintain steady pH (orthophosphoric acid product) in UP as water from Kankakee pH increases in winter due to LSI targets in original Kankakee system

redacted

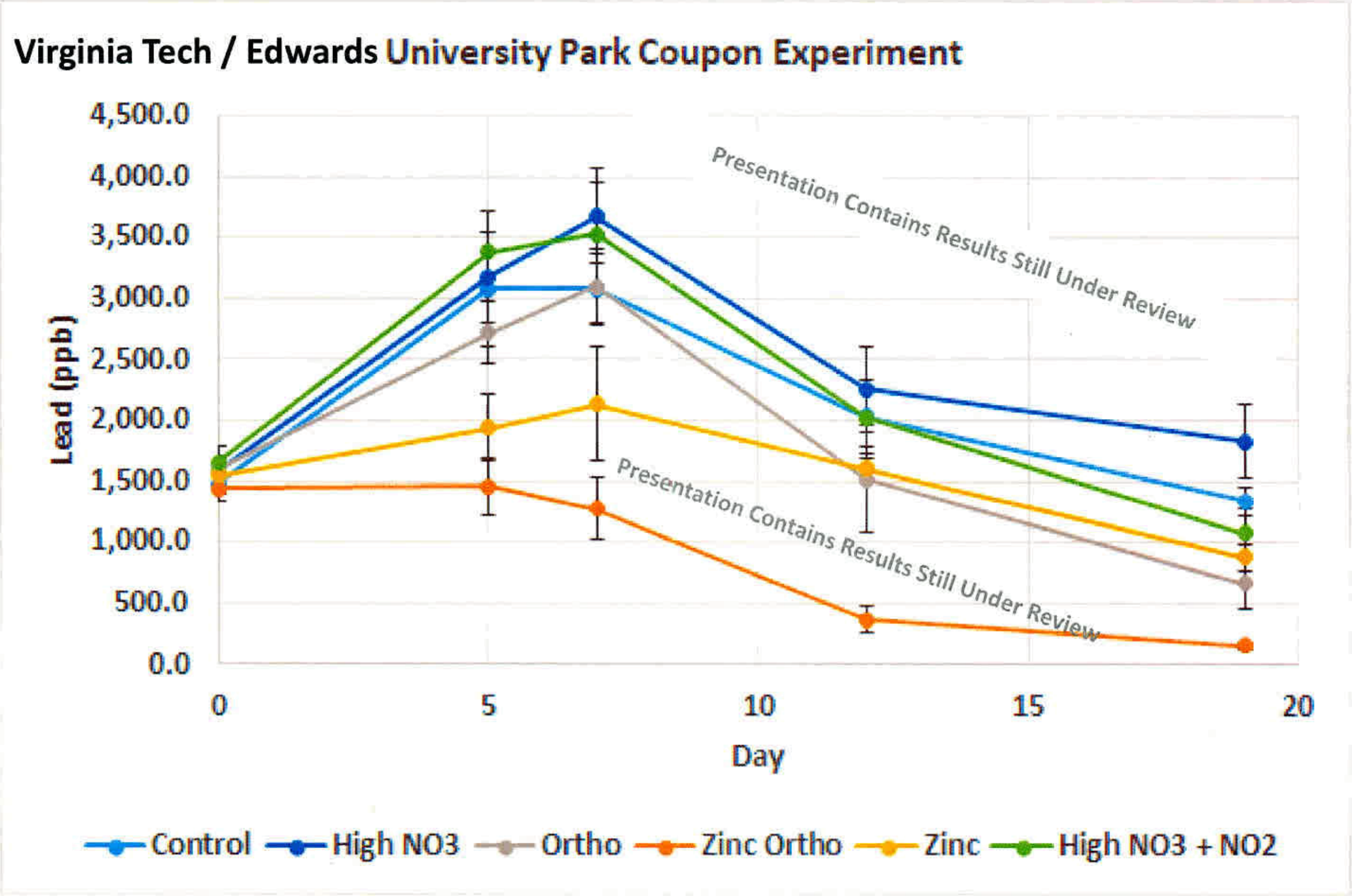
Dr. Marc Edwards and Virginia Tech Experiment Presentation

- Coupon Tests with High Nitrate Water
- [redacted] Harvested Pipe
  - Fill and Draw

Presentation Contains Results Still Under Review

[redacted]

Recap - Zinc Ortho Worked Better In Higher Nitrate Situations



Next Steps

- Aqua will make request to switch to Zinc Orthophosphate to provide added and accelerated protection for certain homes that are not yet responding
  - Request likely within 1 week
  - We respectfully seek State expedited review
- When Aqua requests the switch to supplement the existing treatment, Aqua will also be seeking a modification to the permit sampling regime consistent with the recognition that treatment can take several months before lead levels stabilize. Monthly compliance sampling for the remainder of the 6 month period will begin 30 days after the supplemented treatment is installed. During the period of time prior to installation, Aqua will collect non-compliance samples at 25 sentinel sites monthly within the compliance pool and customer requested sampling will continue.

Questions

University Park Nitrate Experiments

July 14th, 2021

Presentation Contains Data/Results Still Under Review

Current Study

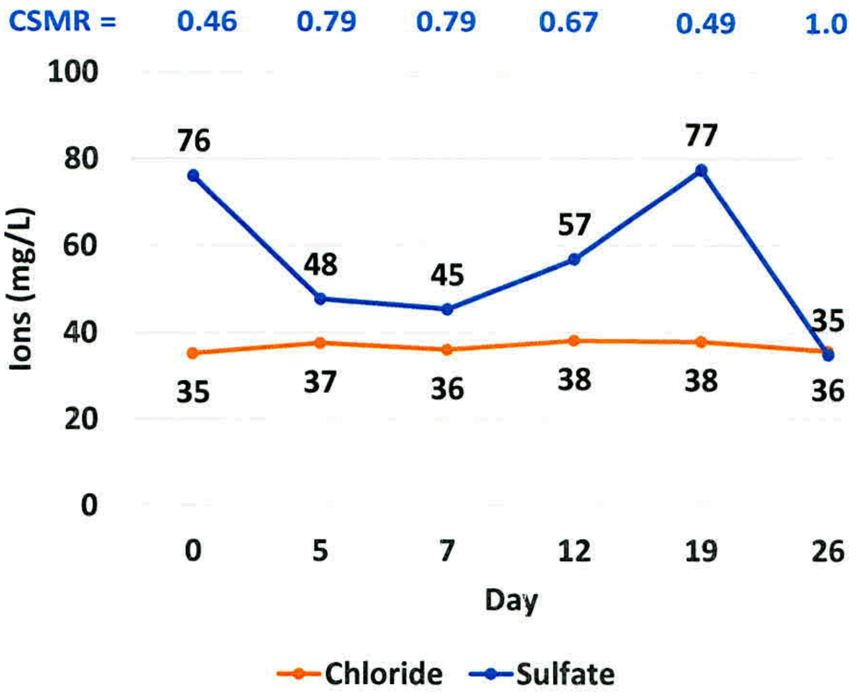
- New copper coupons with 50:50 lead-tin solder
- Conditioned for 1 week with groundwater, then 1 week with Kankakee
    - Coupons tested, selected to minimize relative standard deviation and sorted into 6 statistically similar groupings
- Changed water to create 6 different conditions (n=15)

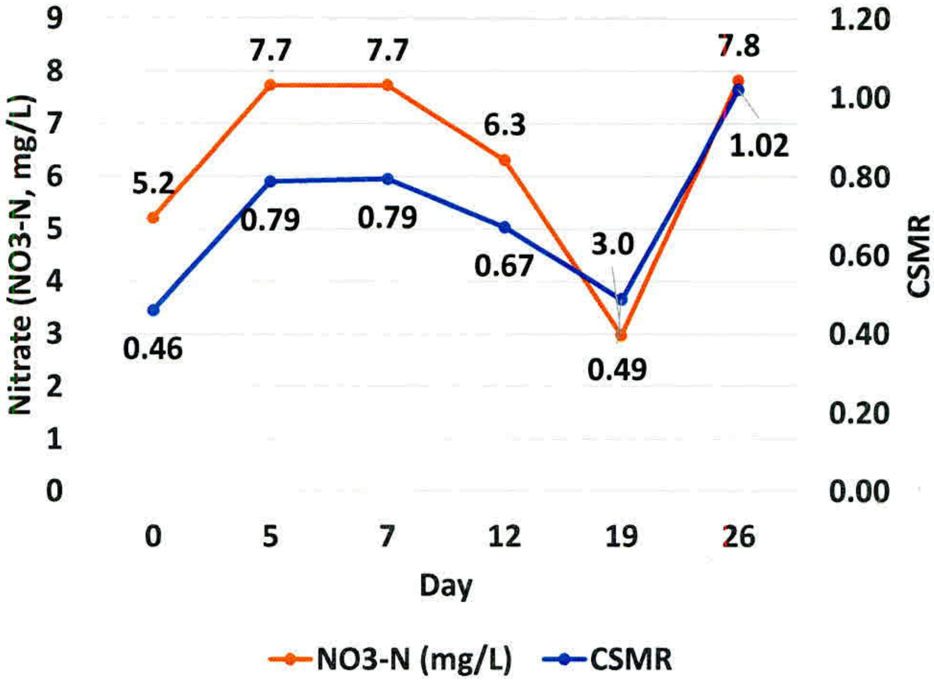
Water Conditions	Phosphate	Zinc	NO3	NO2
Control				
High NO3			+5 mg/L N	
Ortho	0.10-2 mg/L P		+5 mg/L N	
Zinc Ortho	0.10-2 mg/L P	0.33-4 mg/L	+5 mg/L N	
Zinc		0.33-4 mg/L	+5 mg/L N	
High NO3 + NO2			+5 mg/L N	0.5 mg/L N

*Phosphate was 0.10 mg/L P for the 1st 5 days, then 2 mg/L for a week. Final target dose was 1 mg/L P.

**Zn was a conditioning dose of 4 mg/L for the 1st 5 days, then 0.5 mg/L for a week, and the final maintenance dose was 0.33 mg/L.

Water Quality

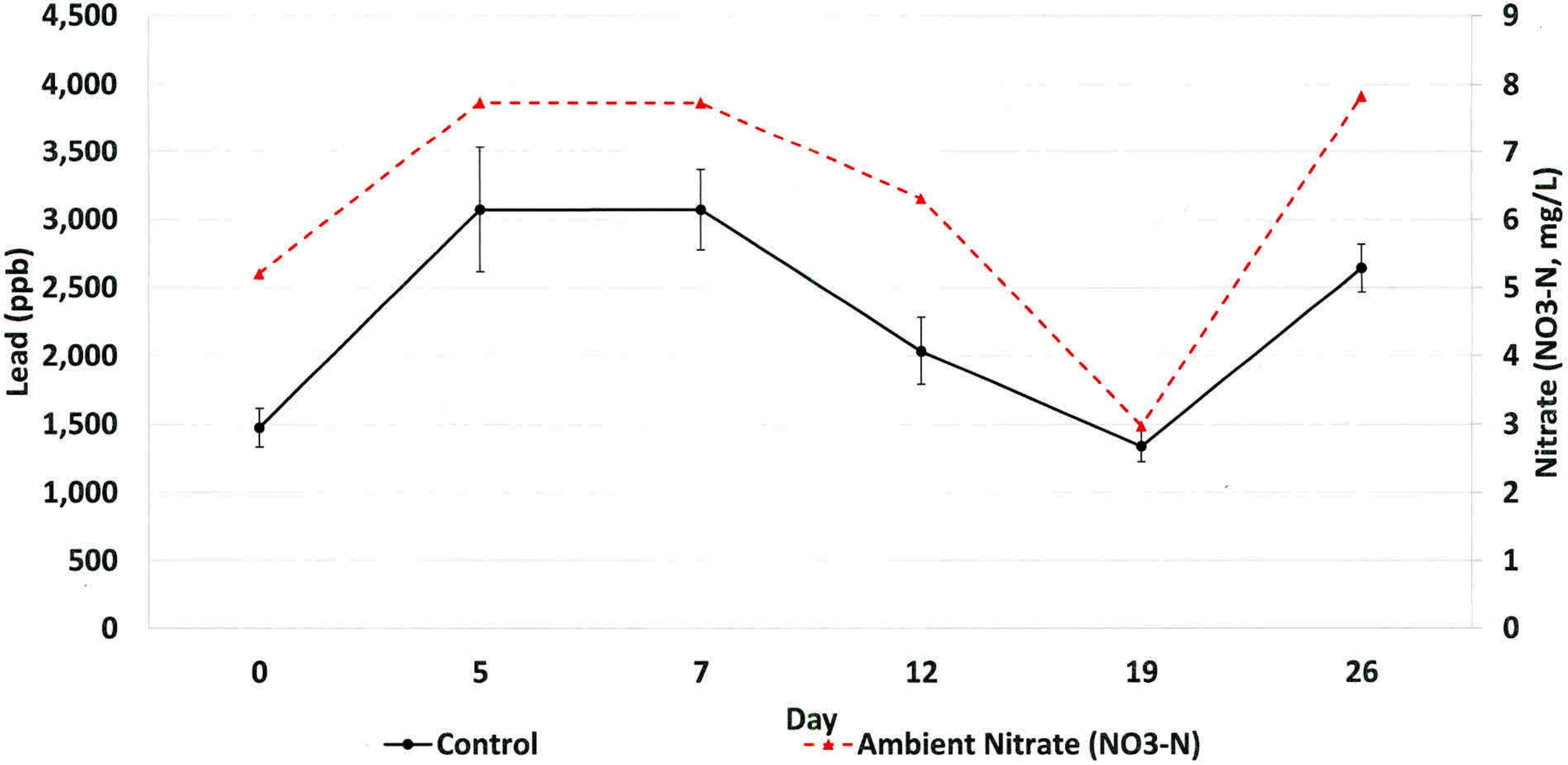




*Time 0 data estimated from AQUA monitoring data from May 17, 2021

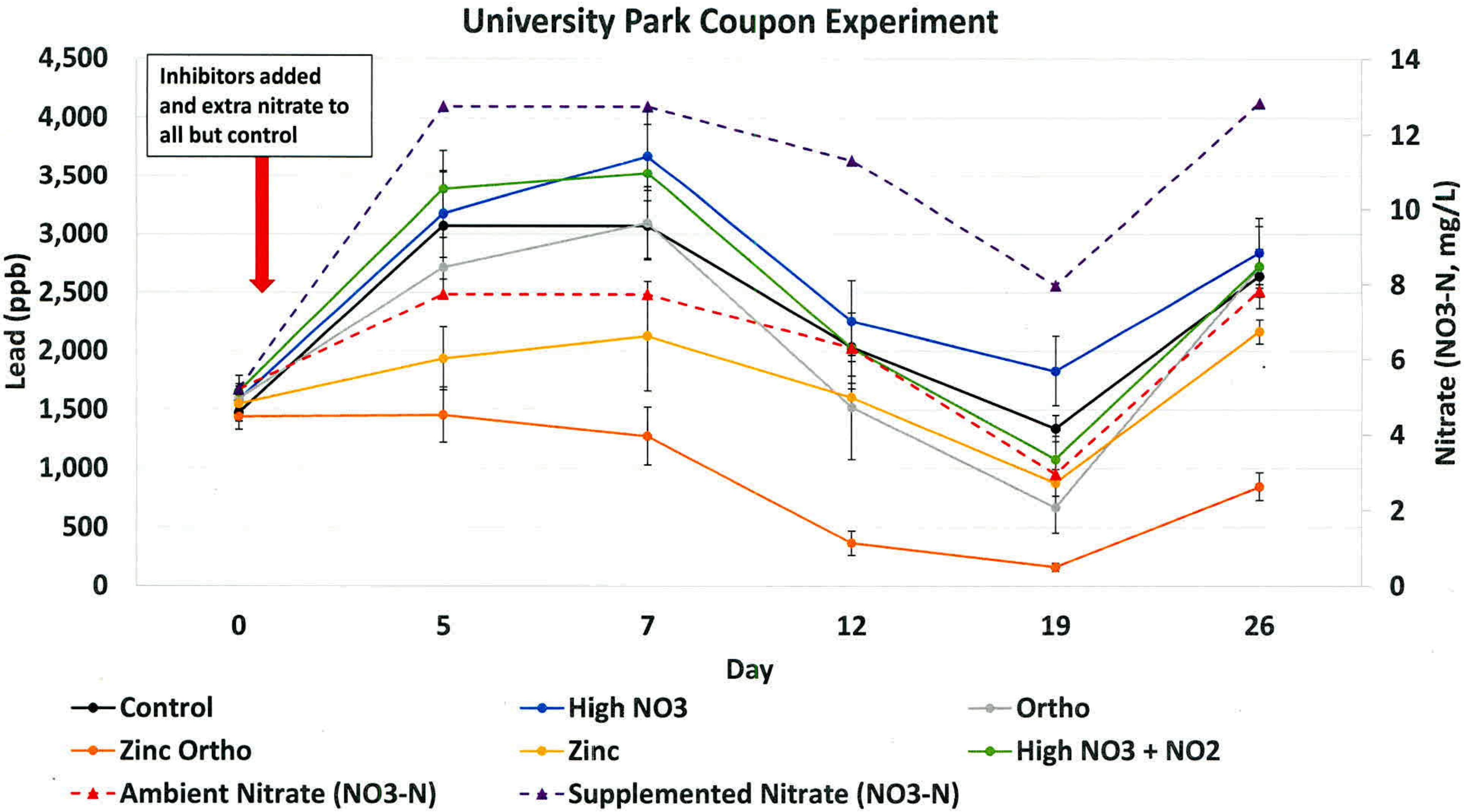
Presentation Contains Data/Results Still Under Review

University Park Coupon Experiment



Error bars represent 95% confidence intervals

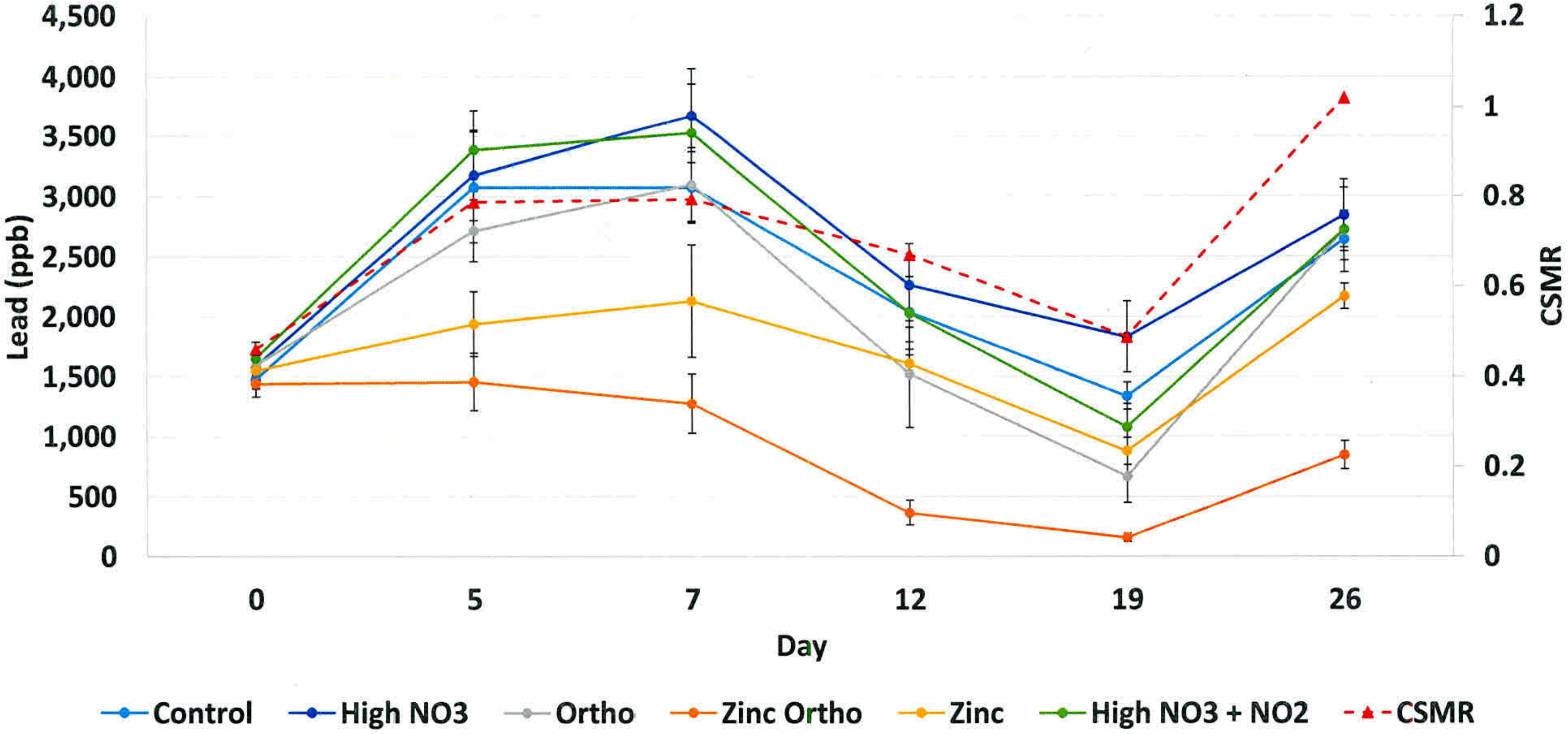
Presentation Contains Data/Results Still Under Review



Error bars represent 95% confidence intervals

Presentation Contains Data/Results Still Under Review

University Park Coupon Experiment



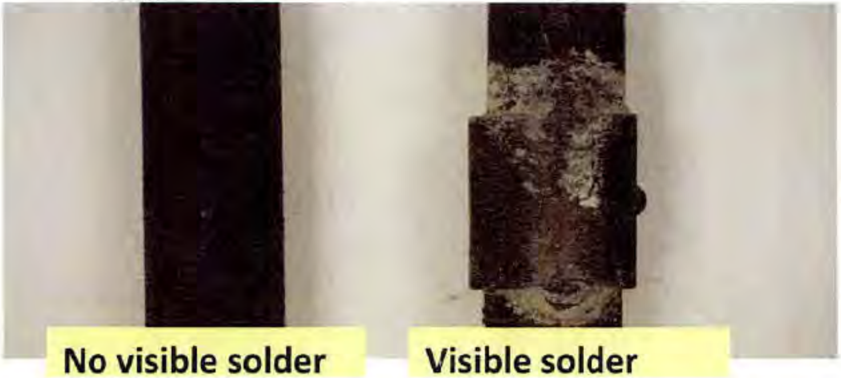
Error bars represent 95% confidence intervals

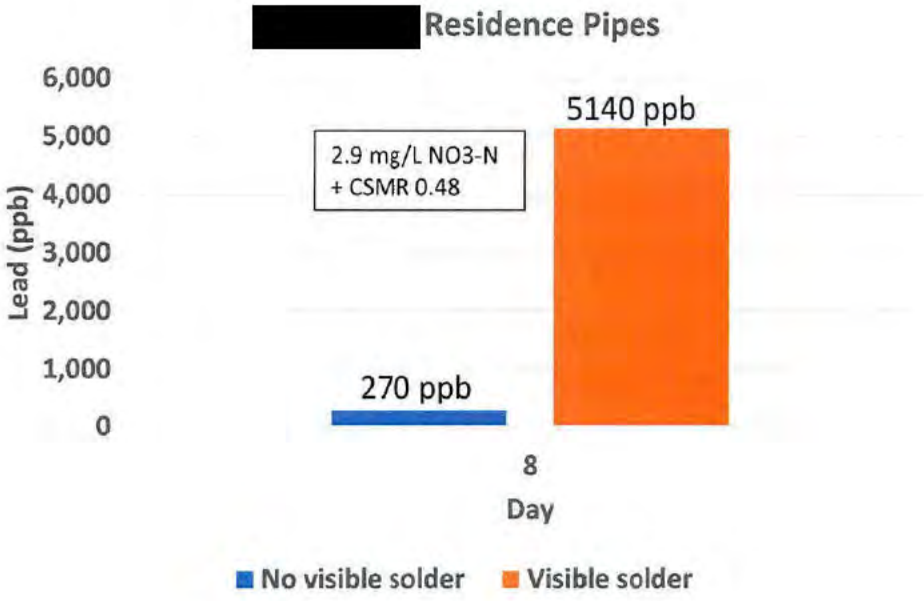
Presentation Contains Data/Results Still Under Review

Redacted

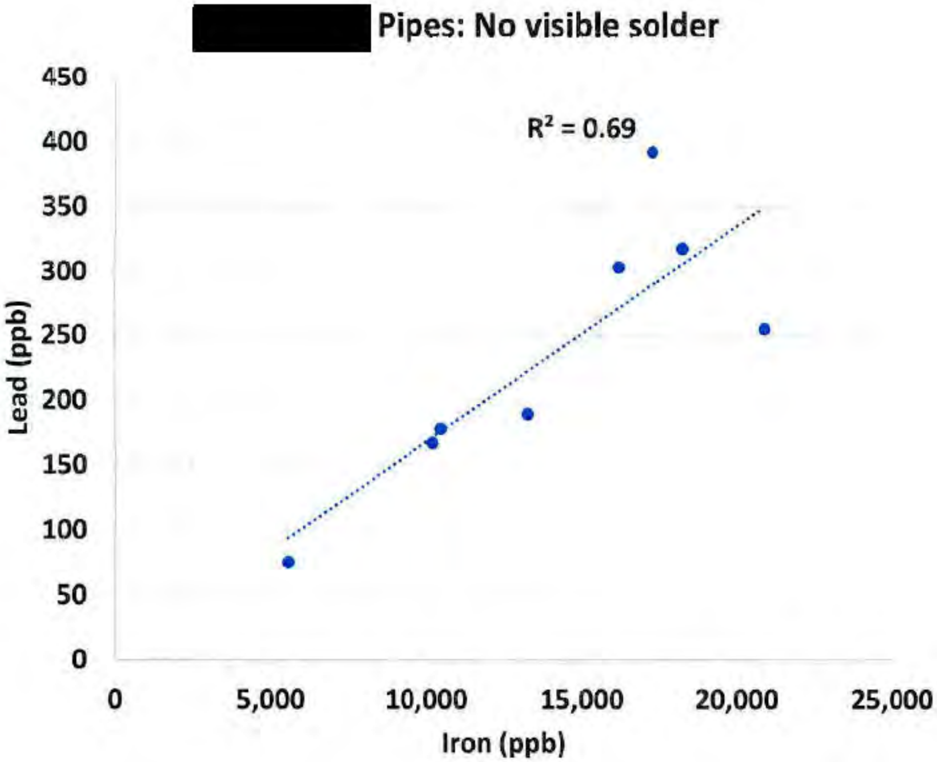
[redacted] Residence Pipe Experiment

- 13 old copper pipes split into 2 groups:
    - No visible lead solder (n=8)
    - Visible lead solder (n=5
- Pipes conditioning in Kankakee water + 1 mg/L P
- Running most recent data w/ aggressive 20% acid digestion

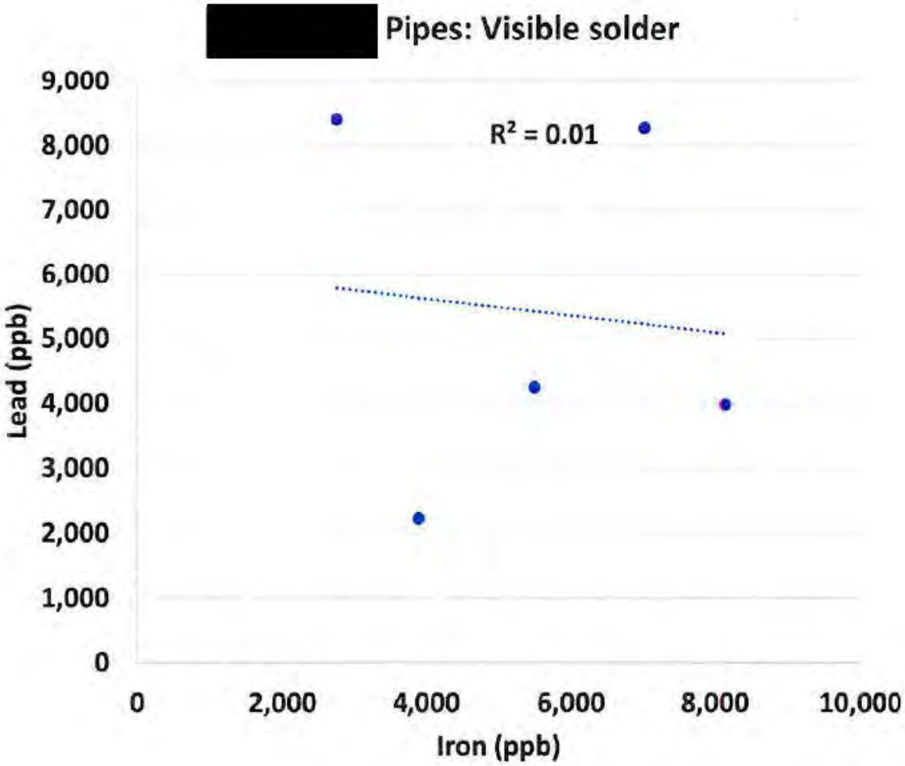




Redacted



[redacted] Pipes: No visible solder



[redacted] Pipes: Visible solder

Experiment Plan Going Forward

- Coupons will continue receiving treatment
- Testing pipes from [redacted] residence
  - Digestion with 2% nitric acid (more than EPA protocol) did not fully dissolve particles
  - More aggressive digestion with 20% nitric acid and 20 hrs heat
  - If remaining particles have lead, the actual lead may be greater than preliminary data shown

Summary

- This case is the first of its kind
  - Relatively short-term changes in nitrate and sulfate are hypothesized to be exacerbating corrosion
  - Possible interaction between nitrate + CSMR
  - Large chunks of solder detaching are contributing to high lead

- Zinc orthophosphate looks promising based on preliminary data

DIVISION OF PUBLIC WATER SUPPLIES - PERMIT TRACKING SYSTEM
DATA PROCESSING SHEET - PERMIT DATA

PWS Engineer: **DCC** **July 16, 2021**

System Number: **IL1975030** Log Number: **2022-0071-0**

System Name: **AQUA ILLINOIS-UNIVERSITY PARK**

Permit Type: CONSTRUCTION

Algaecide Preliminary Plans Non-Permit
Construction Aquatic Pesticide Fee Due
Not Classified Loan

Construction Type: PLANT IMPROVEMENT

Both Plant Improvement Water Main

Permit Subtype: NONE

As Built Operating As Built Approval
As Constructed Plans None

New System: No Yes or No

Population Increase: ____

Variance: No Yes or No

___ Number of Operating Permits

Emergency: No Yes or No

No Final Operating Permit Yes or No

Sample Restriction: No Yes or No

___ Extensions Granted

Project Name: University Park Booster Station - Chemical Feed Change

Consulting Firm Name:
Cornwell Engineering Group
712 Gum Rock Court
Newport News, VA 23606

System Address:
AQUA ILLINOIS-UNIVERSITY PARK
1000 S. SCHUYLER AVE.
KANKAKEE, IL 60901

Permit Status: L

Logged Granted Granted After Denial
Denied PFD Denial No Permit Required

Application Received: 7/16/2021

Grant Date: / /

Denial Date: / /

PFD Date: / /

Waiver Date: / /

PFD Addressed: / /

☐ Fee Requirements Met

☑ Fee Exemption

Fee Type	**Pay Amount**	**Check Record Number**	**Payment Received**

IL532-1764-PWS163 (Rev. 8/14/2007)

Illinois EPA FOIA Exemption Reference Sheet

Agency ID: 170001436845 Media File Type: WATER
Bureau ID: W1970720001
Site Name: Aqua Illinois University Park PWS
Site Address1: 24650 S Western Ave
Site Address2:
Site City: University Park State: IL Zip: 60466-

This record has been determined to be partially or wholly exempt from public disclosure

Exemption Type:

Redaction

Exempt Doc #: 16 **Document Date:** 8 /3 /2021 **Staff:** EMI

Document Description: APPLICATION FOR OPERATING PERMIT

Category ID: 03C **Category Description:** PWS PLANT IMPROVEMENT PERMIT **Exempt Type:** Redaction
Permit ID: 0071-FY2022 **Date of Determination:** 11/29/2021

Illinois Environmental Protection Agency

1021 North Grand Avenue East • P.O Box 19276 • Springfield • Illinois • 62794-9276 • (217) 782-3397

Division of Public Water Supplies, Permit Section
Application for Operating Permit

This form may be completed online, a copy saved locally and printed before it is signed. You may also complete a printed copy manually. Submit the completed and signed form to the Illinois EPA, Division of Public Water Supplies, Permit Section at the address listed above

Facility Name: Aqua Illinois - University Park
Facility ID: IL1975030
Address 1: 1000 S Schuyler
Construction Permit No: 0071-FY2022
Address 2:
Permit Type: Plant Improvement
City: Kankakee State: IL Zip Code: 60901
Date Permit Issued: July 30, 2021
County: Will
Project Title: University Park Booster Station - Chemical Feed Change
Firm Name: Cornwell Engineering Group

Project Status: ☒ Final
○ Partial

Partial A, B, C, etc.

Application Requirements (check when complete):

- ☐ Permit Number, Facility Number, and Facility Name identified on the Lab Report(s)
- ☐ Sample results attached to the Application.
  (If a new well was constructed, provide a copy of the sample results as required by Section II, Part g of the C-1 application)

If you select Partial, you must *also* submit the following items:

- ☐ Cover letter describing which sections were completed
- ☐ General project layout plans.
- ☐ For water main projects, identify the length the Partial. ____ LF

Date of Project Completion: 9-2-21 (Provide the date construction was completed on the project or partial)

Certified Operator in Responsible Charge:
Name:
Classification: Class A
Number: 20313918
Telephone: [redacted]
Email (optional): DMDenault@aquaamerica.com

Owner of the Completed Project:
Name: Aqua Illinois - Melissa Kahoun
Title: Compliance Manager
Telephone: 815.614.2032
Address: 1000 S Schuyler Ave
City: Kankakee
State: IL
Zip Code: 60901

The Owner hereby certifies that the project named and described has been constructed in accordance with plans and specifications approved by the Illinois EPA. See instructions for further information. For Verbal Approvals, please call 217-782-1724

Melissa Kah
Owner/Authorized Personnel Signature

9-2-21
Date

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

FOR IEPA USE ONLY

This operating permit 0071-FY2022 issued on AUG 0 3 2021 is valid until revoked.

This permit is valid only for the work completed under the Construction Permit of the same number

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

Cook, David

From: Cook, David
Sent: Tuesday, August 3, 2021 8:07 AM
To: Kahoun, Melissa A
Subject: RE: Application for Operating Permit - University Park
Attachments: 0071-FY2022.pdf

Melissa,

The operating permit is attached.

David Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies
217/782-1724
David.Cook@Illinois.gov

From: Kahoun, Melissa A <MAKahoun@aquaamerica.com>
Sent: Monday, August 2, 2021 5:06 PM
To: Cook, David <DAVID.COOK@Illinois.gov>
Subject: [External] Application for Operating Permit - University Park

David,

Please see the attached Application for Operating Permit for the change in chemical feed for Aqua's University Park Water System – IL1975030. We are hoping to have this approved quickly. I put the original in the mail and had it overnighted to your attention.

Thank you,

Melissa Kahoun
Environmental Compliance Manager
Aqua Illinois and Aqua Indiana, Inc.
1000 S. Schuyler Ave
Kankakee, IL 60901
O: 815.614.2032 M:815.922.5150

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue, East; Post Office Box 19276; Springfield, IL 62794-9276
Division of Public Water Supplies
Telephone 217/782-1724

PUBLIC WATER SUPPLY CONSTRUCTION PERMIT

SUBJECT: AQUA IL – UNIVERSITY PARK (IL1975030)

Permit Issued to:
Aqua Illinois
1000 S. Schuyler
Kankakee, IL 60901

PERMIT NUMBER: 0071-FY2022

DATE ISSUED: July 30, 2021
PERMIT TYPE: Plant Improvement

The issuance of this permit is based on the Application for Construction Permit and supporting documents prepared by the engineers/architects indicated and are identified in the ADDITIONAL CONDITIONS. This permit is issued for the construction and/or installation of the public water supply improvements described, in accordance with the provisions of the "Environmental Protection Act (Act)", Title IV, Sections 14 through 17, and Title X, Sections 39 and 40, and is subject to the conditions printed on the last page of this permit and the ADDITIONAL CONDITIONS listed below.

FIRM: Cornwell Engineering Group
NUMBER OF PLAN SHEETS: na
TITLE OF PLANS: "University Park Booster Station – Chemical Feed Change"

PROPOSED IMPROVEMENTS:

Switch to a zinc orthophosphate corrosion control chemical

ADDITIONAL CONDITIONS:

1. An operating permit is required before feeding zinc orthophosphate. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.300) The issuance of an operating permit 0071-FY2022 for zinc orthophosphate replaces the additional conditions in construction permit 1020-FY2020.

2. The product must be NSF/ANSI 60 approved and contain a 1:10 Zn to PO_4 ratio. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 604.105(g) and Chemical Change Description dated July 15, 2021)

3. Optimal Water Quality Parameter (OWQP) ranges will be set after the community water supply meets the lead action level in two consecutive six-month monitoring periods.The orthophosphate dose and residual shall be a minimum of 3 mg/L as PO_4. The pH range shall be 7.4 to 8.0 at the Central Avenue Booster Station. The zinc range shall be 0.3 - 0.4 mg/L. Notify the Division of Public Water Supplies, Permit Section staff if results are outside of these ranges in two consecutive weeks of water quality monitoring. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 611.351(e) and the Chemical Change Description dated July 15, 2021)

4. Water quality monitoring must be conducted for the Aqua Illinois - University Park community water supply as described below and results submitted for each month to david.cook@illinois.gov within 10 days after the last day of the month. The submissions must include all water quality parameter monitoring done during the month including any monitoring not mentioned here.

The minimum water quality monitoring parameters, locations, and frequencies are as described in the Chemical Change Description dated July 15, 2021. The Chemical Change Description includes daily monitoring for flow and orthophosphate at the Central Avenue Booster Pump Station and weekly monitoring at nine locations for free chlorine, total chlorine, monochloramine, free ammonia, orthophosphate, pH, and alkalinity. In addition, weekly monitoring at nine locations is required for chloride, sulfate, CSMR (calculated value), nitrite, nitrate, iron, manganese, zinc, and Total Organic Carbon (TOC).

Any water quality parameter monitoring conducted must be reported in a spreadsheet. The data are needed to set Optimal Water Quality Parameter (OWQP) ranges. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 604.140, 611.352(f) and the Chemical Change Description dated July 15, 2021)

5. Water quality monitoring must be conducted for the Aqua Illinois - Kankakee entry point to the distribution system as described below and results submitted to david.cook@illinois.gov within 10 days after the last day of the month. The submissions shall be limited to these parameters at this location: pH, alkalinity, chloride, sulfate, CSMR (calculated), nitrite, nitrate, and TOC. The specified water quality parameters that are monitored must be reported in a spreadsheet. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114 and 611.352(f))

6. Collect between 40 and 60 lead compliance samples from approved individual sample site locations each month beginning 30 days after the issuance of the operating permit for this project. Consideration should be given based upon highest past lead results and geographic representation. Consideration should also be given to sampling when CSMR and nitrate results are the highest for the month, typically following rain events. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 601.101, 611.352(f) and the Chemical Change Description dated July 15, 2021)

7. The permit approval is for the Application, Schedule D, and the Chemical Change Description sealed by David Cornwell, PhD, P.E. that were received on July 16, 2021. The Aqua University Park Technical Response Team PowerPoint® presentation dated July 14, 2021and the University Park Nitrate Experiments presentation dated July 14, 2021 were also reviewed.

cc: Cornwell Engineering Group
DPWS/FOS – Elgin Regional Office
DWPC/Permit Section
DWPC/Standards Section

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The Illinois Environmental Protection Agency Act (415 ILCS 5/39) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

These standard conditions shall apply to all permits which the Agency issues for construction or development projects which require permits under the Division of Water Pollution Control, Air Pollution Control, Public Water Supplies and Land Pollution Control. Special conditions may also be imposed by the separate divisions in addition to these standard conditions.

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire one year after this date of issuance unless construction or development on this project has started on or prior to that date.

2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted the Illinois Pollution Control Board.

3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.

4. The permittee shall allow any agent duly authorized by the Agency upon the presentation of credentials:

   a. to enter at reasonable times the permittee's premises where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit.

   b. to have access to and copy at reasonable times any records required be kept under the terms and conditions of this permit.

   c. to inspect at reasonable times, including during any hours or operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit.

   d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants.

   e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.

5. The issuance of this permit:

   a. shall not be considered as in any manner affecting the title of the permits upon which the permitted facilities are to be located;

   b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;

   c. does not release the permittee from compliance with the other applicable statues and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;

   d. does not take into consideration or attest to the structural stability of any units or parts of the project;

   e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability directly or indirectly for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.

6. These standard conditions shall prevail unless modified by special conditions.

7. The Agency may file a complaint with the Board for modification, suspension or revocation of a permit:

   a. upon discovery that the permit application misrepresentation or false statements or that all relevant facts were not disclosed; or

   b. upon finding that any standard or special conditions have been violated; or

   c. upon any violation of the Environmental Protection Act or any Rules or Regulation effective thereunder as a result of the construction or development authorized by this permit.

Operating Permit Review Sheet

Permit No.: 0071-FY2022 **Today's date:** 8/3/2021

Facility: AQUA ILLINOIS - UNIVERSITY PARK, IL1975030

1. **Project type:** W.M. [✓ P.I.] W.M.E. & P.I.
   a. [✓ Final] or Partial WM: ____
   If partial,
      i. Section ____ Length of Partial: ____
      ii. Submitted map clearly showing portion covered by the partial project(*) ____
   b. Special Requirements ~~R~~ ✓
2. **Project specifications:**
   a. Project completion date indicated is after the construction permit issue date ✓
   b. Correct certified operator ✓ Correct certification class ✓ (for plant improvements)
   c. Correct owner signature ✓ ~~Original owner signature~~ ____
3. **Water Main Replacement:** NA
   a. Lead notification condition on construction permit ____
      i. Box will be checked on General info tab of permit database
      ii. Applies to water main replacement construction permits issued after May 1, 2016
   b. Verification made to Agency that notification made ____
      i. Warning about lead containing sediment ____
      ii. Tips on not consuming lead "contaminated" water: flushing, clean faucet aerator ____
      iii. Dangers of lead and children ____
4. **Lab Report:** NA
   a. Facility name listed ____ Facility # listed ____ Permit # listed ____
   b. Sampling Method: MF MT COLILERT
   c. Specific bacteriological report requirements
      i. site(s) ____ sample(s) each ____ sufficient Cl_2 residual ____
      24 hours apart ____ no disinfection required ____
      ii. location of each sample shown on submitted map(*) ____
5. **Verbal Authorization** (if applicable):
   a. **NAME (initials) OF PERSON PROVIDING AUTHORIZATION** Du
   b. **DATE OF VERBAL AUTHORIZATION** 8/3/2021

NOTES:

University Park Technical Update

October 29, 2021

Agenda

- Switch to zinc ortho 8/3
- Sample result review
- Virginia Tech. Dr. Marc Edwards experiments
    - Coupons
    - Harvested pipe

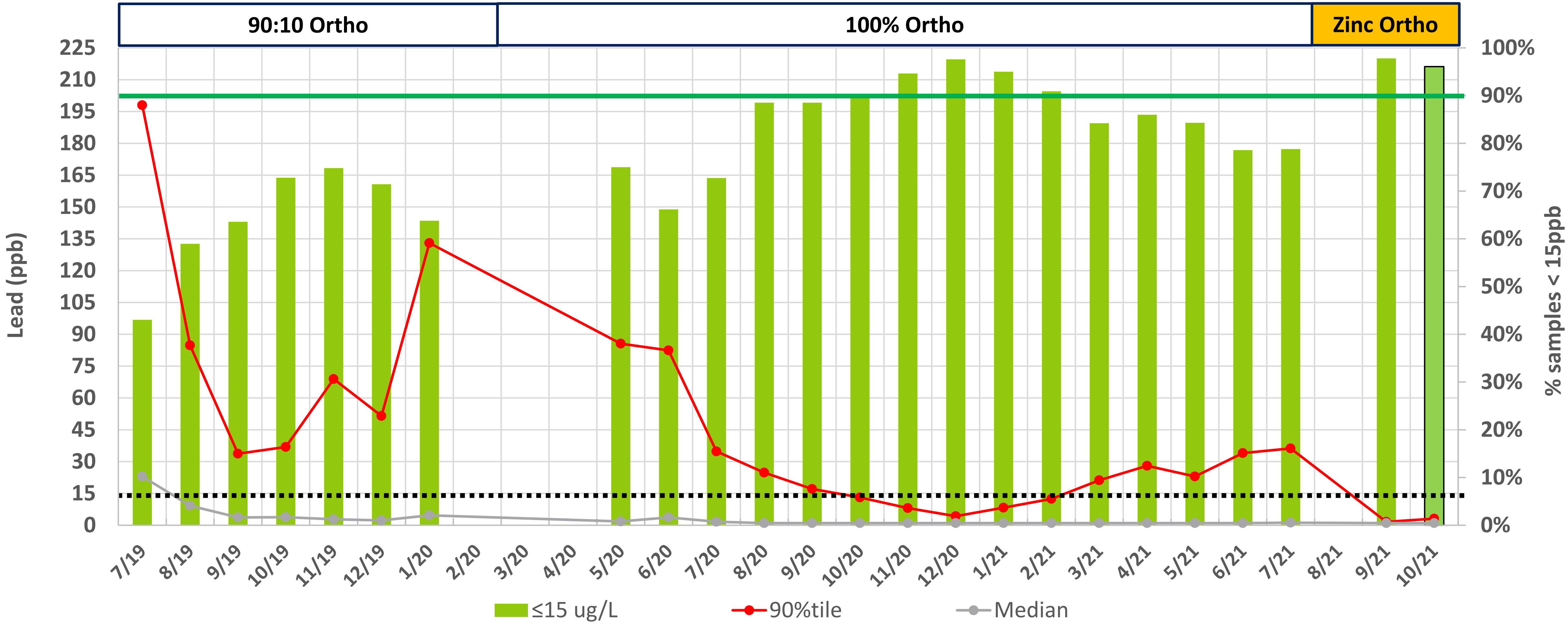
Zinc Orthophosphate

- Zinc Orthophosphate added on 8/3/21
- Product - CP 330S (zinc sulfate and orthophosphoric acid)
- Target - 3 mg/L Ortho, 0.3 mg/L Zinc

University Park
Lead Data Trends

Summary of Progress

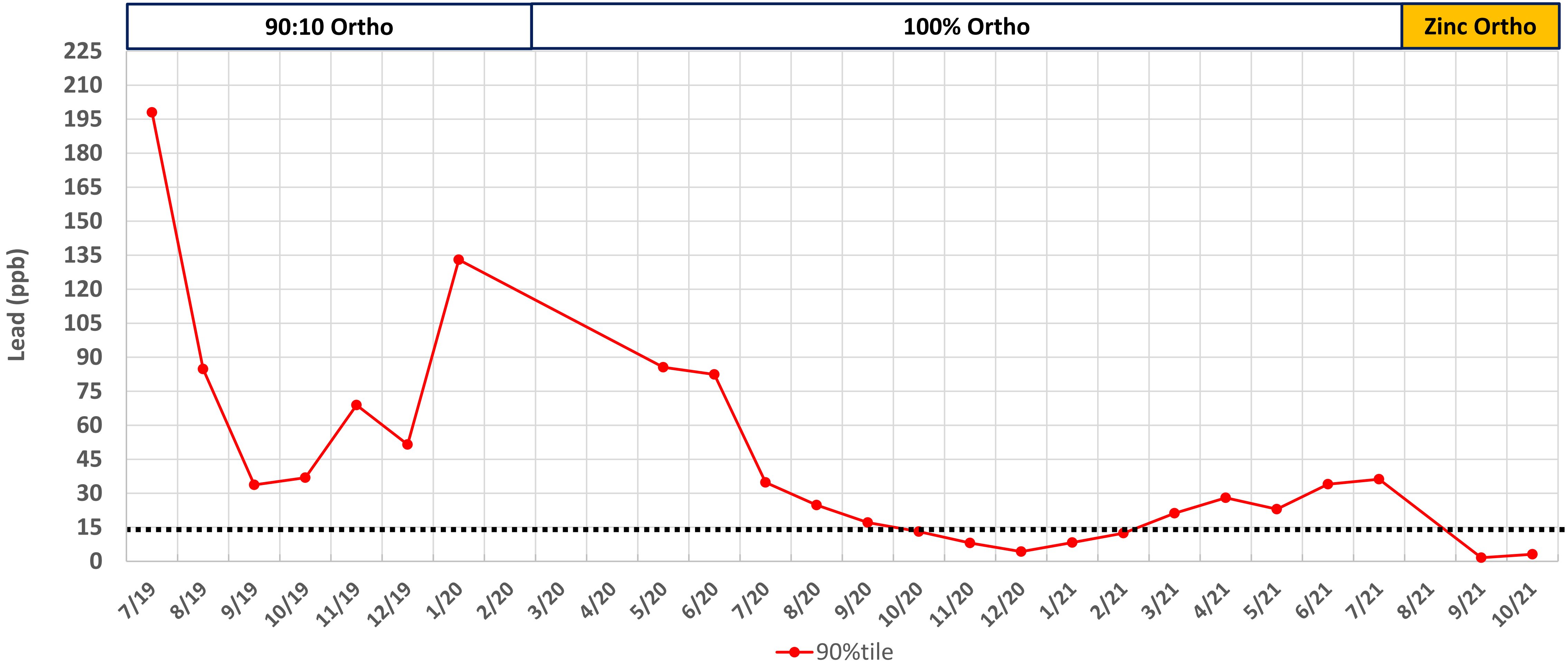
September and October results were best two month stretch to date, 2021 better than Sept/Oct in 2020.



CONFIDENTIAL/CONTAINS SENSITIVE INFORMATION AND PRELIMINARY DATA UNDER REVIEW

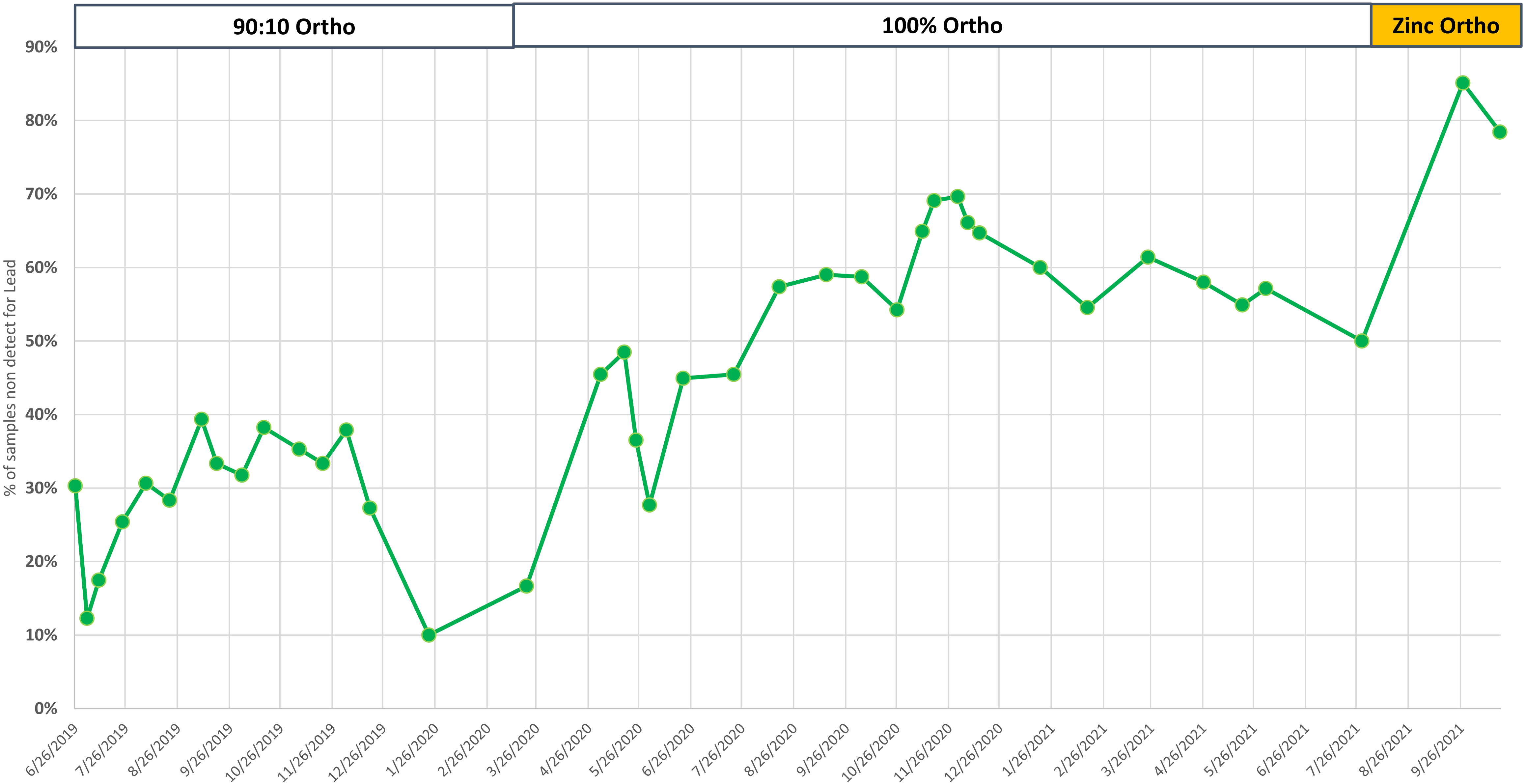
Summary of Progress

September and October results were best two month stretch to date, 2021 better than Sept/Oct in 2020.

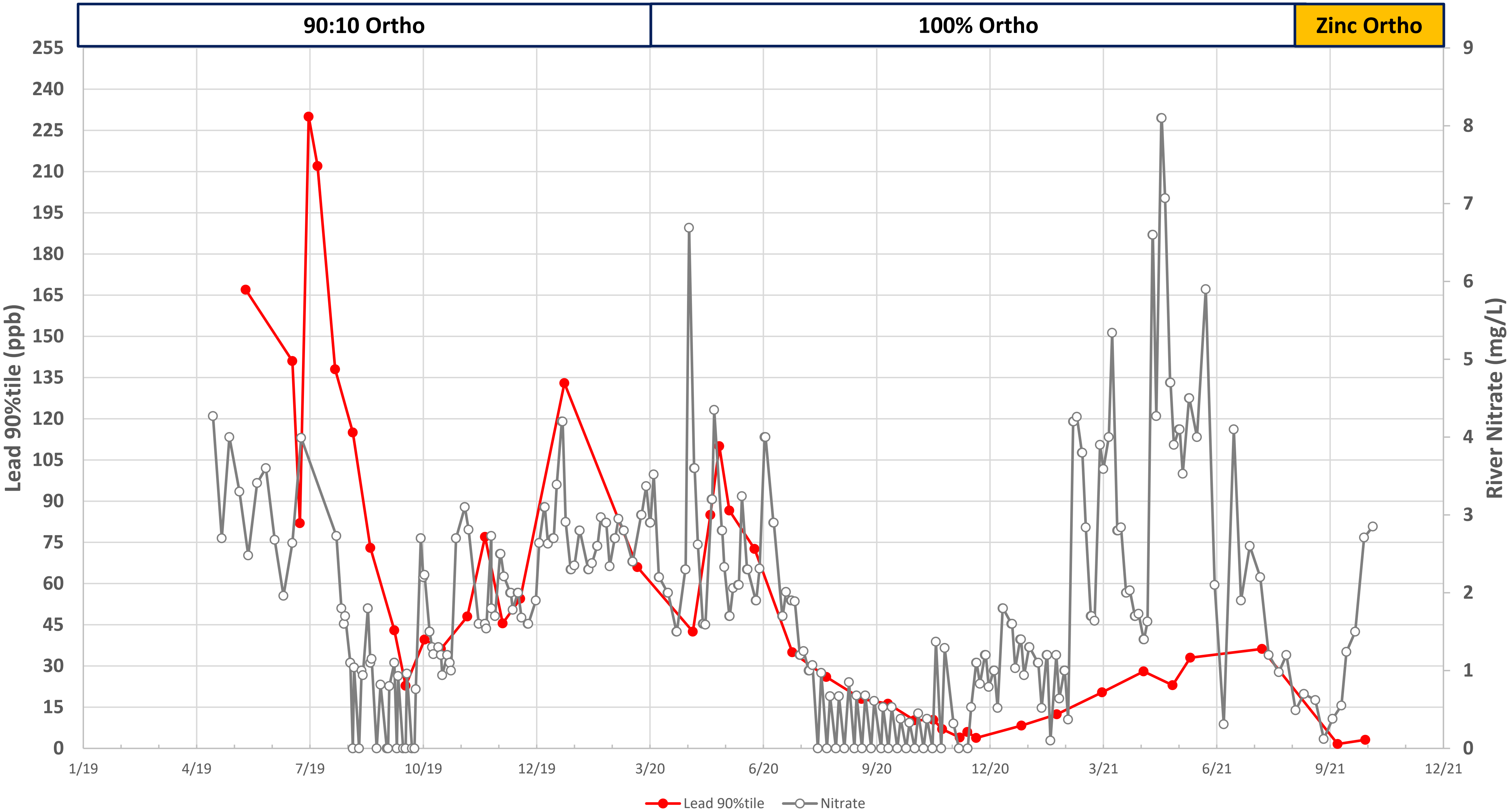


CONFIDENTIAL/CONTAINS SENSITIVE INFORMATION AND PRELIMINARY DATA UNDER REVIEW

Number of Non-Detect Samples Increasing



River Nitrate vs. Lead 90%tile



CONFIDENTIAL PRELIMINARY INFORMATION

Edwards Experiments

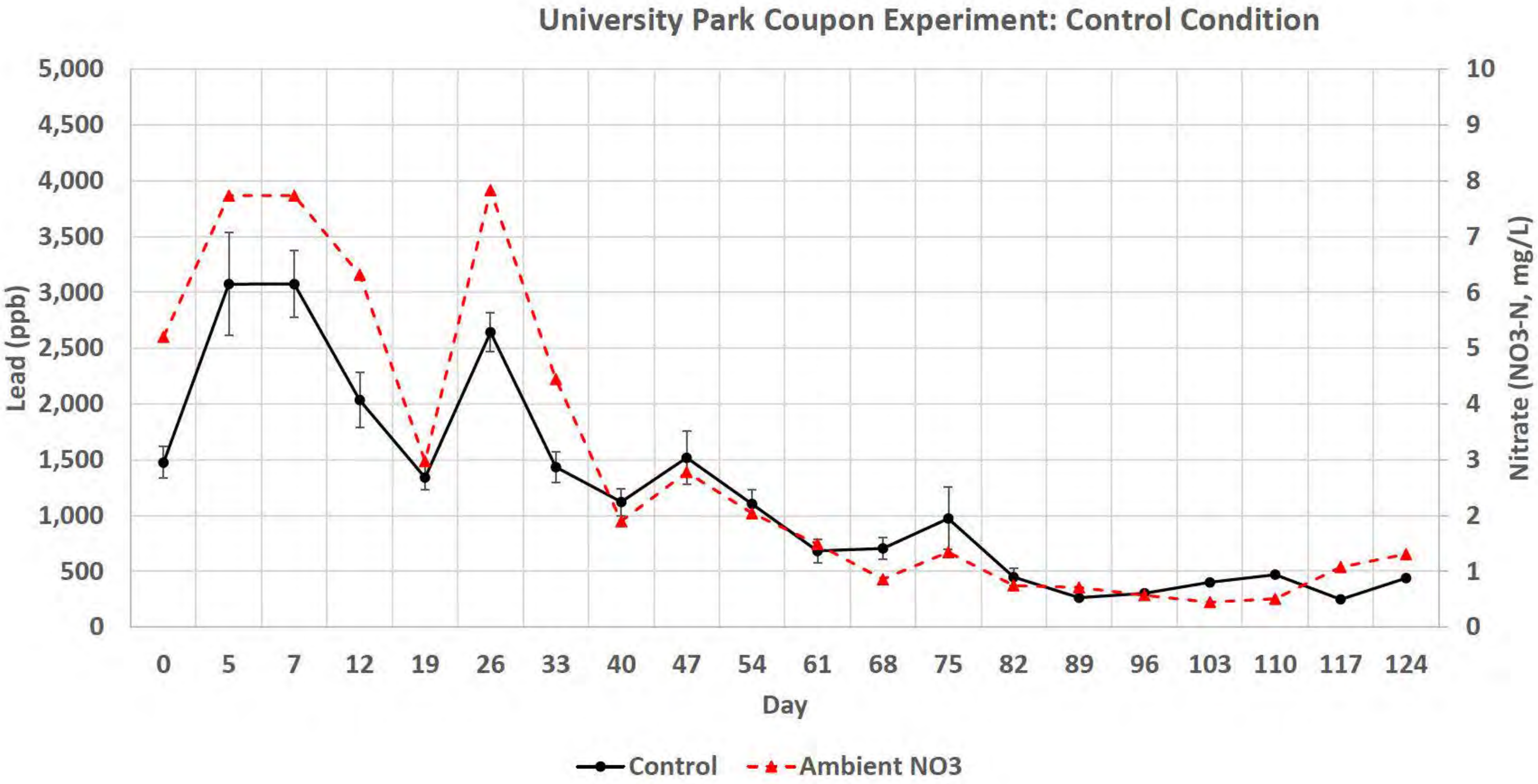
University Park Experiment Updates

10/29/21

Coupon Study

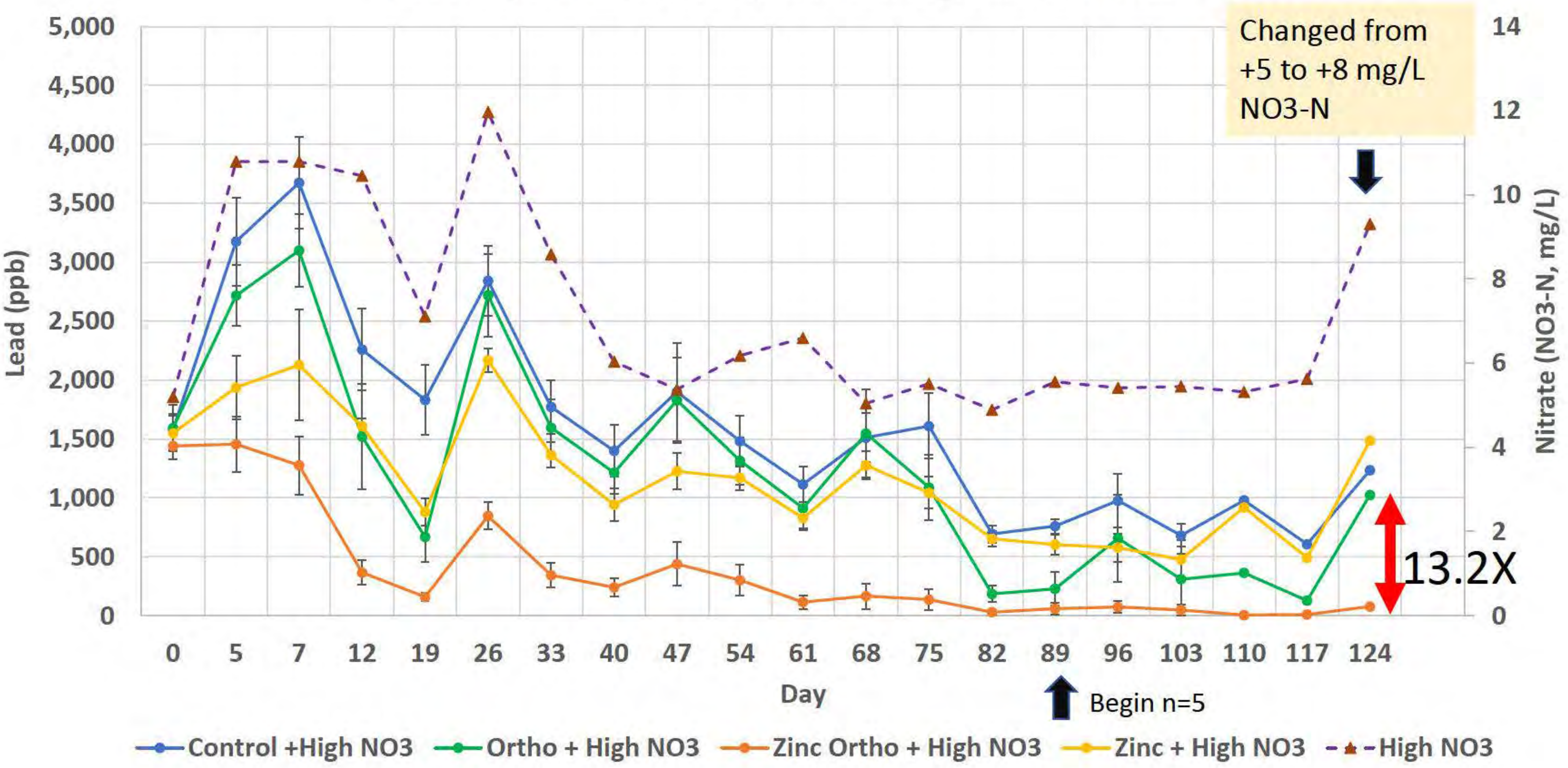
- New copper coupons with 50:50 lead-tin solder
- Conditioning: 1 week groundwater, 1 week Kankakee water
- Phase 1: 6 conditions (n=15)

Water Conditions	Phosphate	Zinc	NO3	NO2
Control				
High NO3			+5 mg/L NO3-N	
Ortho + High NO3	1 mg/L P		+5 mg/L NO3-N	
Zinc Ortho + High NO3	1 mg/L P	0.33 mg/L	+5 mg/L NO3-N	
Zinc + High NO3		0.33 mg/L	+5 mg/L NO3-N	
NO2 + High NO3			+5 mg/L NO3-N	0.5 mg/L NO2-N



Error bars represent 95% CI, composite samples after day 103

University Park Coupon Experiment: High Nitrate Conditions



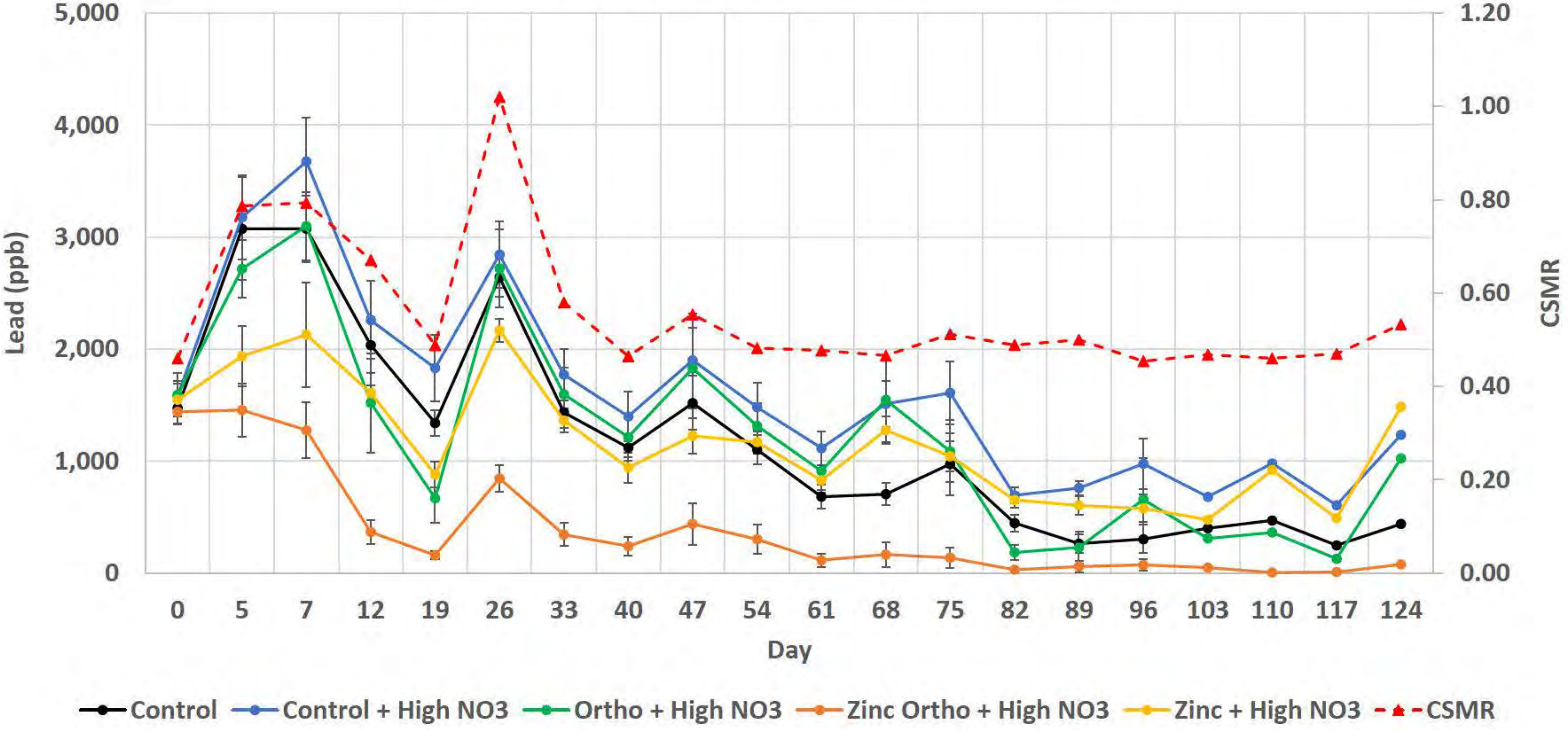
Changed from +5 to +8 mg/L NO3-N

13.2X

Begin n=5

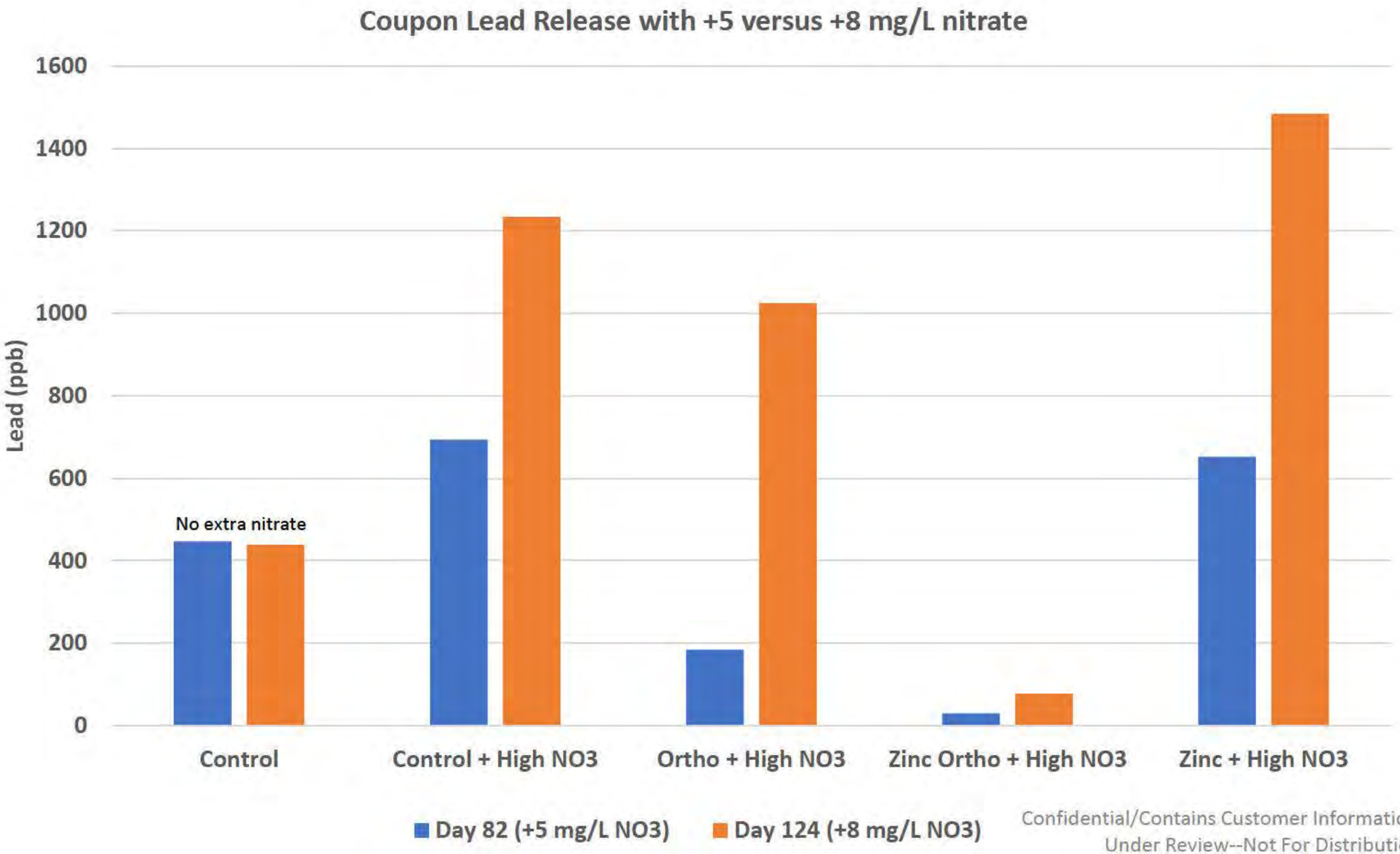
Error bars represent 95% CI, composite samples after day 103

University Park Coupon Experiment: CSMR Effect



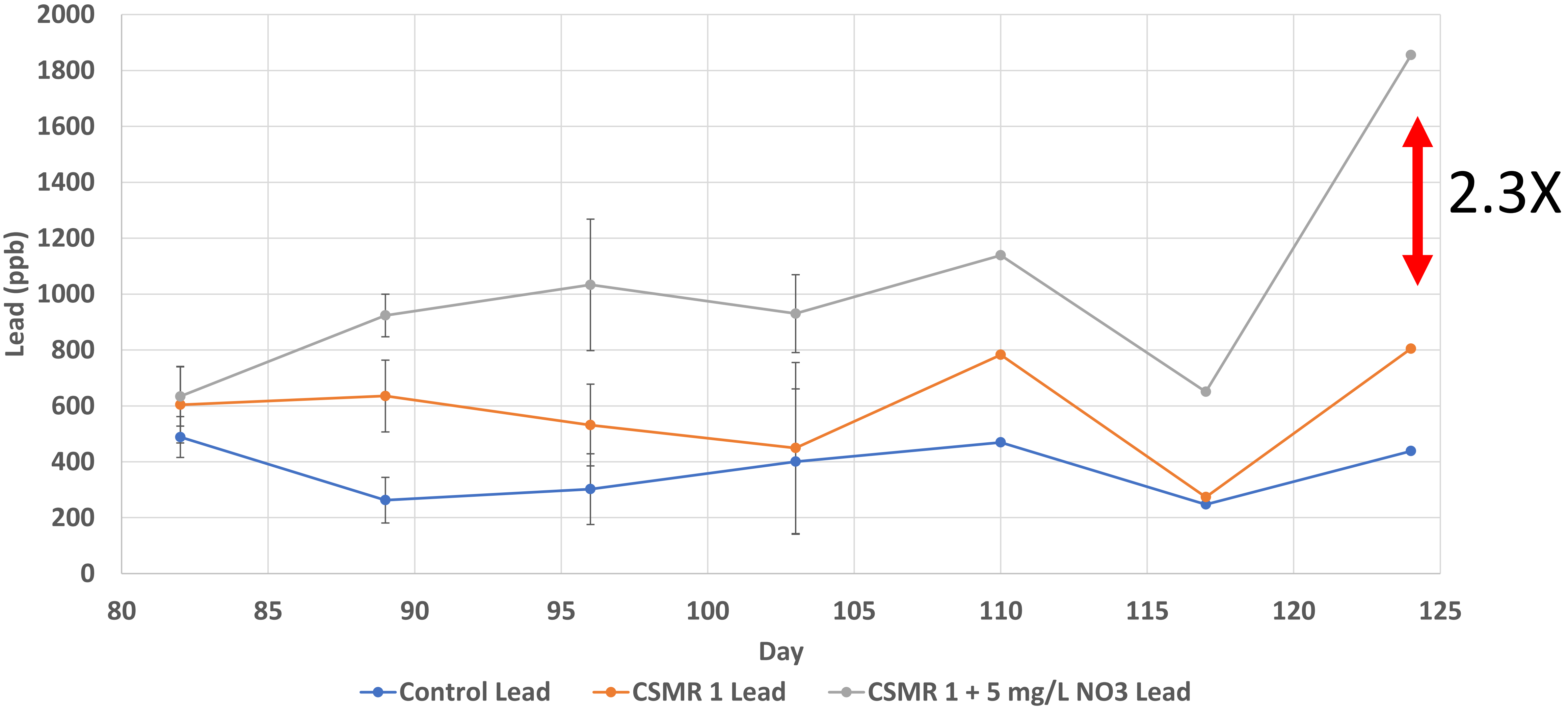
Error bars represent 95% CI, composite samples after day 103

Confidential/Contains Customer Information and Data Under Review--Not For Distribution



Coupon Lead Release with +5 versus +8 mg/L nitrate

Effect of higher CSMR alone (higher Cl-) versus higher CSMR + nitrate



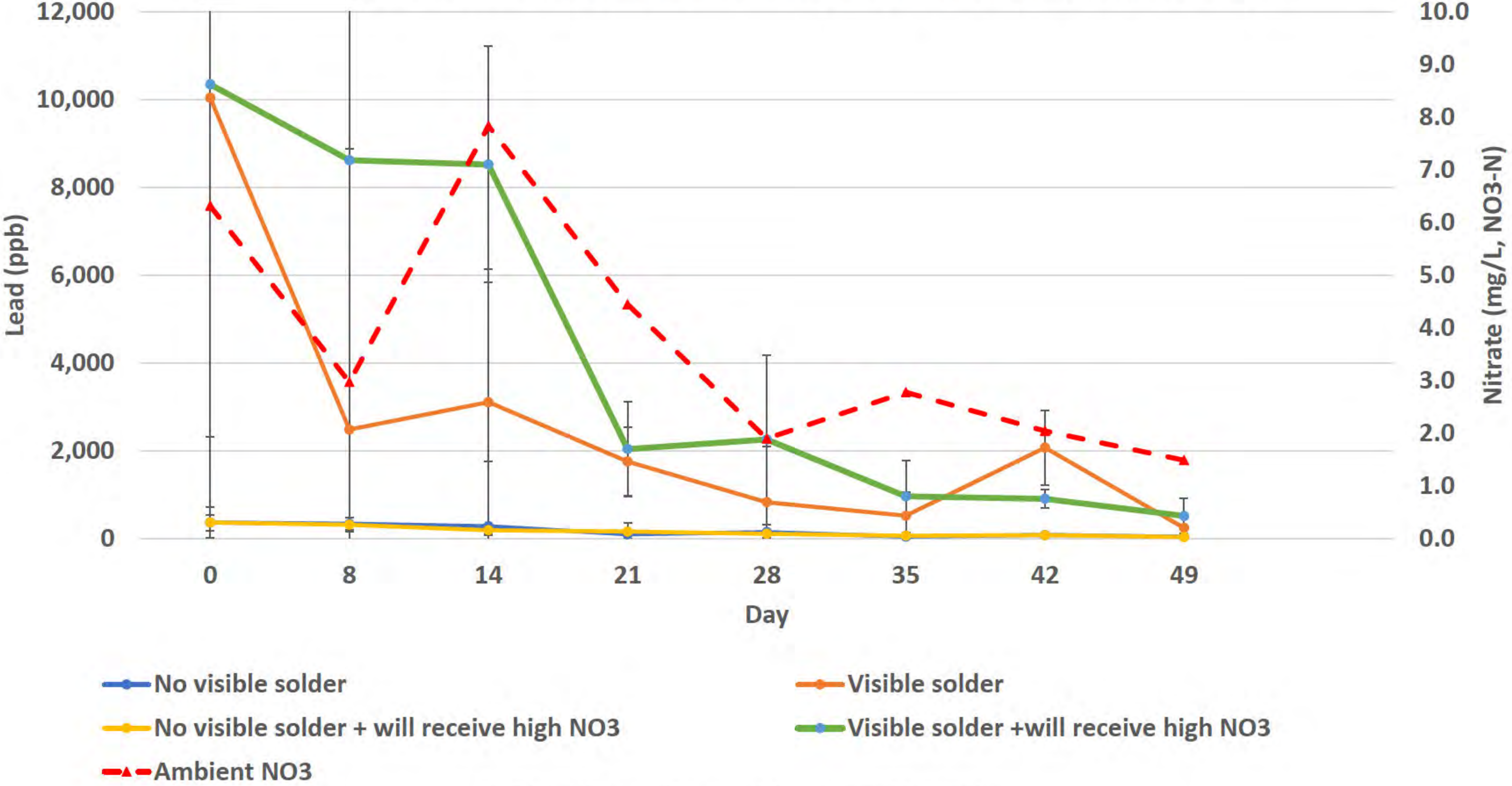
Error bars represent 95% CI, composite samples after day 103

[redacted] Pipes

- 13 harvested copper pipes split into 2 groups:
  - No visible lead solder (n=8)
  - Visible lead solder (n=5)
- Conditioned with Kankakee water + 1 mg/L as P orthophosphate
- Phase 1: no nitrate
- Phase 2: subset with and without solder received nitrate, one solder pipe receiving zinc ortho
- Dump + fill 3x week (48-72 hr stagnation)

redacted

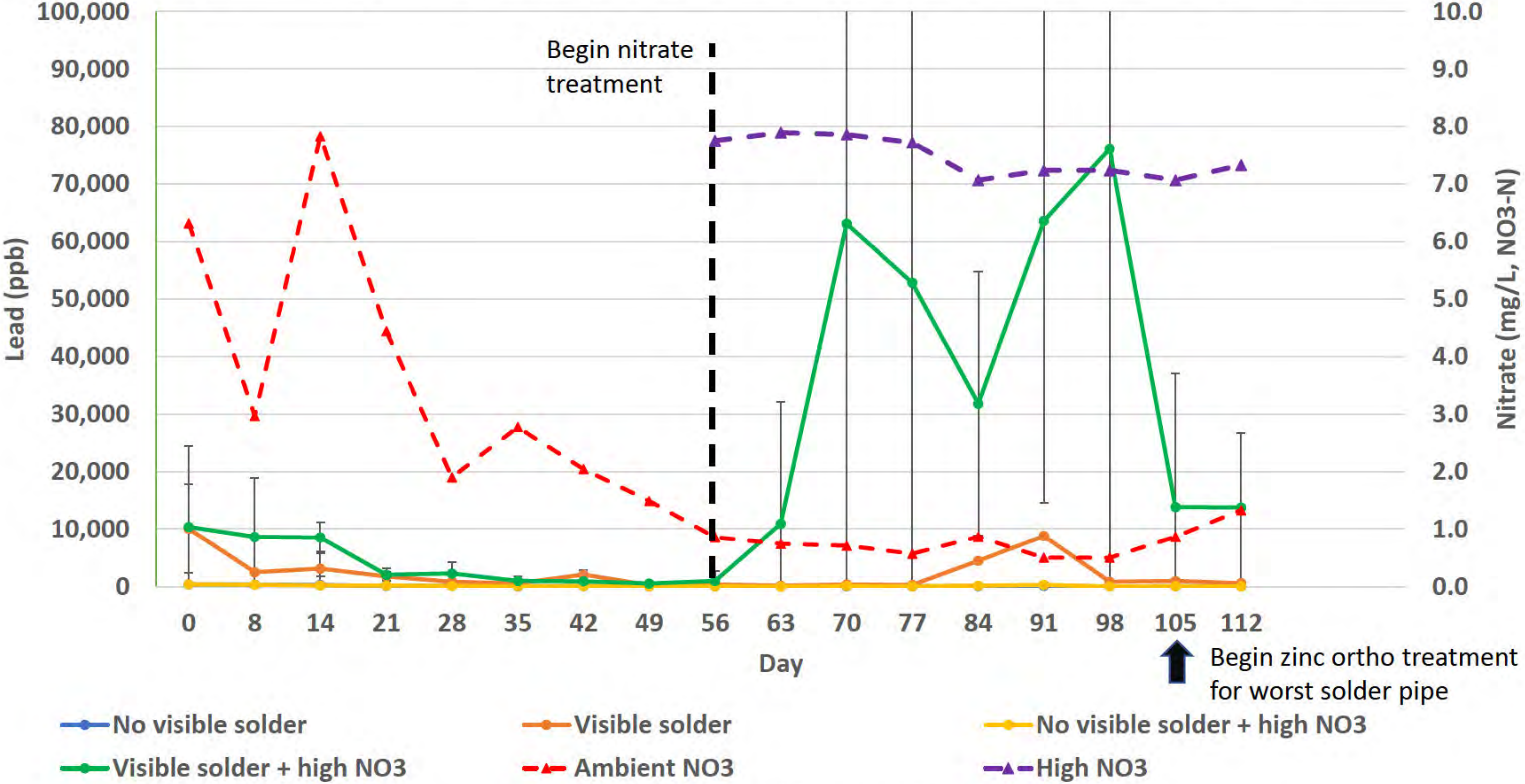
[redacted] Residence Pipes Phase 1: Recovery + 1 mg/L orthophosphate as P



Error bars represent 95% CI

redacted

[redacted] Residence Pipes Phase 2: High nitrate + orthophosphate 1 mg/L as P



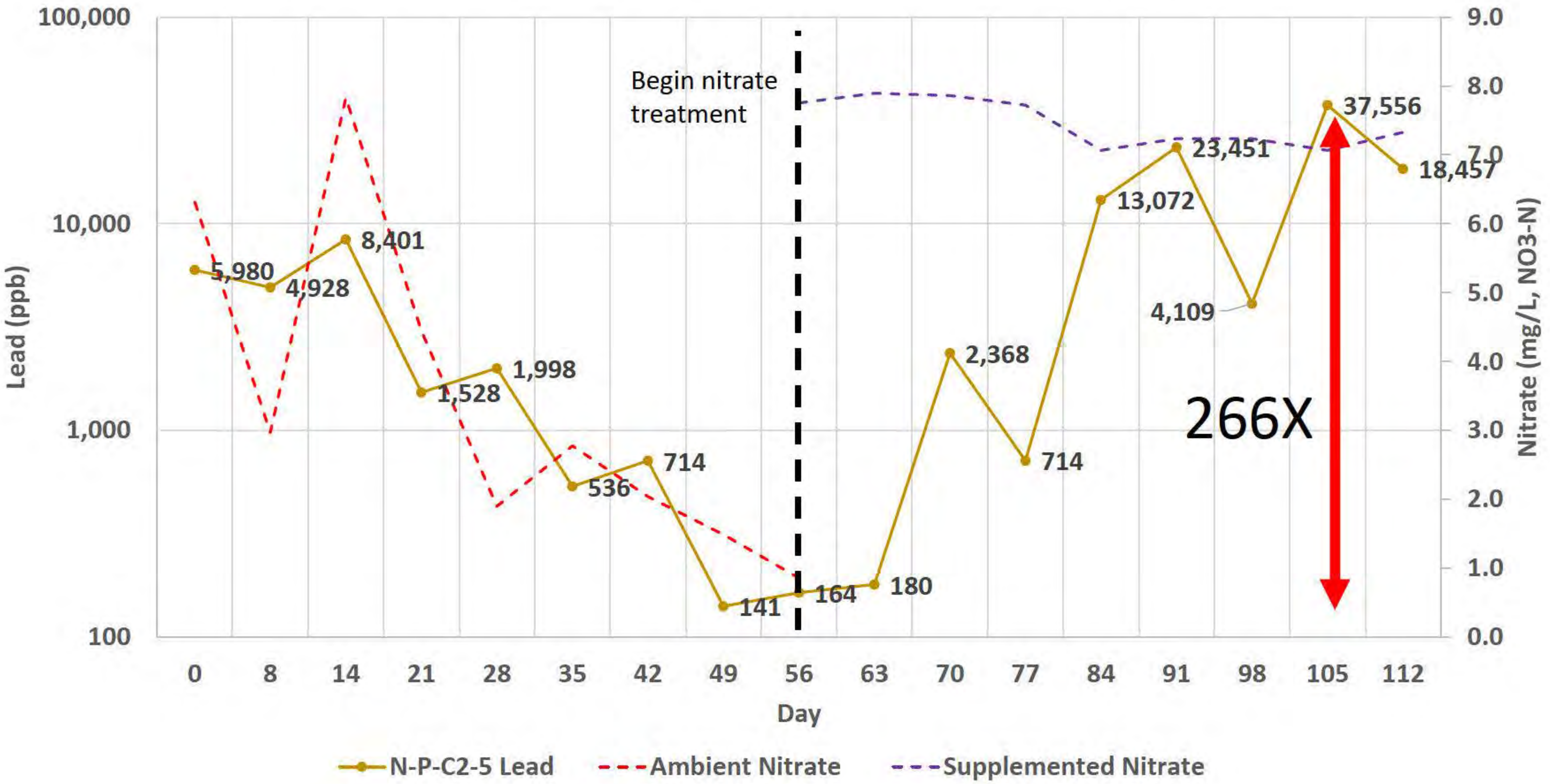
Begin nitrate treatment

Begin zinc ortho treatment for worst solder pipe

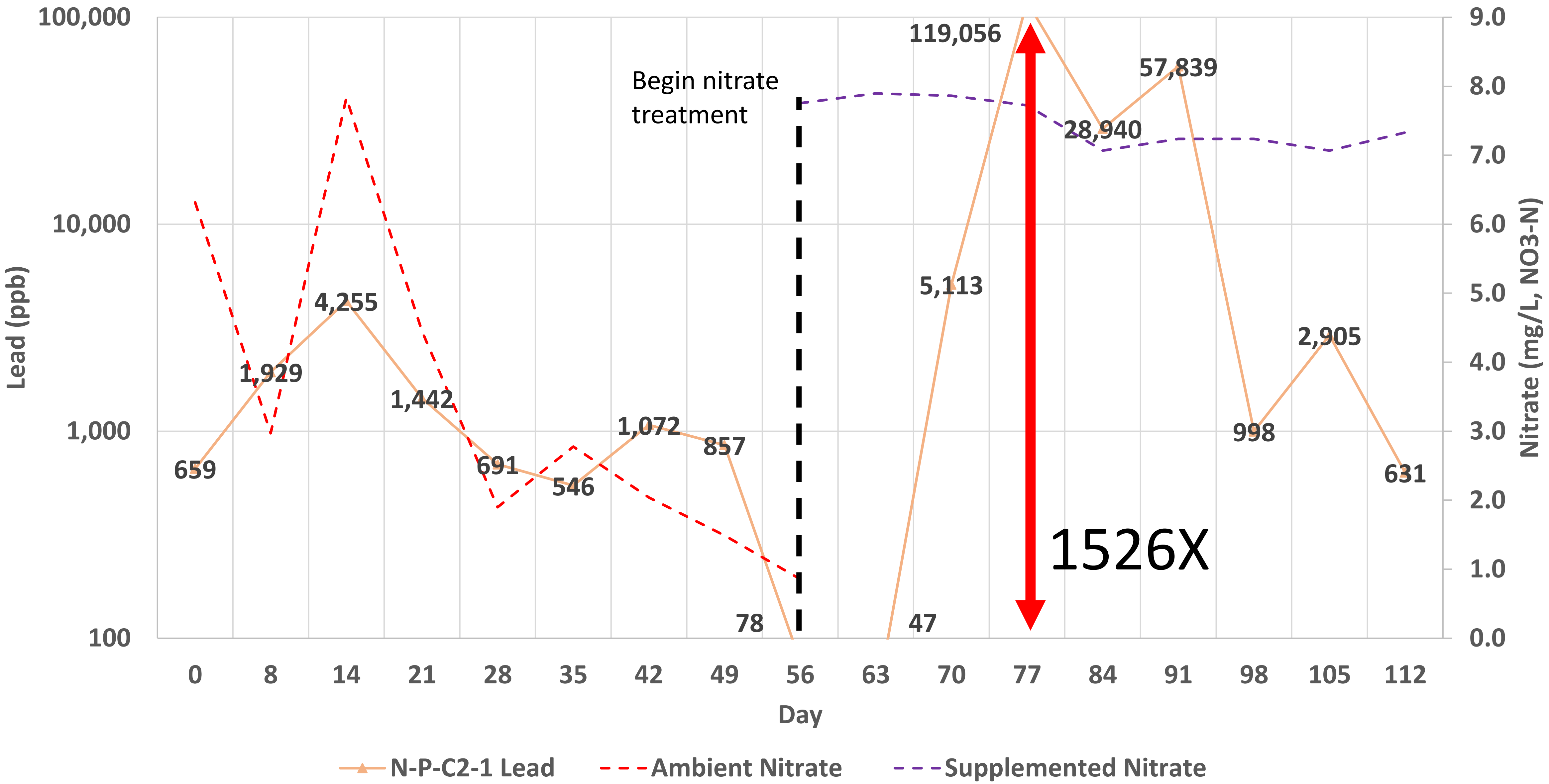
Error bars represent 95% CI

A closer look at lead release from the three pipes with visible exterior solder and high nitrate:

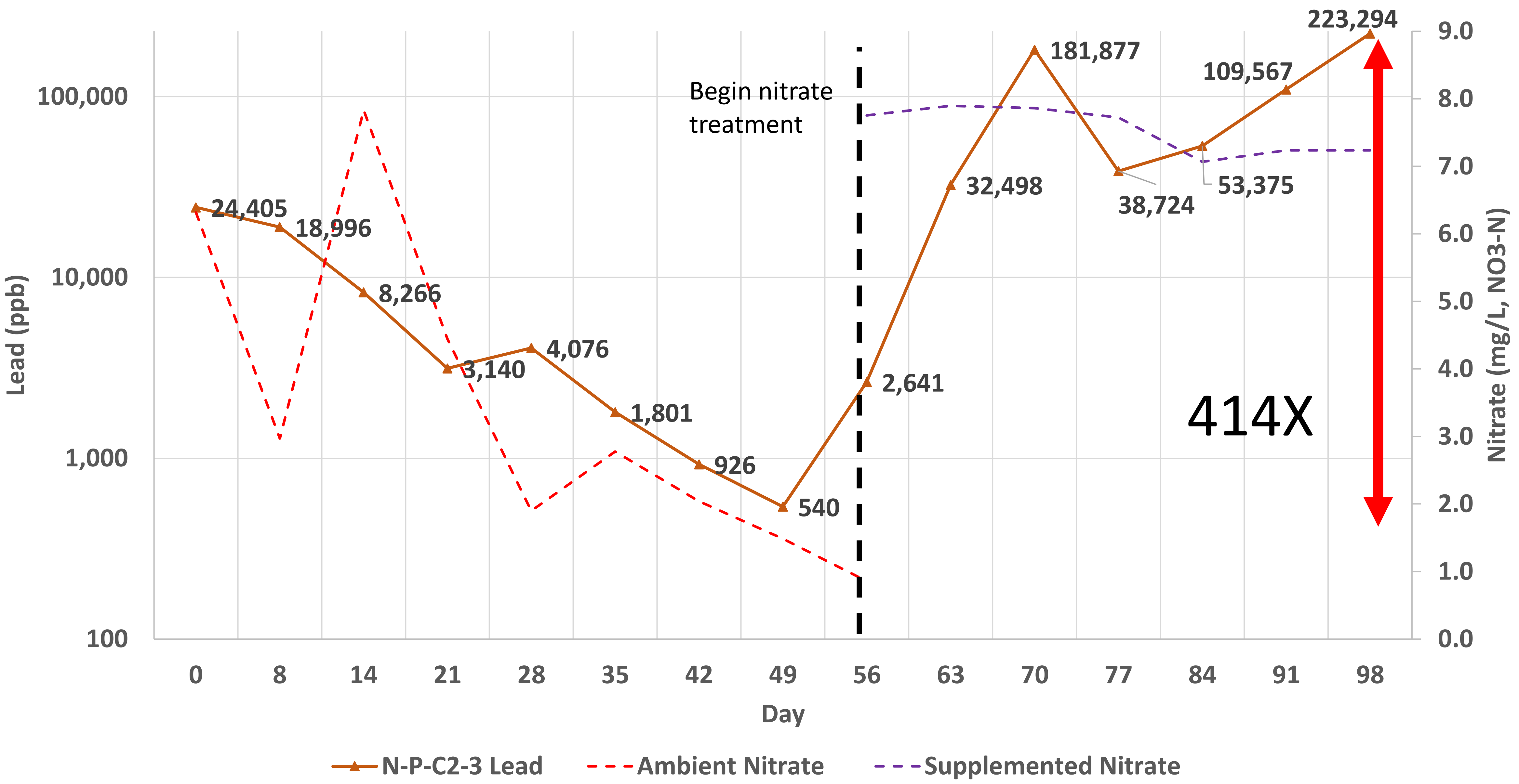
Solder Pipe #1: Receiving 1 mg/L orthophosphate as P and extra nitrate



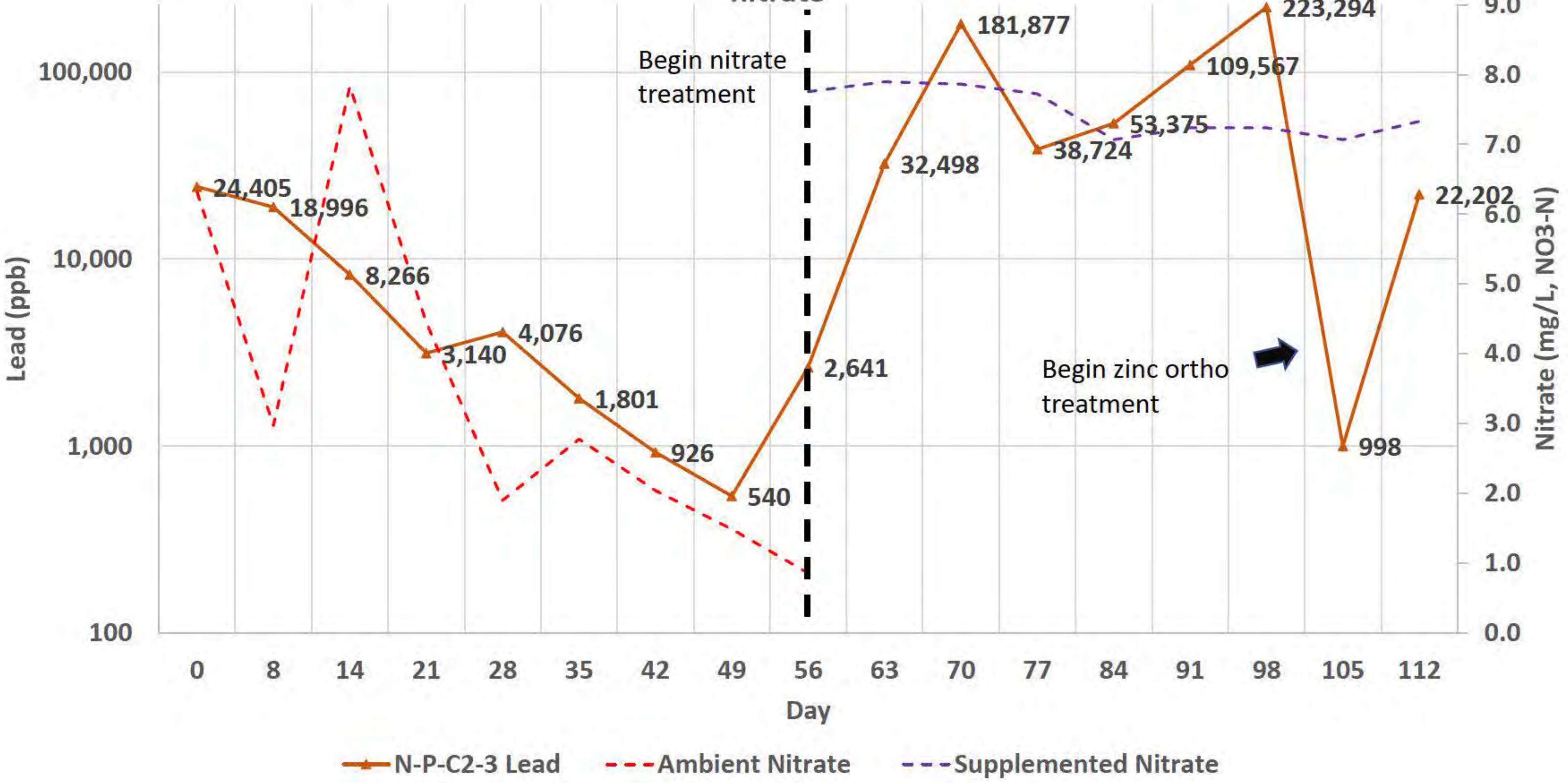
Solder Pipe #2: Receiving 1 mg/L orthophosphate as P and extra nitrate



Solder Pipe #3: Receiving orthophosphate 1 mg/L as P and extra nitrate



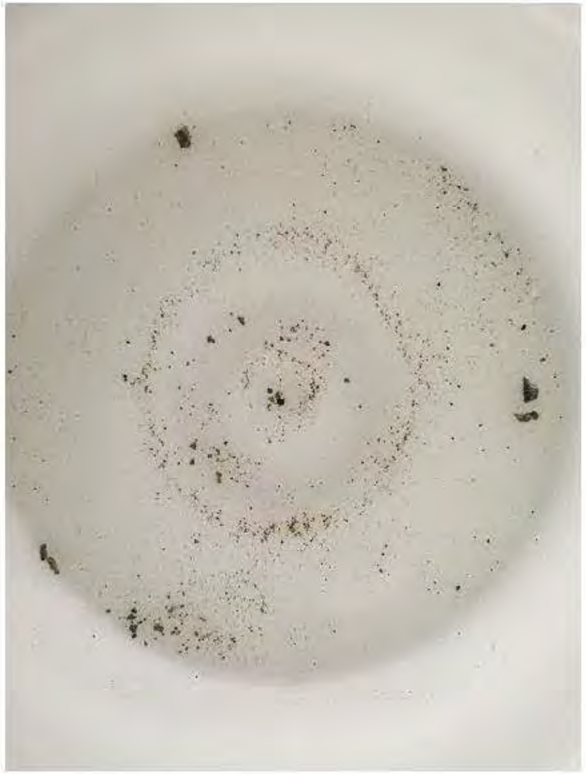
Solder Pipe #3: Receiving zinc orthophosphate 1 mg/L as P + 0.33 mg/L Zn and extra nitrate



Nitrate triggered the release of large, dark particles from pipes with solder (similar to what we have been finding in UP aerators)

8/16/21
Before extra nitrate treatment

8/30/21
2 weeks after extra nitrate treatment



10/3/21
7 weeks after extra nitrate treatment

Particle Composition

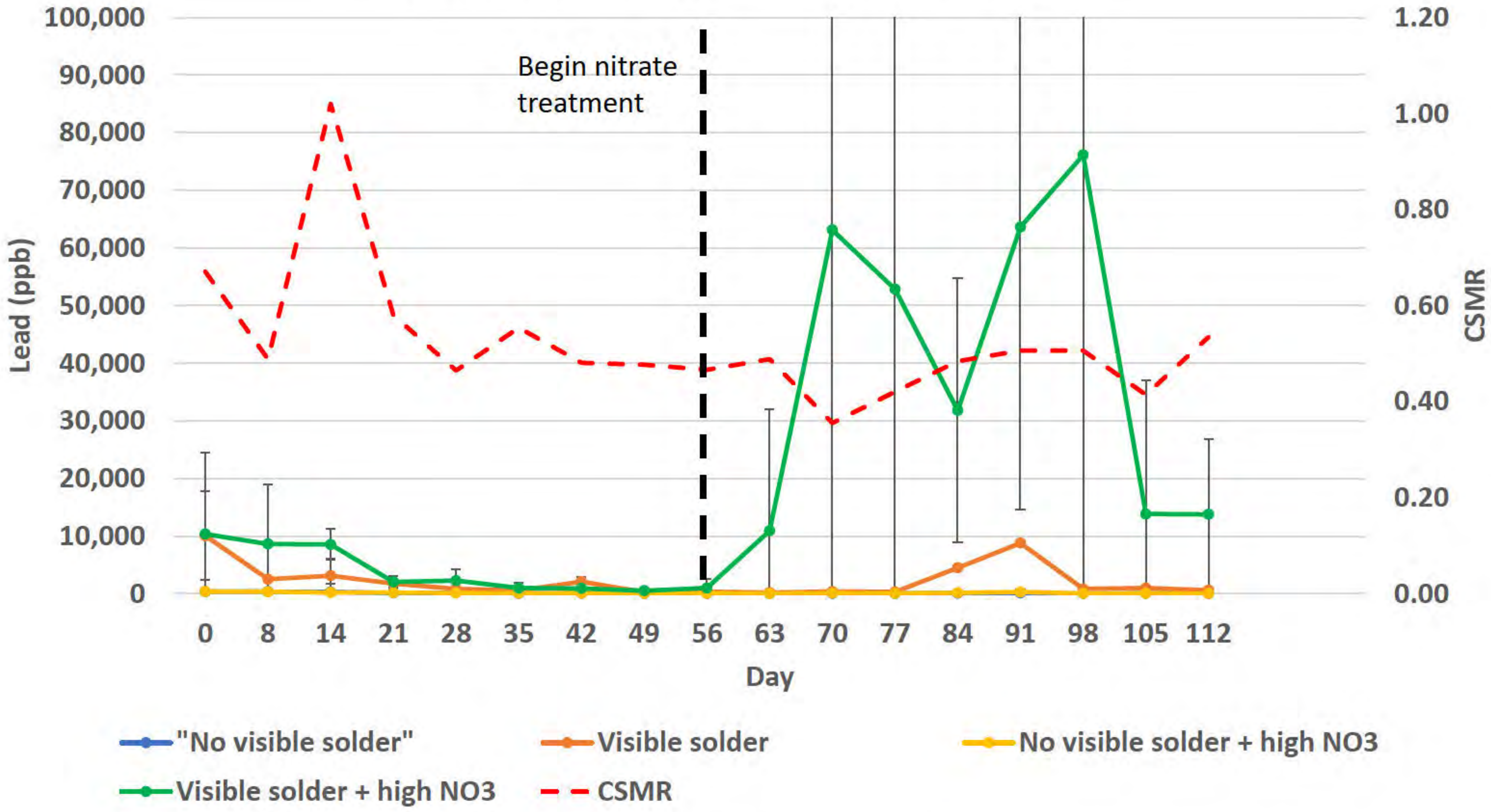
- Largest particle was ~7 mm
- 3.8:1 Pb:Sn (ICP-MS)
    - That one particle contributed 83% of the lead for that pipe that week

Conclusions

- Coupons ("new pipe") and harvested pipe with lead solder have higher water lead when nitrate is higher
- Nitrate only affects pipes with visible lead solder on the outside, and not normal scales on pipes without visible solder on the outside
- Nitrate effect is much worse for some harvested pipes than for newer coupons
    - New mechanism of solder attack that causes very large particles to detach
- Zinc orthophosphate continues to show promise as a superior inhibitor of this type of attack based on data for relatively new pipes

Redacted

Effect of CSMR on [redacted] Residence Pipes



FINAL OPTIMAL CORROSION CONTROL TREATMENT REPORT

AQUA - UNIVERSITY PARK SYSTEM
(PWSID IL1975030)

JANUARY 27, 2022

AQUA ILLINOIS

1000 S. Schuyler Avenue, Kankakee, IL 60901

TABLE OF CONTENTS

January 27, 2022

Aqua Illinois – University Park

Addendum to OCCT Report

Subject: Optimal Corrosion Control Treatment Studies and Recommendations for Aqua - University Park System

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1. NOVEMBER 2019 OCCT SUMMARY

In November 2019, consistent with the November 2019 Interim Agreed Order and the applicable PWS regulations, including specifically, 35 Il. Adm. Code 611.352, Aqua Illinois (Aqua IL) submitted to the Illinois Environmental Protection Agency (ILEPA) information proposing corrosion control treatment (CCT) for University Park (PWSID IL1975030). The submitted information for University Park (UP) included:

"Corrosion Control Study Report" – summary of water quality, desktop studies, scale analysis of harvested pipe from UP, and laboratory solubility studies with: a) lead coupons, b) harvested copper pipe with lead solder, c) new copper pipe with lead solder.

ILEPA form "OCCT Evaluation of Treatment Alternatives", including associated ILEPA form 141-C and an UP schematic.

The solubility studies presented in the November 2019 report were performed by the Cornwell Engineering Group and Dr. Marc Edwards from Virginia Tech University. The testing was performed at a pH range from 8.1 to 8.4 and including the testing of the following corrosion control products: orthophosphate from phosphoric acid (H_3PO_4); zinc orthophosphate (ZOP); and a 90/10 blended phosphate from Hawkins, Inc. (Roseville, MN). The latter is a blended phosphate containing 90 percent sodium orthophosphate (NaH_2PO_4) and sodium polyphosphate.

The recommendation based on findings from the desktop, scale analysis, and solubility studies was to add orthophosphate at UP at a dose >3 mg/L as PO_4 (>1 mg/L as P). The ZOP and H_3PO_4 performed similar or better than the 90/10 blended phosphate tested, so based on the findings of the solubility studies it would have been equivalent to choose any of the products tested, as long as the dose was ≥ 3 mg/L as PO_4. Since polyphosphate had always been present in the UP distribution system in the past, the 90/10 blended phosphate product tested was selected. The UP system started feeding the 90/10 blended phosphate in June 2019 and continued until April 16, 2020.

2. JULY 2020 OCCT ADDENDUM SUMMARY

In July 2020, again consistent with the November 2019 Interim Agreed Order and the applicable PWS regulations, including specifically, 35 Il. Adm. Code 611.352, Aqua IL submitted to the ILEPA an Addendum to the OCCT report dated November 2019 and proposed a change of the corrosion control treatment chemical for the University Park system from 90/10 blended phosphate to phosphoric acid, H_3PO_4, to achieve the optimal pH range expected for lead solubility control with orthophosphate, 7.2-8.0, while continuing to target a residual of >3 mg/L as PO_4 using H_3PO_4. This recommendation was based on results from studies conducted by Mike Shock of USEPA ORD on the relationship between pH and orthophosphate dose for lead reduction (Shock 1999) and the relatively elevated pH observed during 2020 Spring in University Park. The higher pH in treated water from Kankakee WTP in colder water potentially creates treated water pH conditions that are not optimal when the 90/10 blended phosphate is used because the orthophosphate component of this product does not decrease the pH much. The UP system started feeding phosphoric acid on April 17, 2020 and continued until August 3, 2021.

The OCCT Addendum dated July 2020 and the OCCT dated November 2019 are attached as **Appendix A** of this report.

3. ZINC ORTHOPHOSPHATE

In July 2021, Aqua IL submitted a permit application requesting a corrosion control treatment chemical change from phosphoric acid to zinc orthophosphate with targeted pH range and orthophosphate dose unchanged. The permit was approved by ILEPA and the UP system started feeding ZOP on August 3, 2021. The product is CP 330S from Sterling Water Technologies, LLC (Columbia, TN), which is described as a “1:10 Zn to PO4 ratio” product, containing 34 to 36 percent orthophosphate as PO4 (11.1 to 11.7 percent as P) and 2.5 to 4.0 percent zinc (Zn).

ZOP is widely used as a corrosion inhibitor in the US. The composition of this class ranges from about 5 percent to 30 percent zinc and the weight ratio of zinc to orthophosphate can range from less than 1:1 to 1:15 (WRF 2011). It is commonly believed that orthophosphate chemicals form passivating films on anodic sites to suppress electrochemical reactions. The role of zinc in corrosion control is indefinite. The Revised Guidance Manual for Selecting Lead and Copper Control Strategies (USEPA 2003) suggests that for ZOP, the orthophosphate is primarily responsible for corrosion control of metal pipes and solder and that zinc can help protect cement- and cement mortar–lined pipes. However, some researchers believe that zinc deposition could further enhance the protection by forming films over cathodic sites (AwwaRF 1996).

Oliphant (1983) predicted that increasing chloride and nitrate could increase lead release from lead solders based on electrochemical measurements. Galvanic corrosion attributed by higher chloride to sulfate mass ratio (CSMR) has been studied (Gregory 2007; Edwards 2011, Edwards and Triantafyllidou 2007) and some confirmed that ZOP had advantages on controlling lead release in the presence of galvanic couples than did orthophosphate although the benefits of zinc in controlling galvanic corrosion needs to be tested in a wider range of waters. Very little research about nitrate corrosion of leaded solders has been done. Nguyen (2011) reported nitrate could impact on lead release to drinking water from lead solders.

3.1 Review of Previous Laboratory Testing Results Involving Zinc Orthophosphate

Zinc orthophosphate was included in the many of the previous laboratory tests for University Park and the testing results were summarized in the November 2019 OCCT and the July 2020 OCCT Addendum. **Table 1** below listed the studies involving ZOP and the related findings. The key graphs are also included as **Figure 1-4**. Overall, ZOP showed better or similar performance in reducing lead release compared to other tested corrosion inhibitors in all previous laboratory tests. It was not previously selected as the corrosion control treatment for University Park mainly because 90/10 blended phosphate and orthophosphate were considered sufficient in performance.

Table 1: Summary of Previous Experiments Related to ZOP

Test Type	Time	Test Material	Corrosion Inhibitors Tested	Conducted by	Key Findings
Lead solubility test	Fall 2019	Suspended lead coupon	Phosphoric acid, ZOP, 90/10 phosphate blend	Cornwell Engineering	Lead release from conditions dosed with 2 and 3 mg/L as PO4 of ZOP and H3PO4 all leveled off at 5 ug/L-day. Dose requirement for 90/10 blended phosphate is higher to achieve the similar results.
Dump-fill experiment	Summer 2019	Harvested copper pipe with lead solder	Sodium orthophosphate, 90/10 blended phosphate, ZOP	Cornwell Engineering	All three inhibitors successfully decrease lead release.
Dump-fill experiment	Summer 2019	New copper pipe with lead solder	Polyphosphate, ZOP, phosphoric acid, 90/10 blended phosphate	Virginia Tech University	Inhibitor ranking in effectiveness: ZOP, 90/10 blended phosphate, orthophosphate.
Lead Solubility Test	2020	Harvested plumbing	ZOP, phosphoric acid	Cornwell Engineering	Lead release from all conditions but one test (BLK – ortho) stabilized to <10 µg/L-day after about 40 to 50 days of contact with treated water.

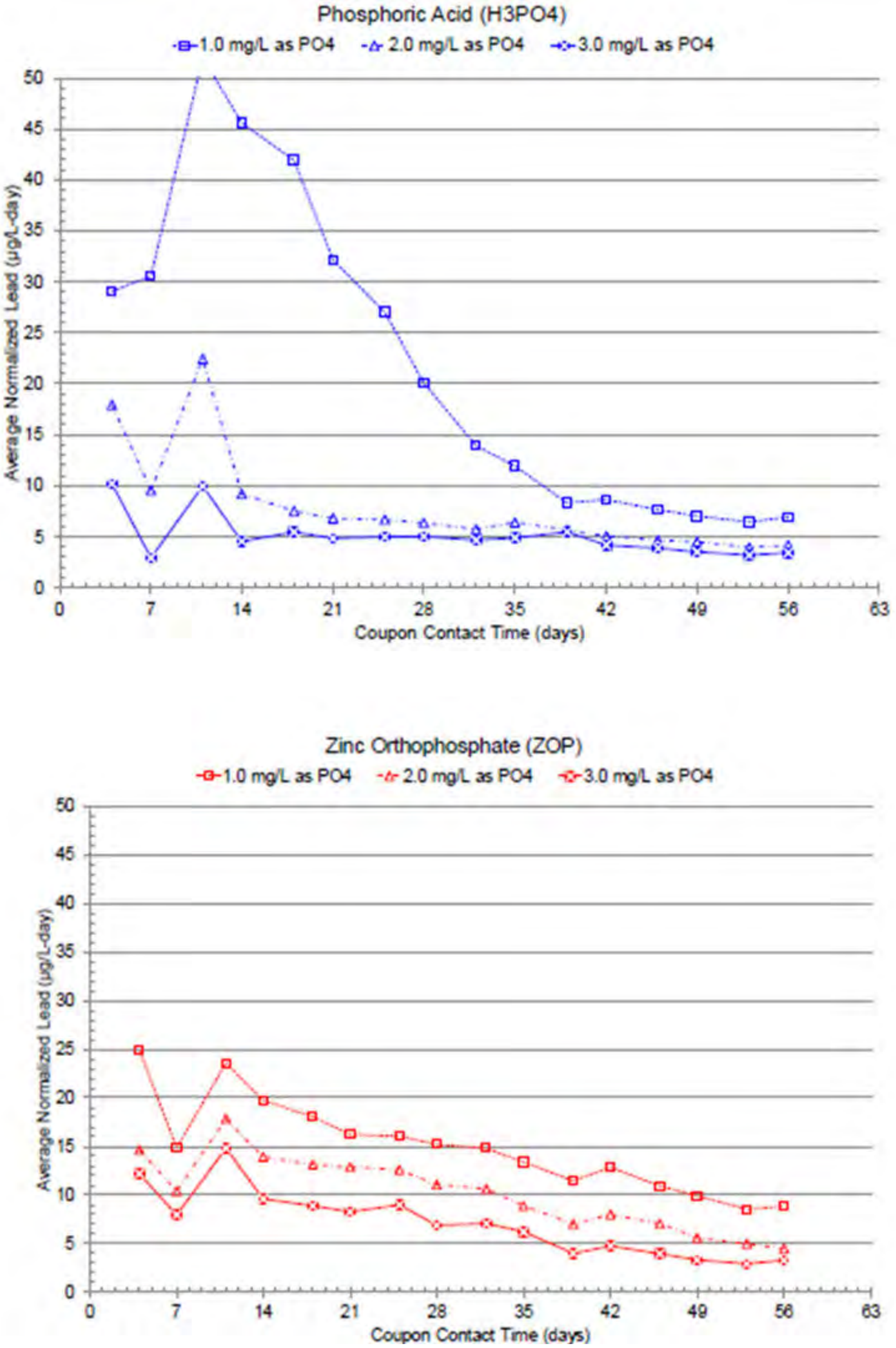
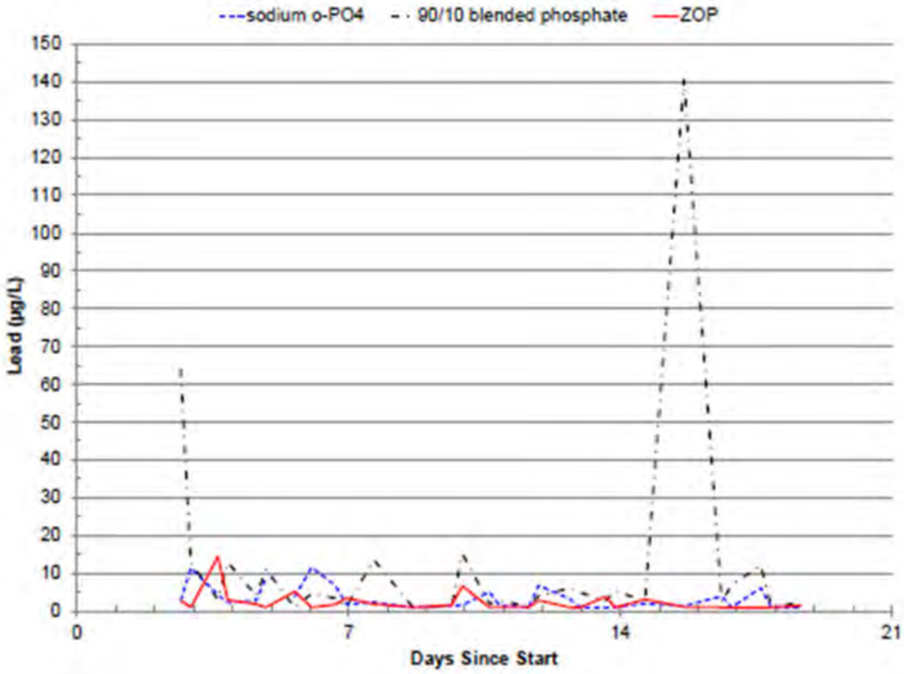


Figure 1: Fall 2019 Lead Solubility Test Results by Cornwell Engineering (Figures 4-3 and 4-4 of Nov 2019 OCCT Report)



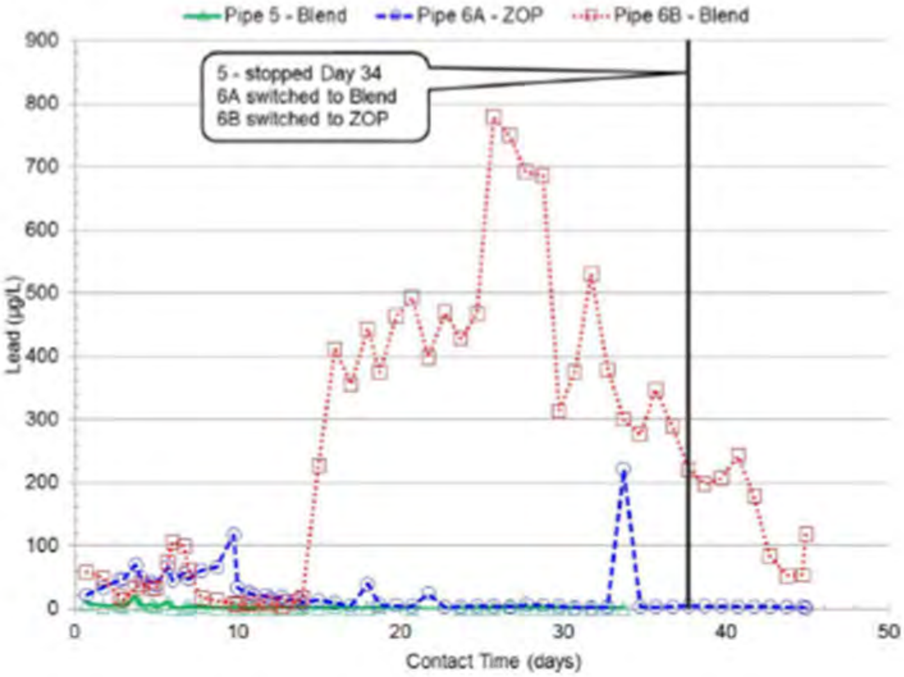


Figure 2: Summer 2019 Dump-Fill Experiment with Harvested Plumbing by Cornwell Engineering (Figures 4-8 and 4-9 of Nov 2019 OCCT Report)

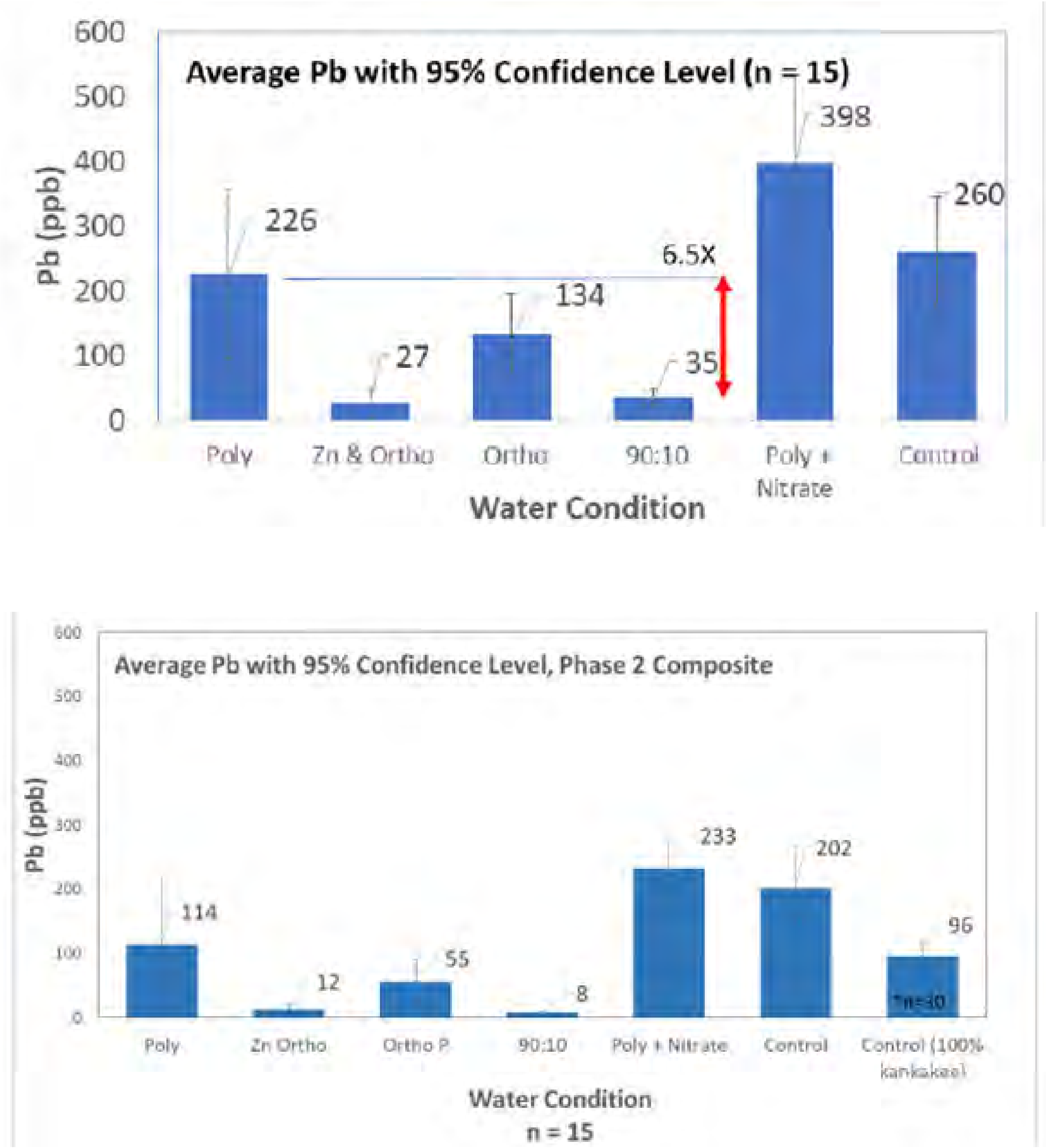


Figure 3: Summer 2019 Dump-Fill Experiment with New Copper with Lead Solder by Virginia Tech (Figures 4-23 and 4-24 of Nov 2019 OCCT Report)

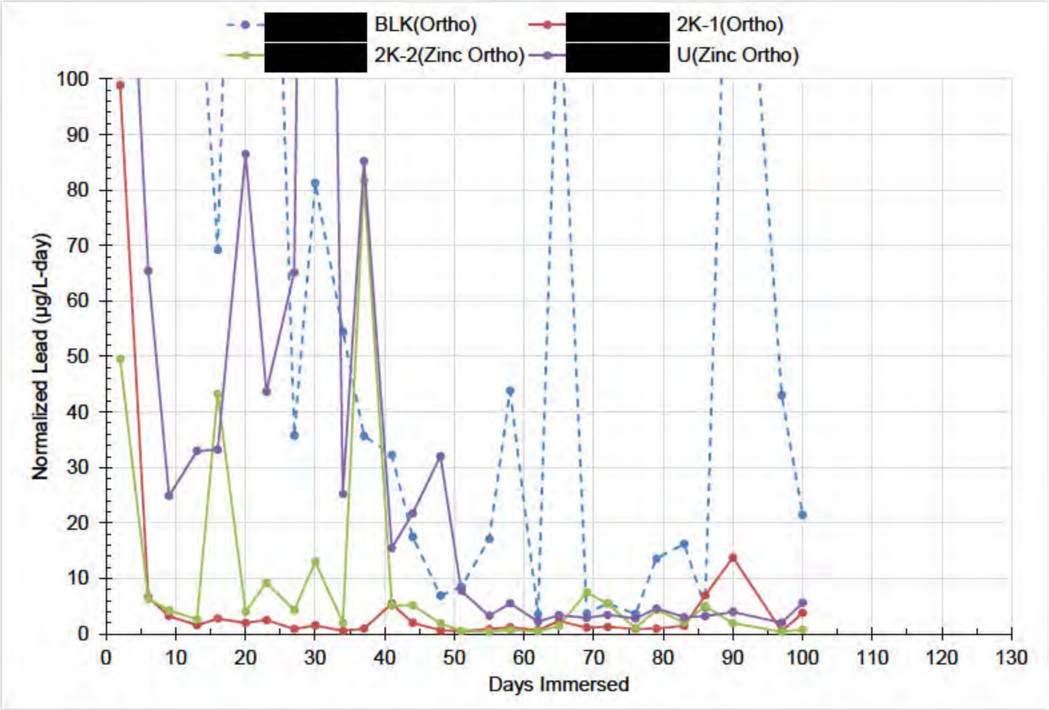


Figure 4: 2020 Lead Solubility Test with Harvested Plumbing by Cornwell Engineering (Figure 15 in Appendix E of July 2020 OCCT Addendum)

3.2 Recent Experiment Results from Virginia Tech University

In the continuing effort to better understand the causes of the lead release in certain homes in University Park , Dr. Edwards from Virginia Tech University conducted a set of coupon study using new copper pipes with lead solder starting in June 2021.

3.2.1 Methods and Materials

The experiment is a dump and fill test using new copper coupons connected to a fixed amount of 50:50 Pb:Sn solder. The new coupons were first acclimated for one week with University Park groundwater, and then one more week with treated surface water from Kankakee WTP without phosphate. These acclimated coupons were then exposed to the conditions listed in **Table 2** made from treated surface water from Kankakee WTP. The target pH prior to exposure for all these coupons was adjusted to 7.6 and the chloramine residual was as received. All experiments except the Control were dosed with additional nitrate.

Table 2: Conditions for Testing of Coupons with Pb/Sn Solder

Label	Additives (and dose)		
	Orthophosphate, mg/L as P	**Zinc, mg/L**	**Nitrate, mg/L as N**
	Day 6 to 12		
Control			
High Nitrate			5
Nitrate and Ortho	2		5
Nitrate and ZOP	2	0.5	5
Nitrate and Zn		0.5	5
	Day 13 to 180		
Control			
High Nitrate			5-8 (1)
Nitrate and Ortho	1		5-8
Nitrate and ZOP	1	0.33	5-8
Nitrate and Zn		0.33	5-8

(1) Additional 5 mg/L of nitrate was added during Day 13-117 and about 8 mg/L was added during Day 118-180.

3.2.2 Experimental Results

Throughout the experiment, the ambient nitrate varied from 0.4 mg/L to 7.8 mg/L as N and the supplement nitrate concentration ranged from 4.9 mg/L to 12 mg/L as N. The ambient CSMR was mostly around 0.5 with a few exceptions (0.7-1.0) in the early days of the experiment resulted from the occasional sulfate decrease in the Kankakee River.

The experimental results were graphed in **Figure 5**. On Day 0, all conditions exposed to the Kankakee control water had virtually identical lead release, after which time the new waters were introduced. Lead release fluctuated with the nitrate concentration that suggests corrosion induced by the additional nitrate in the water. All scenarios showed overall declining trend in lead release over time but the group with zinc orthophosphate addition showed a much faster decline trend followed by orthophosphate alone and zinc alone conditions. Throughout the 180-day experiment, zinc orthophosphate consistently provided the best corrosion inhibition.

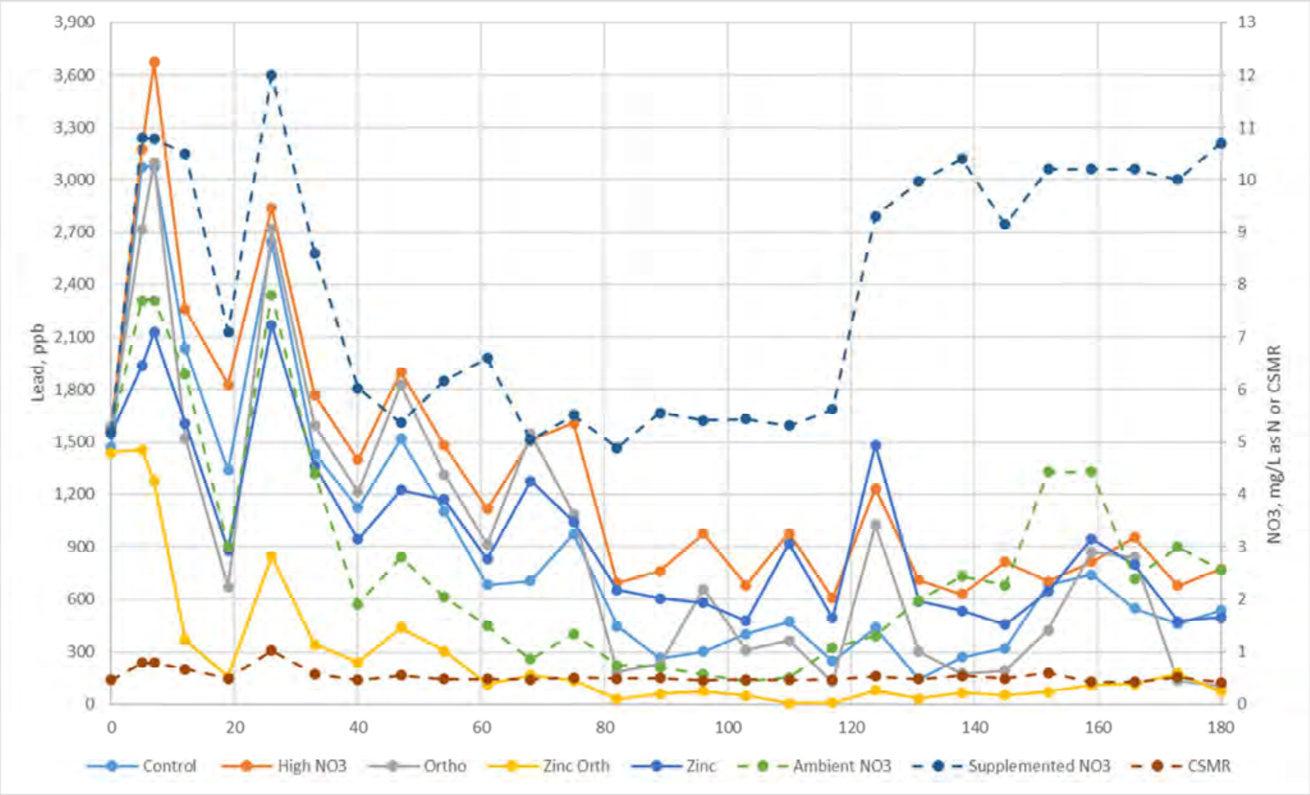


Figure 5: Lead Results during Laboratory Coupon Study 2021 by Virginia Tech University

4. HYDRANT MONITORING AND LCR RESULTS

LCR compliance samples were taken monthly from the approved compliance pool as required by the Illinois EPA through conditions imposed in the chemical treatment change construction permit. The lead 90 percentile over time is graphed in **Figure 6**. A total of 194 compliance samples were taken during September – December 2021 when zinc orthophosphate was in use and the lead 90 percentile of these samples was calculated as 4.8 ppb.

Water quality parameters were monitored at nine hydrants in the University Park distribution system. When zinc orthophosphate in use, pH and orthophosphate in the distribution system remained within the ranges specified in the operating permit (pH 7.4-8.0 and a minimum orthophosphate of 3.0 mg/L as PO4), as shown in **Figure 7** and **Figure 8**. Zinc concentration, presented in **Figure 9**, increased gradually as the zinc demand in the distribution system was satisfied and became more consistent since November 2021.

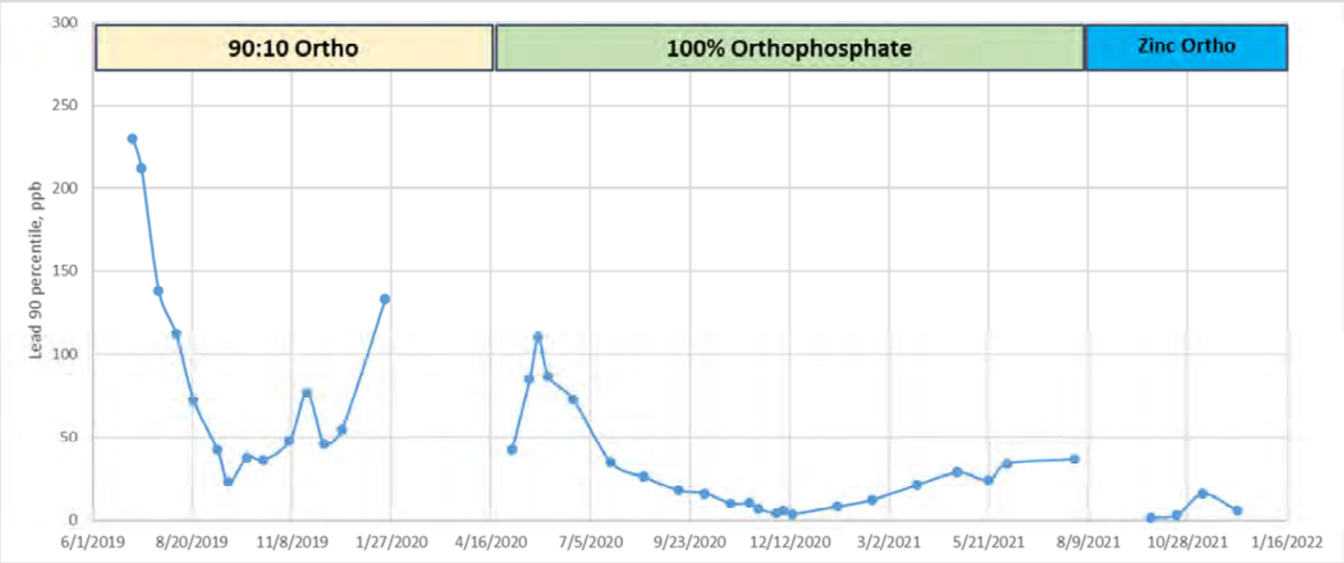


Figure 6: Lead 90 Percentile in UP Decreasing over Time

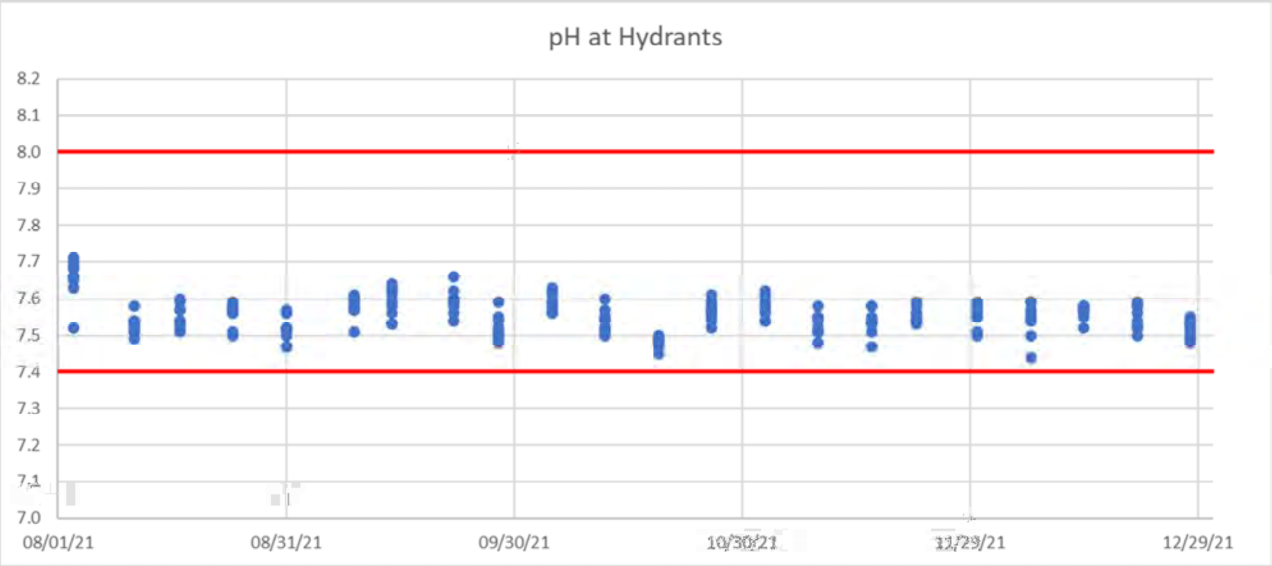


Figure 7: Observed pH at Hydrants

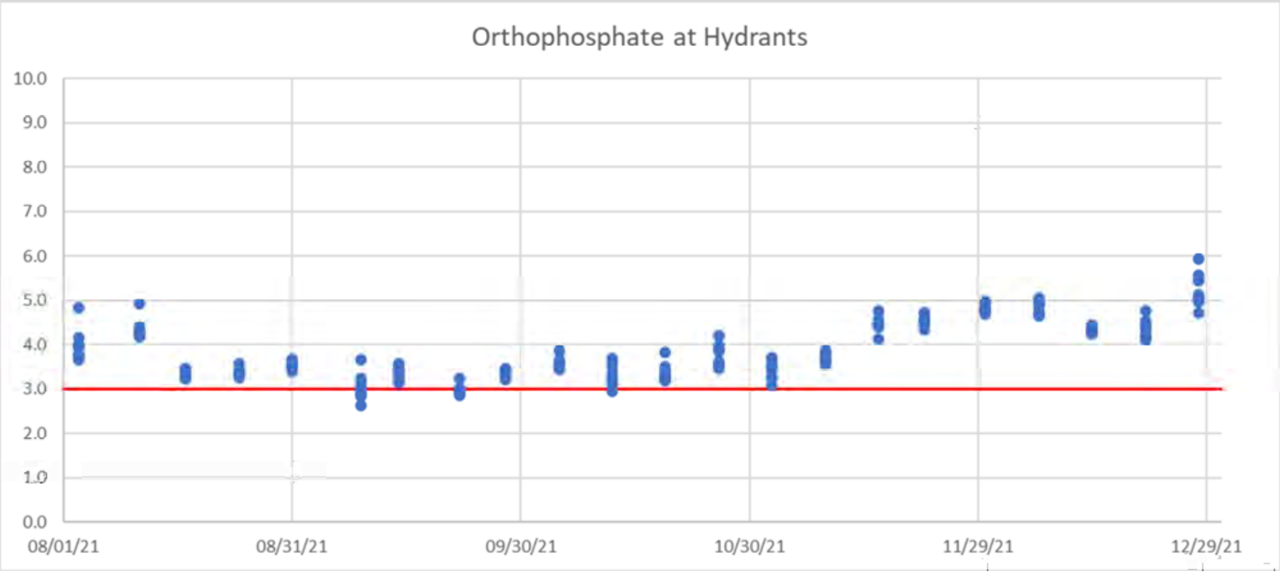


Figure 8: Observed Orthophosphate at Hydrants

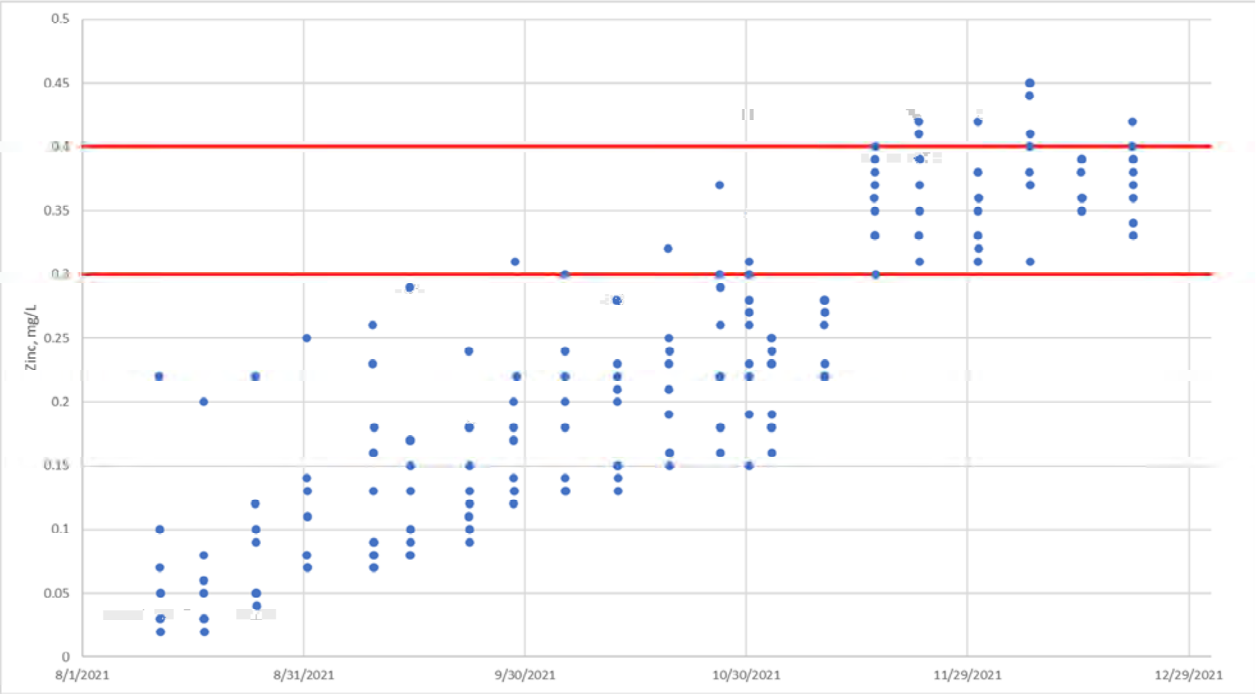


Figure 9: Observed Zinc at Hydrants

5. CONCLUSIONS AND RECOMMENDATIONS

Based on results from various laboratory studies involving zinc orthophosphate including the most recent coupon study conducted by Dr. Edwards from Virginia Tech University, it is evident that zinc orthophosphate is the most superior corrosion control treatment chemical for the UP system compared to orthophosphate, 90/10 phosphate blend, and zinc. A total of 194 compliance samples were taken during September – December 2021 when zinc orthophosphate was in use and the lead 90 percentile of these samples was calculated as 4.8 ppb. Therefore, it is recommended that the optimal corrosion control treatment be achieved in the UP system by targeting an orthophosphate dose above 3 mg/L as PO4 and pH 7.4-8.0 using zinc orthophosphate.

REFERENCES

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Edwards, M., and S. Triantafyllidou. 2007. Chloride:Sulfate Mass Ratio and Lead Contamination of Drinking Water. Journal AWWA, 99(7):96–109

Gregory, R., and J. Gardiner. 2007. Galvanic Corrosion of Lead in Copper Pipework. Water and Environment Journal, 4(2):112 – 118

Oliphant, R.J. 1983. Summary Report on the Contamination of Potable Water by Lead for Soldered Joints. Report No. 125E. Swindon, England: Water Research Center.

Schock, M.R. 1999. Internal Corrosion and Deposition Control. In Water Quality and Treatment: A Handbook of Community Water Supplies. 5th ed. Denver, Co: AWWA

Nguyen, C., K. Stone, and M. Edwards. 2011. Nitrate accelerated corrosion of lead solder in potable water systems. Corrosion Science, 53(3):1044-1049

Water Research Foundation. 2011. Comparison of Zinc Versus Non-Zinc Corrosion Control for Lead and Copper. Denver, Co: AWWA

USEPA (U.S. Environmental Protection Agency). 2003. Revised Guidance Manual for Selecting Lead and Copper Control Strategies. EPA-816-R-03–001. Washington, D.C.: USEPA

APPENDIX A: OCCT DATED NOVEMBER 2019 AND OCCT ADDENDUM DATED JULY 2020

Illinois Environmental Protection Agency

1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276 • (217) 782-3397

Optimal Corrosion Control Treatment (OCCT)
Evaluation of Treatment Alternatives

System

System Number: IL1975030 County: Will

System Name: Aqua Illinois - University Park

Contact Name: Melissa Kahoun

Street Address: 1000 S. Schuyler Ave

City: Kankakee State: IL Zip: 60901

Phone: 815.614.2032

Email: makahoun@aquaamerica.com

Engineer (Optional)

Engineer Name:

Company:

Street Address:

City: State: Zip:

Phone:

Email:

Form 141-C: Optimal Corrosion Control Treatment Recommendation

Attach a copy of the properly completed Form 141-C.

Step 1: Summary of Water Quality Data and Other PWS Information

1.1 General PWS Information

Approximate Population Served: 7,052

Water Source: ● Surface Water ○ Groundwater ○ Both

Is water purchased?: ● Yes ○ No If yes, enter the name and ID number below.

Name: Aqua Illinois - Kankakee ID Number: IL0915030

Average Daily Usage: 1.9 ○ Gallons/Day ● MGD

ALE for: ● Lead ○ Copper ○ Both

Does the system have lead service lines?: ○ Yes ● No If yes, approximately how many?:

1.2 Description of Water Treatment System

1.2.1 Flowchart of Water System / Treatment

Attach a flowchart or schematic of the water system.

1.2.2 Chemicals Used

Identify the chemicals used and their feed rates.

Chemical	Feed Rate (mg/l)
Zinc Orthophosphate as PO4	3

1.2.3 Change in Treatment

Has there been a chemical or physical change in the treatment system within 3 years prior to the date of the ALE to the present?

☑ Yes ○ No

If yes, describe below.

The original water supply in University Park was from local wells treated with chloramines and a 60/40 blended phosphate product (Carus 8600), the latter at a dose targeted to deliver an orthophosphate residual of 3.6 mg/L as PO4. Starting in June 2017, the original blended phosphate was replaced with a proprietary blended phosphate from a different manufacturer (approx. 8% orthophosphate (as PO4) and >23% polyphosphate (as PO4) by weight) with a target dose 4.5 mg/L (as product) in the distribution system.

During October to December 2017, the water supply was switched from local wells to imported water from the Kankakee WTP (IL0915030), which includes treated water from the Kankakee River (lime softening, ferric sulfate coagulation, chloramination). The interconnect for the new purchased water is designated by IL-EPA as "CC01". The imported water is already chloraminated so the addition of chlorine and ammonia in the University Park has been discontinued but addition of the proprietary blended phosphate continued until 2019 (see below). The imported water with the added blended phosphate is supplied to the University Park Distribution System via the treated water entry point (IL-EPA location ID "TP03").

Since June 2019, use of the blended phosphate was discontinued and a 90/10 blended phosphate (LPC-132 from Hawkins, Inc.) was added to achieve a target orthophosphate residual of >3 mg/L as PO4 (>1mg/L as P). This continued until April 16, 2020. Starting April 17, 2020, an orthophosphate product (28% Phosphoric Acid from Hawkins, Inc.) has been added to achieve a target orthophosphate residual of >3 mg/L as PO4 (>1mg/L as P). The change was made to better optimize lead reduction.

On August 3, 2021, the corrosion control inhibitor was changed to zinc orthophosphate (operating permit 0071-FY2022). The targeted orthophosphate dosage is a minimum of 3 mg/L as PO4, pH range is 7.4-8.0 and the zinc range is 0.3-0.4 mg/L.

1.2.4 Change in Sampling Plan

Has there been a change in the in the lead/copper sampling plan that occurred within 3 years prior to the date of the ALE to the present?

☑ Yes ○ No

If yes, describe below.

Change in sampling plans as previously submitted to the IEPA.

1.3 Water Quality Data

Provide water quality data for the finished/treated water from each source.

Water Quality Data - Entry Point

Entry Point Name: TP03 - Central Avenue BS w/ zinc orthophosphate

Sample Point ID: TP03

Source Type: CC01 - Connection to Kankakee WTP

Date					
Parameters	Results (mg/l)	Results (mg/l)	Results (mg/l)	Results (mg/l)	Average
pH	7.5				7.5
Alkalinity (Total as $CaCO_3$)	52				52
Hardness (Total as $CaCO_3$)	145				145
Calcium	38				38
Chloride	34				34
Sulfate	79				79
Aluminum	0				0
Iron	0				0
Manganese	0				0
TDS					
Conductivity	358				358
Temperature	15				15
Total Chlorine	3				3
Free Chlorine					
Orthophosphate	4.2				4.2

1.4 Water Quality & Physical Factors

Describe the water quality factors and physical factors that may be contributing to the lead and/or copper release.

It is believed that the water chemistry change has altered the scales on the copper pipes and triggered galvanic corrosion in some homes resulting in a release of lead. Experiments are underway with Virginia Tech and Dr. Marc Edwards to understand specific mechanisms.

Step 2: Evaluate Potential for Scaling

Saturation pH & Potential for Scaling	
Parameter	Value
Alkalinity	52
System pH	7.5
DIC	13.5
Calcium	38
Saturation pH	8.2
Potential for Scaling	○ High ☑ Low

Step 3: Technical Recommendations for Selecting One or More Treatment Options

3.1 Identify the Appropriate Flowchart for Preliminary OCCT Selection

Is iron or manganese present in finished water? ○ Yes ● No

The OCCT is designed to treat: ○ Lead ○ Copper ● Both

The pH of the finished water is: 7.5

Recommended Flowchart per Exhibit 3.3: 1b

3.2 Identify the Recommended OCCT

The Recommended OCCT is:

Addition of zinc orthophosphate at a minimum target dose of 3 mg/L as PO4

Step 4: Identifying Possible Limitations for Treatment Options

4.1 Possible Limitations of pH / Alkalinity / DIC Adjustment

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.1.1 Optimizing pH for Other Purposes ○ Applicable ● Not Applicable

4.1.2 Calcium Carbonate Precipitation ○ Applicable ● Not Applicable

4.1.3 Oxidation of Iron and Manganese ○ Applicable ● Not Applicable

4.2 Possible Limitations of Phosphate-Based Corrosion Inhibitors

Indicate if any of the following are applicable. If they are, describe how they are addressed relative to the Recommended OCCT.

4.2.1 Reactions with Aluminum ○ Applicable ● Not Applicable

4.2.2 Impacts on Wastewater Treatment ● Applicable ○ Not Applicable

Wastewater in the UP water service area is collected and treated at the UP WWTP, also owned and operated by Aqua IL. Aqua IL is currently monitoring the zinc concentration in the WWTP inflow and effluent and have not noticed obvious negative impact on the biological process caused by the zinc orthophosphate addition in the drinking water. Aqua IL will continue monitoring zinc in the WWTP and will take action if necessary.

Step 5: Evaluation of Feasibility and Cost

5.1 Feasibility and Cost

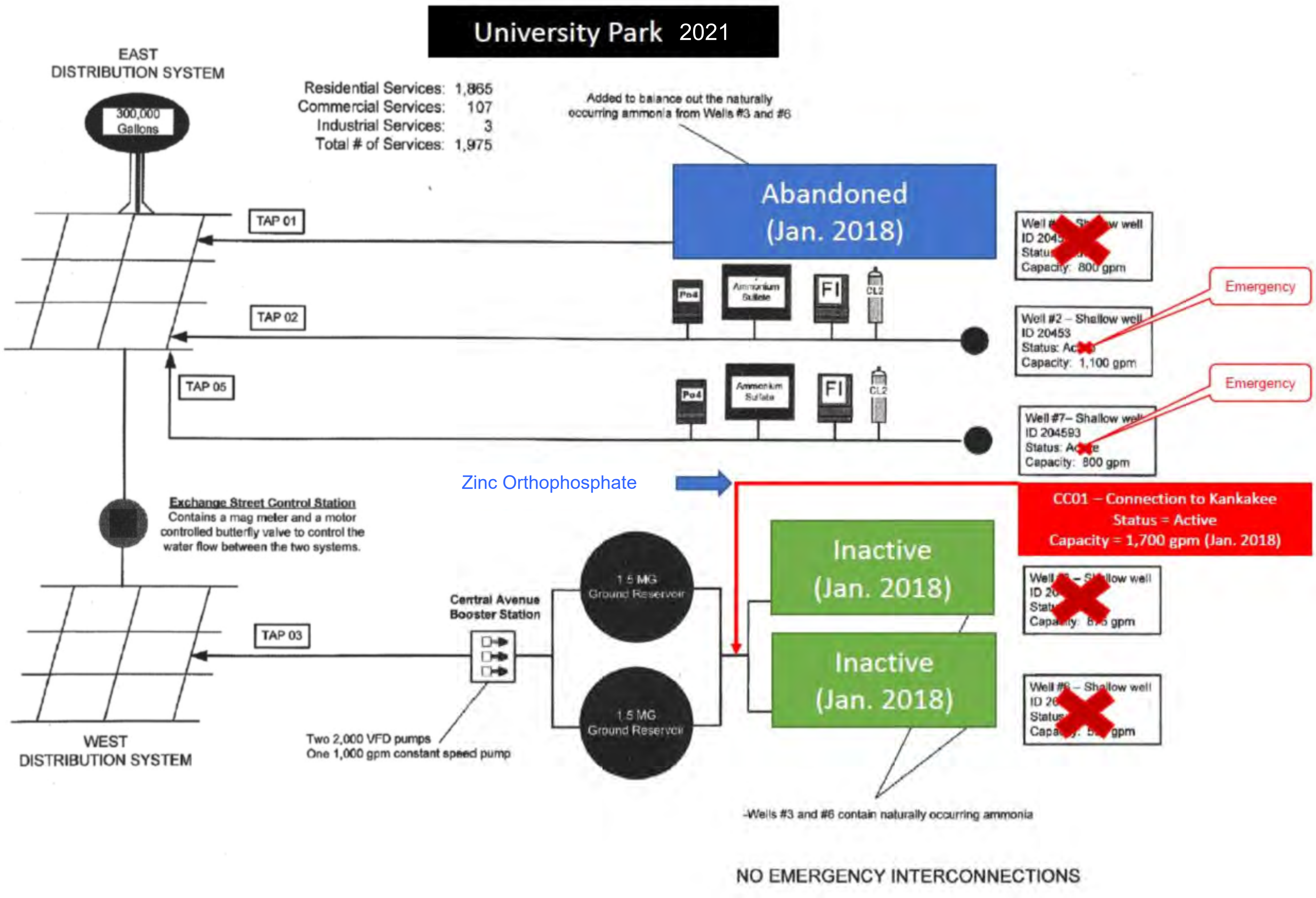
Provide a discussion of the feasibility and cost of the selected OCCT.

The water system has selected the best option for the OCCT, which we believe to be easy to operate and cost effective.

Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Melissa Kahoun	Environmental Compliance Manager
Printed Name	Title
Melissa Kah	2-14-22
Signature	Date


University Park 2021
EAST
DISTRIBUTION SYSTEM
300,000
Gallons
Residential Services: 1,865
Commercial Services: 107
Industrial Services: 3
Total # of Services: 1,975
Added to balance out the naturally
occurring ammonia from Wells #3 and #6
Abandoned
(Jan. 2018)
TAP 01
TAP 02
TAP 05
Po4
Ammonium
Sulfate
FI
CL2
Well # Sh w well
ID 204
Statu
Capacity: 800 gpm
Emergency
Well #2 – Shallow well
ID 20453
Status: Ac
Capacity: 1,100 gpm
Emergency
Well #7– Shallow well
ID 204593
Status: A e
Capacity: 800 gpm
Zinc Orthophosphate
Exchange Street Control Station
Contains a mag meter and a motor
controlled butterfly valve to control the
water flow between the two systems.
CC01 – Connection to Kankakee
Status = Active
Capacity = 1,700 gpm (Jan. 2018)
1.5 MG
Ground Reservoir
Central Avenue
Booster Station
Inactive
(Jan. 2018)
Well – S low well
ID 2
Stat
Capa ity: gpm
Inactive
(Jan. 2018)
Well # – Sh llow well
ID 2
Status
Capa gpm
TAP 03
1.5 MG
Ground Reservoir
WEST
DISTRIBUTION SYSTEM
Two 2,000 VFD pumps
One 1,000 gpm constant speed pump
-Wells #3 and #6 contain naturally occurring ammonia
NO EMERGENCY INTERCONNECTIONS

Illinois Environmental Protection Agency

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Optimal Corrosion Control Treatment (OCCT) Recommendation

Public Water Supply Systems required to submit an OCCT Recommendation to the Illinois EPA need to provide this form and all the information required in the IEPA's Instructions for an OCCT Evaluation of Treatment Alternatives.

This form may be completed in Acrobat, a copy saved locally, and then printed before it is signed. You may also complete a printed copy normally. Submit the completed and signed form the the Illinois EPA, Division of Public Water Supplies.

System

System Number: IL1975030 County: Will

System Name: Aqua Illinois - University Park

Street Address: 1000 S. Schuyler Ave

City: Kankakee State: IL Zip: 60901

Contact Name: Melissa Kahoun

Phone: 815.614.2032

Email: makahoun@aquaamerica.com

Number of People Served:

○ ≤ 100 ○ 101 to 500 ○ 501 to 3,000 ☑ 3,001 to 10,000 ○ 10,001 to 100,000 ○ > 100,000

OCCT Recommendation

The following OCCT is recommended:

- ○ pH / Alkalinity / DIC Adjustment
- ☑ Orthophosphate Zinc orthophosphate
- ○ Blended phosphate (/ ortho / poly ratio)
- ○ Silicates
- ○ Remove iron and/or manganese and add ortho phosphate
- ○ No treatment or treatment change at this time **(Attach justification)**

Signature of Owner, Official Custodian, or Authorized Agent

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Printed Name: Melissa Kahoun

Title: Environmental Compliance Manager

Signature: Melissa Kah

Date: 2-14-22

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397
JB PRITZKER, GOVERNOR
JOHN J. KIM, DIRECTOR

217/782-1724

SPECIAL EXCEPTION PERMIT

June 2022 (draft letter with explanations)

Ms. Melissa Kahoun
Environmental Compliance Manager
Aqua Illinois Water Company
1000 South Schuyler Avenue
Kankakee, IL 60901

Re: Aqua IL University Park (IL1975030)
Request to Modify Permit Conditions for 0071-FY2022

Dear Ms. Kahoun:

The Illinois Environmental Protection Agency (Agency) has reviewed Aqua's two letters. The request in both letters was to modify additional condition #6 on Construction Permit 0071-FY2022 and to add a new additional condition #7. The March 24, 2022 letter was a request for supplemental permit and was received on March 31, 2022. The March 28, 2022 letter was a request for a special exception permit and was received on April 1, 2022. Both letters were reviewed together and logged into Permit Tracking using log number 2022-1072.

The letters were reviewed along with the data received from the additional conditions in construction permit 0071-FY2022. Pursuant to 35 Ill. Adm. Code 602.600 the Agency has decided to replace all the permit conditions to construction permit 0071-FY2022 for clarity and based upon the Lead and Copper Rule steps in the Part 611 regulations.

The conditions below supersede and replace the additional conditions in Construction Permit 0071-FY2022. The conditions are in the same order as the construction permit for clarity. Significant additions from the language in the construction permit are underlined.

ADDITIONAL CONDITIONS:

1. *An operating permit is required before feeding zinc orthophosphate. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.300) The issuance of an operating permit 0071-FY2022 for zinc orthophosphate replaces the additional conditions in construction permit 1020-FY2020.*

1. An operating permit was required prior to feeding zinc orthophospate. The operating permit for permit number 0071-FY2022 was issued on August 3, 2021. This Special Exception Permit replaces the additional conditions in construction permit 0071-FY2022.

2. The product must be NSF/ANSI 60 approved and contain a 1:10 Zn to PO_4 *ratio. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 604.105(g) and Chemical Change Description dated July 15, 2021)*

2. The zinc orthophosphate product must be NSF/ANSI 60 approved and contain a 1:10 Zn to PO_4 **ratio. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 604.105(g) and Chemical Change Description dated July 15, 2021.)**

3. Optimal Water Quality Parameter (OWQP) ranges will be set after the community water supply meets the lead action level in two consecutive six-month monitoring periods.The orthophosphate dose and residual shall be a minimum of 3 mg/L as PO_4*. The pH range shall be 7.4 to 8.0 at the Central Avenue Booster Station. The zinc range shall be 0.3 - 0.4 mg/L. Notify the Division of Public Water Supplies, Permit Section staff if results are outside of these ranges in two consecutive weeks of water quality monitoring. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 611.351(e) and the Chemical Change Description dated July 15, 2021)*

Condition #3 is replaced with the following language below. The upper end of the zinc range is increased to 0.5 mg/L based upon actual results. The requirement to notify the Permit Section for water quality results outside of the ranges in the permit has been removed. OWQP ranges cannot be set until after OCCT is approved. See the steps in 35 Ill. Adm. Code 611.351(e). The Agency must approve OCCT within six months after completion of the corrosion control study. The OWQP ranges rely on water quality parameter data collected. This data collection needs to continue until so the Agency can set OWQP ranges. After OWQP ranges are set, a semi-annual excursion form has to be completed and sent to the Compliance Assurance Section.

3. Optimal Water Quality Parameter (OWQP) ranges will be set <u>after Optimal Corrosion Control Treatment (OCCT) is designated</u> and the community water supply meets the lead action level in two consecutive six-month monitoring periods.The orthophosphate dose and residual shall be a minimum of 3 mg/L as PO_4**. The pH range shall be 7.4 to 8.0 at the Central Avenue Booster Station. The zinc range shall be 0.3 - <u>0.5</u> mg/L. (Section 18 of the Act 415 ILCS 5/18, 35 Ill. Adm. Code 602.114, 611.351(e) and the Chemical Change Description dated July 15, 2021)**

4. Water quality monitoring must be conducted for the Aqua Illinois - University Park community water supply as described below and results submitted for each month to david.cook@illinois.gov within 10 days after the last day of the month. The submissions *must include all water quality parameter monitoring done during the month including any monitoring not mentioned here.*

The minimum water quality monitoring parameters, locations, and frequencies are as described in the Chemical Change Description dated July 15, 2021. The Chemical Change Description includes daily monitoring for flow and orthophosphate at the Central Avenue Booster Pump Station and weekly monitoring at nine locations for free chlorine, total chlorine, monochloramine, free ammonia, orthophosphate, pH, and alkalinity. In addition, weekly monitoring at nine locations is required for chloride, sulfate, CSMR (calculated value), nitrite, nitrate, iron, manganese, zinc, and Total Organic Carbon (TOC).

Any water quality parameter monitoring conducted must be reported in a spreadsheet. The data are needed to set Optimal Water Quality Parameter (OWQP) ranges. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 604.140, 611.352(f) and the Chemical Change Description dated July 15, 2021)

Condition #4 is replaced with the following language below. The changes include the addition of pH and nitrate monitoring at the Central Avenue Booster Station and reducing the frequency and number of locations for the distribution system water quality monitoring. The changes are in according with the USEPA OCCT Guidance manual and Part 611. OWQP ranges cannot be set until after OCCT is approved. See the steps in 35 Ill. Adm. Code 611.351(e). The Agency must approve OCCT within six months after completion of the corrosion control study. The OWQP ranges rely on water quality parameter data collected. This data collection needs to continue until so the Agency can set OWQP ranges. The pH and nitrate monitoring will be part of the future OWQP SEP. The OWQP SEP will require bi-weekly monitoring per the Guidance manual. Nitrate is a key water quality variable identified by Aqua and there isn't extensive data for lead and nitrate monitoring together at different nitrate values. This is why weekly monitoring is required instead of bi-weekly monitoring. Due to the consistent water quality results the number of distribution sample sites has been reduced to the minimum recommended in the Guidance Manual. Continued data collection is needed to set ranges in a OWQP SEP. The monitoring is extended until replaced by a OWQP SEP. The quarterly sampling is in accordance with the Guidance manual for sampling water quality parameters in the distribution system twice during each six month period.

4. Water quality monitoring must be conducted for the Aqua Illinois - University Park community water supply as described below and results submitted for each month to david.cook@illinois.gov within 10 days after the last day of the month. The submissions must include all water quality parameter monitoring done during the month including any monitoring not mentioned here.

The revised water quality monitoring requirements include daily monitoring for flow and orthophosphate at the Central Avenue Booster Pump Station, weekly monitoring for pH and nitrate at the Central Avenue Booster Pump Station, and quarterly monitoring at three locations for free chlorine, total chlorine, monochloramine, free ammonia, orthophosphate, pH, and alkalinity. In addition, quarterly monitoring at three locations is required for chloride, sulfate, CSMR (calculated value), nitrite, nitrate, iron, manganese, and zinc. Quarterly monitoring at one location is required for Total Organic Carbon (TOC).

Any water quality parameter monitoring conducted must be reported in a spreadsheet. The data are needed to set Optimal Water Quality Parameter (OWQP) ranges. This additional condition expires after the Agency sets OWQP ranges. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 604.140, 611.352(a), 611.352(f), the Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Supplies, USEPA March 2016 (Updated), and the Chemical Change Description dated July 15, 2021)

5. Water quality monitoring must be conducted for the Aqua Illinois - Kankakee entry point to the distribution system as described below and results submitted to david.cook@illinois.gov within 10 days after the last day of the month. The submissions shall be limited to these parameters at this location: pH, alkalinity, chloride, sulfate, CSMR (calculated), nitrite, nitrate, and TOC. The specified water quality parameters that are monitored must be reported in a spreadsheet. This additional condition expires after the community water supply meets the lead action level in two consecutive six-month monitoring periods. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114 and 611.352(f))

Condition #5 is replaced with the following language below. The water quality monitoring at this location is limited to nitrate. There haven't been the high results for nitrate yet in the source water that their corrosion control study identified as a key variable. The monitoring is extended until replaced by a OWQP SEP. OWQP ranges cannot be set until after OCCT is approved. See the steps in 35 Ill. Adm. Code 611.351(e). The Agency must approve OCCT within six months after completion of the corrosion control study. The OWQP ranges rely on water quality parameter data collected. This data collection needs to continue until so the Agency can set OWQP ranges. This is in addition to the monitoring for completion of the monthly operating reports. There is a significant travel time that can affect the data and there isn't extensive data yet. A decision whether to limit nitrate monitoring to the entry point in UP per the Guidance Manual or both entry points due to the travel time will be made later and reflected in the OWQP SEP.

5. Nitrate water quality monitoring must be conducted for the Aqua Illinois - Kankakee entry point to the distribution system on a weekly basis and results submitted to david.cook@illinois.gov within 10 days after the last day of the month. The nitrate water quality results must be reported in a spreadsheet. This additional condition expires after the Agency sets OWQP ranges. This is in addition to any monthly operating report requirements submitted to the Elgin Regional Office pursuant to Ill. Adm. Code, Title 35, Subtitle F, Section 604.165. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114 and 611.352(f))

6. Collect between 40 and 60 lead compliance samples from approved individual sample site locations each month beginning 30 days after the issuance of the operating permit for this project. Consideration should be given based upon highest past lead results and geographic representation. Consideration should also be given to sampling when CSMR and nitrate results are the highest for the month, typically following rain events. (Section 18 and 19 of the Act 415 ILCS 5/18 & 19, 35 Ill. Adm. Code 602.114, 601.101. 611.352(f) and the Chemical Change Description dated July 15, 2021)

6. Additional condition #6 of construction permit 0071-FY2022 is terminated by this Special Exception Permit as it is duplicative to the lead compliance monitoring requirement in the Agreed Interim Order. The elimination of this condition does not eliminate the monthly lead compliance monitoring that is required pursuant to the Agreed Interim Order. (People of the State of Illinois, No. 19 CH 1208, November 1, 2019)

7. The permit approval is for the Application, Schedule D, and the Chemical Change Description sealed by David Cornwell, PhD, P.E. that were received on July 16, 2021. The Aqua University Park Technical Response Team PowerPoint® presentation dated July 14, 2021and the University Park Nitrate Experiments presentation dated July 14, 2021 were also reviewed.

Condition #7 was for the list of reviewed documents for the construction permit. I wasn't planning to mention it again in the SEP.

As the Agreed Interim Order requires monthly monitoring, Aqua's request to modify additional condition #6 is denied. The request to add a new additional condition #7 is denied, since it is moot based upon Agreed Interim Order that continues to require monthly lead compliance monitoring.

Sincerely,

David C. Cook, P.E.
Manager, Permit Section
Division of Public Water Supplies

cc: Donald Denault, Certified Operator
Elgin Regional Office
DPWS/CAS

MONITORING REQUIREMENTS

Red Font - outside lab needs to test

UP Booster Station

Flow	daily
Ortho	daily

UP Distribution System - 9 locations

Free Cl	weekly
Total Cl	weekly
NH2Cl	weekly
Free NH3	weekly
Orthophosphate	weekly
pH	weekly
Alkalinity	weekly
Nitrite	weekly
Nitrate	weekly
Iron	weekly
Manganese	weekly
Zinc	weekly
Chloride	weekly
Sulfate	weekly
CSMR (calc value)	weekly

UP Distribution System - alternate between 9 locations

Note: each week locations of sample should rotate between nine different locations

Total Organic Carbon (TOC)	weekly

Kankakee Entry Point to Distribution System (TP01)

Note: the testing frequency for these parameters can be changed. No set frequency designated in permit.

pH	daily
Alkalinity	daily
Nitrite	weekly
Nitrate	weekly
Chloride	weekly
Sulfate	weekly
CSMR (calc value)	weekly
Total Organic Carbon (TOC)	monthly

UP Distribution System: 40 - 60 locations

LCR	monthly

Note 1: consideration to highest past lead results and geographic representation

Note 2: consideration to sampling when CSMR and nitrate results are highest for the month, typically after rain events

OWQP - Optimal Water Quality Parameters

Ortho dose	≥ 3	mg/L as PO4
pH	7.4 - 8.0	
Zn	0.3 - 0.4	mg/L

Notify IEPA if results are out of range for 2 consecutive weeks

Samples highlighted in grey are additional sampling we do
Parameters in red are sent to an outside lab
TOC - Monthly for Kankakee WTP (TP01)
TOC - Weekly for 1 of the 9 UP Distribution Sites (alt sites)

			AQUA LAB TESTING										OUTSIDE LAB TESTING								
Week of	Date	Sample Locations	Free Cl	Total Cl	pH	Nitrite	Nitrate	Ortho as PO4	Alkalinity	Iron	Free NH3	NH2Cl	Manganese	Zinc	Zinc Dissolved	Chloride	Sulfate	CSMR (calc value)	Date TP01 TOC	Total Organic Carbon (TOC)	
			ppm	ppm		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		ppm	ppm			ppm	
1-Aug	8/3/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.004	1.19	NA	Daily	NA	NA	NA	NA	NA							Monthly
	8/3/2021	UP- 437	0.03	2.77	7.52	0.005	1.66	4.84	51	0.01	0.09	2.9	0	0.00		35	65	0.5		0	alternate TOC weekly sample between these 9 sites
	8/3/2021	UP-647	0	2.34	7.66	0.004	1.7	3.94	52	0.01	0.14	2.43									
	8/3/2021	UP-187	0.02	2.35	7.68	0.006	1.69	3.96	53	0.03	0.23	2.29									
	8/3/2021	UP-629	0.08	2.21	7.7	0.005	1.8	3.76	52	0.41	0.2	1.97									
	8/3/2021	UP-713	0.06	2.28	7.65	0.005	1.69	4.16	52	0.37	0.19	2.27									
	8/3/2021	UP-644	0.13	2.02	7.71	0.005	1.79	3.78	51	0.11	0.2	1.96									
	8/3/2021	UP-222	0.06	1.95	7.63	0.007	1.83	4	52	0.07	0.18	1.78									
	8/3/2021	UP-649	0.05	1.82	7.66	0.007	1.88	3.76	51	0.04	0	1.73									
	8/3/2021	UP WWTP	0.05	1.92	7.69	0.006	1.86	3.68	52	0.02	0.19	1.9	0	0.00		35	64	0.5			
	8/3/2021	UP-612	0.09	1.77	7.7	0.008	1.84	3.82	54	0.35	0.2	2.23								NA	
	8/3/2021	UP WWTP Men's Room	0.08	1.57	7.66	0.015	1.91	3.96	54	0.04	0.26	1.59								NA	
	8/3/2021	BN-2098	0	3.76	8.44	0.001	1.16		57	0.01	0.06	3.98								NA	
	8/3/2021	MT-2810	0	3.76	8.44	0.001	1.16		57	0.01	0.06	3.98								NA	
8-Aug	8/11/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.005	0.6	NA	Daily	NA	NA	NA	NA	NA		38	74	0.5		2.2	Monthly
	8/11/2021	UP- 437	0	3.18	7.49	0.009	0.62	4.92	51	0.02	0.23	3.32	0	0.22		38	77	0.5		2.2	alternate TOC weekly sample between these 9 sites
	8/11/2021	UP-647	0	2.72	7.53	0.005	0.58	4.42	50	0.02	0.23	2.89	0	0.10		38	76	0.5			
	8/11/2021	UP-187	0	2.78	7.51	0.009	0.61	4.18	51	0.03	0.22	2.77	0	0.07		38	76	0.5			
	8/11/2021	UP-629	0	2.31	7.54	0.012	0.65	4.22	50	0.22	0.29	2.52	0.01	0.05		38	75	0.5			
	8/11/2021	UP-713	0	2.75	7.51	0.007	0.61	4.22	50	0.2	0.28	2.74	0	0.05		38	76	0.5			
	8/11/2021	UP-644	0	2.29	7.54	0.011	0.72	4.23	51	0.18	0.34	2.22	0	0.02		38	75	0.5			
	8/11/2021	UP-222	0	2.22	7.53	0.009	0.7	4.32	51	0.22	0.4	2.18	0	0.03		38	76	0.5			
	8/11/2021	UP-649	0	2.09	7.52	0.009	0.73	4.24	50	0.06	0.36	2.06	0	0.02		38	75	0.5			
	8/11/2021	UP WWTP	0.04	2.11	7.58	0.01	0.82	4.24	51	0.03	0.26	2.16	0	0.03		37	74	0.5			
	8/11/2021	UP-612	0	2.1	7.57	0.011	0.73	4.42	51	0.18	0.35	2.06								NA	
	8/11/2021	UP WWTP Men's Room	0.06	1.91	7.58	0.025	0.78	4.4	54	0.04	0.3	1.91								NA	
	8/11/2021	BN-2098	0	3.46	8.36	0.007	0.56		54	0.01	0.11	3.5								NA	
	8/11/2021	MT-2810	0	3.09	8.11	0.004	0.54		51	0.01	0.05	3.32								NA	
15-Aug	8/17/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.003	1.36	NA	Daily	NA	NA	NA	NA	NA		38	76	0.5			Monthly
	8/17/2021	UP- 437	0	2.88	7.52	0.007	0.69	3.24	51	0.02	0.14	3.08	0	0.20		39	76	0.5			alternate TOC weekly sample between these 9 sites
	8/17/2021	UP-647	0	2.5	7.54	0.007	0.66	3.38	50	0.02	0.17	2.62	0	0.08		39	76	0.5		2.5	
	8/17/2021	UP-187	0	2.49	7.51	0.009	0.66	3.24	51	0.03	0.16	2.52	0	0.06		39	77	0.5			
	8/17/2021	UP-629	0	2.08	7.53	0.012	0.67	3.32	52	0.14	0.23	2.08	0	0.03		39	77	0.5			
	8/17/2021	UP-713	0	2.34	7.54	0.009	0.66	3.28	51	0.43	0.15	2.45	0.01	0.05		39	77	0.5			
	8/17/2021	UP-644	0	2.07	7.59	0.014	0.64	3.28	52	0.2	0.24	1.95	0.01	0.02		39	78	0.5			
	8/17/2021	UP-222	0	2.09	7.57	0.009	0.65	3.38	52	0.24	0.21	1.92	0.01	0.03		39	79	0.5			
	8/17/2021	UP-649	0	1.79	7.57	0.021	0.7	3.46	53	0.05	0.19	1.79	0.01	0.02		40	79	0.5			
	8/17/2021	UP WWTP	0	1.94	7.6	0.01	0.64	3.46	52	0.03	0.23	1.99	0	0.03		39	79	0.5			
	8/17/2021	UP-612	0	2.22	7.55	0.011	0.64	3.28	51	0.62	0.18	2.29								NA	
	8/17/2021	UP WWTP Men's Room	0	1.83	7.57	0.022	0.65	3.34	51	0.05	0.25	1.84								NA	
	8/17/2021	BN-2098	0	3.24	8.12	0.008	1.13		55	0.02	0.1	3.51								NA	
	8/17/2021	MT-2810	0	3.2	8.05	0.007	0.99		58	0.01	0.12	3.45								NA	
22-Aug	8/24/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.003	0.42	NA	Daily	NA	NA	NA	NA	NA		37	76	0.5			Monthly
	8/24/2021	UP- 437	0	3.08	7.5	0.01	0.5	3.58	49	0.02	0.1	3.08	0	0.22		37	74	0.5			ernate TOC weekly nple between these 9 es
	8/24/2021	UP-647	0	2.5	7.57	0.009	0.59	3.42	50	0.02	0.15	2.38	0	0.12		37	73	0.5			
	8/24/2021	UP-187	0	2.44	7.51	0.01	0.6	3.26	50	0.03	0.08	2.4	0	0.10		37	74	0.5		2.8	
	8/24/2021	UP-629	0	1.91	7.58	0.013	0.67	3.34	50	0.09	0.13	1.91	0	0.05		37	73	0.5			
	8/24/2021	UP-713	0	2.32	7.56	0.01	0.63	3.3	50	0.12	0.1	2.26	0	0.09		37	73	0.5			
	8/24/2021	UP-644	0	1.99	7.58	0.012	0.68	3.32	52	0.19	0.11	1.98	0.01	0.05		37	73	0.5			
	8/24/2021	UP-222	0	1.87	7.57	0.011	0.69	3.38	51	0.17	0.31	1.76	0.01	0.05		37	73	0.5			
	8/24/2021	UP-649	0	1.68	7.56	0.011	0.72	3.38	51	0.31	0.39	1.6	0.01	0.04		37	72	0.5			

	8/24/2021	UP WWTP	0	1.92	7.59	0.009	0.86	3.34	52	0.02	0.15	1.94	0	0.05		38	75	0.5				alt sa sit
	8/24/2021	UP-612	0	1.85	7.58	0.011	0.75	3.52	52	0.62	0.23	1.77									NA	
	8/24/2021	UP WWTP Men's Room	0	1.62	7.52	0.024	0.83	3.58	50	0.06	0.2	1.6									NA	
	8/24/2021	BN-2098	0	3.75	8.85	0.008	0.42		53	0.01	0	4.17									NA	
	8/24/2021	MT-2810	0	3.28	8.25	0.008	0.44		50	0.01	0	3.58									NA	
29-Aug	8/31/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.003	0.41	NA	Daily	NA	NA	NA	NA	NA		39	80	0.5				Monthly
	8/31/2021	UP- 437	0	2.58	7.47	0.008	0.67	3.558	51	0.04	0.12	2.95	0	0.25		39	73	0.5				alternate TOC weekly sample between these 9 sites
	8/31/2021	UP-647	0	2.38	7.52	0.005	0.66	3.66	50	0.03	0.16	2.48	0	0.14		39	70	0.6				
	8/31/2021	UP-187	0	2.44	7.47	0.007	0.7	3.4	51	0.02	0.17	2.42	0	0.13		39	70	0.6				
	8/31/2021	UP-629	0	2.03	7.52	0.009	0.68	3.62	51	0.01	0.19	2.08	0.01	0.08		38	69	0.6			2.5	
	8/31/2021	UP-713	0	2.29	7.57	0.005	0.68	3.48	51	0.34	0.18	2.34	0.01	0.11		39	70	0.6				
	8/31/2021	UP-644	0	1.96	7.5	0.008	0.66	3.56	50	0.22	0.23	2	0.01	0.07		38	69	0.6				
	8/31/2021	UP-222	0	1.8	7.51	0.006	0.64	3.5	52	0.11	0.23	1.86	0	0.07		38	70	0.5				
	8/31/2021	UP-649	0	1.82	7.56	0.006	0.67	3.66	52	0.09	0.22	1.83	0	0.07		37	69	0.5				
	8/31/2021	UP WWTP	0	1.77	7.56	0.012	0.7	3.5	51	0.04	0.18	1.79	0	0.08		38	69	0.6				
	8/31/2021	UP-612	0	2.06	7.63	0.004	0.68	3.66	52	0.64	0.29	2.07									NA	
	8/31/2021	UP WWTP Men's Room	0	1.62	7.51	0.021	0.66	3.62	53	0.06	0.21	1.63									NA	
	8/31/2021	BN-2098	0	2.82	8.11	0.003	0.42		52	0.02	0	2.96									NA	
	8/31/2021	MT-2810	0	3.13	8.14	0.005	0.59		55	0.01	0.07	3.45									NA	
5-Sep	9/9/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.003	0.43	NA	Daily	NA	NA	NA	NA	NA		39	77	0.5		9/8/2021	2.7	Monthly
	9/9/2021	UP- 437	0	2.74	7.51	0.008	0.19	2.64	51	0.05	0.13	3.02	0	0.23		45	88	0.5				alternate TOC weekly sample between these 9 sites
	9/9/2021	UP-647	0	2.34	7.59	0.01	0.19	2.84	50	0.04	0.22	2.46	0	0.16		43	89	0.5				
	9/9/2021	UP-187	0	2.2	7.57	0.006	0.18	3.04	50	0.44	0.23	2.22	0	0.16		42	87	0.5				
	9/9/2021	UP-629	0	1.74	7.58	0.012	0.21	3.24	56	0.33	0.26	1.72	0	0.07		43	87	0.5				
	9/9/2021	UP-713	0	2.21	7.61	0.008	0.21	3.02	51	0.88	0.21	2.28	0.01	0.18		45	87	0.5			2.5	
	9/9/2021	UP-644	0	1.95	7.6	0.01	0.2	3.14	52	0.43	0.3	1.96	0.01	0.08		42	86	0.5				
	9/9/2021	UP-222	0	1.96	7.6	0.006	0.2	3.66	50	0.67	0.31	1.87	0.02	0.09		43	89	0.5				
	9/9/2021	UP-649	0	1.75	7.57	0.009	0.2	2.9	51	0.09	0.34	1.71	0.01	0.07		43	87	0.5				
	9/9/2021	UP WWTP	0	1.84	7.58	0.011	0.18	2.88	52	0.02	0.29	1.77	0	0.09		41	83	0.5				
	9/9/2021	UP-612	0	2.24	7.56	0.01	0.19	2.86	51	0.47	0.25	2.1									NA	
	9/9/2021	UP WWTP Men's Room	0	1.63	7.5	0.024	0.21	2.9	52	0.05	0.29	1.62									NA	
	9/9/2021	BN-2098	0	3.47	8.12	0.007	0.31	NA	59	0.01	0.03	3.74									NA	
	9/9/2021	MT-2810	0	3.24	8.27	0.007	0.3	NA	56	0.01	0.09	3.51									NA	
12-Sep	9/14/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.002	0.21	NA	Daily	NA	NA	NA	ND	ND		40	80	0.5				Monthly
	9/14/2021	UP- 437	0	2.51	7.53	0.004	0.5	3.15	52	0.02	0	3.03	ND	0.29		38	73	0.5				alternate TOC weekly sample between these 9 sites
	9/14/2021	UP-647	0	2.51	7.59	0.004	0.49	3.42	52	0.03	0.19	2.61	ND	0.17		38	75	0.5				
	9/14/2021	UP-187	0	2.35	7.53	0.001	0.48	3.22	53	0.17	0.18	2.58	ND	0.17		38	75	0.5				
	9/14/2021	UP-629	0	2.16	7.63	0.008	0.45	3.32	54	0.38	0.25	2.26	0.01	0.13		39	78	0.5				
	9/14/2021	UP-713	0	2.39	7.61	0.005	0.49	3.54	54	0.57	0.16	2.51	0.01	0.15		39	76	0.5				
	9/14/2021	UP-644	0	2.1	7.62	0	0.43	3.58	54	0.65	0.26	2.09	0.01	0.09		39	72	0.5			2.6	
	9/14/2021	UP-222	0	2.1	7.58	0.008	0.4	3.44	53	0.41	0.22	2.01	0.01	0.10		40	79	0.5				
	9/14/2021	UP-649	0	1.85	7.56	0.014	0.4	3.3	55	0.11	0.2	1.86	0.01	0.08		40	81	0.5				
	9/14/2021	UP WWTP	0	1.87	7.64	0.009	0.35	3.28	54	0.02	0.24	1.9	ND	0.08		40	82	0.5				
	9/14/2021	UP-612	0	2.32	7.56	0.001	0.43	3.58	53	0.67	0.29	2.23									NA	
	9/14/2021	UP WWTP Men's Room	0	1.74	7.58	0.029	0.39	3.28	52	0.13	0.25	1.74									NA	
	9/14/2021	BN-2098	0	3.31	8.21	0.005	0.21	NA	58	0.02	0.01	3.64									NA	
	9/14/2021	MT-2810	0	2.99	8.06	0.003	0.22	NA	56	0.01	0.02	3.18									NA	
19-Sep	9/22/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.007	0.24	NA	Daily	NA	NA	NA	ND	ND		44	94	0.5				Monthly
	9/22/2021	UP- 437	0	2.69	7.54	0.004	0.15	3.24	52	0.02	0.21	2.88	ND	0.24		42	88	0.5				alternate TOC weekly sample between these 9 sites
	9/22/2021	UP-647	0.02	2.35	7.59	0.005	0.03	3	50	0.03	0.24	2.43	ND	0.18		42	86	0.5				
	9/22/2021	UP-187	0	1.96	7.6	0.004	0.02	2.86	50	0.14	0.23	2.5	ND	0.18		42	87	0.5				
	9/22/2021	UP-629	0.14	2.15	7.6	0.007	0.11	3.02	51	0.43	0.25	2.26	0.01	0.13		42	86	0.5				
	9/22/2021	UP-713	0.01	2.23	7.62	0.006	0.07	2.96	50	0.48	0.24	2.24	0.01	0.15		42	87	0.5				
	9/22/2021	UP-644	0.19	2.07	7.59	0.011	0.04	2.98	52	0.64	0.26	1.96	0.01	0.10		42	86	0.5				
	9/22/2021	UP-222	0	1.72	7.58	0.006	0.05	3.02	52	0.63	0.26	1.8	0.01	0.12		42	85	0.5			2.5	
	9/22/2021	UP-649	0	1.7	7.56	0.012	0.07	2.92	50	0.21	0.26	1.68	ND	0.09		42	85	0.5				
	9/22/2021	UP WWTP	0.02	1.91	7.66	0.008	..04	2.9	51	0.02	0.25	1.88	ND	0.11		41	85	0.5				
	9/22/2021	UP-612	0.05	2.06	7.6	0.002	0.07	3.04	51	0.81	0.23	2.18									NA	
	9/22/2021	UP WWTP Men's Room	0.02	1.58	7.57	0.027	0.11	2.96	51	0.05	0.26	1.47									NA	
	9/22/2021	BN-2098	0	3.28	8.06	0.003	0.11	NA	51	0.01	0.14	3.59									NA	
	9/22/2021	MT-2810	0.01	2.24	8.05	0.003	0.05	NA	50	0.01	0.09	2.25									NA	

26-Sep	9/28/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.003	0.49	NA	Daily	NA	NA	NA	ND	ND		42	89	0.5				Monthly
	9/28/2021	UP- 437	0	2.76	7.49	0.005	0.4	3.32	49	0.02	0.15	3.02	ND	0.31		43	91	0.5				alternate TOC weekly sample between these 9 sites
	9/28/2021	UP-647	0.04	2.29	7.51	0.004	0.3	3.4	49	0.03	0.23	2.42	ND	0.22		43	92	0.5				
	9/28/2021	UP-187	0.01	2.18	7.54	0.008	0.32	3.28	50	0.16	0.24	2.18	ND	0.17		43	92	0.5				
	9/28/2021	UP-629	0	2.32	7.5	0.004	0.3	3.44	50	0.09	0.19	2.44	ND	0.20		43	92	0.5				
	9/28/2021	UP-713	0	2.1	7.51	0.006	0.28	3.34	51	0.34	0.22	2.2	0.01	0.18		43	92	0.5				
	9/28/2021	UP-644	0	1.91	7.55	0.011	0.34	3.46	51	0.53	0.27	1.94	0.01	0.12		44	92	0.5				
	9/28/2021	UP-222	0	1.81	7.52	0.008	0.28	3.34	50	0.36	0.24	1.74	0.01	0.13		44	93	0.5				
	9/28/2021	UP-649	0.02	1.8	7.48	0.016	0.34	3.22	51	0.28	0.14	1.81	0.01	0.13		44	93	0.5			2.4	
	9/28/2021	UP WWTP	0.02	1.86	7.59	0.01	0.28	3.3	51	0.03	0.28	1.86	ND	0.14		44	93	0.5				
	9/28/2021	UP-612	0	2.11	7.51	0	0.34	3.36	51	0.71	0.17	2.13									NA	
	9/28/2021	UP WWTP Men's Room	0.05	1.46	7.53	0.023	0.29	3.14	48	0.06	0.3	1.43									NA	
	9/28/2021	BN-2098	0	3.82	8.53	0.005	0.49	NA	45	0.01	0	4.23									NA	
	9/28/2021	MT-2810	0	3.18	8.21	0.005	0.47	NA	52	0.01	0.1	3.57									NA	
3-Oct	10/5/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.004	1.69	NA	Daily	NA	NA	NA	ND	ND		35	61	0.6				Monthly
	10/5/2021	UP- 437	0	2.84	7.56	0.009	0.43	3.64	52	0.01	0.14	3.01	ND	0.30		41	88	0.5				alternate TOC weekly sample between these 9 sites
	10/5/2021	UP-647	0	2.51	7.58	0.007	0.39	3.86	51	0.01	0.18	2.62	ND	0.22		41	87	0.5				
	10/5/2021	UP-187	0.18	2.56	7.61	0.005	0.36	3.6	51	0.16	0.21	2.49	0.01	0.24		41	87	0.5				
	10/5/2021	UP-629	0.05	2.49	7.57	0.007	0.38	3.44	52	0.16	0.18	2.61	ND	0.18		41	88	0.5				
	10/5/2021	UP-713	0	2.4	7.59	0.008	0.37	3.66	51	0.43	0.17	2.49	0.01	0.20		41	88	0.5				
	10/5/2021	UP-644	0.04	2.04	7.63	0.016	0.43	3.48	52	0.39	0.22	2.12	0.01	0.13		41	88	0.5				
	10/5/2021	UP-222	0	1.88	7.62	0.015	0.4	3.48	51	0.26	0.26	1.81	ND	0.13		41	87	0.5				
	10/5/2021	UP-649	0.19	1.99	7.56	0.014	0.46	3.46	53	0.18	0.22	1.97	ND	0.13		41	87	0.5				
	10/5/2021	UP WWTP	0.05	2.11	7.59	0.011	0.42	3.52	51	0.01	0.24	2.21	ND	0.14		41	87	0.5			2.6	
	10/5/2021	UP-612	0.04	2.36	7.6	0.005	0.44	3.62	51	1.02	0.19	2.45									NA	
	10/5/2021	UP WWTP Men's Room	0.07	1.84	7.59	0.023	0.47	3.42	52	0.14	0.26	1.85									NA	
	10/5/2021	BN-2098	0	3.39	8.47	0.006	1.75	NA	52	0	0	3.67									NA	
	10/5/2021	MT-2810	0	3.14	8.26	0.009	0.73	NA	54	0	0.11	3.5									NA	
10-Oct	10/12/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.006	2.03	NA	Daily	NA	NA	NA	ND	ND		39	69	0.6				Monthly
	10/12/2021	UP- 437	0	2.79	7.52	0.004	1.41	3.1	50	0.01	0.16	2.83	ND	0.28		37	66	0.6			3.5	alternate TOC weekly sample between these 9 sites
	10/12/2021	UP-647	0.14	2.33	7.55	0.006	1.42	2.96	50	0.04	0.21	2.22	ND	0.22		37	64	0.6				
	10/12/2021	UP-187	0	2.38	7.51	0.006	1.24	3.28	49	0.03	0.22	2.23	ND	0.21		37	64	0.6				
	10/12/2021	UP-629	0.06	2.16	7.54	0.002	1.44	3.2	50	0.1	0.22	2.02	ND	0.15		37	65	0.6				
	10/12/2021	UP-713	0.01	2.14	7.52	0.006	1.31	3.38	50	0.25	0	2.04	0.01	0.23		37	64	0.6				
	10/12/2021	UP-644	0.03	2.06	7.6	0.011	1.03	3.24	50	0.29	0.24	1.94	ND	0.13		38	64	0.6				
	10/12/2021	UP-222	0.12	2.02	7.55	0.009	1.08	3.62	51	0.08	0.24	1.89	ND	0.15		38	64	0.6				
	10/12/2021	UP-649	0.15	1.82	7.5	0.01	1.3	3.7	50	0.05	0.26	1.75	ND	0.14		38	65	0.6				
	10/12/2021	UP WWTP	0.2	1.91	7.57	0.01	1.27	3.52	51	0.05	0.26	1.81	ND	0.20		38	65	0.6				
	10/12/2021	UP-612	0.06	1.83	7.61	0.012	1.37	3.64	51	0.65	0.28	1.66									NA	
	10/12/2021	UP WWTP Men's Room	0.12	0.65	7.32	0.284	1.36	3.58	49	0.07	0.07	0.56									NA	
	10/12/2021	BN-2098	0	3.53	8.53	0.003	1.17	NA	56	0	0.44	2.04									NA	
	10/12/2021	MT-2810	0	3.43	8.21	0.006	1.56	NA	54	0	0.13	3.41									NA	
17-Oct	10/19/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.002	2.58	NA	Daily	NA	NA	NA	ND	0.01		42	77	0.5				Monthly
	10/19/2021	UP- 437	0	2.7	7.45	0.006	2.43	3.52	53	0.01	0.19	2.69	ND	0.32		38	58	0.7				alternate TOC weekly sample between these 9 sites
	10/19/2021	UP-647	0.11	2.39	7.47	0.006	1.99	3.82	53	0.04	0.22	2.29	ND	0.25		40	63	0.6			3.1	
	10/19/2021	UP-187	0.06	2.28	7.49	0.006	1.89	3.26	52	0.06	0.25	2.1	ND	0.23		40	64	0.6				
	10/19/2021	UP-629	0	2.17	7.49	0.007	1.29	3.28	52	0.09	0.24	2.07	ND	0.19		39	62	0.6				
	10/19/2021	UP-713	0.09	2.34	7.48	0.006	1.21	3.42	54	0.24	0.25	2.18	0.01	0.24		39	62	0.6				
	10/19/2021	UP-644	0	2.16	7.49	0.01	1.9	3.3	54	0.18	0.25	1.99	0.01	0.16		40	65	0.6				
	10/19/2021	UP-222	0.5	1.97	7.48	0.011	1.91	3.2	54	0.12	0.28	1.72	ND	0.16		40	66	0.6				
	10/19/2021	UP-649	0.29	1.9	7.5	0.011	1.66	3.22	51	0.03	0.25	1.76	ND	0.15		40	66	0.6				
	10/19/2021	UP WWTP	0.08	1.83	7.5	0.008	0.78	3.4	52	0.38	0.29	1.74	ND	0.21		39	67	0.6				
	10/19/2021	UP-612	0.09	1.88	7.53	0.013	1.42	3.44	53	0.43	0.26	1.81									NA	
	10/19/2021	UP WWTP Men's Room	0.1	1.4	7.42	0.035	1.57	3.2	52	0.05	0.26	1.34									NA	
	10/19/2021	BN-2098	0.1	3.73	8.16	0.004	2.26	NA	54	0	0	3.68									NA	
	10/19/2021	MT-2810	0	3.39	8.02	0.003	2.42	NA	52	0.01	0.07	3.31									NA	
24-Oct	10/26/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.35	NA	Daily	NA	NA	NA	ND	0.01		39	22	1.8			3.7	Monthly
	10/26/2021	UP- 437	0.2	3.04	7.52	0.008	2.32	4.2	51	0.02	0.23	3.32	ND	0.37		42	92	0.5				eekly n these 9
	10/26/2021	UP-647	0.07	2.86	7.57	0.007	2.44	3.98	52	0.04	0.15	2.9	ND	0.30		39	85	0.5				
	10/26/2021	UP-187	0.25	2.64	7.54	0.005	2.34	3.9	53	0.08	0.16	2.84	ND	0.29		41	88	0.5			3.2	
	10/26/2021	UP-629	0.17	2.34	7.56	0.01	2.58	3.62	52	0.23	0.16	2.46	ND	0.22		42	89	0.5				

	10/26/2021	UP-713	0.2	2.59	7.58	0.01	2.54	3.84	53	0.3	0.16	2.64	ND	0.26		43	91	0.5				alternate TOC w sample betweer sites
	10/26/2021	UP-644	0.25	2.2	7.57	0.012	2.59	3.98	51	0.32	0.21	2.28	0.01	0.18		43	90	0.5				
	10/26/2021	UP-222	0.29	1.86	7.55	0.001	2.65	3.52	52	0.16	0.21	2.02	ND	0.18		43	89	0.5				
	10/26/2021	UP-649	0.11	1.92	7.59	0.018	2.64	3.46	52	0.19	0.21	1.94	ND	0.16		46	92	0.5				
	10/26/2021	UP WWTP	0.14	2.24	7.61	0.008	2.57	3.56	52	0.1	0.18	2.31	ND	0.22		43	86	0.5				
	10/26/2021	UP-612	0.09	1.57	7.64	0.017	2.68	3.3	51	0.35	0.09	1.57									NA	
	10/26/2021	UP WWTP Men's Room	0.2	1.81	7.59	0.02	2.59	3.36	52	0.05	0.23	1.73									NA	
	10/26/2021	BN-2098	0.07	3.16	8.18	0.008	1.71	NA	78	0.01	0.21	3.42									NA	
	10/26/2021	MT-2810	0	3.25	8.3	0.008	1.86	NA	54	0.01	0.06	3.56									NA	
31-Oct	10/30/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.35	NA	Daily	NA	NA	NA	ND	ND		38	51	0.7				Monthly
	10/30/2021	UP- 437	0.2	3.04	7.52	0.008	2.32	4.2	51	0.02	0.23	3.32	ND	0.31		38	44	0.9				alternate TOC weekly sample between these 9 sites
	10/30/2021	UP-647	0.07	2.86	7.57	0.007	2.44	3.98	52	0.04	0.15	2.9	ND	0.30		39	44	0.9				
	10/30/2021	UP-187	0.25	2.64	7.54	0.005	2.34	3.9	53	0.08	0.16	2.84	ND	0.27		39	45	0.9			3	
	10/30/2021	UP-629	0.17	2.34	7.56	0.01	2.58	3.62	52	0.23	0.16	2.46	ND	0.26		39	45	0.9				
	10/30/2021	UP-713	0.2	2.59	7.58	0.01	2.54	3.84	53	0.3	0.16	2.64	ND	0.28		39	46	0.8				
	10/30/2021	UP-644	0.25	2.2	7.57	0.012	2.59	3.98	51	0.32	0.21	2.28	0.01	0.15		40	61	0.7				
	10/30/2021	UP-222	0.29	1.86	7.55	0.001	2.65	3.52	52	0.16	0.21	2.02	0.01	0.22		40	54	0.7				
	10/30/2021	UP-649	0.11	1.92	7.59	0.018	2.64	3.46	52	0.19	0.21	1.94	ND	0.19		41	60	0.7				
	10/30/2021	UP WWTP	0.14	2.24	7.61	0.008	2.57	3.56	52	0.1	0.18	2.31	ND	0.23		40	64	0.6				
	10/30/2021	UP-612	0.09	1.57	7.64	0.017	2.68	3.3	51	0.35	0.09	1.57									NA	
	10/30/2021	UP WWTP Men's Room	0.2	1.81	7.59	0.02	2.59	3.36	52	0.05	0.23	1.73									NA	
	10/30/2021	BN-2098	0.07	3.16	8.18	0.008	1.71	NA	78	0.01	0.21	3.42									NA	
	10/30/2021	MT-2810	0	3.25	8.3	0.008	1.86	NA	54	0.01	0.06	3.56									NA	
31-Oct	11/2/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.005	4.12	NA	Daily	NA	NA	NA	ND	ND		31	55	0.6				Monthly
	11/2/2021	UP- 437	0	2.75	7.58	0.007	2.97	3.08	51	0.02	0.13	3.05	ND	0.25		30	41	0.7				alternate TOC weekly sample between these 9 sites
	11/2/2021	UP-647	0.04	2.54	7.59	0.008	2.71	3.5	52	0.02	0.14	2.74	ND	0.23		31	41	0.8				
	11/2/2021	UP-187	0.07	2.66	7.57	0.009	2.65	3.24	51	0.05	0.19	2.72	ND	0.23		31	41	0.8				
	11/2/2021	UP-629	0.07	2.47	7.56	0.008	2.68	3.52	50	0.24	0.15	2.63	0.03	0.24		33	44	0.8			3.2	
	11/2/2021	UP-713	0	2.5	7.54	0.007	2.65	3.26	50	0.25	0.13	2.63	0.01	0.25		31	40	0.8				
	11/2/2021	UP-644	0	2.18	7.61	0.012	2.51	3.72	51	0.24	0.21	2.29	0.02	0.19		31	37	0.8				
	11/2/2021	UP-222	0.02	2.19	7.62	0.01	2.51	3.42	52	0.11	0.2	2.22	ND	0.18		32	39	0.8				
	11/2/2021	UP-649	0.03	2.06	7.54	0.015	2.48	3.68	52	0.06	0.18	2.1	ND	0.16		32	39	0.8				
	11/2/2021	UP WWTP	0.04	2.1	7.61	0.013	2.34	3.56	53	0.02	0.16	2.23	ND	0.18		32	38	0.8				
	11/2/2021	UP-612	0.01	2.23	7.58	0.008	2.39	3.66	53	0.06	0.19	2.45									NA	
	11/2/2021	UP WWTP Men's Room	0.05	1.88	7.63	0.019	2.43	3.6	53	0.03	0.28	1.42									NA	
	11/2/2021	BN-2098	0	3.51	8.57	0.007	3.97	NA	57	0.02	0.05	3.97									NA	
	11/2/2021	MT-2810	0	3.22	8.34	0.008	3.48	NA	59	0.02	0.09	3.53									NA	
7-Nov	11/9/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.006	2.81	NA	Daily	NA	NA	NA	ND	ND		38	91	0.4		11/9/2021	3.6	Monthly
	11/9/2021	UP- 437	0	2.78	7.54	0.007	3.5	3.72	52	0.03	0.16	2.91	ND	0.26		36	81	0.4				alternate TOC weekly sample between these 9 sites
	11/9/2021	UP-647	0	2.37	7.52	0.006	3.73	3.86	51	0.01	0.18	2.47	ND	0.28		36	78	0.5				
	11/9/2021	UP-187	0.02	2.42	7.48	0.007	3.75	3.68	51	0.05	0.17	2.41	ND	0.27		36	78	0.5				
	11/9/2021	UP-629	0.07	2.17	7.55	0.008	3.82	3.66	53	0.33	0.22	2.05	0.01	0.22		36	76	0.5				
	11/9/2021	UP-713	0.05	2.22	7.55	0.005	3.87	3.62	52	0.73	0.21	2.21	0.01	0.28		36	76	0.5			3.9	
	11/9/2021	UP-644	0	2.11	7.51	0.007	3.44	3.8	52	0.48	0.24	2.07	0.01	0.22		36	75	0.5				
	11/9/2021	UP-222	0.03	2.01	7.51	0.011	3.48	3.56	54	0.32	0.23	1.92	0.01	0.23		36	75	0.5				
	11/9/2021	UP-649	0.07	1.89	7.48	0.017	3.57	3.68	53	0.05	0.24	1.85	ND	0.22		36	74	0.5				
	11/9/2021	UP WWTP	0.05	2.07	7.58	0.009	3.67	3.72	53	0.03	0.25	1.96	ND	0.22		35	73	0.5				
	11/9/2021	UP-612	0.04	1.86	7.47	0.008	3.93	3.98	52	0.18	0.26	1.91									NA	
	11/9/2021	UP WWTP Men's Room	0.11	1.82	7.55	0.016	3.91	3.82	53	0.05	0.24	1.8									NA	
	11/9/2021	BN-2098	0	2.89	8.39	0	2.45	NA	53	0.04	0.03	3.16									NA	
	11/9/2021	MT-2810	0	3.56	8.36	0	2.75	NA	55	0.03	0.13	3.75									NA	
14-Nov	11/16/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.1	NA	Daily	NA	NA	NA	ND	ND		36	84	0.4				Monthly
	11/16/2021	UP- 437	0.09	2.63	7.51	0.009	2.11	4.44	47	0.02	0.11	3.01	ND	0.36		37	85	0.4				alternate TOC weekly sample between these 9 sites
	11/16/2021	UP-647	0.11	2.69	7.53	0.007	2.23	4.42	48	0.02	0.16	2.73	ND	0.40		37	86	0.4				
	11/16/2021	UP-187	0.1	2.43	7.53	0.008	2.3	4.14	49	0.05	0.22	2.51	ND	0.38		37	85	0.4				
	11/16/2021	UP-629	0.07	2.49	7.54	0.008	2.23	4.58	49	0.26	0.19	2.6	ND	0.37		37	85	0.4				
	11/16/2021	UP-713	0.09	2.44	7.55	0.007	2.17	4.48	49	0.58	0.21	2.54	0.01	0.39		37	86	0.4				
	11/16/2021	UP-644	0.03	2.31	7.58	0.012	2.28	4.76	49	0.94	0.25	2.36	0.02	0.35		37	85	0.4			3.3	
	11/16/2021	UP-222	0	2.32	7.47	0.014	2.27	4.42	48	0.37	0.26	2.21	0.01	0.33		37	85	0.4				
	11/16/2021	UP-649	0	2.25	7.54	0.021	2.25	4.46	48	0.156	0.26	2.12	ND	0.30		37	85	0.4				
	11/16/2021	UP WWTP	0.04	2.38	7.58	0.008	2.21	4.4	50	0.02	0.23	2.46	ND	0.33		37	85	0.4				

	11/16/2021	UP-612	0	2.27	7.48	0.008	2.42	4.66	48	0.08	0.25	2.52								NA	
	11/16/2021	UP WWTP Men's Room	0.12	2.26	7.53	0.011	2.38	4.44	49	0.06	0.28	2.21								NA	
	11/16/2021	BN-2098	0	3.25	8.71	0.008	2.1	NA	55	0.01	0.08	3.64								NA	
	11/16/2021	MT-2810	0.03	3.17	8.4	0.009	2.2	NA	50	0.02	0.09	3.58								NA	
21-Nov	11/22/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.35	NA	Daily	NA	NA	NA	ND	ND		35	81	0.4			Monthly
	11/22/2021	UP- 437	0.12	3	7.54	0.008	2.22	4.52	51	0.05	0.06	3.37	ND	0.42		36	81	0.4			alternate TOC weekly sample between these 9 sites
	11/22/2021	UP-647	0.02	2.84	7.59	0.006	2.06	4.72	50	0.04	0.13	2.95	ND	0.41		35	81	0.4			
	11/22/2021	UP-187	0.03	2.64	7.56	0.004	2.1	4.6	49	0.07	0.16	2.82	ND	0.39		35	80	0.4			
	11/22/2021	UP-629	0.03	2.43	7.55	0.009	2.14	4.58	49	0.52	0.18	2.51	0.01	0.39		36	81	0.4			
	11/22/2021	UP-713	0	2.6	7.53	0.007	2.08	4.48	49	0.23	0.16	2.68	ND	0.39		36	81	0.4			
	11/22/2021	UP-644	0	2.46	7.58	0.006	2.11	4.72	50	1.22	0.2	2.49	0.02	0.37		36	81	0.4			
	11/22/2021	UP-222	0	2.41	7.54	0.008	2.08	4.52	49	0.55	0.2	2.41	0.01	0.35		36	81	0.4		3.2	
	11/22/2021	UP-649	0.09	2.16	7.56	0.013	2.1	4.5	50	0.07	0.2	2.3	ND	0.31		36	81	0.4			
	11/22/2021	UP WWTP	0	2.51	7.54	0.007	2.12	4.34	48	0.02	0.21	2.46	ND	0.33		35	81	0.4			
	11/22/2021	UP-612	0	2.48	7.59	0.002	2.11	4.24	50	0.11	0.21	2.47								NA	
	11/22/2021	UP WWTP Men's Room	0.06	2.03	7.57	0.012	2.13	4.16	49	0.03	0.24	2.03								NA	
	11/22/2021	BN-2098	0	3.29	8.5	0.007	2.64	NA	59	0.01	0	3.61								NA	
	11/22/2021	MT-2810	0	3.45	8.64	0.008	2.26	NA	55	0.01	0.04	3.56								NA	
28-Nov	11/30/2021	Kankakee WTP (TP01)	NA	NA	Daily	0.004	2.14	NA	Daily	NA	NA	NA	ND	ND		38	88	0.4			Monthly
	11/30/2021	UP- 437	0.03	3.07	7.5	0.004	2.4	5	55	0.02	0.07	3.24	ND	0.42		37	89	0.4			alternate TOC weekly sample between these 9 sites
	11/30/2021	UP-647	0.08	3.1	7.55	0.004	2.49	4.76	58	0.02	0.11	2.8	ND	0.38		37	88	0.4			
	11/30/2021	UP-187	0.07	2.73	7.58	0.008	2.53	4.8	58	0.04	0.12	2.61	ND	0.38		37	88	0.4			
	11/30/2021	UP-629	0	2.81	7.56	0.006	2.54	4.7	59	0.19	0.16	2.38	ND	0.31		38	88	0.4			
	11/30/2021	UP-713	0	2.87	7.51	0.004	2.55	4.92	59	0.14	0.14	2.65	ND	0.36		37	88	0.4			
	11/30/2021	UP-644	0	2.53	7.58	0.01	2.56	4.82	59	0.78	0.16	2.44	ND	0.35		37	89	0.4			
	11/30/2021	UP-222	0.01	2.26	7.57	0.008	2.52	4.82	57	0.43	0.13	2.41	ND	0.36		37	88	0.4			
	11/30/2021	UP-649	0	2.1	7.55	0.01	2.56	4.8	57	0.08	0.15	2.18	ND	0.32		37	88	0.4		3.0	
	11/30/2021	UP WWTP	0.12	2.89	7.59	0.007	2.52	4.82	58	0.04	0.14	2.58	ND	0.33		37	89	0.4			
	11/30/2021	UP-612	0	2.63	7.53	0.005	2.55	4.9	55	0.1	0.14	2.54								NA	
	11/30/2021	UP WWTP Men's Room	0.17	2.62	7.55	0.013	2.54	4.86	58	0.04	0.3	1.6								NA	
	11/30/2021	BN-2098	0	3.83	8.28	0.004	2.21	NA	59	0	0	3.65								NA	
	11/30/2021	MT-2810	0	3.55	8.29	0.007	2.26	NA	58	0.01	0	3.36								NA	
5-Dec	12/7/21	Kankakee WTP (TP01)	NA	NA	Daily	0.006	1.86	NA	Daily	NA	NA	NA	ND	ND	ND	38	91	0.4	12/8/2021	2.9	Monthly
	12/7/21	UP- 437	0.06	2.94	7.44	0.007	2.16	4.92	56	0.02	0.08	3.3	ND	0.44	0.40	38	89	0.4			alternate TOC weekly sample between these 9 sites
	12/7/21	UP-647	0.08	2.79	7.5	0.009	2.18	5.06	55	0.02	0.09	2.92	ND	0.45	0.40	38	89	0.4			
	12/7/21	UP-187	0.1	2.66	7.54	0.008	2.16	4.98	56	0.2	0.11	2.89	ND	0.45	0.38	38	89	0.4			
	12/7/21	UP-629	0.02	2.51	7.59	0.009	2.13	4.88	56	0.15	0.12	2.69	ND	0.40	0.36	38	89	0.4			
	12/7/21	UP-713	0.09	2.61	7.56	0.006	2.18	4.74	56	0.04	0.12	2.72	ND	0.41	0.37	37	88	0.4			
	12/7/21	UP-644	0.1	2.12	7.59	0.013	2.19	4.68	57	0.58	0.17	2.04	ND	0.31	0.21	37	86	0.4			
	12/7/21	UP-222	0.12	2.46	7.55	0.007	2.18	4.7	57	0.07	0.13	2.5	ND	0.37	0.34	37	87	0.4			
	12/7/21	UP-649	0.1	2.2	7.54	0.009	2.17	4.66	57	0.09	0.13	2.3	ND	0.37	0.33	37	87	0.4			
	12/7/21	UP WWTP	0.13	2.5	7.57	0.009	2.19	4.72	57	0.02	0.11	2.57	ND	0.38	0.34	37	86	0.4		2.6	
	12/7/21	UP-612	0.09	2.31	7.61	0.006	2.233	4.62	57	0.11	0.13	2.44								NA	
	12/7/21	UP WWTP Men's Room	0.24	2.36	7.55	0.012	2.26	4.58	57	0.03	0.16	2.32								NA	
	12/7/21	BN-2098	0.03	3.52	8.45	0.006	2.01	NA	58	0.01	0	3.8								NA	
	12/7/21	MT-2810	0.05	3	8.41	0.005	2.2	NA	54	0.01	0	3.3								NA	
12-Dec	12/14/21	Kankakee WTP (TP01)	NA	NA	Daily	0.006	3.39	NA	Daily	NA	NA	NA	ND	ND	ND	39	68	0.6			Monthly
	12/14/21	UP- 437	0.01	3.1	7.52	0.007	2.28	4.46	47	0.02	0.09	3.35	ND	0.38	0.35	39	88	0.4		2.7	alternate TOC weekly sample between these 9 sites
	12/14/21	UP-647	0	2.79	7.58	0.006	2.29	4.32	50	0.04	0.1	3.04	ND	0.39	0.35	39	90	0.4			
	12/14/21	UP-187	0.09	2.73	7.55	0.006	2.25	4.4	51	0.05	0.11	2.85	ND	0.39	0.35	39	90	0.4			
	12/14/21	UP-629	0.04	2.53	7.56	0.006	2.27	4.38	51	0.13	0.12	2.76	ND	0.35	0.30	39	90	0.4			
	12/14/21	UP-713	0	2.77	7.57	0.007	2.27	4.34	50	0.2	0.11	2.93	ND	0.39	0.32	39	91	0.4			
	12/14/21	UP-644	0	2.58	7.58	0.004	2.27	4.32	52	0.34	0.13	2.68	ND	0.35	0.29	39	91	0.4			
	12/14/21	UP-222	0	2.69	7.57	0.009	2.24	4.26	52	0.31	0.13	2.72	ND	0.36	0.32	39	90	0.4			
	12/14/21	UP-649	0	2.46	7.58	0.01	2.26	4.34	53	0.03	0.15	2.42	ND	0.36	0.31	39	91	0.4			
	12/14/21	UP WWTP	0	2.62	7.57	0.008	2.26	4.26	51	0.02	0.12	2.82	ND	0.36	0.33	39	90	0.4			
	12/14/21	UP-612	0	2.12	7.6	0.016	2.36	4.4	54	0.15	0.16	2.32								NA	
	12/14/21	UP WWTP Men's Room																		NA	
	12/14/21	BN-2098	0	3.34	7.96	0.006	3.16	NA	54	0.02	0.06	3.77								NA	
	12/14/21	MT-2810	0.06	3.2	8.3	0.009	2.34	NA	47	0.02	0.06	3.7								NA	
19-Dec	12/21/21	Kankakee WTP (TP01)	NA	NA	Daily	0.005	3.19	NA	Daily	NA	NA	NA	ND	ND	ND	37	79	0.5			Monthly

	12/21/21	UP- 437	0.04	2.96	7.5	0.008	3.83	4.78	51	0.09	0.02	3	ND	0.42	0.38	38	77	0.5			alternate TOC weekly sample between these 9 sites
	12/21/21	UP-647	0.02	3.19	7.59	0.009	3.81	4.54	53	0.07	0.12	2.96	ND	0.40	0.36	39	75	0.5		3.3	
	12/21/21	UP-187	0.02	3.23	7.56	0.009	3.89	4.46	54	0.08	0.15	2.95	ND	0.39	0.36	38	74	0.5			
	12/21/21	UP-629	0.01	3.13	7.53	0.009	3.91	4.38	53	0.09	0.17	2.85	ND	0.38	0.33	39	74	0.5			
	12/21/21	UP-713	0.06	3.18	7.54	0.009	3.82	4.36	52	0.19	0.12	2.96	ND	0.39	0.35	39	75	0.5			
	12/21/21	UP-644	0.04	3.08	7.58	0.008	3.67	4.2	51	0.26	0.18	2.78	ND	0.36	0.29	40	74	0.5			
	12/21/21	UP-222	0.05	2.93	7.52	0.009	3.63	4.24	52	0.16	0.17	2.73	ND	0.37	0.31	40	74	0.5			
	12/21/21	UP-649	0.02	2.91	7.52	0.009	3.52	4.12	52	0.05	0.18	2.5	ND	0.34	0.31	41	74	0.6			
	12/21/21	UP WWTP	0	2.79	7.58	0.007	3.38	4.18	51	0.02	0.2	2.47	ND	0.33	0.30	42	76	0.6			
	12/21/21	UP-612	0.01	2.78	7.53	0.009	3.28	3.98	50	0.14	0.17	2.56								NA	
	12/21/21	UP WWTP Men's Room																		NA	
	12/21/21	BN-2098	0.06	3.83	8.5	0.006	3.1	NA	54	0.03	0	3.76								NA	
	12/21/21	MT-2810	0.04	3.66	8.46	0.008	3.22	NA	49	0.02	0.05	3.71								NA	
26-Dec	12/28/21	Kankakee WTP (TP01)	NA	NA	Daily	0.005	2.61	NA	Daily	NA	NA	NA	ND	ND	ND	35	84	0.4			Monthly
	12/28/21	UP- 437	0	3.2	7.48	0.007	3.18	5.94	52	0	0.1	3.12	ND	0.52	0.48	34	81	0.4			alternate TOC weekly sample between these 9 sites
	12/28/21	UP-647	0	3.07	7.49	0.007	3.12	5.44	53	0.1	0.11	2.85	ND	0.47	0.44	34	80	0.4			
	12/28/21	UP-187	0.02	2.91	7.52	0.007	3.17	5.46	51	0.04	0.12	2.66	ND	0.47	0.43	35	99	0.4		3.3	
	12/28/21	UP-629	0	2.84	7.51	0.008	3.39	5.58	52	0.2	0.14	2.49	ND	0.42	0.36	35	79	0.4			
	12/28/21	UP-713	0.04	2.98	7.53	0.008	3.26	5.14	53	0.21	0.1	2.73	ND	0.47	0.41	34	80	0.4			
	12/28/21	UP-644	0	2.92	7.54	0.009	3.22	5.08	53	0.28	0.1	2.6	ND	0.43	0.36	35	79	0.4			
	12/28/21	UP-222	0.02	2.8	7.53	0.009	3.14	4.98	52	0.2	0.15	2.41	ND	0.46	0.38	35	79	0.4			
	12/28/21	UP-649	0.09	2.58	7.5	0.004	3.1	4.72	52	0.05	0.2	2.34	ND	0.41	0.38	35	78	0.4			
	12/28/21	UP WWTP	0.06	2.86	7.55	0.008	3.15	5	53	0.02	0.12	2.56	ND	0.42	0.37	35	79	0.4			
	12/28/21	UP-612	0.01	2.54	7.55	0.009	3.17	4.78	51	0.13	0.17	2.19								NA	
	12/28/21	UP WWTP Men's Room																		NA	
	12/28/21	BN-2098	0.02	3.44	8.61	0.005	2.58	NA	51	0	0	3.32								NA	
	12/28/21	MT-2810	0.07	3.43	8.51	0.007	2.77	NA	52	0.03	0.07	3.41								NA	
2-Jan	1/4/22	Kankakee WTP (TP01)	NA	NA	Daily	0.004	4.52	NA	Daily	NA	NA	NA	ND	ND	ND	36	73	0.5			Monthly
	1/4/22	UP- 437	0	3.39	7.52	0.006	3.19	5.22	50	0.02	0.07	3.23	ND	0.47	0.43	36	78	0.5			alternate TOC weekly sample between these 9 sites
	1/4/22	UP-647	0.03	3.3	7.55	0.004	2.85	5.32	50	0.08	0.09	2.96	ND	0.48	0.43	36	81	0.4			
	1/4/22	UP-187	0	3.34	7.49	0.005	2.88	5.24	49	0.04	0.08	2.84	ND	0.47	0.44	36	83	0.4			
	1/4/22	UP-629	0	3.22	7.54	0.003	2.8	5.3	51	0.22	0.08	2.79	ND	0.47	0.39	37	84	0.4		3.1	
	1/4/22	UP-713	0	3.24	7.55	0.004	2.9	5.12	50	0.13	0.08	2.8	ND	0.47	0.42	36	84	0.4			
	1/4/22	UP-644	0	2.85	7.61	0.008	2.73	5.06	52	0.28	0.15	2.23	0.01	0.35	0.29	36	86	0.4			
	1/4/22	UP-222	0	2.83	7.55	0.003	2.8	5.36	51	0.04	0.11	2.6	ND	0.42	0.39	36	86	0.4			
	1/4/22	UP-649	0	2.98	7.49	0.004	2.82	5.12	52	0.02	0.11	2.44	ND	0.42	0.39	36	89	0.4			
	1/4/22	UP WWTP	0	2.94	7.5	0.001	2.76	5.22	50	0.04	0.12	2.59	ND	0.43	0.41	36	86	0.4			
	1/4/22	UP-612	0	2.85	7.54	0.006	2.66	5.06	51	0.06	0.13	2.3								NA	
	1/4/22	UP WWTP Men's Room																		NA	
	1/4/22	BN-2098	0	3.76	8.73	0.003	4.27	NA	57	0.08	0.08	3.51								NA	
	1/4/22	MT-2810	0	3.68	8.43	0.002	3.93	NA	51	0.02	0.08	3.54								NA	
9-Jan	1/11/22	Kankakee WTP (TP01)	NA	NA	Daily	0.006	2.96	NA	Daily	NA	NA	NA	ND	ND	ND	39	91	0.4	1/12/2022	2.5	Monthly
	1/11/22	UP- 437	0.02	3.26	7.49	0.006	3.97	5.86	55	0.06	0.03	3.28	ND	0.61	0.54	38	81	0.5			alternate TOC weekly sample between these 9 sites
	1/11/22	UP-647	0.02	3.19	7.56	0.003	4.08	5.46	56	0.12	0.07	3	ND	0.52	0.46	38	78	0.5			
	1/11/22	UP-187	0.07	2.95	7.49	0.005	4.08	5.1	55	0.07	0.07	2.8	ND	0.49	0.44	37	77	0.5			
	1/11/22	UP-629	0.03	2.93	7.57	0.004	4.02	5.04	56	0.27	0.08	2.8	ND	0.48	0.40	38	78	0.5			
	1/11/22	UP-713	0	3	7.47	0.003	4.25	5.12	56	0.04	0.08	2.87	ND	0.49	0.44	37	78	0.5		3.3	
	1/11/22	UP-644	0.03	2.69	7.56	0.007	4.19	5.06	56	0.35	0.08	2.51	ND	0.41	0.34	37	76	0.5			
	1/11/22	UP-222	0.06	2.97	7.48	0.006	4.04	5.08	55	0.16	0.07	2.6	0.01	0.47	0.43	38	78	0.5			
	1/11/22	UP-649	0.07	2.67	7.5	0.005	4.31	5.1	55	0.06	0.05	2.52	0.01	0.46	0.41	37	76	0.5			
	1/11/22	UP WWTP	0.08	2.8	7.53	0.005	4.14	5.18	55	0.05	0.13	2.46	ND	0.46	0.41	37	77	0.5			
	1/11/22	UP-612	0.02	2.52	7.58	0.004	4.29	5.08	54	0.1	0.12	2.35								NA	
	1/11/22	UP WWTP Men's Room																		NA	
	1/11/22	BN-2098	0	3.52	8.22	0.003	3.23	NA	68	0.03	0	3.45								NA	
	1/11/22	MT-2810	0.04	3.27	8.38	0.004	3.32	NA	64	0.05	0	3.28								NA	
16-Jan	1/18/22	Kankakee WTP (TP01)	NA	NA	Daily	0.002	2.04	NA	Daily	NA	NA	NA	ND	ND	ND	38	95	0.4			Monthly
	1/18/22	UP- 437	0.02	3.4	7.54	0.004	2.76	5.84	58	0.06	0.04	3.37	ND	0.43	0.39	39	94	0.4			C weekly een these 9
	1/18/22	UP-647	0.03	3.21	7.57	0.003	2.82	5.78	58	0.08	0.07	3.09	ND	0.52	0.47	40	95	0.4			
	1/18/22	UP-187	0.02	3.12	7.51	0.005	2.77	5.56	59	0.15	0.1	2.88	ND	0.51	0.48	39	95	0.4			
	1/18/22	UP-629	0	3.13	7.53	0.001	2.85	5.72	59	0.16	0.07	2.86	ND	0.49	0.44	40	95	0.4			
	1/18/22	UP-713	0.03	3.16	7.57	0.005	2.84	5.38	60	0.14	0.07	3.01	ND	0.50	0.45	39	94	0.4			

	1/18/22	UP-644	0.05	3.06	7.57	0.005	2.96	5.6	61	0.14	0.15	2.59	ND	0.45	0.42	40	96	0.4			2.8	alternate TO sample betw sites
	1/18/22	UP-222	0.01	3.03	7.49	0.006	2.98	5.56	61	0.15	0.05	2.75	ND	0.48	0.44	39	94	0.4				
	1/18/22	UP-649	0.04	2.87	7.51	0.005	2.98	5.58	661	0.03	0.05	2.71	ND	0.47	0.44	39	94	0.4				
	1/18/22	UP WWTP	0	2.84	7.58	0.001	3.04	5.52	61	0.03	0.08	2.53	ND	0.46	0.43	39	93	0.4				
	1/18/22	UP-612	0	2.59	7.57	0.001	3.08	5.34	62	0.14	0.14	2.27									NA	
	1/18/22	UP WWTP Men's Room																			NA	
	1/18/22	BN-2098	0	3.66	8.34	0.003	1.97	NA	58	0.08	0	3.54									NA	
	1/18/22	MT-2810	0	3.67	8.45	0.003	2.21	NA	61	0.05	0.09	3.66									NA	
23-Jan	1/25/22	Kankakee WTP (TP01)	NA	NA	Daily	0.003	2.04	NA	Daily	NA	NA	NA	ND	ND	ND	36	90	0.4				Monthly
	1/25/22	UP- 437	0	3.48	7.51	0.004	2.03	5.6	61	0.1	0.04	3.28	ND	0.60	0.53	37	93	0.4				alternate TOC weekly sample between these 9 sites
	1/25/22	UP-647	0	3.34	7.63	0.003	2.08	5.36	61	0.11	0.04	3.13	ND	0.52	0.45	37	91	0.4				
	1/25/22	UP-187	0.05	3.23	7.63	0.001	2.04	5.4	61	0.25	0.07	2.9	ND	0.49	0.44	37	90	0.4				
	1/25/22	UP-629	0.04	3.1	7.6	0.007	2.04	5.46	61	0.49	0.06	2.92	ND	0.47	0.42	37	91	0.4				
	1/25/22	UP-713	0.02	3.32	7.61	0.001	2.03	5.52	62	0.112	0.06	3.01	ND	0.49	0.44	37	91	0.4				
	1/25/22	UP-644	0.05	2.89	7.64	0.005	2.04	5.46	60	0.4	0.05	2.5	ND	0.38	0.34	37	90	0.4				
	1/25/22	UP-222	0.01	3.48	7.62	0.003	2.09	5.5	60	0.1	0.07	2.84	ND	0.47	0.42	37	90	0.4			2.6	
	1/25/22	UP-649	0.05	3	7.61	0.003	2.11	5.42	61	0.11	0.11	2.55	ND	0.46	0.42	37	90	0.4				
	1/25/22	UP WWTP	0	3.26	7.65	0.002	2.11	5.32	60	0.04	0.08	2.89	ND	0.47	0.43	37	90	0.4				
	1/25/22	UP-612	0.1	2.87	7.6	0.004	2.13	5.52	58	0.13	0.11	2.48									NA	
	1/25/22	UP WWTP Men's Room	0.08	2.85	7.59	0.007	2.06	5.26	60	0.05	0.07	2.54									NA	
	1/25/22	BN-2098	0.02	3.35	8.52	0.002	2.1	NA	66	0.07	0	3.64									NA	
	1/25/22	MT-2810	0.04	3.51	8.33	0.002	2.09	NA	63	0.05	0	3.29									NA	
30-Jan	2/1/22	Kankakee WTP (TP01)	NA	NA	Daily	0.007	1.95	NA	Daily	NA	NA	NA	ND	ND	ND	34	92	0.4				Monthly
	2/1/22	UP- 437	0	3.47	7.53	0.005	2.09	5.92	63	0.05	0.05	3.37	ND	0.56	0.52	36	95	0.4				alternate TOC weekly sample between these 9 sites
	2/1/22	UP-647	0	3.37	7.62	0.005	2.15	5.54	63	0.05	0.07	3.15	ND	0.47	0.42	36	93	0.4				
	2/1/22	UP-187	0	3.27	7.61	0.009	2.15	5.32	61	0.1	0.08	3.03	ND	0.47	0.42	36	93	0.4				
	2/1/22	UP-629	0.03	3.2	7.65	0.001	2.14	5.22	61	0.35	0.08	2.97	ND	0.48	0.38	36	93	0.4				
	2/1/22	UP-713	0	3.33	7.65	0.009	2.17	5.38	62	0.2	0.07	3.07	ND	0.48	0.42	36	94	0.4				
	2/1/22	UP-644	0	3.23	7.66	0.008	2.16	5.28	62	0.31	0.07	2.95	ND	0.44	0.39	36	93	0.4				
	2/1/22	UP-222	0	3.19	7.67	0.005	2.14	5.18	63	0.06	0.09	2.87	ND	0.43	0.39	36	94	0.4				
	2/1/22	UP-649	0	3	7.64	0.005	2.14	5.3	61	0.04	0.05	2.87	ND	0.43	0.40	36	93	0.4			2.5	
	2/1/22	UP WWTP	0	3.25	7.65	0.005	2.17	5.4	62	0.05	0.07	3.03	ND	0.43	0.41	36	94	0.4				
	2/1/22	UP-612	0	2.74	7.66	0.007	2.12	5.26	59	0.16	0.11	2.46									NA	
	2/1/22	UP WWTP Men's Room	0.02	2.95	7.59	0.01	2.16	5.24	59	0.02	0.1	2.72									NA	
	2/1/22	BN-2098	0	3.53	8.51	0.005	1.94	NA	65	0.06	0.07	3.64									NA	
	2/1/22	MT-2810	0	3.36	8.41	0.006	1.97	NA	65	0.02	0.05	3.37									NA	
6-Feb	2/8/22	Kankakee WTP (TP01)	NA	NA	Daily	0.006	1.96	NA	Daily	NA	NA	NA	ND	ND	ND	43	91	0.5			3.3	Monthly
	2/8/22	UP- 437	0	3.4	7.52	0.008	1.94	5.88	63	0.04	0.05	3.29	ND	0.66	0.60	41	91	0.5				alternate TOC weekly sample between these 9 sites
	2/8/22	UP-647	0	3.28	7.65	0.007	1.86	5.74	64	0.07	0.07	3.07	ND	0.51	0.48	39	89	0.4				
	2/8/22	UP-187	0.01	3.26	7.65	0.006	1.81	5.48	62	0.18	0.09	3.01	ND	0.52	0.47	39	91	0.4				
	2/8/22	UP-629	0.03	3.26	7.58	0.007	1.83	5.7	63	0.23	0.07	3.07	ND	0.52	0.45	39	90	0.4				
	2/8/22	UP-713	0	3.27	7.64	0.007	1.84	5.42	63	0.12	0.07	3.08	0.01	0.52	0.48	39	90	0.4				
	2/8/22	UP-644	0	3.07	7.67	0.009	1.87	5.38	64	0.36	0.12	2.69	ND	0.42	0.35	38	93	0.4				
	2/8/22	UP-222	0	3.25	7.62	0.007	1.82	5.34	62	0.17	0.09	2.95	ND	0.50	0.45	39	90	0.4				
	2/8/22	UP-649	0	3.11	7.64	0.008	1.81	5.4	63	0.08	0.12	2.84	ND	0.49	0.44	38	93	0.4				
	2/8/22	UP WWTP	0	3.24	7.64	0.006	1.93	5.4	63	0.03	0.08	3.02	ND	0.49	0.46	39	91	0.4			2.9	
	2/8/22	UP-612	0	2.92	7.69	0.009	1.91	5.42	65	0.11	0.16	2.68									NA	
	2/8/22	UP WWTP Men's Room	0.03	3.05	7.53	0.007	1.94	5.36	64	0.06	0.09	2.76									NA	
	2/8/22	BN-2098	0	3.31	8.42	0.005	1.94	NA	68	0.07	0.02	3.18									NA	
	2/8/22	MT-2810	0	3.49	8.37	0.008	1.99	NA	68	0.04	0.01	3.32									NA	
13-Feb	2/15/22	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.17	NA	Daily	NA	NA	NA	ND	NA	ND	45	72	0.6				Monthly
	2/15/22	UP- 437	0.12	3.4	7.55	0.004	1.78	5.92	65	0.06	0.06	3.43	ND	0.64	0.58	43	94	0.5			3	alternate TOC weekly sample between these 9 sites
	2/15/22	UP-647	0.07	3.48	7.64	0.002	1.78	5.56	63	0.06	0.03	3.21	ND	0.54	0.50	43	95	0.5				
	2/15/22	UP-187	0.14	3.41	7.65	0.002	1.79	5.38	65	0.09	0.06	3.2	ND	0.53	0.49	43	95	0.5				
	2/15/22	UP-629	0.04	3.36	7.66	0.002	1.83	5.08	65	0.16	0.07	3.05	ND	0.52	0.46	42	95	0.4				
	2/15/22	UP-713	0.2	3.33	7.65	0.003	1.83	5.18	65	0.06	0.15	3.13	ND	0.54	0.48	43	96	0.4				
	2/15/22	UP-644	0.14	3.14	7.69	0.003	1.86	5.32	65	0.07	0.09	2.89	0.01	0.47	0.41	43	96	0.4				
	2/15/22	UP-222	0.21	3.32	7.69	0.002	1.81	5.18	66	0.12	0.08	2.92	ND	0.51	0.47	43	96	0.4				
	2/15/22	UP-649	0.06	3.17	7.68	0.012	1.83	5.1	65	0.08	0.14	2.81	ND	0.49	0.46	43	96	0.4				
	2/15/22	UP WWTP	0.1	3.37	7.67	0.004	1.87	5.28	63	0.05	0.09	3.1	ND	0.51	0.48	42	95	0.4				
	2/15/22	UP-612	0.07	3	7.7	0.007	1.89	5.32	65	0.11	0.12	2.55									NA	

	2/15/22	UP WWTP Men's Room	0.16	2.62	7.58	0.018	1.81	5.3	64	0.05	0.08	2.78									NA	
	2/15/22	BN-2098	0.13	3.52	8.55	0.002	2.08	NA	67	0.05	0	3.38									NA	
	2/15/22	MT-2810	0.07	3.33	8.48	0.004	1.8	NA	67	0.04	0.17	3.11									NA	
20-Feb	2/22/22	Kankakee WTP (TP01)	NA	NA	Daily	0.002	3.62	NA	Daily	NA	NA	NA	ND	NA	ND	35	37	0.9				Monthly
	2/22/22	UP- 437	0.01	3.23	7.61	0.004	2.54	5.96	76	0.11	0.15	3	ND	0.58	0.54	40	41	1.0				alternate TOC weekly sample between these 9 sites
	2/22/22	UP-647	0	3.26	7.64	0.003	2.47	5.92	71	0.05	0.13	3.07	ND	0.57	0.52	41	46	0.9			3.7	
	2/22/22	UP-187	0.08	3.21	7.67	0.003	2.43	6	72	0.11	0.13	3.09	ND	0.56	0.52	41	46	0.9				
	2/22/22	UP-629	0.15	3.23	7.66	0.009	2.42	6.04	72	0.18	0.15	2.94	ND	0.55	0.49	42	49	0.9				
	2/22/22	UP-713	0.16	3.24	7.61	0.003	2.4	5.86	73	0.14	0.14	3.04	ND	0.56	0.50	41	47	0.9				
	2/22/22	UP-644	0.09	3.21	7.68	0.003	2.38	6.22	69	0.28	0.16	2.94	0.01	0.54	0.46	42	51	0.8				
	2/22/22	UP-222	0.1	3.14	7.62	0.002	2.37	6.02	73	0.29	0.17	2.97	0.01	0.56	0.47	43	56	0.8				
	2/22/22	UP-649	0.12	3.1	7.67	0.003	2.35	5.84	69	0.31	0.17	2.78	0.01	0.51	0.47	43	58	0.7				
	2/22/22	UP WWTP	0.04	3.19	7.59	0.003	2.37	5.98	71	0.03	0.13	2.95	ND	0.54	0.48	42	51	0.8				
	2/22/22	UP-612	0.23	2.84	7.71	0.002	2.23	5.62	65	0.14	0.17	2.5									NA	
	2/22/22	UP WWTP Men's Room	0	3.05	7.63	0.004	2.35	5.48	67	0.04	0.15	2.71									NA	
	2/22/22	BN-2098	0.03	3.44	8.68	0.002	3.8	NA	52	0.03	0.03	3.36									NA	
	2/22/22	MT-2810	0.02	3.33	8.58	0.005	3.22	NA	71	0.01	0.08	3.15									NA	
27-Feb	3/1/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.002	3.99	NA	Daily	NA	NA	NA	ND	ND	ND	36	66	0.5				Monthly
	3/1/2022	UP- 437	0.02	3.46	7.52	0.004	4.17	5.48	64	0.05	0.09	3.39	ND	0.45	0.41	35	46	0.8				alternate TOC weekly sample between these 9 sites
	3/1/2022	UP-647	0.05	3.45	7.61	0.002	4.09	5.6	65	0.04	0.09	3.29	ND	0.51	0.47	36	45	0.8				
	3/1/2022	UP-187	0	3.47	7.62	0.002	4.12	5.5	54	0.14	0.14	3.02	ND	0.53	0.47	36	44	0.8			3.1	
	3/1/2022	UP-629	0.06	3.41	7.67	0.002	4.11	5.52	62	0.33	0.08	3.25	0.01	0.54	0.44	36	44	0.8				
	3/1/2022	UP-713	0.03	3.38	7.59	0.002	4.12	5.64	63	0.46	0.08	3.24	0.01	0.55	0.44	36	44	0.8				
	3/1/2022	UP-644	0	3.27	7.61	0.002	4.13	5.46	63	0.44	0.13	3.08	0.01	0.53	0.41	37	43	0.9				
	3/1/2022	UP-222	0	3.28	7.64	0.002	4.11	5.42	64	0.5	0.09	3.02	0.01	0.56	0.43	36	43	0.8				
	3/1/2022	UP-649	0	3.12	7.66	0.004	3.92	5.22	62	0.08	0.11	2.8	ND	0.48	0.43	37	40	0.9				
	3/1/2022	UP WWTP	0	3.31	7.66	0.002	4.07	5.34	63	0.06	0.11	3.05	ND	0.49	0.45	36	42	0.9				
	3/1/2022	UP-612	0	3.2	7.69	0.001	3.94	5.2	64	0.18	0.11	2.9									NA	
	3/1/2022	UP WWTP Men's Room	0.02	3.13	7.63	0.004	4.21	5.3	63	0.07	0.09	2.89									NA	
	3/1/2022	BN-2098	0.05	3.95	8.72	0.004	4.05	NA	67	0.05	0.02	3.69									NA	
	3/1/2022	MT-2810	0.01	3.61	8.62	0.003	4.32	NA	66	0.03	0.08	3.63									NA	
6-Mar	3/8/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.004	3.09	NA	Daily	NA	NA	NA	ND	ND	ND	35	72	0.5			2.9	Monthly
	3/8/2022	UP- 437	0.13	3.38	7.62	0.008	3.44	6.02	66	0.05	0.07	3.38	ND	0.58	0.55	33	69	0.5				alternate TOC weekly sample between these 9 sites
	3/8/2022	UP-647	0.21	3.37	7.61	0.001	3.65	6.1	68	0.04	0.11	3.19	ND	0.58	0.53	33	68	0.5				
	3/8/2022	UP-187	0.13	3.38	7.56	0.005	3.43	6.2	68	0.05	0.08	3.22	ND	0.59	0.54	33	68	0.5				
	3/8/2022	UP-629	0.12	3.28	7.59	0.005	3.45	6.2	68	0.41	0.1	3.05	0.01	0.58	0.48	33	67	0.5			3.4	
	3/8/2022	UP-713	0.16	3.34	7.56	0.004	3.59	6.3	66	0.31	0.09	3.15	ND	0.61	0.54	33	67	0.5				
	3/8/2022	UP-644	0	3.21	7.6	0.005	3.54	5.98	68	0.3	0.11	2.96	0.01	0.60	0.47	33	66	0.5				
	3/8/2022	UP-222	0.08	3.22	7.58	0.005	3.61	6.14	66	0.32	0.09	3.07	0.01	0.59	0.48	33	65	0.5				
	3/8/2022	UP-649	0.1	3.08	7.56	0.005	3.67	5.98	63	0.08	0	2.72	ND	0.54	0.48	33	64	0.5				
	3/8/2022	UP WWTP	0.06	3.25	7.61	0.006	3.71	6	68	0.06	0.12	2.93	ND	0.54	0.49	33	65	0.5				
	3/8/2022	UP-612	0.06	2.82	7.58	0	4.04	5.96	67	0.16	0.13	2.59									NA	
	3/8/2022	UP WWTP Men's Room	0.05	3.09	7.52	0.008	3.48	5.94	66	0.05	0.12	2.87									NA	
	3/8/2022	BN-2098	0.06	3.91	8.81	0.005	3.03	NA	56	0.04	0.01	3.84									NA	
	3/8/2022	MT-2810	0.07	3.62	8.75	0.007	3.29	NA	59	0.04	0.02	3.57									NA	
13-Mar	3/15/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.6	NA	Daily	NA	NA	NA	ND	ND	ND	37	73	0.5				Monthly
	3/15/2022	UP- 437	0.09	3.37	7.51	0.003	3	6.2	51	0.04	0.08	3.34	ND	0.57	0.53	38	72	0.5				alternate TOC weekly sample between these 9 sites
	3/15/2022	UP-647	0	3.35	7.59	0.004	3	6.1	54	0.06	0.11	3.13	ND	0.52	0.48	38	72	0.5				
	3/15/2022	UP-187	0.07	3.33	7.59	0.002	2.97	5.66	55	0.23	0.1	3.08	ND	0.53	0.49	38	72	0.5				
	3/15/2022	UP-629	0	3.28	7.59	0.002	2.94	5.78	53	0.08	0.11	3.08	ND	0.51	0.46	38	72	0.5				
	3/15/2022	UP-713	0	3.33	7.62	0.007	2.96	5.96	54	0.29	0.12	3.12	ND	0.53	0.49	38	72	0.5			3.2	
	3/15/2022	UP-644	0	3.21	7.63	0.003	2.94	5.94	53	0.61	0.1	2.95	0.01	0.50	0.44	38	73	0.5				
	3/15/2022	UP-222	0.06	3.37	7.63	0.003	3.02	5.58	52	0.08	0.11	2.92	0.01	0.55	0.46	38	72	0.5				
	3/15/2022	UP-649	0	3.12	7.64	0.002	2.86	6	53	0.12	0.11	2.75	ND	0.54	0.49	38	73	0.5				
	3/15/2022	UP WWTP	0.03	3.25	7.61	0.001	2.94	6.14	52	0.07	0.12	2.96	ND	0.51	0.49	38	72	0.5				
	3/15/2022	UP-612	0	3.16	7.65	0.001	2.94	6	57	0.15	0.13	2.92									NA	
	3/15/2022	UP WWTP Men's Room	0.08	3.01	7.57	0.007	2.98	5.74	55	0.26	0.13	2.77									NA	
	3/15/2022	BN-2098	0	3.59	8.56	0.003	2.66	NA	51	0.04	0.01	3.44									NA	
	3/15/2022	MT-2810	0.11	3.56	8.42	0.007	2.92	NA	54	0.03	0.05	3.37									NA	
20-Mar	3/20/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.005	2.75	NA	Daily	NA	NA	NA	ND	ND	ND	43	67	0.6				Monthly
	3/20/2022	UP- 437	0.1	3.29	7.51	0.006	2.68	4.54	52	0.04	0.03	3.28	ND	0.41	0.38	35	74	0.5				

	3/20/2022	UP-647	0	3.27	7.55	0.006	2.76	5	52	0.07	0.01	3.05	ND	0.44	0.44	36	74	0.5				alternate TOC weekly sample between these 9 sites
	3/20/2022	UP-187	0.08	3.28	7.49	0.007	2.66	4.94	52	0.06	0.05	3.08	ND	0.47	0.43	36	74	0.5				
	3/20/2022	UP-629	0.15	3.15	7.5	0.006	2.76	4.9	51	0.11	0.1	2.95	ND	0.46	0.42	36	74	0.5				
	3/20/2022	UP-713	0.03	3.28	7.49	0.004	2.72	4.88	51	0.11	0.04	3	0.01	0.49	0.43	36	74	0.5				
	3/20/2022	UP-644	0	3.1	7.55	0.005	2.74	4.84	53	0.16	0.09	2.79	0.01	0.49	0.41	36	74	0.5			2.7	
	3/20/2022	UP-222	0	3.12	7.59	0.006	2.66	4.82	51	0.26	0.07	2.78	0.01	0.53	0.42	36	74	0.5				
	3/20/2022	UP-649	0	3.03	7.58	0.005	2.79	4.78	52	0.09	0.06	2.74	ND	0.47	0.43	36	74	0.5				
	3/20/2022	UP WWTP	0.15	3.14	7.53	0.006	2.84	4.76	51	0.04	0.06	2.87	ND	0.44	0.39	36	74	0.5				
	3/20/2022	UP-612	0.12	3	7.61	0.003	2.78	4.66	54	0.16	0.1	2.76									NA	
	3/20/2022	UP WWTP Men's Room	0.01	3.11	7.49	0.005	2.8	4.82	52	0.06	0.08	2.84									NA	
	3/20/2022	BN-2098	0.11	3.96	8.84	0.005	2.73	NA	56	0.02	0.02	3.94									NA	
	3/20/2022	MT-2810	0.09	3.6	8.52	0.006	2.64	NA	54	0.03	0.07	3.48									NA	
27-Mar	3/29/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.003	4.02	NA	Daily	NA	NA	NA	ND	ND	ND	37	65	0.6				Monthly
	3/29/2022	UP- 437	0.1	3.47	7.49	0.004	3.84	6.42	52	0.04	0.08	3.38	ND	0.53	0.48	40	63	0.6				alternate TOC weekly sample between these 9 sites
	3/29/2022	UP-647	0.04	3.26	7.58	0.007	3.79	5.54	51	0.05	0.12	3.05	ND	0.45	0.41	40	63	0.6				
	3/29/2022	UP-187	0.13	3.29	7.63	0.005	3.77	5.56	50	0.06	0.11	3.01	ND	0.45	0.41	40	63	0.6				
	3/29/2022	UP-629	0.04	3.24	7.62	0.007	3.71	5.2	50	0.1	0.12	3	ND	0.44	0.39	41	64	0.6				
	3/29/2022	UP-713	0.14	3.28	7.59	0.005	3.71	5.22	52	0.12	0.1	3.01	ND	0.45	0.40	40	63	0.6				
	3/29/2022	UP-644	0.06	3.19	7.6	0.002	3.58	5.34	51	0.2	0.11	2.93	0.01	0.46	0.37	40	64	0.6				
	3/29/2022	UP-222	0.09	3.14	7.62	0.006	3.51	5.42	52	0.26	0.14	2.81	ND	0.44	0.40	41	64	0.6			2.6	
	3/29/2022	UP-649	0.15	3.08	7.61	0.003	3.53	5.24	51	0.12	0.12	2.81	ND	0.45	0.40	41	64	0.6				
	3/29/2022	UP WWTP	0.15	3.24	7.61	0.005	3.50	5.28	52	0.04	0.12	2.98	ND	0.44	0.40	41	64	0.6				
	3/29/2022	UP-612	0.06	2.96	7.63	0.005	3.33	5.3	52	0.15	0.11	2.7									NA	
	3/29/2022	UP WWTP Men's Room	0.16	2.98	7.60	0.007	3.67	5.28	52	0.05	0.15	2.71									NA	
	3/29/2022	BN-2098	0.00	3.87	8.6	0.005	4.04	NA	57	0.08	0.02	3.85									NA	
	3/29/2022	MT-2810	0.00	3.47	8.39	0.00	3.93	NA	54	0.04	0.04	3.49									NA	
3-Apr	4/5/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.005	4.35	NA	Daily	NA	NA	NA	ND	ND	ND	37	64	0.6				Monthly
	4/5/2022	UP- 437	0.03	3.37	7.57	0.004	3.87	5.4	53	0.02	0.05	3.25	ND	0.44	0.42	38	55	0.7				alternate TOC weekly sample between these 9 sites
	4/5/2022	UP-647	0.00	3.18	7.56	0.002	3.83	4.94	54	0.03	0.1	2.99	ND	0.39	0.39	38	60	0.6				
	4/5/2022	UP-187	0.00	3.18	7.58	0.000	3.75	4.68	52	0.04	0.08	3.07	ND	0.45	0.41	37	60	0.6				
	4/5/2022	UP-629	0.00	3.17	7.59	0.002	3.72	4.86	54	0.1	0.11	2.87	ND	0.43	0.38	37	61	0.6				
	4/5/2022	UP-713	0.00	3.14	7.57	0.002	3.69	4.98	55	0.2	0.08	2.91	ND	0.46	0.40	37	61	0.6				
	4/5/2022	UP-644	0.00	3.06	7.59	0.005	3.77	5.00	56	0.26	0.14	2.84	ND	0.41	0.40	38	63	0.6				
	4/5/2022	UP-222	0.00	2.95	7.6	0.004	3.85	4.98	55	0.2	0.11	2.59	ND	0.47	0.40	38	65	0.6				
	4/5/2022	UP-649	0.00	2.94	7.61	0.004	3.81	4.96	55	0.14	0.13	2.59	ND	0.44	0.39	38	66	0.6			3.1	
	4/5/2022	UP WWTP	0.00	2.98	7.64	0.002	3.88	5.00	55	0.04	0.12	2.65	ND	0.43	0.41	38	66	0.6				
	4/5/2022	UP-612	0.00	2.75	7.63	0.003	3.88	4.94	55	0.14	0.18	2.49									NA	
	4/5/2022	UP WWTP Men's Room	0.00	2.90	7.57	0.005	3.83	4.98	54	0.03	0.12	2.66									NA	
	4/5/2022	BN-2098	0.00	3.79	8.22	0.002	4.23	NA	61	0.02	0	3.63									NA	
	4/5/2022	MT-2810	0.01	3.37	8.31	0.002	4.18	NA	58	0.01	0.02	3.32									NA	
10-Apr	4/12/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.006	3.49	NA	Daily	NA	NA	NA	ND	ND	ND	36	63	0.6		4/12/2022	2.7	Monthly
	4/12/2022	UP- 437	0.00	3.15	7.69	0.006	3.92	3.8	53	0.02	0.06	3.25	ND	0.29	0.29	171	23	7.4				alternate TOC weekly sample between these 9 sites
	4/12/2022	UP-647	0.00	3.01	7.64	0.004	4.09	5.16	53	0.06	0.3	2.82	ND	0.42	0.41	37	63	0.6				
	4/12/2022	UP-187	0.00	3.01	7.59	0.005	3.98	4.96	53	0.03	0.12	2.85	ND	0.43	0.42	37	63	0.6				
	4/12/2022	UP-629	0.00	2.97	7.6	0.007	3.92	4.9	54	0.14	0.31	2.77	ND	0.40	0.41	37	64	0.6				
	4/12/2022	UP-713	0.00	2.99	7.6	0.000	3.99	5.02	52	0.15	0.14	2.77	ND	0.41	0.41	35	69	0.5				
	4/12/2022	UP-644	0.00	2.92	7.63	0.005	4.00	5.00	53	0.25	0.19	2.81	ND	0.40	0.36	36	64	0.6				
	4/12/2022	UP-222	0.00	2.82	7.66	0.004	3.95	4.84	52	0.08	0.15	2.67	ND	0.40	0.38	36	62	0.6				
	4/12/2022	UP-649	0.00	2.73	7.63	0.004	3.97	4.94	54	0.03	0.14	2.45	ND	0.40	0.38	37	62	0.6				
	4/12/2022	UP WWTP	0.00	2.86	7.63	0.004	4.11	4.96	54	0.02	0.15	2.68	ND	0.41	0.40	36	62	0.6			3.3	
	4/12/2022	UP-612	0.00	2.68	7.64	0.005	4.21	5.00	53	0.08	0.14	2.43									NA	
	4/12/2022	UP WWTP Men's Room	0.00	2.76	7.58	0.008	3.9	4.96	55	0.03	0.16	2.56									NA	
	4/12/2022	BN-2098	0.00	3.65	8.49	0.005	3.58	NA	61	0.02	0	3.63									NA	
	4/12/2022	MT-2810	0.01	3.46	8.45	0.005	3.82	NA	58	0.01	0.02	3.32									NA	
17-Apr	4/19/2022	Kankakee WTP (TP01)	NA	NA	Daily	0.004	2.54	NA	Daily	NA	NA	NA	ND	ND	ND	34	73	0.5				Monthly
	4/19/2022	UP- 437	0.03	3.16	7.56	0.006	2.96	4.36	49	0.02	0.06	3.06	ND	0.38	0.36	35	74	0.5			2.6	TOC weekly etween these 9
	4/19/2022	UP-647	0.23	2.72	7.53	0.003	3.14	5.16	51	0.07	0.05	2.74	ND	0.43	0.40	35	74	0.5				
	4/19/2022	UP-187	0.05	2.89	7.58	0.003	3.09	4.88	51	0.04	0.12	2.72	ND	0.44	0.42	35	74	0.5				
	4/19/2022	UP-629	0.02	2.85	7.56	0.005	3.15	4.76	50	0.08	0.11	2.7	ND	0.38	0.41	35	74	0.5				
	4/19/2022	UP-713	0.04	2.89	7.56	0.006	3.15	4.96	49	0.12	0.07	2.7	ND	0.45	0.42	35	74	0.5				
	4/19/2022	UP-644	0	2.82	7.57	0.003	3.27	4.92	49	0.17	0.1	2.56	ND	0.41	0.39	35	73	0.5				

	4/19/2022	UP-222	0.01	2.83	7.57	0.002	3.25	4.74	50	0.06	0.02	2.55	ND	0.41	0.41	35	73	0.5				alternate sample b sites
	4/19/2022	UP-649	0.02	2.72	7.57	0.001	3.37	4.74	50	0.04	0.11	2.43	ND	0.40	0.39	35	73	0.5				
	4/19/2022	UP WWTP	0.29	2.7	7.66	0.003	3.48	4.48	49	0.04	0.1	2.41	ND	0.39	0.39	35	72	0.5				
	4/19/2022	UP-612	0.01	2.62	7.58	0.003	3.44	4.7	50	0.09	0.16	2.4									NA	
	4/19/2022	UP WWTP Men's Room	0.08	2.68	7.55	0.006	3.42	4.7	50	0.04	0.17	2.43									NA	
	4/19/2022	BN-2098	0.23	3.31	8.4	0.005	2.74	NA	54	0.04	0.12	3.41									NA	
	4/19/2022	MT-2810	0.09	3.31	8.43	0.007	2.7	NA	50	0.02	0.01	3.39									NA	
24-Apr	4/26/22	Kankakee WTP (TP01)	NA	NA	Daily	0.002	2.20	NA	Daily	NA	NA	NA	ND	ND	ND	37	73	0.5				Monthly
	4/26/22	UP- 437	0.11	3.31	7.54	0.005	2.38	5.38	50	0.03	0.00	3.56	ND	ND	ND	35	72	0.5				alternate TOC weekly sample between these 9 sites
	4/26/22	UP-647	0.04	3.2	7.79	0.003	2.37	5.12	51	0.06	0.06	3.16	ND	0.38	0.38	36	74	0.5			3.5	
	4/26/22	UP-187	0.17	3.21	7.72	0.005	2.39	5.04	51	0.04	0.08	3.05	ND	0.40	0.37	36	73	0.5				
	4/26/22	UP-629	0.12	3.19	7.67	0.002	2.36	5.04	50	0.05	0.05	3.02	ND	0.38	0.38	35	73	0.5				
	4/26/22	UP-713	0.18	3.04	7.71	0.002	2.41	5.06	51	0.07	0.04	3.01	ND	0.39	0.37	35	72	0.5				
	4/26/22	UP-644	0.07	2.87	7.73	0.003	2.51	4.94	50	0.1	0.00	2.71	ND	0.33	0.32	35	72	0.5				
	4/26/22	UP-222	0.22	2.77	7.74	0.005	2.58	4.94	51	0.13	0.02	2.54	ND	0.37	0.35	35	72	0.5				
	4/26/22	UP-649	0.08	2.86	7.69	0.004	2.50	4.96	50	0.05	0.11	2.62	ND	0.36	0.35	36	72	0.5				
	4/26/22	UP WWTP	0.25	2.93	7.72	0.003	2.50	4.92	49	0.03	0.08	2.69	ND	0.35	0.35	36	72	0.5				
	4/26/22	UP-612	0.31	2.58	7.71	0.009	2.58	4.92	50	0.07	0.10	2.35									NA	
	4/26/22	UP WWTP Men's Room	0.24	2.97	7.65	0.004	2.45	4.96	50	0.06	0.11	2.63									NA	
	4/26/22	BN-2098	0.07	3.22	8.37	0.008	2.22	NA	54	0.06	0.02	3.20									NA	
	4/26/22	MT-2810	0.25	3.56	8.61	0.007	2.40	NA	51	0.02	0.02	3.49									NA	
1-May	5/3/22	Kankakee WTP (TP01)	NA	NA	Daily	0.004	2.43	NA	Daily	NA	NA	NA	ND	ND	ND	37	69	0.5				Monthly
	5/3/22	UP- 437	0.01	3.25	7.57	0.006	2.25	5.28	54	0.02	0.04	3.28	ND	0.51	0.50	36	72	0.5				alternate TOC weekly sample between these 9 sites
	5/3/22	UP-647	0	3.17	7.59	0.007	2.26	5.28	51	0.03	0.08	2.94	ND	0.46	0.46	37	73	0.5				
	5/3/22	UP-187	0	3.12	7.6	0.004	2.24	5.48	52	0.03	0	2.93	ND	0.44	0.44	37	73	0.5			2	
	5/3/22	UP-629	0	3.13	7.66	0.004	2.24	5.06	52	0.03	0.112	2.76	ND	0.44	0.42	37	73	0.5				
	5/3/22	UP-713	0	3.02	7.62	0.005	2.28	4.74	54	0.03	0.05	2.93	ND	0.42	0.42	37	73	0.5				
	5/3/22	UP-644	0	2.98	7.64	0.004	2.23	5.16	53	0.09	0.08	2.68	ND	0.41	0.40	36	71	0.5				
	5/3/22	UP-222	0	2.9	7.64	0.004	2.28	4.88	52	0.11	0.07	2.6	NA	0.43	0.41	37	73	0.5				
	5/3/22	UP-649	0	2.86	7.62	0.006	2.24	5.2	52	0.03	0.09	2.5	ND	0.40	0.41	37	73	0.5				
	5/3/22	UP WWTP	0	2.78	7.6	0.004	2.25	5.12	52	0.04	0.08	2.48	ND	0.41	0.40	37	73	0.5				
	5/3/22	UP-612	0	2.62	7.65	0.007	2.25	4.64	52	0.07	0.09	2.28									NA	
	5/3/22	UP WWTP Men's Room	0	2.78	7.6	0.004	2.23	5.12	52	0.04	0.08	2.48									NA	
	5/3/22	BN-2098	0	3.65	8.52	0.005	2.47	NA	59	0.02	0	3.62									NA	
	5/3/22	MT-2810	0	3.37	8.24	0.005	2.19	NA	57	0	0.03	3.39									NA	
8-May	5/10/22	Kankakee WTP (TP01)	NA	NA	Daily	0.003	4.5	NA	Daily	NA	NA	NA	ND	ND	ND	34	56	0.6			2.8	Monthly
	5/10/22	UP- 437	0	3.09	7.58	0.007	3.55	5	53	0.06	0.17	3.12	ND	0.46	0.44	40	59	0.7				alternate TOC weekly sample between these 9 sites
	5/10/22	UP-647	0	3.05	7.57	0.005	3.31	5.14	53	0.03	0.14	2.95	ND	0.50	0.44	40	60	0.7				
	5/10/22	UP-187	0	2.95	7.64	0.005	3.34	5.04	52	0.02	0.15	3	ND	0.48	0.43	40	60	0.7				
	5/10/22	UP-629	0	3.03	7.61	0.004	3.31	5.12	54	0.07	0.21	2.92	ND	0.47	0.42	40	61	0.7			1.9	
	5/10/22	UP-713	0	3.04	7.6	0.005	3.34	4.94	52	0.2	0.16	2.91	ND	0.48	0.43	40	60	0.7				
	5/10/22	UP-644	0	2.88	7.63	0.008	3.18	5.34	54	0.19	0.32	2.69	ND	0.44	0.41	39	61	0.6				
	5/10/22	UP-222	0	2.82	7.63	0.005	3.17	5.18	52	0.1	0.18	2.63	ND	0.43	0.41	33	59	0.6				
	5/10/22	UP-649	0	2.56	7.65	0.003	2.98	5.36	54	0.03	0.21	2.39	ND	0.46	0.41	39	65	0.6				
	5/10/22	UP WWTP	0.04	2.76	7.6	0.006	2.97	5.2	54	0.02	0.16	2.59	ND	0.47	0.41	39	65	0.6				
	5/10/22	UP-612	0	2.54	7.58	0.005	2.84	5.24	54	0.07	0.2	2.31									NA	
	5/10/22	UP WWTP Men's Room	0	2.66	7.57	0.006	3	5.34	55	0.04	0.18	2.49									NA	
	5/10/22	BN-2098	0	3.72	8.53	0.005	4.18	NA	59	0.04	0.04	3.79									NA	
	5/10/22	MT-2810	0	3.27	8.55	0.006	4.16	NA	55	0.01	0.11	3.3									NA	
15-May	5/17/22	Kankakee WTP (TP01)	NA	NA	Daily	0.004	2.1	NA	Daily	NA	NA	NA	NA	NA	ND	34	71	0.5				Monthly
	5/17/22	UP- 437	0	3.05	7.56	0.005	3.87	5.48	50	0.02	0.09	3.13	ND	0.46	0.49	36	63	0.6				alternate TOC weekly sample between these 9 sites
	5/17/22	UP-647	0	2.91	7.55	0.005	4.09	5.62	50	0.02	0.13	2.81	ND	0.47	0.47	33	61	0.5				
	5/17/22	UP-187	0	2.96	7.56	0.007	4.02	5.36	50	0.05	0.11	2.76	ND	0.45	0.45	32	60	0.5				
	5/17/22	UP-629	0	2.8	7.62	0.005	4.21	5.74	51	0.16	0.15	2.59	ND	0.40	0.42	33	61	0.5				
	5/17/22	UP-713	0	2.84	7.52	0.004	4.1	5.48	50	0.21	0.12	2.7	ND	0.45	0.43	33	61	0.5			3.4	
	5/17/22	UP-644	0	2.81	7.58	0.007	4.19	5.28	50	0.16	0.19	2.57	ND	0.41	0.41	33	60	0.6				
	5/17/22	UP-222	0	2.76	7.58	0.004	4.28	5.46	50	0.14	0.16	2.48	ND	0.42	0.40	38	58	0.7				
	5/17/22	UP-649	0	2.58	7.59	0.008	4.35	5.15	50	0.07	0.14	2.36	ND	0.41	0.41	33	59	0.6				
	5/17/22	UP WWTP	0	2.64	7.59	0.008	4.38	5.32	51	0.03	0.15	2.42	ND	0.39	0.40	33	58	0.6				
	5/17/22	UP-612	0	2.47	7.62	0.007	4.36	5.24	49	0.1	0.2	2.27									NA	
	5/17/22	UP WWTP Men's Room	0	2.59	7.61	0.005	4.36	5.1	50	0.04	0.18	2.39									NA	

	5/17/22	BN-2098	0	3.72	8.51	0.004	2.03	NA	51	0.03	0.06	3.64									NA	
	5/17/22	MT-2810	0	3.27	8.52	0.007	2.65	NA	53	0.02	0.11	3.41									NA	
22-May	5/24/22	Kankakee WTP (TP01)	NA	NA	Daily	0.007	2.31	NA	Daily	NA	NA	NA	ND	ND	ND	35	72	0.5				Monthly
	5/24/22	UP- 437	0	2.91	7.53	0.008	2.27	4.86	50	0.04	0.11	2.91	ND	0.43	0.42	34	73	0.5				alternate TOC weekly sample between these 9 sites
	5/24/22	UP-647	0	2.78	7.51	0.007	2.25	4.92	51	0.04	0.11	2.66	ND	0.44	0.39	35	74	0.5				
	5/24/22	UP-187	0	2.79	7.55	0.007	2.23	4.74	51	0.14	0.16	2.61	ND	0.44	0.40	34	73	0.5				
	5/24/22	UP-629	0	2.78	7.57	0.006	2.22	4.8	50	0.02	0.14	2.58	ND	0.44	0.38	34	73	0.5				
	5/24/22	UP-713	0	2.6	7.58	0.006	2.24	4.84	51	0.06	0.32	2.54	ND	0.45	0.38	34	73	0.5				
	5/24/22	UP-644	0	2.7	7.59	0.005	2.22	4.88	50	0.19	0.14	2.53	ND	0.42	0.37	34	73	0.5			2.8	
	5/24/22	UP-222	0	2.66	7.58	0.005	2.29	4.94	50	0.17	0.2	2.34	0.01	0.44	0.37	34	73	0.5				
	5/24/22	UP-649	0.14	2.56	7.62	0.006	2.27	4.92	49	0.2	0.12	2.27	ND	0.43	0.37	35	73	0.5				
	5/24/22	UP WWTP	0	2.71	7.57	0.004	2.29	4.82	50	0.01	0.18	2.49	ND	0.42	0.38	34	73	0.5				
	5/24/22	UP-612	0	2.56	7.61	0.005	2.36	4.98	51	0.11	0.13	2.34									NA	
	5/24/22	UP WWTP Men's Room	0	2.55	7.55	0.005	2.21	4.96	50	0.02	0.25	2.35									NA	
	5/24/22	BN-2098	0.17	3.2	8.3	0.006	2.21	NA	55	0.02	0.09	3.18									NA	
	5/24/22	MT-2810	0.02	2.93	8.44	0.005	2.22	NA	52	0.1	0.07	2.87									NA	
29-May	5/31/22	Kankakee WTP (TP01)	NA	NA	Daily	0.003	2.27	NA	Daily	NA	NA	NA	ND	ND	ND	35	71	0.5				Monthly
	5/31/22	UP- 437	0	3.07	7.49	<0.200	2.11	4.72	50	0.01	0.08	3.17	ND	0.44	0.41	34	76	0.4				alternate TOC weekly sample between these 9 sites
	5/31/22	UP-647	0	2.75	7.52	<0.200	2.13	4.98	50	0.03	0.16	2.73	ND	0.40	0.42	34	75	0.5				
	5/31/22	UP-187	0.01	2.69	7.58	<0.200	2.09	4.64	50	0.03	0.2	2.71	ND	0.42	0.43	34	76	0.4				
	5/31/22	UP-629	0	2.61	7.6	<0.200	2.15	4.82	52	0.18	0.15	2.56	ND	0.38	0.35	34	75	0.5				
	5/31/22	UP-713	0	2.68	7.58	<0.200	2.16	4.84	49	0.07	0.22	2.67	ND	0.39	0.39	34	75	0.5				
	5/31/22	UP-644	0	2.73	7.58	<0.200	2.22	4.56	50	0.11	0.15	2.54	ND	0.38	0.35	34	76	0.4				
	5/31/22	UP-222	0	2.62	7.6	<0.200	2.17	4.74	50	0.13	0.19	2.45	ND	0.38	0.36	34	75	0.5			2.7	
	5/31/22	UP-649	0	2.47	7.59	<0.200	2.16	4.68	49	0.08	0.19	2.31	ND	0.36	0.36	34	75	0.5				
	5/31/22	UP WWTP	0	2.56	7.56	<0.200	2.2	4.68	50	0.02	0.28	2.18	ND	0.36	0.35	34	75	0.5				
	5/31/22	UP-612	0	2.6	7.63		2.19	4.79	51	0.09	0.14	2.6									NA	
	5/31/22	UP WWTP Men's Room	0	2.43	7.58		2.21	4.58	52	0.06	0.36	2.37									NA	
	5/31/22	BN-2098	0.09	3.01	8.27		2.55	NA	54	0.05	0	3.06									NA	
	5/31/22	MT-2810	0	3.29	8.53		2.32	NA	54	0.01	0.09	3.42									NA	
5-Jun	6/7/22	Kankakee WTP (TP01)	NA	NA	Daily		2.37	NA	Daily	NA	NA	NA	ND	ND	ND	60	71	0.8				Monthly
	6/7/22	UP- 437	0.08	3.12	7.49	<0.200	2.79	5.16	52	0.01	0	3.13	ND	0.36	0.37	35	74	0.5				alternate TOC weekly sample between these 9 sites
	6/7/22	UP-647	0.08	2.91	7.51	<0.200	2.66	5.28	52	0.01	0.03	2.77	ND	0.35	0.35	35	72	0.5				
	6/7/22	UP-187	0.02	2.71	7.5	<0.200	2.57	5.08	51	0.03	0.07	2.57	ND	0.35	0.34	35	73	0.5				
	6/7/22	UP-629	0	2.55	7.52	<0.200	2.63	5.14	52	0.07	0.12	2.47	ND	0.34	0.35	35	73	0.5				
	6/7/22	UP-713	0.12	2.82	7.5	<0.200	2.65	5.14	50	0.08	0.04	2.73	ND	0.37	0.34	35	73	0.5				
	6/7/22	UP-644	0.08	2.78	7.51	<0.200	2.63	4.9	50	0.07	0.06	2.53	ND	0.32	0.32	35	73	0.5				
	6/7/22	UP-222	0.03	2.67	7.53	<0.200	2.62	5.02	52	0.07	0.06	2.47	ND	0.34	0.33	35	73	0.5				
	6/7/22	UP-649	0.08	2.46	7.59	<0.200	2.53	4.9	52	0.04	0.1	2.29	ND	0.34	0.33	35	73	0.5			2.5	
	6/7/22	UP WWTP	0.1	2.52	7.54	<0.200	2.56	4.82	51	0.02	0.13	2.28	ND	0.34	0.34	35	74	0.5				
	6/7/22	UP-612	0.09	2.39	7.6		2.48	4.8	51	0.07	0.1	2.22									NA	
	6/7/22	UP WWTP Men's Room	0.04	2.44	7.54		2.51	4.84	50	0.03	0.11	2.32									NA	
	6/7/22	BN-2098	0.12	3.44	8.38		2.69	NA	57	0	0.11	3.47									NA	
	6/7/22	MT-2810	0	3.62	8.63		2.58	NA	56	0	0.02	3.62									NA	
12-Jun	6/14/22	Kankakee WTP (TP01)	NA	NA	Daily	0.005	7.04	NA	Daily	NA	NA	NA	ND	ND	ND	31	57	0.5				Monthly
	6/14/22	UP- 437	0	3.13	7.48	0.009	6.02	5.74	51	0.01	0.08	3.16	ND	0.40	0.42	34	63	0.5				alternate TOC weekly sample between these 9 sites
	6/14/22	UP-647	0	2.8	7.49	0.006	5.90	6.26	50	0.01	0.14	2.69	ND	0.38	0.41	34	64	0.5				
	6/14/22	UP-187	0	2.74	7.5	0.005	6.07	5.94	51	0.02	0.15	2.64	ND	0.38	0.40	34	63	0.5				
	6/14/22	UP-629	0	2.81	7.49	0.005	6.00	5.7	52	0.05	0.16	2.6	ND	0.36	0.38	34	64	0.5				
	6/14/22	UP-713	0	2.67	7.49	0.005	5.82	6.08	52	0.06	0.11	2.58	ND	0.39	0.38	34	64	0.5				
	6/14/22	UP-644	0	2.48	7.49	0.007	5.70	5.82	51	0.06	0.19	2.36	ND	0.36	0.35	34	64	0.5				
	6/14/22	UP-222	0	2.53	7.52	0.006	5.66	5.94	53	0.17	0.24	2.28	ND	0.39	0.37	35	64	0.5				
	6/14/22	UP-649	0	2.41	7.56	0.004	5.64	5.98	51	0.12	0.18	2.24	ND	0.37	0.38	35	64	0.5				
	6/14/22	UP WWTP	0	2.52	7.51	0.005	5.62	5.68	51	0.01	0.17	2.38	ND	0.36	0.39	35	65	0.5			2.6	
	6/14/22	UP-612	0	2.28	7.61	0.008	4.84	6	52	0.07	0.19	2.19									NA	
	6/14/22	UP WWTP Men's Room	0	2.43	7.52	0.009	5.78	6.02	50	0.01	0.19	2.33									NA	
	6/14/22	BN-2098	0.01	3.72	8.23	0.004	7.56	NA	61	0.01	0.01	3.62									NA	
	6/14/22	MT-2810	0	3.5	8.63	0.007	6.24	NA	54	0	0.22	3.44									NA	
19-Jun	6/21/22	Kankakee WTP (TP01)	NA	NA	Daily	0.005	3.42	NA	Daily	NA	NA	NA	ND	ND	ND	33	68	0.5				Monthly
	6/21/22	UP- 437	0.09	3.06	7.68	0.008	5.93	6.26	52	0.01	0	3.07	ND	0.45	0.43	32	60	0.5			2.8	
	6/21/22	UP-647	0.01	2.46	7.49	0.006	7.06	6.24	51	0.03	0.05	2.45	ND	0.43	0.39	32	57	0.6				

	6/21/22	UP-187	0.08	2.51	7.42	0.006	7.18	6.44	50	0.06	0.07	2.31	ND	0.44	0.39	32	57	0.6				alternate TOC weekly sample between these sites
	6/21/22	UP-629	0.05	2.36	7.45	0.005	7.35	6.6	49	0.08	0.08	2.17	ND	0.40	0.38	32	57	0.6				
	6/21/22	UP-713	0.04	2.48	7.42	0.006	7.03	6	49	0.14	0.05	2.26	ND	0.40	0.38	32	57	0.6				
	6/21/22	UP-644	0.01	2.4	7.47	0.012	6.9	6	50	0.09	0.05	2.25	ND	0.37	0.34	32	57	0.6				
	6/21/22	UP-222	0.03	2.34	7.48	0.006	7.32	6.24	50	0.22	0.07	2.13	0.02	0.35	0.35	32	57	0.6				
	6/21/22	UP-649	0	2.21	7.43	0.005	7.24	6.48	51	0.05	0.09	2.02	ND	0.39	0.36	32	57	0.6				
	6/21/22	UP WWTP	0.01	2.31	7.43	0.006	7.13	6.32	50	0.01	0.12	2.05	ND	0.40	0.36	32	57	0.6				
	6/21/22	UP-612	0	2.24	7.46	0.006	7.13	6.18	52	0.11	0.05	2.11									NA	
	6/21/22	UP WWTP Men's Room	0.09	2.23	7.45	0.01	7.36	6.12	51	0.02	0.09	2.06									NA	
	6/21/22	BN-2098	0.45	2.91	8.3	0.006	3.58	NA	53	0.01	0	2.95									NA	
	6/21/22	MT-2810	0	3.22	8.28	0.008	4.04	NA	53	0.01	0	3.22									NA	
26-Jun	6/28/22	Kankakee WTP (TP01)	NA	NA	Daily	0.004	2.02	NA	Daily	NA	NA	NA	NA	NA								Monthly
	6/28/22	UP- 437	0.03	3.25	7.45	0.01	2.83	6.46	51	0.01	0.13	3.28										alternate TOC weekly sample between these 9 sites
	6/28/22	UP-647	0.06	3	7.46	0.006	2.92	6.26	50	0.02	0.1	3.02										
	6/28/22	UP-187	0.00	2.94	7.44	0.006	2.95	6.32	50	0.09	0.17	2.91										
	6/28/22	UP-629	0.01	2.92	7.46	0.006	2.99	6.16	51	0.11	0.2	2.92										
	6/28/22	UP-713	0.00	2.93	7.48	0.007	2.98	6.08	50	0.18	0.15	2.93										
	6/28/22	UP-644	0.00	2.56	7.49	0.006	3.08	5.74	51	0.13	0.22	2.43										
	6/28/22	UP-222	0.00	2.69	7.49	0.004	3.1	6.22	52	0.76	0.21	2.47										
	6/28/22	UP-649	0.00	2.42	7.49	0.008	3.21	5.76	52	0.04	0.2	2.44										
	6/28/22	UP WWTP	0.05	2.55	7.5	0.007	3.2	5.82	50	0.01	0.21	2.39										
	6/28/22	UP-612	0.01	2.25	7.54	0.006	3.31	5.64	50	0.07	0.21	2.28									NA	
	6/28/22	UP WWTP Men's Room	0.01	2.62	7.51	0.009	3.17	5.68	51	0.02	0.22	2.45									NA	
	6/28/22	BN-2098	0.11	3.8	8.31	0.003	2.45	NA	56	0	0.16	3.84									NA	
	6/28/22	MT-2810	0.02	3.29	8.52	0.007	2.23	NA	55	0	0	3.39									NA	
3-Jul		Kankakee WTP (TP01)	NA	NA	Daily			NA	Daily	NA	NA	NA	NA	NA								Monthly

	UP Booster		Kankakee - TP01	
Date	**Flow**	**Ortho**	**pH**	**Alkalinity**
8/1/2021	2.367	3.9	8.46	52
8/2/2021	2.341	3.9	8.39	56
8/3/2021	2.739	4.2	8.36	56
8/4/2021	2.891	4.5	8.40	57
8/5/2021	2.951	4.4	8.26	55
8/6/2021	2.726	4.6	8.35	51
8/7/2021	2.511	4.5	8.29	52
8/8/2021	2.009	4.2	8.46	55
8/9/2021	2.105	3.8	8.31	55
8/10/2021	2.507	3.8	8.33	52
8/11/2021	2.444	4.2	8.26	58
8/12/2021	2.611	3.3	8.11	56
8/13/2021	2.351	3.1	8.26	52
8/14/2021	3.212	3.2	8.30	56
8/15/2021	1.902	3.2	8.35	61
8/16/2021	2.141	3.0	8.14	56
8/17/2021	2.619	3.1	8.27	54
8/18/2021	2.885	3.5	8.28	53
8/19/2021	2.534	3.3	8.41	56
8/20/2021	2.835	3.3	8.22	52
8/21/2021	2.437	3.5	8.26	51
8/22/2021	2.428	3.5	8.34	51
8/23/2021	3.187	3.3	8.31	53
8/24/2021	3.309	3.3	8.33	54
8/25/2021	3.029	3.4	8.30	56
8/26/2021	3.191	3.5	8.22	57
8/27/2021	3.611	3.7	8.49	61
8/28/2021	3.353	3.6	8.45	52
8/29/2021	3.183	3.9	8.32	54
8/30/2021	3.174	3.5	8.21	54
8/31/2021	2.774	3.3	8.27	53
9/1/2021	2.597	3.3	8.27	53
9/2/2021	2.661	3.1	8.32	51
9/3/2021	1.449	3.1	8.37	53
9/4/2021	1.365	3.0	8.23	50
9/5/2021	1.465	3.0	8.32	51
9/6/2021	1.925	3.0	8.21	51
9/7/2021	2.176	3.0	8.53	53
9/8/2021	2.416	3.0	8.40	55
9/9/2021	2.097	3.3	8.23	57
9/10/2021	1.692	3.6	8.21	56
9/11/2021	1.396	3.7	8.31	50
9/12/2021	1.979	3.6	8.32	53
9/13/2021	2.244	3.4	8.32	53
9/14/2021	2.211	3.2	8.25	52

9/15/2021	2.659	3.0	8.24	52
9/16/2021	2.002	3.1	8.23	52
9/17/2021	3.031	3.2	8.34	53
9/18/2021	2.39	3.0	8.23	52
9/19/2021	2.308	3.0	8.33	51
9/20/2021	2.635	3.0	8.38	53
9/21/2021	1.672	3.0	8.17	52
9/22/2021	1.465	3.2	8.29	51
9/23/2021	1.423	3.1	8.23	50
9/24/2021	1.495	3.5	8.22	50
9/25/2021	1.523	3.6	8.42	50
9/26/2021	1.492	3.5	8.35	52
9/27/2021	2.214	3.2	8.35	51
9/28/2021	2.023	3.2	8.46	50
9/29/2021	2.112	3.4	8.34	53
9/30/2021	2.854	3.6	8.36	53
10/1/2021	1.78	3.8	8.35	52
10/2/2021	2.031	3.7	8.33	52
10/3/2021	2.038	3.5	8.39	53
10/4/2021	2.555	3.4	8.27	54
10/5/2021	2.107	3.4	8.29	53
10/6/2021	2.609	3.5	8.37	54
10/7/2021	1.936	3.5	8.32	51
10/8/2021	1.808	3.5	8.31	51
10/9/2021	1.496	3.4	8.36	52
10/10/2021	1.365	3.7	8.36	53
10/11/2021	1.641	3.3	8.35	52
10/12/2021	2.42	3.4	8.34	53
10/13/2021	1.744	3.6	8.40	54
10/14/2021	1.606	3.6	8.37	53
10/15/2021	2.244	3.4	8.22	55
10/16/2021	1.34	3.5	8.34	51
10/17/2021	1.399	3.5	8.41	50
10/18/2021	1.937	3.5	8.31	53
10/19/2021	2.699	3.3	8.40	53
10/20/2021	2.591	3.2	8.32	56
10/21/2021	2.406	3.3	8.45	54
10/22/2021	2.248	3.4	8.47	54
10/23/2021	2.17	3.5	8.49	55
10/24/2021	2.282	3.5	8.54	53
10/25/2021	2.217	3.9	8.45	63
10/26/2021	2.956	3.9	8.75	71
10/27/2021	2.908	4.6	8.52	52
10/28/2021	2.415	5.2	8.50	51
10/29/2021	1.885	3.5	8.44	49
10/30/2021	1.689	3.1	8.43	54
10/31/2021	1.551	3.0	8.45	65

11/1/2021	1.574	3.0	8.18	63
11/2/2021	2.14	3.5	8.40	55
11/3/2021	2.432	4.0	8.12	54
11/4/2021	2.572	4.0	8.20	54
11/5/2021	2.194	3.9	8.29	52
11/6/2021	2.068	3.8	8.48	51
11/7/2021	1.854	3.4	8.47	49
11/8/2021	1.6	3.7	8.76	53
11/9/2021	2.142	3.7	8.47	52
11/10/2021	1.748	4.0	8.45	51
11/11/2021	1.907	4.4	8.55	48
11/12/2021	1.559	4.7	8.30	47
11/13/2021	1.262	4.8	8.55	51
11/14/2021	1.232	4.5	8.55	53
11/15/2021	1.848	3.9	8.66	52
11/16/2021	1.539	3.9	8.61	52
11/17/2021	1.372	3.9	8.68	49
11/18/2021	1.322	4.3	8.72	53
11/19/2021	2.069	4.1	8.58	53
11/20/2021	1.527	4.7	8.70	54
11/21/2021	1.372	4.3	8.70	57
11/22/2021	1.322	4.0	8.51	59
11/23/2021	1.774	4.3	8.60	58
11/24/2021	1.424	4.8	8.60	62
11/25/2021	1.228	5.2	8.61	62
11/26/2021	1.32	4.8	8.54	55
11/27/2021	1.571	4.7	8.52	54
11/28/2021	1.439	4.6	8.66	57
11/29/2021	1.976	4.8	8.56	59
11/30/2021	1.549	4.4	8.47	64
12/1/2021	1.832	4.2	8.57	57
12/2/2021	1.367	4.3	8.70	57
12/3/2021	1.535	4.8	8.78	55
12/4/2021	1.319	4.6	8.58	57
12/5/2021	1.632	5.0	8.59	52
12/6/2021	1.453	4.8	8.57	56
12/7/2021	1.445	4.8	8.48	58
12/8/2021	1.445	4.2	8.65	53
12/9/2021	1.42	4.7	8.59	50
12/10/2021	1.395	4.5	8.65	51
12/11/2021	1.423	4.5	8.67	50
12/12/2021	1.614	4.3	8.66	45
12/13/2021	1.476	3.9	8.56	51
12/14/2021	1.45	3.7	8.60	55
12/15/2021	1.385	3.7	8.70	57
12/16/2021	1.412	3.8	8.62	53
12/17/2021	1.303	3.9	8.72	48

12/18/2021	1.261	4.2	8.64	50
12/19/2021	1.285	4.2	8.80	49
12/20/2021	1.401	4.4	8.65	52
12/21/2021	1.393	4.7	8.55	55
12/22/2021	1.475	4.9	8.60	60
12/23/2021	1.395	4.5	8.56	58
12/24/2021	1.299	4.7	8.52	57
12/25/2021	1.047	5.0	8.75	54
12/26/2021	1.293	5.0	8.74	54
12/27/2021	1.387	4.9	8.71	52
12/28/2021	1.418	4.8	8.84	51
12/29/2021	1.334	5.2	8.87	53
12/30/2021	1.283	5.0	8.64	54
12/31/2021	1.361	5.3	8.69	52
1/1/2022	1.195	5.3	8.61	54
1/2/2022	1.243	5.4	8.66	53
1/3/2022	1.386	5.5	8.66	56
1/4/2022	1.37	5.3	8.64	57
1/5/2022	1.485	5.2	8.54	58
1/6/2022	1.514	5.0	8.59	58
1/7/2022	1.606	5.0	8.62	58
1/8/2022	1.469	5.0	8.64	59
1/9/2022	1.543	5.0	8.53	63
1/10/2022	1.442	5.0	8.54	66
1/11/2022	1.613	5.0	8.62	65
1/12/2022	1.564	5.0	8.61	63
1/13/2022	1.856	5.0	8.63	64
1/14/2022	1.5	5.5	8.56	62
1/15/2022	1.368	5.5	8.60	61
1/16/2022	1.372	5.5	8.57	61
1/17/2022	1.645	5.5	8.62	59
1/18/2022	1.561	5.5	8.64	61
1/19/2022	1.59	5.5	8.73	62
1/20/2022	1.466	5.5	8.53	64
1/21/2022	1.467	5.0	8.57	65
1/22/2022	1.446	5.0	8.65	63
1/23/2022	1.389	5.0	8.58	60
1/24/2022	1.418	5.0	8.65	61
1/25/2022	1.428	6.0	8.59	62
1/26/2022	1.446	5.5	8.56	65
1/27/2022	1.553	5.0	8.58	68
1/28/2022	1.661	5.5	8.60	62
1/29/2022	1.63	5.5	8.68	64
1/30/2022	1.55	5.5	8.57	67
1/31/2022	1.822	5.5	8.69	68
2/1/2022	1.535	5.5	8.63	67
2/2/2022	1.406	5.5	8.66	67

2/3/2022	1.657	5.5	8.65	65
2/4/2022	1.737	5.5	8.65	65
2/5/2022	1.687	6.0	8.60	68
2/6/2022	1.643	6.0	8.64	73
2/7/2022	1.732	5.5	8.62	72
2/8/2022	1.828	5.5	8.66	61
2/9/2022	1.874	5.5	8.72	66
2/10/2022	1.769	5.5	8.72	66
2/11/2022	1.694	5.5	8.64	67
2/12/2022	1.554	6.5	8.62	69
2/13/2022	1.581	6.0	8.68	68
2/14/2022	1.686	6.0	8.70	72
2/15/2022	1.7	6.0	8.60	68
2/16/2022	1.719	6.0	8.61	67
2/17/2022	1.671	6.0	8.66	77
2/18/2022	1.679	6.5	8.75	81
2/19/2022	1.639	7.0	7.44	73
2/20/2022	1.66	7.0	8.66	73
2/21/2022	1.701	7.0	8.31	60
2/22/2022	1.95	6.5	8.83	60
2/23/2022	1.783	7.0	8.56	66
2/24/2022	1.875	5.0	8.60	64
2/25/2022	1.86	5.0	8.63	64
2/26/2022	1.741	5.5	8.73	68
2/27/2022	1.642	6.0	8.55	65
2/28/2022	1.714	5.0	8.93	69
3/1/2022		5.5	8.52	68
3/2/2022	1.571	6.0	8.71	66
3/3/2022	1.565	6.5	8.93	68
3/4/2022	1.565	6.5	8.90	77
3/5/2022	1.691	6.0	8.82	68
3/6/2022	1.621	6.0	8.86	61
3/7/2022	2.027	6.0	8.89	53
3/8/2022	1.803	6.5	8.82	56
3/9/2022	1.633	7.0	8.81	56
3/10/2022	1.597	6.0	8.66	56
3/11/2022	1.662	6.5	8.63	55
3/12/2022	1.534	6.0	8.61	56
3/13/2022	1.443	6.0	8.60	53
3/14/2022	1.85	5.0	8.49	53
3/15/2022	1.687	5.5	8.61	54
3/16/2022	1.533	5.0	8.64	56
3/17/2022	1.561	5.0	8.46	60
3/18/2022	1.491	4.5	8.56	57
3/19/2022	1.379	5.0	8.53	56
3/20/2022	1.479	5.0	8.59	58
3/21/2022	1.448	5.0	8.65	51

3/22/2022	1.69	5.0	8.65	54
3/23/2022	1.448	5.0	8.64	53
3/24/2022	1.69	5.0	8.74	59
3/25/2022	1.62	5.0	8.52	57
3/26/2022	1.467	5.0	8.61	55
3/27/2022	1.509	5.0	8.64	55
3/28/2022	1.479	5.0	8.69	53
3/29/2022	1.579	5.5	8.64	56
3/30/2022	1.585	5.0	8.53	60
3/31/2022	1.542	5.0	8.27	54
4/1/2022	1.605	5.0	8.59	56
4/2/2022	1.477	5.0	8.51	58
4/3/2022	1.547	5.0	8.40	58
4/4/2022	1.553	5.0	8.69	54
4/5/2022	1.925	5.0	8.54	56
4/6/2022	1.51	5.0	8.77	56
4/7/2022	1.545	5.0	8.69	55
4/8/2022	1.525	5.0	8.53	56
4/9/2022	1.43	5.0	8.59	57
4/10/2022	1.421	5.0	8.69	53
4/11/2022	1.526	5.0	8.49	52
4/12/2022	1.661	5.0	8.64	51
4/13/2022	1.589	5.0	8.59	50
4/14/2022	1.592	5.0	8.65	53
4/15/2022	1.598	5.0	8.52	51
4/16/2022	1.462	5.0	8.60	54
4/17/2022	1.482	5.0	8.65	52
4/18/2022	1.605	5.0	8.72	50
4/19/2022	1.679	4.5	8.61	52
4/20/2022	1.925	4.5	8.55	57
4/21/2022	1.582	5.0	8.66	52
4/22/2022	1.606	5.0	8.68	54
4/23/2022	1.607	5.0	8.56	54
4/24/2022	1.457	5.0	8.61	52
4/25/2022	1.651	5.0	8.61	52
4/26/2022	1.628	4.8	8.66	53
4/27/2022	1.705	5.0	8.61	56
4/28/2022	1.476	5.0	8.49	57
4/29/2022	1.673	5.0	8.56	55
4/30/2022	1.479	5.0	8.60	59
5/1/2022	1.487	5.0	8.50	58
5/2/2022	1.666	4.9	8.60	59
5/3/2022	1.652	5.3	8.56	59
5/4/2022	1.585	5.3	8.64	55
5/5/2022	1.683	5.0	8.56	56
5/6/2022	1.532	5.0	8.54	53
5/7/2022	1.579	5.0	8.56	55

5/8/2022	1.559	5.0	8.57	54
5/9/2022	1.715	5.0	8.51	57
5/10/2022	1.853	4.5	8.55	56
5/11/2022	2.154	5.0	8.55	53
5/12/2022	2.447	4.5	8.60	52
5/13/2022	2.426	5.0	8.57	54
5/14/2022	1.77	5.0	8.69	54
5/15/2022	1.582	5.0	8.36	54
5/16/2022	1.659	5.0	8.54	51
5/17/2022	1.692	5.0	8.62	51
5/18/2022	1.607	5.0	8.51	53
5/19/2022	1.674	4.5	8.48	51
5/20/2022	1.643	4.5	8.53	51
5/21/2022	1.635	4.5	8.50	53
5/22/2022	1.584	4.5	8.45	53
5/23/2022	1.606	4.0	8.41	52
5/24/2022	1.824	4.0	8.39	52
5/25/2022	1.731	4.0	8.34	53
5/26/2022	1.76	4.0	8.58	53
5/27/2022	1.671	4.0	8.35	51
5/28/2022	1.525	4.0	8.47	50
5/29/2022	1.489	4.0	8.46	53
5/30/2022	1.502	4.0	8.44	52
5/31/2022	1.681	4.0	8.54	53
6/1/2022	1.975	4.0	8.46	52
6/2/2022	1.939	4.5	8.59	53
6/3/2022	1.829	4.5	8.54	54
6/4/2022	1.628	4.5	8.52	55
6/5/2022	1.642	4.0	8.55	56
6/6/2022	1.745	4.0	8.51	53
6/7/2022	1.976	4.5	8.42	55
6/8/2022	1.816	5.0	8.55	53
6/9/2022	1.891	5.0	8.53	56
6/10/2022	1.842	5.0	8.59	54
6/11/2022	1.808	5.0	8.47	53
6/12/2022	1.701	5.0	8.43	50
6/13/2022	1.808	5.0	8.40	54
6/14/2022	1.701	5.0	8.44	53
6/15/2022	2.881	5.0	8.64	50
6/16/2022	3.192	5.0	8.79	55
6/17/2022	1.778	5.0	8.42	55
6/18/2022	1.573	5.0	8.56	53
6/19/2022	1.746	5.5	8.52	53
6/20/2022	1.965	5.0	8.50	53
6/21/2022	2.227	5.0	8.45	53
6/22/2022	2.416	5.0	8.46	53
6/23/2022	1.9	4.5	8.44	54

6/24/2022	2.68	4.5	8.54	54
6/25/2022	1.524	5.0	8.48	56
6/26/2022	1.782	5.0	8.44	53
6/27/2022	1.707	5.5	8.63	53
6/28/2022	1.754	5.5	8.33	55
6/29/2022	1.863	5.0	8.22	51
6/30/2022	2.338	5.0	8.33	53
7/1/2022	2.206	5.5	8.31	54
7/2/2022	1.585	5.0	8.26	51
7/3/2022	1.525	4.5	8.30	52
7/4/2022	1.494	4.0	8.28	52
7/5/2022	1.972	4.0	8.27	52
7/6/2022	1.96	4.0	8.39	53
7/7/2022	1.742	4.5	8.35	54

NUMBER0	mple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	21-Jul-22	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	21-Jul-22	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	19-Jul-22	1.3	UG/L		0		LA3S094	[redacted]
IL1975030	18-Jul-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	18-Jul-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	18-Jul-22	0		Y	1	UG/L	LP3S059	[redacted]
IL1975030	18-Jul-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	18-Jul-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	17-Jul-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	09-Jun-22	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	07-Jun-22	9.2	UG/L		0		LP3S046	[redacted]
IL1975030	06-Jun-22	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	04-Jun-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	03-Jun-22	16	UG/L		0		LA3S086	[redacted]
IL1975030	03-Jun-22	12	UG/L		0		LP3S049	[redacted]
IL1975030	03-Jun-22	1	UG/L		0		LP3S054	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	03-Jun-22	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	02-Jun-22	3	UG/L		0		LA3S087	[redacted]
IL1975030	02-Jun-22	1.6	UG/L		0		LP3S044	[redacted]
IL1975030	02-Jun-22	1	UG/L		0		LP1A119	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S085	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S073	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	02-Jun-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	01-Jun-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	10-May-22	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	10-May-22	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	09-May-22	1.3	UG/L		0		LA3S094	[redacted]
IL1975030	09-May-22	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	09-May-22	0		Y	1.1	UG/L	LP3S063	[redacted]
IL1975030	06-May-22	13	UG/L		0		LA3S118	[redacted]
IL1975030	06-May-22	3	UG/L		0		LA3S099	[redacted]
IL1975030	05-May-22	3.4	UG/L		0		LA3S098	[redacted]
IL1975030	05-May-22	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	04-May-22	65	UG/L		0		LP3S013	[redacted]
IL1975030	04-May-22	34	UG/L		0		LA3S093	[redacted]
IL1975030	04-May-22	2.7	UG/L		0		LA3S086	[redacted]
IL1975030	04-May-22	1.5	UG/L		0		LP3S071	[redacted]
IL1975030	04-May-22	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	04-May-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	03-May-22	97	UG/L		0		LA3S092	[redacted]
IL1975030	03-May-22	25	UG/L		0		LP3S040	[redacted]
IL1975030	03-May-22	16	UG/L		0		LP3S046	[redacted]
IL1975030	03-May-22	12	UG/L		0		LP3S048	[redacted]
IL1975030	03-May-22	2.9	UG/L		0		LA3S085	[redacted]
IL1975030	03-May-22	1.5	UG/L		0		LA3S102	[redacted]
IL1975030	03-May-22	1.3	UG/L		0		LP3S019	[redacted]
IL1975030	03-May-22	1.2	UG/L		0		LP3S044	[redacted]
IL1975030	03-May-22	1.1	UG/L		0		LP1A119	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S054	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	03-May-22	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	03-May-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	02-May-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	02-May-22	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	02-May-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	02-May-22	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	02-May-22	0		Y	1	UG/L	LP3S074	[redacted]
IL1975030	28-Apr-22	1.1	UG/L		0		LP3S055	[redacted]
IL1975030	28-Apr-22	0		Y	1	UG/L	LP3S018	[redacted]
IL1975030	25-Apr-22	4.4	UG/L		0		LP3S048	[redacted]
IL1975030	25-Apr-22	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	25-Apr-22	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	22-Apr-22	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	21-Apr-22	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	06-Apr-22	36	UG/L		0		LP3S070	[redacted]
IL1975030	06-Apr-22	11	UG/L		0		LP3S054	[redacted]
IL1975030	06-Apr-22	4	UG/L		0		LP3S013	[redacted]
IL1975030	06-Apr-22	2.1	UG/L		0		LA3S094	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	06-Apr-22	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	05-Apr-22	1100	UG/L		0		LP3S048	[redacted]
IL1975030	05-Apr-22	76	UG/L		0		LP3S040	[redacted]
IL1975030	05-Apr-22	33	UG/L		0		LP3S049	[redacted]
IL1975030	05-Apr-22	28	UG/L		0		LP3S046	[redacted]
IL1975030	05-Apr-22	26	UG/L		0		LA3S091	[redacted]
IL1975030	05-Apr-22	4.7	UG/L		0		LA3S085	[redacted]
IL1975030	05-Apr-22	2.1	UG/L		0		LP3S019	[redacted]
IL1975030	05-Apr-22	1.4	UG/L		0		LP1A119	[redacted]
IL1975030	05-Apr-22	1.3	UG/L		0		LA3S116	[redacted]
IL1975030	05-Apr-22	1.3	UG/L		0		LP3S044	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S100	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	05-Apr-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	04-Apr-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	18-Mar-22	1.4	UG/L		0		LP3S013	[redacted]
IL1975030	18-Mar-22	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	17-Mar-22	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	11-Mar-22	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	09-Mar-22	76	UG/L		0		LA3S099	[redacted]
IL1975030	09-Mar-22	4.2	UG/L		0		LP3S055	[redacted]
IL1975030	09-Mar-22	1.3	UG/L		0		LA3S094	[redacted]
IL1975030	09-Mar-22	1.3	UG/L		0		LP3S019	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	09-Mar-22	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	08-Mar-22	75	UG/L		0		LA3S091	[redacted]
IL1975030	08-Mar-22	59	UG/L		0		LP3S040	[redacted]
IL1975030	08-Mar-22	58	UG/L		0		LA3S093	[redacted]
IL1975030	08-Mar-22	22	UG/L		0		LP3S046	[redacted]
IL1975030	08-Mar-22	7.4	UG/L		0		LA3S102	[redacted]
IL1975030	08-Mar-22	6.1	UG/L		0		LP3S054	[redacted]
IL1975030	08-Mar-22	3.7	UG/L		0		LA3S087	[redacted]
IL1975030	08-Mar-22	2.9	UG/L		0		LA3S101	[redacted]
IL1975030	08-Mar-22	1.9	UG/L		0		LA3S085	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	08-Mar-22	1.7	UG/L		0		LP1A119	[redacted]
IL1975030	08-Mar-22	1.1	UG/L		0		LP3S044	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S049	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	08-Mar-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	07-Mar-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	16-Feb-22	1.5	UG/L		0		LA3S094	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LP3S013	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	16-Feb-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	15-Feb-22	24	UG/L		0		LA3S118	[redacted]
IL1975030	15-Feb-22	16	UG/L		0		LP3S074	[redacted]
IL1975030	15-Feb-22	10	UG/L		0		LP3S046	[redacted]
IL1975030	15-Feb-22	8.3	UG/L		0		LA3S091	[redacted]
IL1975030	15-Feb-22	4.3	UG/L		0		LP3S044	[redacted]
IL1975030	15-Feb-22	3	UG/L		0		LP3S040	[redacted]
IL1975030	15-Feb-22	2	UG/L		0		LA3S101	[redacted]
IL1975030	15-Feb-22	1.3	UG/L		0		LP1A119	[redacted]
IL1975030	15-Feb-22	1.1	UG/L		0		LA3S085	[redacted]
IL1975030	15-Feb-22	1.1	UG/L		0		LP3S019	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S093	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S049	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	15-Feb-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	14-Feb-22	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	14-Feb-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	30-Jan-22	25	UG/L		0		LP3S070	[redacted]
IL1975030	26-Jan-22	56	UG/L		0		LA3S086	[redacted]
IL1975030	26-Jan-22	37	UG/L		0		LA3S098	[redacted]
IL1975030	26-Jan-22	31	UG/L		0		LP3S059	[redacted]
IL1975030	26-Jan-22	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	26-Jan-22	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	26-Jan-22	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	26-Jan-22	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	26-Jan-22	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	25-Jan-22	51	UG/L		0		LA3S091	[redacted]
IL1975030	25-Jan-22	34	UG/L		0		LA3S092	[redacted]
IL1975030	25-Jan-22	30	UG/L		0		LA3S118	[redacted]
IL1975030	25-Jan-22	21	UG/L		0		LP3S074	[redacted]
IL1975030	25-Jan-22	5.9	UG/L		0		LP3S046	[redacted]
IL1975030	25-Jan-22	5.5	UG/L		0		LA3S093	[redacted]
IL1975030	25-Jan-22	4.1	UG/L		0		LP3S044	[redacted]
IL1975030	25-Jan-22	2.9	UG/L		0		LP3S040	[redacted]
IL1975030	25-Jan-22	1.4	UG/L		0		LP3S049	[redacted]
IL1975030	25-Jan-22	1.3	UG/L		0		LP1A119	[redacted]
IL1975030	25-Jan-22	1.2	UG/L		0		LA3S087	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S094	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	25-Jan-22	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	24-Jan-22	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	24-Jan-22	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	08-Dec-21	8.4	UG/L		0		LA3S105	[redacted]
IL1975030	08-Dec-21	1.1	UG/L		0		LP3S035	[redacted]
IL1975030	08-Dec-21	1	UG/L		0		LA3S101	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	08-Dec-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	07-Dec-21	19	UG/L		0		LP3S042	[redacted]
IL1975030	07-Dec-21	12	UG/L		0		LP3S040	[redacted]
IL1975030	07-Dec-21	7.8	UG/L		0		LA3S093	[redacted]
IL1975030	07-Dec-21	7.5	UG/L		0		LP3S046	[redacted]
IL1975030	07-Dec-21	3.1	UG/L		0		LA3S086	[redacted]
IL1975030	07-Dec-21	1.9	UG/L		0		LP3S019	[redacted]
IL1975030	07-Dec-21	1.3	UG/L		0		LP3S074	[redacted]
IL1975030	07-Dec-21	1.2	UG/L		0		LP1A119	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S094	[redacted]

NUMBER0	nple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	07-Dec-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	06-Dec-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	12-Nov-21	0		Y	1	UG/L	LP3S018	[redacted]
IL1975030	10-Nov-21	26	UG/L		0		LA3S091	[redacted]
IL1975030	10-Nov-21	23	UG/L		0		LP3S042	[redacted]
IL1975030	10-Nov-21	1.5	UG/L		0		LP3S074	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	10-Nov-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	09-Nov-21	38	UG/L		0		LA3S092	[redacted]
IL1975030	09-Nov-21	30	UG/L		0		LA3S096	[redacted]
IL1975030	09-Nov-21	22	UG/L		0		LA3S098	[redacted]
IL1975030	09-Nov-21	16	UG/L		0		LP3S046	[redacted]
IL1975030	09-Nov-21	7.9	UG/L		0		LP3S040	[redacted]
IL1975030	09-Nov-21	5.5	UG/L		0		LP3S055	[redacted]
IL1975030	09-Nov-21	5	UG/L		0		LA3S086	[redacted]
IL1975030	09-Nov-21	4.2	UG/L		0		LA3S093	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	09-Nov-21	1.6	UG/L		0		LP3S044	[redacted]
IL1975030	09-Nov-21	1.3	UG/L		0		LP1A119	[redacted]
IL1975030	09-Nov-21	1.1	UG/L		0		LP3S048	[redacted]
IL1975030	09-Nov-21	1	UG/L		0		LA3S085	[redacted]
IL1975030	09-Nov-21	1	UG/L		0		LA3S089	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S035	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	09-Nov-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	21-Oct-21	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	20-Oct-21	8.5	UG/L		0		LA3S092	[redacted]
IL1975030	20-Oct-21	1.1	UG/L		0		LP3S058	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	20-Oct-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	19-Oct-21	46	UG/L		0		LA3S107	[redacted]
IL1975030	19-Oct-21	22	UG/L		0		LA3S098	[redacted]
IL1975030	19-Oct-21	5.2	UG/L		0		LP3S042	[redacted]
IL1975030	19-Oct-21	4.3	UG/L		0		LA3S091	[redacted]
IL1975030	19-Oct-21	3.1	UG/L		0		LA3S086	[redacted]
IL1975030	19-Oct-21	2.7	UG/L		0		LP3S044	[redacted]
IL1975030	19-Oct-21	1.7	UG/L		0		LP1A119	[redacted]

NUMBER0	nple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	19-Oct-21	1.3	UG/L		0		LA3S087	[redacted]
IL1975030	19-Oct-21	1.1	UG/L		0		LA3S094	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S085	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S035	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	19-Oct-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	18-Oct-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	29-Sep-21	3.5	UG/L		0		LP3S042	[redacted]
IL1975030	29-Sep-21	1.7	UG/L		0		LP3S054	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LA3S107	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	29-Sep-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	28-Sep-21	20	UG/L		0		LP3S040	[redacted]
IL1975030	28-Sep-21	5.2	UG/L		0		LA3S098	[redacted]
IL1975030	28-Sep-21	4.3	UG/L		0		LA3S091	[redacted]
IL1975030	28-Sep-21	1.5	UG/L		0		LP1A119	[redacted]

NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	28-Sep-21	1.1	UG/L		0		LA3S093	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S085	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S035	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	28-Sep-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	27-Sep-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	27-Sep-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	30-Jul-21	25	UG/L		0		LA3S086	[redacted]
IL1975030	30-Jul-21	7.3	UG/L		0		LA3S087	[redacted]
IL1975030	30-Jul-21	1.3	UG/L		0		LP3S054	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	30-Jul-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	29-Jul-21	230	UG/L		0		LP3S040	[redacted]
IL1975030	29-Jul-21	140	UG/L		0		LP3S082	[redacted]
IL1975030	29-Jul-21	60	UG/L		0		LP3S015	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	29-Jul-21	51	UG/L		0		LP3S078	[redacted]
IL1975030	29-Jul-21	41	UG/L		0		LP3S044	[redacted]
IL1975030	29-Jul-21	37	UG/L		0		LA3S093	[redacted]
IL1975030	29-Jul-21	33	UG/L		0		LA3S091	[redacted]
IL1975030	29-Jul-21	26	UG/L		0		LP3S042	[redacted]
IL1975030	29-Jul-21	17	UG/L		0		LA3S092	[redacted]
IL1975030	29-Jul-21	17	UG/L		0		LP3S074	[redacted]
IL1975030	29-Jul-21	12	UG/L		0		LA3S107	[redacted]
IL1975030	29-Jul-21	9.1	UG/L		0		LA3S098	[redacted]
IL1975030	29-Jul-21	8.6	UG/L		0		LP3S008	[redacted]
IL1975030	29-Jul-21	6.3	UG/L		0		LP3S035	[redacted]
IL1975030	29-Jul-21	5.8	UG/L		0		LP3S046	[redacted]
IL1975030	29-Jul-21	5.5	UG/L		0		LP1A119	[redacted]
IL1975030	29-Jul-21	4.1	UG/L		0		LA3S088	[redacted]
IL1975030	29-Jul-21	4	UG/L		0		LP3S002	[redacted]
IL1975030	29-Jul-21	3.9	UG/L		0		LA3S089	[redacted]
IL1975030	29-Jul-21	2.1	UG/L		0		LP3S048	[redacted]
IL1975030	29-Jul-21	2	UG/L		0		LA3S102	[redacted]
IL1975030	29-Jul-21	1.8	UG/L		0		LA3S114	[redacted]
IL1975030	29-Jul-21	1.6	UG/L		0		LA3S085	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	29-Jul-21	0		Y	1.1	UG/L	LA3S103	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	29-Jul-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	11-Jun-21	25	UG/L		0		LP3S071	[redacted]
IL1975030	10-Jun-21	3.4	UG/L		0		LA3S099	[redacted]
IL1975030	10-Jun-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	10-Jun-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	10-Jun-21	0		Y	1	UG/L	LP3S029	[redacted]
IL1975030	09-Jun-21	100	UG/L		0		LP3S082	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	09-Jun-21	29	UG/L		0		LA3S092	[redacted]
IL1975030	09-Jun-21	16	UG/L		0		LA3S086	[redacted]
IL1975030	09-Jun-21	2.9	UG/L		0		LA3S107	[redacted]
IL1975030	09-Jun-21	2.4	UG/L		0		LP3S076	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	09-Jun-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	08-Jun-21	69	UG/L		0		LA3S085	[redacted]
IL1975030	08-Jun-21	1.4	UG/L		0		LP3S062	[redacted]
IL1975030	07-Jun-21	3.2	UG/L		0		LA3S103	[redacted]
IL1975030	04-Jun-21	130	UG/L		0		LP3S015	[redacted]
IL1975030	04-Jun-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	04-Jun-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	04-Jun-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	03-Jun-21	90	UG/L		0		LA3S116	[redacted]
IL1975030	03-Jun-21	9.2	UG/L		0		LP3S008	[redacted]
IL1975030	03-Jun-21	6.3	UG/L		0		LA3S093	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	03-Jun-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	02-Jun-21	880	UG/L		0		LA3S098	[redacted]
IL1975030	02-Jun-21	39	UG/L		0		LA3S091	[redacted]
IL1975030	02-Jun-21	26	UG/L		0		LP3S078	[redacted]
IL1975030	02-Jun-21	20	UG/L		0		LP3S040	[redacted]
IL1975030	02-Jun-21	17	UG/L		0		LP3S042	[redacted]
IL1975030	02-Jun-21	7.1	UG/L		0		LP1A119	[redacted]
IL1975030	02-Jun-21	6.1	UG/L		0		LA3S087	[redacted]
IL1975030	02-Jun-21	4.6	UG/L		0		LP3S035	[redacted]
IL1975030	02-Jun-21	2.9	UG/L		0		LA3S102	[redacted]
IL1975030	02-Jun-21	2.5	UG/L		0		LA3S089	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LA3S112	[redacted]

NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	02-Jun-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	02-Jun-21	0		Y	1	UG/L	LP3S074	[redacted]
IL1975030	31-May-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	30-May-21	0		Y	1	UG/L	LP3S077	[redacted]
IL1975030	28-May-21	18	UG/L		0		LP3S042	[redacted]
IL1975030	28-May-21	8.6	UG/L		0		LP1A121	[redacted]
IL1975030	28-May-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	28-May-21	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	28-May-21	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	27-May-21	2.3	UG/L		0		LP3S046	[redacted]
IL1975030	27-May-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	27-May-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	26-May-21	11	UG/L		0		LA3S096	[redacted]
IL1975030	26-May-21	5.5	UG/L		0		LA3S087	[redacted]
IL1975030	25-May-21	78	UG/L		0		LA3S091	[redacted]
IL1975030	25-May-21	23	UG/L		0		LA3S104	[redacted]
IL1975030	25-May-21	13	UG/L		0		LP3S008	[redacted]
IL1975030	25-May-21	7.3	UG/L		0		LP3S071	[redacted]
IL1975030	25-May-21	1.1	UG/L		0		LA3S103	[redacted]
IL1975030	25-May-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	25-May-21	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	25-May-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	24-May-21	18	UG/L		0		LP3S015	[redacted]
IL1975030	24-May-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	24-May-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	24-May-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	19-May-21	98	UG/L		0		LP3S078	[redacted]
IL1975030	19-May-21	12	UG/L		0		LA3S093	[redacted]
IL1975030	19-May-21	1.5	UG/L		0		LA3S094	[redacted]
IL1975030	19-May-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	18-May-21	120	UG/L		0		LA3S116	[redacted]
IL1975030	18-May-21	6.5	UG/L		0		LP3S040	[redacted]
IL1975030	18-May-21	4.6	UG/L		0		LP3S074	[redacted]
IL1975030	17-May-21	350	UG/L		0		LA3S098	[redacted]
IL1975030	17-May-21	33	UG/L		0		LA3S085	[redacted]
IL1975030	17-May-21	5.3	UG/L		0		LP3S070	[redacted]
IL1975030	17-May-21	1.2	UG/L		0		LP3S035	[redacted]
IL1975030	17-May-21	1	UG/L		0		LP3S048	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	17-May-21	0		Y	1	UG/L	LP3S047	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-May-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	15-May-21	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	15-May-21	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	14-May-21	7	UG/L		0		LP1A119	[redacted]
IL1975030	14-May-21	2.2	UG/L		0		LA3S089	[redacted]
IL1975030	14-May-21	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	14-May-21	0		Y	1	UG/L	LP3S010	[redacted]
IL1975030	14-May-21	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	28-Apr-21	470	UG/L		0		LA3S098	[redacted]
IL1975030	28-Apr-21	6.1	UG/L		0		LA3S107	[redacted]
IL1975030	28-Apr-21	5.4	UG/L		0		LA3S093	[redacted]
IL1975030	28-Apr-21	4.9	UG/L		0		LP3S042	[redacted]
IL1975030	28-Apr-21	3.5	UG/L		0		LA3S087	[redacted]
IL1975030	28-Apr-21	1.5	UG/L		0		LA3S086	[redacted]
IL1975030	28-Apr-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	28-Apr-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	28-Apr-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	28-Apr-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	28-Apr-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	27-Apr-21	170	UG/L		0		LP3S015	[redacted]
IL1975030	27-Apr-21	52	UG/L		0		LA3S116	[redacted]
IL1975030	27-Apr-21	40	UG/L		0		LP3S078	[redacted]
IL1975030	27-Apr-21	35	UG/L		0		LA3S118	[redacted]
IL1975030	27-Apr-21	28	UG/L		0		LP3S082	[redacted]
IL1975030	27-Apr-21	20	UG/L		0		LP3S081	[redacted]
IL1975030	27-Apr-21	15	UG/L		0		LA3S091	[redacted]
IL1975030	27-Apr-21	11	UG/L		0		LP1A119	[redacted]
IL1975030	27-Apr-21	9	UG/L		0		LA3S085	[redacted]
IL1975030	27-Apr-21	8.5	UG/L		0		LP3S074	[redacted]
IL1975030	27-Apr-21	4.7	UG/L		0		LA3S096	[redacted]
IL1975030	27-Apr-21	2.3	UG/L		0		LP3S048	[redacted]
IL1975030	27-Apr-21	1.9	UG/L		0		LP3S062	[redacted]
IL1975030	27-Apr-21	1.5	UG/L		0		LP3S071	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	27-Apr-21	0		Y	5.6	UG/L	LA3S101	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S102	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S112	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	ENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	27-Apr-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S040	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	27-Apr-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	26-Apr-21	1.6	UG/L		0		LP3S054	[redacted]
IL1975030	25-Mar-21	17	UG/L		0		LP3S080	[redacted]
IL1975030	25-Mar-21	11	UG/L		0		LP3S081	[redacted]
IL1975030	25-Mar-21	3.4	UG/L		0		LP3S042	[redacted]
IL1975030	25-Mar-21	3	UG/L		0		LP3S074	[redacted]
IL1975030	25-Mar-21	1.1	UG/L		0		LA3S089	[redacted]
IL1975030	25-Mar-21	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	25-Mar-21	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	25-Mar-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	25-Mar-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	25-Mar-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	24-Mar-21	1100	UG/L		0		LA3S110	[redacted]
IL1975030	24-Mar-21	79	UG/L		0		LA3S093	[redacted]
IL1975030	24-Mar-21	42	UG/L		0		LA3S085	[redacted]
IL1975030	24-Mar-21	41	UG/L		0		LA3S098	[redacted]
IL1975030	24-Mar-21	37	UG/L		0		LP3S068	[redacted]
IL1975030	24-Mar-21	26	UG/L		0		LP3S056	[redacted]
IL1975030	24-Mar-21	18	UG/L		0		LA3S087	[redacted]
IL1975030	24-Mar-21	17	UG/L		0		LP3S054	[redacted]
IL1975030	24-Mar-21	14	UG/L		0		LP3S018	[redacted]
IL1975030	24-Mar-21	11	UG/L		0		LP3S035	[redacted]
IL1975030	24-Mar-21	9.5	UG/L		0		LA3S107	[redacted]
IL1975030	24-Mar-21	9.3	UG/L		0		LA3S102	[redacted]
IL1975030	24-Mar-21	3.4	UG/L		0		LP1A119	[redacted]
IL1975030	24-Mar-21	2.6	UG/L		0		LA3S101	[redacted]
IL1975030	24-Mar-21	2.6	UG/L		0		LP3S040	[redacted]
IL1975030	24-Mar-21	1.9	UG/L		0		LA3S106	[redacted]
IL1975030	24-Mar-21	1.8	UG/L		0		LA3S096	[redacted]
IL1975030	24-Mar-21	1	UG/L		0		LP3S051	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S091	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S100	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	24-Mar-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	23-Mar-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	23-Mar-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	17-Feb-21	190	UG/L		0		LP3S054	[redacted]
IL1975030	17-Feb-21	83	UG/L		0		LA3S092	[redacted]
IL1975030	17-Feb-21	19	UG/L		0		LA3S116	[redacted]
IL1975030	17-Feb-21	16	UG/L		0		LA3S110	[redacted]
IL1975030	17-Feb-21	10	UG/L		0		LP3S082	[redacted]
IL1975030	17-Feb-21	5.1	UG/L		0		LP3S073	[redacted]
IL1975030	17-Feb-21	4.9	UG/L		0		LP3S042	[redacted]
IL1975030	17-Feb-21	3.6	UG/L		0		LA3S091	[redacted]
IL1975030	17-Feb-21	3.6	UG/L		0		LA3S094	[redacted]
IL1975030	17-Feb-21	1.3	UG/L		0		LP3S044	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	17-Feb-21	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	16-Feb-21	20	UG/L		0		LP3S081	[redacted]
IL1975030	16-Feb-21	14	UG/L		0		LA3S085	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	16-Feb-21	9.8	UG/L		0		LP1A119	[redacted]
IL1975030	16-Feb-21	7	UG/L		0		LA3S087	[redacted]
IL1975030	16-Feb-21	6.4	UG/L		0		LP3S056	[redacted]
IL1975030	16-Feb-21	5.3	UG/L		0		LA3S118	[redacted]
IL1975030	16-Feb-21	2.6	UG/L		0		LA3S096	[redacted]
IL1975030	16-Feb-21	2.4	UG/L		0		LA3S102	[redacted]
IL1975030	16-Feb-21	2.4	UG/L		0		LP3S074	[redacted]
IL1975030	16-Feb-21	1.4	UG/L		0		LP3S048	[redacted]
IL1975030	16-Feb-21	1.2	UG/L		0		LA3S093	[redacted]
IL1975030	16-Feb-21	1.2	UG/L		0		LP3S015	[redacted]
IL1975030	16-Feb-21	1.1	UG/L		0		LA3S107	[redacted]
IL1975030	16-Feb-21	1	UG/L		0		LA3S086	[redacted]
IL1975030	16-Feb-21	1	UG/L		0		LP3S078	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S098	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	16-Feb-21	0		Y	5.6	UG/L	LA3S101	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S040	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	16-Feb-21	0		Y	5	UG/L	LP3S076	[redacted]
IL1975030	16-Feb-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	20-Jan-21	27	UG/L		0		LA3S085	[redacted]
IL1975030	20-Jan-21	4.1	UG/L		0		LP3S042	[redacted]
IL1975030	20-Jan-21	4.1	UG/L		0		LP3S054	[redacted]
IL1975030	20-Jan-21	1.1	UG/L		0		LP3S044	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S040	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	20-Jan-21	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	19-Jan-21	32	UG/L		0		LP3S049	[redacted]
IL1975030	19-Jan-21	16	UG/L		0		LP3S056	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	19-Jan-21	13	UG/L		0		LA3S110	[redacted]
IL1975030	19-Jan-21	10	UG/L		0		LA3S118	[redacted]
IL1975030	19-Jan-21	9.2	UG/L		0		LP3S081	[redacted]
IL1975030	19-Jan-21	8.2	UG/L		0		LP3S018	[redacted]
IL1975030	19-Jan-21	8.2	UG/L		0		LP3S082	[redacted]
IL1975030	19-Jan-21	8.1	UG/L		0		LA3S087	[redacted]
IL1975030	19-Jan-21	3.8	UG/L		0		LA3S091	[redacted]
IL1975030	19-Jan-21	3.4	UG/L		0		LA3S102	[redacted]
IL1975030	19-Jan-21	3.2	UG/L		0		LA3S086	[redacted]
IL1975030	19-Jan-21	3	UG/L		0		LP3S074	[redacted]
IL1975030	19-Jan-21	2.6	UG/L		0		LA3S094	[redacted]
IL1975030	19-Jan-21	2.2	UG/L		0		LA3S107	[redacted]
IL1975030	19-Jan-21	1.9	UG/L		0		LA3S093	[redacted]
IL1975030	19-Jan-21	1.4	UG/L		0		LP1A119	[redacted]
IL1975030	19-Jan-21	1.3	UG/L		0		LA3S112	[redacted]
IL1975030	19-Jan-21	1.2	UG/L		0		LP3S008	[redacted]
IL1975030	19-Jan-21	1.2	UG/L		0		LP3S015	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S098	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	19-Jan-21	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	18-Jan-21	3.8	UG/L		0		LA3S116	[redacted]
IL1975030	11-Jan-21	0		Y	1	UG/L	LP3S058	[redacted]

NUMBER0	nple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-Dec-20	9.3	UG/L		0		LA3S085	[redacted]
IL1975030	17-Dec-20	6.7	UG/L		0		LP3S047	[redacted]
IL1975030	17-Dec-20	2.7	UG/L		0		LA3S092	[redacted]
IL1975030	17-Dec-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	17-Dec-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	17-Dec-20	0		Y	1	UG/L	LP3S056	[redacted]
IL1975030	17-Dec-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	16-Dec-20	4.3	UG/L		0		LP3S042	[redacted]
IL1975030	16-Dec-20	4	UG/L		0		LP3S040	[redacted]
IL1975030	16-Dec-20	3.8	UG/L		0		LP3S066	[redacted]
IL1975030	16-Dec-20	3.7	UG/L		0		LP3S018	[redacted]
IL1975030	16-Dec-20	3.5	UG/L		0		LP3S046	[redacted]
IL1975030	16-Dec-20	3.2	UG/L		0		LP1A119	[redacted]
IL1975030	16-Dec-20	2.7	UG/L		0		LP3S071	[redacted]
IL1975030	16-Dec-20	2.1	UG/L		0		LA3S097	[redacted]
IL1975030	16-Dec-20	2	UG/L		0		LP3S019	[redacted]
IL1975030	16-Dec-20	1.4	UG/L		0		LA3S102	[redacted]
IL1975030	16-Dec-20	1.4	UG/L		0		LA3S107	[redacted]
IL1975030	16-Dec-20	1.2	UG/L		0		LA3S108	[redacted]
IL1975030	16-Dec-20	1	UG/L		0		LP3S051	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S098	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	16-Dec-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	15-Dec-20	4.4	UG/L		0		LA3S086	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LP3S008	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	15-Dec-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	15-Dec-20	0		Y	1	UG/L	LP3S074	[redacted]
IL1975030	14-Dec-20	1.1	UG/L		0		LP3S063	[redacted]
IL1975030	09-Dec-20	70	UG/L		0		LA3S110	[redacted]
IL1975030	09-Dec-20	4	UG/L		0		LA3S086	[redacted]
IL1975030	09-Dec-20	1.6	UG/L		0		LP3S018	[redacted]
IL1975030	09-Dec-20	1.6	UG/L		0		LP3S054	[redacted]
IL1975030	09-Dec-20	1.5	UG/L		0		LA3S096	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LA3S092	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	09-Dec-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	08-Dec-20	43	UG/L		0		LA3S118	[redacted]
IL1975030	08-Dec-20	21	UG/L		0		LA3S087	[redacted]
IL1975030	08-Dec-20	12	UG/L		0		LP3S081	[redacted]
IL1975030	08-Dec-20	8.7	UG/L		0		LA3S088	[redacted]
IL1975030	08-Dec-20	6.7	UG/L		0		LP3S074	[redacted]
IL1975030	08-Dec-20	5.8	UG/L		0		LP3S056	[redacted]
IL1975030	08-Dec-20	4.9	UG/L		0		LA3S085	[redacted]
IL1975030	08-Dec-20	3.7	UG/L		0		LA3S107	[redacted]
IL1975030	08-Dec-20	3	UG/L		0		LP3S066	[redacted]
IL1975030	08-Dec-20	2.8	UG/L		0		LP3S040	[redacted]
IL1975030	08-Dec-20	2.4	UG/L		0		LA3S093	[redacted]
IL1975030	08-Dec-20	2.4	UG/L		0		LA3S102	[redacted]
IL1975030	08-Dec-20	2.4	UG/L		0		LP1A119	[redacted]
IL1975030	08-Dec-20	2	UG/L		0		LP3S042	[redacted]
IL1975030	08-Dec-20	1.4	UG/L		0		LP3S015	[redacted]
IL1975030	08-Dec-20	1.3	UG/L		0		LP3S073	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S098	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S099	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP1A121	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	08-Dec-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	07-Dec-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	07-Dec-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	03-Dec-20	32	UG/L		0		LA3S110	[redacted]
IL1975030	03-Dec-20	6.7	UG/L		0		LP3S035	[redacted]
IL1975030	03-Dec-20	3.4	UG/L		0		LP3S074	[redacted]
IL1975030	03-Dec-20	0		Y	1	UG/L	LA3S092	[redacted]
IL1975030	03-Dec-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	03-Dec-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	03-Dec-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	02-Dec-20	11	UG/L		0		LP3S082	[redacted]
IL1975030	02-Dec-20	7.5	UG/L		0		LA3S086	[redacted]
IL1975030	02-Dec-20	5.2	UG/L		0		LP3S056	[redacted]
IL1975030	02-Dec-20	4.4	UG/L		0		LA3S085	[redacted]
IL1975030	02-Dec-20	3.5	UG/L		0		LP3S040	[redacted]
IL1975030	02-Dec-20	3.5	UG/L		0		LP3S054	[redacted]
IL1975030	02-Dec-20	2.7	UG/L		0		LP3S042	[redacted]
IL1975030	02-Dec-20	2.5	UG/L		0		LP1A119	[redacted]
IL1975030	02-Dec-20	2.3	UG/L		0		LA3S107	[redacted]
IL1975030	02-Dec-20	1.9	UG/L		0		LA3S098	[redacted]
IL1975030	02-Dec-20	1.7	UG/L		0		LA3S102	[redacted]
IL1975030	02-Dec-20	1.7	UG/L		0		LP3S066	[redacted]
IL1975030	02-Dec-20	1.6	UG/L		0		LP3S048	[redacted]
IL1975030	02-Dec-20	1.2	UG/L		0		LA3S101	[redacted]
IL1975030	02-Dec-20	1	UG/L		0		LP3S018	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S097	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	02-Dec-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	01-Dec-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	18-Nov-20	8.3	UG/L		0		LA3S085	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LP3S018	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	18-Nov-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	17-Nov-20	39	UG/L		0		LA3S093	[redacted]
IL1975030	17-Nov-20	18	UG/L		0		LA3S096	[redacted]
IL1975030	17-Nov-20	10	UG/L		0		LA3S091	[redacted]
IL1975030	17-Nov-20	7.4	UG/L		0		LA3S107	[redacted]
IL1975030	17-Nov-20	6.4	UG/L		0		LA3S102	[redacted]
IL1975030	17-Nov-20	6.2	UG/L		0		LA3S110	[redacted]
IL1975030	17-Nov-20	5.8	UG/L		0		LP3S056	[redacted]
IL1975030	17-Nov-20	4.2	UG/L		0		LP1A119	[redacted]
IL1975030	17-Nov-20	4	UG/L		0		LP3S054	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-Nov-20	3.8	UG/L		0		LP3S015	[redacted]
IL1975030	17-Nov-20	3.2	UG/L		0		LP3S074	[redacted]
IL1975030	17-Nov-20	2.4	UG/L		0		LA3S086	[redacted]
IL1975030	17-Nov-20	2.3	UG/L		0		LP3S040	[redacted]
IL1975030	17-Nov-20	1.4	UG/L		0		LA3S098	[redacted]
IL1975030	17-Nov-20	1.2	UG/L		0		LP3S066	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S042	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	17-Nov-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	16-Nov-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	16-Nov-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	12-Nov-20	11	UG/L		0		LA3S116	[redacted]
IL1975030	11-Nov-20	16	UG/L		0		LP3S018	[redacted]
IL1975030	11-Nov-20	12	UG/L		0		LP3S035	[redacted]
IL1975030	11-Nov-20	10	UG/L		0		LA3S118	[redacted]
IL1975030	11-Nov-20	2.4	UG/L		0		LP3S074	[redacted]
IL1975030	11-Nov-20	2.2	UG/L		0		LP3S054	[redacted]
IL1975030	11-Nov-20	1.3	UG/L		0		LA3S086	[redacted]
IL1975030	11-Nov-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	11-Nov-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	11-Nov-20	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	11-Nov-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	11-Nov-20	0		Y	1	UG/L	LP3S080	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	10-Nov-20	22	UG/L		0		LP3S081	[redacted]
IL1975030	10-Nov-20	19	UG/L		0		LA3S096	[redacted]
IL1975030	10-Nov-20	18	UG/L		0		LA3S110	[redacted]
IL1975030	10-Nov-20	11	UG/L		0		LP3S056	[redacted]
IL1975030	10-Nov-20	7.4	UG/L		0		LA3S091	[redacted]
IL1975030	10-Nov-20	6.5	UG/L		0		LA3S107	[redacted]
IL1975030	10-Nov-20	6.3	UG/L		0		LA3S093	[redacted]
IL1975030	10-Nov-20	5.2	UG/L		0		LA3S085	[redacted]
IL1975030	10-Nov-20	4.6	UG/L		0		LP3S040	[redacted]
IL1975030	10-Nov-20	3.2	UG/L		0		LP1A119	[redacted]
IL1975030	10-Nov-20	3	UG/L		0		LP3S042	[redacted]
IL1975030	10-Nov-20	2.3	UG/L		0		LA3S102	[redacted]
IL1975030	10-Nov-20	2.2	UG/L		0		LA3S101	[redacted]
IL1975030	10-Nov-20	1	UG/L		0		LA3S097	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S087	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S008	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	10-Nov-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	09-Nov-20	0		Y	1	UG/L	LP3S011	[redacted]

NUMBER0	nple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	09-Nov-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	03-Nov-20	2.4	UG/L		0		LP3S063	[redacted]
IL1975030	28-Oct-20	29	UG/L		0		LA3S118	[redacted]
IL1975030	28-Oct-20	16	UG/L		0		LP3S035	[redacted]
IL1975030	28-Oct-20	3.5	UG/L		0		LP1A119	[redacted]
IL1975030	28-Oct-20	3.3	UG/L		0		LP3S074	[redacted]
IL1975030	28-Oct-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	28-Oct-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	28-Oct-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	28-Oct-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	28-Oct-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	27-Oct-20	48	UG/L		0		LP3S049	[redacted]
IL1975030	27-Oct-20	32	UG/L		0		LA3S116	[redacted]
IL1975030	27-Oct-20	17	UG/L		0		LP3S081	[redacted]
IL1975030	27-Oct-20	14	UG/L		0		LA3S091	[redacted]
IL1975030	27-Oct-20	9.3	UG/L		0		LA3S096	[redacted]
IL1975030	27-Oct-20	7.4	UG/L		0		LP3S056	[redacted]
IL1975030	27-Oct-20	5.9	UG/L		0		LA3S093	[redacted]
IL1975030	27-Oct-20	5.8	UG/L		0		LA3S110	[redacted]
IL1975030	27-Oct-20	4.8	UG/L		0		LA3S107	[redacted]
IL1975030	27-Oct-20	4.7	UG/L		0		LP3S066	[redacted]
IL1975030	27-Oct-20	4.6	UG/L		0		LA3S085	[redacted]
IL1975030	27-Oct-20	4.2	UG/L		0		LP3S018	[redacted]
IL1975030	27-Oct-20	3.8	UG/L		0		LA3S098	[redacted]
IL1975030	27-Oct-20	3.7	UG/L		0		LP3S054	[redacted]
IL1975030	27-Oct-20	3.1	UG/L		0		LA3S097	[redacted]
IL1975030	27-Oct-20	3	UG/L		0		LP3S008	[redacted]
IL1975030	27-Oct-20	2.5	UG/L		0		LA3S087	[redacted]
IL1975030	27-Oct-20	2.2	UG/L		0		LP3S042	[redacted]
IL1975030	27-Oct-20	2	UG/L		0		LA3S094	[redacted]
IL1975030	27-Oct-20	1.6	UG/L		0		LP3S062	[redacted]
IL1975030	27-Oct-20	1.4	UG/L		0		LA3S086	[redacted]
IL1975030	27-Oct-20	1.4	UG/L		0		LA3S102	[redacted]
IL1975030	27-Oct-20	1.2	UG/L		0		LA3S106	[redacted]
IL1975030	27-Oct-20	1	UG/L		0		LP3S044	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S015	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S040	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	27-Oct-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	26-Oct-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	12-Oct-20	4	UG/L		0		LA3S098	[redacted]
IL1975030	09-Oct-20	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	08-Oct-20	9.2	UG/L		0		LP1A119	[redacted]
IL1975030	08-Oct-20	2.1	UG/L		0		LP3S063	[redacted]
IL1975030	07-Oct-20	140	UG/L		0		LP3S049	[redacted]
IL1975030	07-Oct-20	51	UG/L		0		LA3S110	[redacted]
IL1975030	07-Oct-20	3.4	UG/L		0		LA3S086	[redacted]
IL1975030	07-Oct-20	2.8	UG/L		0		LP3S008	[redacted]
IL1975030	07-Oct-20	1.3	UG/L		0		LP3S042	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	07-Oct-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	06-Oct-20	84	UG/L		0		LA3S093	[redacted]
IL1975030	06-Oct-20	45	UG/L		0		LA3S118	[redacted]
IL1975030	06-Oct-20	40	UG/L		0		LA3S091	[redacted]
IL1975030	06-Oct-20	26	UG/L		0		LP3S035	[redacted]
IL1975030	06-Oct-20	18	UG/L		0		LA3S085	[redacted]
IL1975030	06-Oct-20	8.9	UG/L		0		LP3S074	[redacted]
IL1975030	06-Oct-20	8.1	UG/L		0		LA3S096	[redacted]
IL1975030	06-Oct-20	7.3	UG/L		0		LP3S018	[redacted]
IL1975030	06-Oct-20	7.2	UG/L		0		LP3S056	[redacted]
IL1975030	06-Oct-20	6.8	UG/L		0		LP3S054	[redacted]
IL1975030	06-Oct-20	5.6	UG/L		0		LA3S116	[redacted]
IL1975030	06-Oct-20	4.1	UG/L		0		LP3S066	[redacted]

NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	06-Oct-20	2.3	UG/L		0		LA3S107	[redacted]
IL1975030	06-Oct-20	2	UG/L		0		LA3S087	[redacted]
IL1975030	06-Oct-20	2	UG/L		0		LP3S081	[redacted]
IL1975030	06-Oct-20	1.9	UG/L		0		LA3S102	[redacted]
IL1975030	06-Oct-20	1.3	UG/L		0		LP3S040	[redacted]
IL1975030	06-Oct-20	1.2	UG/L		0		LA3S104	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S048	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	06-Oct-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	05-Oct-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	16-Sep-20	18	UG/L		0		LA3S112	[redacted]
IL1975030	16-Sep-20	8.6	UG/L		0		LA3S107	[redacted]
IL1975030	16-Sep-20	4.8	UG/L		0		LA3S104	[redacted]
IL1975030	16-Sep-20	4.5	UG/L		0		LA3S110	[redacted]
IL1975030	16-Sep-20	3.2	UG/L		0		LP3S042	[redacted]
IL1975030	16-Sep-20	1.9	UG/L		0		LA3S102	[redacted]
IL1975030	16-Sep-20	1.6	UG/L		0		LP1A121	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LA3S116	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S068	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	15-Sep-20	190	UG/L		0		LP3S081	[redacted]
IL1975030	15-Sep-20	55	UG/L		0		LA3S091	[redacted]
IL1975030	15-Sep-20	45	UG/L		0		LA3S098	[redacted]
IL1975030	15-Sep-20	23	UG/L		0		LP3S049	[redacted]
IL1975030	15-Sep-20	21	UG/L		0		LP3S035	[redacted]
IL1975030	15-Sep-20	18	UG/L		0		LP1A119	[redacted]
IL1975030	15-Sep-20	8.5	UG/L		0		LP3S056	[redacted]
IL1975030	15-Sep-20	7.5	UG/L		0		LP3S008	[redacted]
IL1975030	15-Sep-20	7.1	UG/L		0		LA3S093	[redacted]
IL1975030	15-Sep-20	6.2	UG/L		0		LA3S096	[redacted]
IL1975030	15-Sep-20	4.9	UG/L		0		LA3S085	[redacted]
IL1975030	15-Sep-20	4.1	UG/L		0		LA3S118	[redacted]
IL1975030	15-Sep-20	3.5	UG/L		0		LP3S048	[redacted]
IL1975030	15-Sep-20	2.6	UG/L		0		LP3S015	[redacted]
IL1975030	15-Sep-20	1.9	UG/L		0		LP3S040	[redacted]
IL1975030	15-Sep-20	1.3	UG/L		0		LP3S054	[redacted]
IL1975030	15-Sep-20	1.2	UG/L		0		LA3S087	[redacted]
IL1975030	15-Sep-20	1.2	UG/L		0		LP3S078	[redacted]
IL1975030	15-Sep-20	1	UG/L		0		LA3S097	[redacted]
IL1975030	15-Sep-20	1	UG/L		0		LP3S066	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S086	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S089	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	16-Sep-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S074	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	15-Sep-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	19-Aug-20	78	UG/L		0		LP3S035	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	19-Aug-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	18-Aug-20	86	UG/L		0		LP3S082	[redacted]
IL1975030	18-Aug-20	77	UG/L		0		LA3S098	[redacted]
IL1975030	18-Aug-20	71	UG/L		0		LA3S091	[redacted]
IL1975030	18-Aug-20	32	UG/L		0		LA3S117	[redacted]
IL1975030	18-Aug-20	26	UG/L		0		LA3S116	[redacted]
IL1975030	18-Aug-20	26	UG/L		0		LP3S056	[redacted]
IL1975030	18-Aug-20	14	UG/L		0		LA3S085	[redacted]
IL1975030	18-Aug-20	14	UG/L		0		LA3S107	[redacted]
IL1975030	18-Aug-20	7.9	UG/L		0		LA3S086	[redacted]
IL1975030	18-Aug-20	7.7	UG/L		0		LP3S040	[redacted]
IL1975030	18-Aug-20	7.6	UG/L		0		LP3S081	[redacted]
IL1975030	18-Aug-20	7.3	UG/L		0		LA3S118	[redacted]
IL1975030	18-Aug-20	6.4	UG/L		0		LA3S093	[redacted]
IL1975030	18-Aug-20	5.4	UG/L		0		LP3S074	[redacted]
IL1975030	18-Aug-20	5	UG/L		0		LP3S042	[redacted]
IL1975030	18-Aug-20	4.7	UG/L		0		LA3S113	[redacted]
IL1975030	18-Aug-20	3.1	UG/L		0		LP1A119	[redacted]
IL1975030	18-Aug-20	2.3	UG/L		0		LA3S102	[redacted]
IL1975030	18-Aug-20	2.1	UG/L		0		LP3S008	[redacted]
IL1975030	18-Aug-20	1.9	UG/L		0		LA3S089	[redacted]
IL1975030	18-Aug-20	1.9	UG/L		0		LP3S044	[redacted]
IL1975030	18-Aug-20	1.6	UG/L		0		LP3S054	[redacted]
IL1975030	18-Aug-20	1.4	UG/L		0		LP1A121	[redacted]
IL1975030	18-Aug-20	1.3	UG/L		0		LP3S015	[redacted]
IL1975030	18-Aug-20	1.2	UG/L		0		LP3S048	[redacted]
IL1975030	18-Aug-20	1	UG/L		0		LP3S078	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LA3S114	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	ENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S018	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	18-Aug-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	22-Jul-20	65	UG/L		0		LA3S092	[redacted]
IL1975030	22-Jul-20	28	UG/L		0		LA3S116	[redacted]
IL1975030	22-Jul-20	16	UG/L		0		LP3S074	[redacted]
IL1975030	22-Jul-20	1.7	UG/L		0		LP3S044	[redacted]
IL1975030	22-Jul-20	1.2	UG/L		0		LP3S019	[redacted]
IL1975030	22-Jul-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	22-Jul-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	21-Jul-20	110	UG/L		0		LP3S035	[redacted]
IL1975030	21-Jul-20	100	UG/L		0		LP3S082	[redacted]
IL1975030	21-Jul-20	88	UG/L		0		LA3S099	[redacted]
IL1975030	21-Jul-20	53	UG/L		0		LA3S098	[redacted]
IL1975030	21-Jul-20	50	UG/L		0		LA3S117	[redacted]
IL1975030	21-Jul-20	36	UG/L		0		LP3S081	[redacted]
IL1975030	21-Jul-20	34	UG/L		0		LA3S110	[redacted]
IL1975030	21-Jul-20	30	UG/L		0		LP3S042	[redacted]
IL1975030	21-Jul-20	25	UG/L		0		LP3S050	[redacted]
IL1975030	21-Jul-20	21	UG/L		0		LA3S087	[redacted]
IL1975030	21-Jul-20	21	UG/L		0		LA3S118	[redacted]
IL1975030	21-Jul-20	21	UG/L		0		LP3S008	[redacted]
IL1975030	21-Jul-20	21	UG/L		0		LP3S049	[redacted]
IL1975030	21-Jul-20	19	UG/L		0		LP1A121	[redacted]
IL1975030	21-Jul-20	18	UG/L		0		LA3S091	[redacted]
IL1975030	21-Jul-20	15	UG/L		0		LA3S089	[redacted]
IL1975030	21-Jul-20	15	UG/L		0		LP3S056	[redacted]
IL1975030	21-Jul-20	15	UG/L		0		LP3S071	[redacted]
IL1975030	21-Jul-20	13	UG/L		0		LA3S107	[redacted]
IL1975030	21-Jul-20	12	UG/L		0		LP3S018	[redacted]
IL1975030	21-Jul-20	9.7	UG/L		0		LA3S086	[redacted]
IL1975030	21-Jul-20	8.6	UG/L		0		LA3S112	[redacted]
IL1975030	21-Jul-20	7.4	UG/L		0		LA3S096	[redacted]

NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	21-Jul-20	6.6	UG/L		0		LP3S040	[redacted]
IL1975030	21-Jul-20	5.8	UG/L		0		LA3S085	[redacted]
IL1975030	21-Jul-20	3.9	UG/L		0		LA3S093	[redacted]
IL1975030	21-Jul-20	3.3	UG/L		0		LP1A119	[redacted]
IL1975030	21-Jul-20	2.9	UG/L		0		LA3S102	[redacted]
IL1975030	21-Jul-20	2.8	UG/L		0		LP3S048	[redacted]
IL1975030	21-Jul-20	1.6	UG/L		0		LP3S078	[redacted]
IL1975030	21-Jul-20	1.3	UG/L		0		LA3S113	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	21-Jul-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	25-Jun-20	9.3	UG/L		0		LA3S089	[redacted]
IL1975030	25-Jun-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	25-Jun-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	24-Jun-20	51	UG/L		0		LA3S099	[redacted]
IL1975030	24-Jun-20	38	UG/L		0		LA3S118	[redacted]
IL1975030	24-Jun-20	32	UG/L		0		LP3S071	[redacted]
IL1975030	24-Jun-20	29	UG/L		0		LP3S035	[redacted]
IL1975030	24-Jun-20	1.9	UG/L		0		LP3S062	[redacted]
IL1975030	24-Jun-20	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	24-Jun-20	0		Y	1	UG/L	LA3S105	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	ENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	24-Jun-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	24-Jun-20	0		Y	1	UG/L	LP3S050	[redacted]
IL1975030	24-Jun-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	24-Jun-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	23-Jun-20	3700	UG/L		0		LA3S111	[redacted]
IL1975030	23-Jun-20	250	UG/L		0		LP3S049	[redacted]
IL1975030	23-Jun-20	220	UG/L		0		LA3R109	[redacted]
IL1975030	23-Jun-20	150	UG/L		0		LA3S117	[redacted]
IL1975030	23-Jun-20	120	UG/L		0		LA3S085	[redacted]
IL1975030	23-Jun-20	110	UG/L		0		LA3S092	[redacted]
IL1975030	23-Jun-20	75	UG/L		0		LA3S096	[redacted]
IL1975030	23-Jun-20	72	UG/L		0		LP3S082	[redacted]
IL1975030	23-Jun-20	33	UG/L		0		LP3S081	[redacted]
IL1975030	23-Jun-20	28	UG/L		0		LP3S042	[redacted]
IL1975030	23-Jun-20	25	UG/L		0		LA3S107	[redacted]
IL1975030	23-Jun-20	24	UG/L		0		LP3S048	[redacted]
IL1975030	23-Jun-20	19	UG/L		0		LA3S091	[redacted]
IL1975030	23-Jun-20	19	UG/L		0		LA3S110	[redacted]
IL1975030	23-Jun-20	19	UG/L		0		LP3S008	[redacted]
IL1975030	23-Jun-20	15	UG/L		0		LA3S102	[redacted]
IL1975030	23-Jun-20	14	UG/L		0		LA3S098	[redacted]
IL1975030	23-Jun-20	14	UG/L		0		LP3S056	[redacted]
IL1975030	23-Jun-20	14	UG/L		0		LP3S074	[redacted]
IL1975030	23-Jun-20	11	UG/L		0		LP3S018	[redacted]
IL1975030	23-Jun-20	8.7	UG/L		0		LA3S086	[redacted]
IL1975030	23-Jun-20	8.6	UG/L		0		LP1A119	[redacted]
IL1975030	23-Jun-20	6.6	UG/L		0		LP3S040	[redacted]
IL1975030	23-Jun-20	5.1	UG/L		0		LP3S046	[redacted]
IL1975030	23-Jun-20	4.3	UG/L		0		LA3S093	[redacted]
IL1975030	23-Jun-20	3.7	UG/L		0		LA3S087	[redacted]
IL1975030	23-Jun-20	2.3	UG/L		0		LA3S090	[redacted]
IL1975030	23-Jun-20	1.7	UG/L		0		LP3S078	[redacted]
IL1975030	23-Jun-20	1.6	UG/L		0		LP3S015	[redacted]
IL1975030	23-Jun-20	1.5	UG/L		0		LA3S097	[redacted]
IL1975030	23-Jun-20	1.1	UG/L		0		LP3S054	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S002	[redacted]

NUMBER0	mple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S029	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	23-Jun-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	04-Jun-20	61	UG/L		0		LP3S042	[redacted]
IL1975030	03-Jun-20	9.4	UG/L		0		LP1A121	[redacted]
IL1975030	03-Jun-20	1.9	UG/L		0		LP3S080	[redacted]
IL1975030	03-Jun-20	1.2	UG/L		0		LP3S070	[redacted]
IL1975030	03-Jun-20	1.1	UG/L		0		LP3S062	[redacted]
IL1975030	03-Jun-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	03-Jun-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	02-Jun-20	940	UG/L		0		LA3S107	[redacted]
IL1975030	02-Jun-20	350	UG/L		0		LA3S085	[redacted]
IL1975030	02-Jun-20	210	UG/L		0		LA3S092	[redacted]
IL1975030	02-Jun-20	170	UG/L		0		LP3S081	[redacted]
IL1975030	02-Jun-20	150	UG/L		0		LP3S018	[redacted]
IL1975030	02-Jun-20	120	UG/L		0		LP3S082	[redacted]
IL1975030	02-Jun-20	89	UG/L		0		LP3S008	[redacted]
IL1975030	02-Jun-20	83	UG/L		0		LA3S112	[redacted]
IL1975030	02-Jun-20	81	UG/L		0		LA3S111	[redacted]
IL1975030	02-Jun-20	69	UG/L		0		LP3S049	[redacted]
IL1975030	02-Jun-20	66	UG/L		0		LP3S035	[redacted]
IL1975030	02-Jun-20	63	UG/L		0		LA3S110	[redacted]
IL1975030	02-Jun-20	51	UG/L		0		LA3S090	[redacted]
IL1975030	02-Jun-20	43	UG/L		0		LA3S099	[redacted]
IL1975030	02-Jun-20	42	UG/L		0		LA3S117	[redacted]
IL1975030	02-Jun-20	41	UG/L		0		LA3S098	[redacted]
IL1975030	02-Jun-20	40	UG/L		0		LA3R109	[redacted]
IL1975030	02-Jun-20	38	UG/L		0		LA3S102	[redacted]
IL1975030	02-Jun-20	32	UG/L		0		LA3S116	[redacted]
IL1975030	02-Jun-20	30	UG/L		0		LA3S118	[redacted]
IL1975030	02-Jun-20	28	UG/L		0		LP3S048	[redacted]
IL1975030	02-Jun-20	24	UG/L		0		LP1A119	[redacted]
IL1975030	02-Jun-20	23	UG/L		0		LP3S056	[redacted]
IL1975030	02-Jun-20	22	UG/L		0		LA3S089	[redacted]
IL1975030	02-Jun-20	16	UG/L		0		LA3S086	[redacted]
IL1975030	02-Jun-20	13	UG/L		0		LA3S087	[redacted]

NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	02-Jun-20	13	UG/L		0		LP3S074	[redacted]
IL1975030	02-Jun-20	11	UG/L		0		LP3S040	[redacted]
IL1975030	02-Jun-20	8.3	UG/L		0		LA3S097	[redacted]
IL1975030	02-Jun-20	7.2	UG/L		0		LA3S091	[redacted]
IL1975030	02-Jun-20	6.7	UG/L		0		LP3S071	[redacted]
IL1975030	02-Jun-20	5.6	UG/L		0		LA3S094	[redacted]
IL1975030	02-Jun-20	5.5	UG/L		0		LP3S055	[redacted]
IL1975030	02-Jun-20	5.3	UG/L		0		LA3S096	[redacted]
IL1975030	02-Jun-20	3.6	UG/L		0		LP3S046	[redacted]
IL1975030	02-Jun-20	2.3	UG/L		0		LA3S093	[redacted]
IL1975030	02-Jun-20	2.1	UG/L		0		LA3S113	[redacted]
IL1975030	02-Jun-20	2	UG/L		0		LP3S019	[redacted]
IL1975030	02-Jun-20	1.3	UG/L		0		LA3S103	[redacted]
IL1975030	02-Jun-20	1.3	UG/L		0		LP3S011	[redacted]
IL1975030	02-Jun-20	1.2	UG/L		0		LP3S015	[redacted]
IL1975030	02-Jun-20	1.1	UG/L		0		LP3S076	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	02-Jun-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	28-May-20	100	UG/L		0		LA3S110	[redacted]
IL1975030	28-May-20	24	UG/L		0		LP3S074	[redacted]
IL1975030	28-May-20	0		Y	1	UG/L	LCR0001	[redacted]
IL1975030	28-May-20	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	28-May-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	27-May-20	950	UG/L		0		LA3R109	[redacted]
IL1975030	27-May-20	330	UG/L		0		LP3S040	[redacted]
IL1975030	27-May-20	310	UG/L		0		LP3S049	[redacted]
IL1975030	27-May-20	180	UG/L		0		LP3S082	[redacted]
IL1975030	27-May-20	170	UG/L		0		LP3S008	[redacted]
IL1975030	27-May-20	120	UG/L		0		LA3S089	[redacted]
IL1975030	27-May-20	110	UG/L		0		LA3S117	[redacted]
IL1975030	27-May-20	110	UG/L		0		LP3S035	[redacted]
IL1975030	27-May-20	100	UG/L		0		LA3S085	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	27-May-20	93	UG/L		0		LP3S081	[redacted]
IL1975030	27-May-20	77	UG/L		0		LP3S042	[redacted]
IL1975030	27-May-20	54	UG/L		0		LA3S090	[redacted]
IL1975030	27-May-20	43	UG/L		0		LP3S018	[redacted]
IL1975030	27-May-20	41	UG/L		0		LA3S102	[redacted]
IL1975030	27-May-20	37	UG/L		0		LA3S112	[redacted]
IL1975030	27-May-20	34	UG/L		0		LA3S091	[redacted]
IL1975030	27-May-20	34	UG/L		0		LP3S068	[redacted]
IL1975030	27-May-20	33	UG/L		0		LA3S118	[redacted]
IL1975030	27-May-20	30	UG/L		0		LP3S056	[redacted]
IL1975030	27-May-20	14	UG/L		0		LA3S093	[redacted]
IL1975030	27-May-20	10	UG/L		0		LP3S046	[redacted]
IL1975030	27-May-20	8.8	UG/L		0		LA3S099	[redacted]
IL1975030	27-May-20	8	UG/L		0		LA3S098	[redacted]
IL1975030	27-May-20	7	UG/L		0		LP3S055	[redacted]
IL1975030	27-May-20	6.7	UG/L		0		LA3S116	[redacted]
IL1975030	27-May-20	6.6	UG/L		0		LA3S107	[redacted]
IL1975030	27-May-20	5.6	UG/L		0		LP1A119	[redacted]
IL1975030	27-May-20	5.5	UG/L		0		LA3S094	[redacted]
IL1975030	27-May-20	5.3	UG/L		0		LA3S100	[redacted]
IL1975030	27-May-20	4.2	UG/L		0		LP3S048	[redacted]
IL1975030	27-May-20	2.6	UG/L		0		LP3S019	[redacted]
IL1975030	27-May-20	2.4	UG/L		0		LA3S087	[redacted]
IL1975030	27-May-20	2.3	UG/L		0		LA3S114	[redacted]
IL1975030	27-May-20	1.8	UG/L		0		LP3S015	[redacted]
IL1975030	27-May-20	1.6	UG/L		0		LA3S097	[redacted]
IL1975030	27-May-20	1.4	UG/L		0		LA3S096	[redacted]
IL1975030	27-May-20	1.4	UG/L		0		LP3S070	[redacted]
IL1975030	27-May-20	1.3	UG/L		0		LP3S073	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S066	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	27-May-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	27-May-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	26-May-20	0		Y	1	UG/L	LP1A121	[redacted]
IL1975030	21-May-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	20-May-20	56	UG/L		0		LA3S085	[redacted]
IL1975030	20-May-20	9.7	UG/L		0		LP3S080	[redacted]
IL1975030	20-May-20	3.6	UG/L		0		LP3S074	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LA3S114	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	20-May-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	19-May-20	2000	UG/L		0		LA3R109	[redacted]
IL1975030	19-May-20	1100	UG/L		0		LP3S049	[redacted]
IL1975030	19-May-20	200	UG/L		0		LP3S018	[redacted]
IL1975030	19-May-20	110	UG/L		0		LP3S042	[redacted]
IL1975030	19-May-20	91	UG/L		0		LP3S008	[redacted]
IL1975030	19-May-20	89	UG/L		0		LP3S046	[redacted]
IL1975030	19-May-20	88	UG/L		0		LP3S035	[redacted]
IL1975030	19-May-20	82	UG/L		0		LA3S110	[redacted]
IL1975030	19-May-20	48	UG/L		0		LA3S097	[redacted]
IL1975030	19-May-20	43	UG/L		0		LA3S117	[redacted]
IL1975030	19-May-20	37	UG/L		0		LA3S099	[redacted]
IL1975030	19-May-20	35	UG/L		0		LP1A119	[redacted]
IL1975030	19-May-20	35	UG/L		0		LP3S081	[redacted]
IL1975030	19-May-20	31	UG/L		0		LP3S082	[redacted]
IL1975030	19-May-20	26	UG/L		0		LA3S096	[redacted]
IL1975030	19-May-20	20	UG/L		0		LA3S102	[redacted]
IL1975030	19-May-20	16	UG/L		0		LA3S086	[redacted]
IL1975030	19-May-20	16	UG/L		0		LA3S116	[redacted]
IL1975030	19-May-20	15	UG/L		0		LP3S040	[redacted]
IL1975030	19-May-20	14	UG/L		0		LA3S112	[redacted]
IL1975030	19-May-20	11	UG/L		0		LP3S056	[redacted]
IL1975030	19-May-20	9.2	UG/L		0		LA3S093	[redacted]
IL1975030	19-May-20	5.9	UG/L		0		LA3S087	[redacted]
IL1975030	19-May-20	5.3	UG/L		0		LP3S048	[redacted]
IL1975030	19-May-20	5	UG/L		0		LA3S090	[redacted]
IL1975030	19-May-20	4.9	UG/L		0		LA3S107	[redacted]
IL1975030	19-May-20	3.6	UG/L		0		LA3S091	[redacted]
IL1975030	19-May-20	3.1	UG/L		0		LP3S015	[redacted]
IL1975030	19-May-20	1.8	UG/L		0		LA3S089	[redacted]
IL1975030	19-May-20	1.7	UG/L		0		LA3S094	[redacted]
IL1975030	19-May-20	1.7	UG/L		0		LA3S098	[redacted]

NUMBER0	mple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	19-May-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LA3S118	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LCR0001	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S027	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S044	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S054	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	19-May-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	06-May-20	78	UG/L		0		LA3S085	[redacted]
IL1975030	06-May-20	75	UG/L		0		LP3S035	[redacted]
IL1975030	06-May-20	49	UG/L		0		LP3S042	[redacted]
IL1975030	06-May-20	1.5	UG/L		0		LA3S114	[redacted]
IL1975030	06-May-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	06-May-20	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	05-May-20	1100	UG/L		0		LA3R109	[redacted]
IL1975030	05-May-20	180	UG/L		0		LP3S049	[redacted]
IL1975030	05-May-20	81	UG/L		0		LA3S110	[redacted]
IL1975030	05-May-20	43	UG/L		0		LA3S117	[redacted]
IL1975030	05-May-20	42	UG/L		0		LP3S082	[redacted]
IL1975030	05-May-20	34	UG/L		0		LP3S008	[redacted]
IL1975030	05-May-20	18	UG/L		0		LA3S102	[redacted]
IL1975030	05-May-20	13	UG/L		0		LA3S098	[redacted]
IL1975030	05-May-20	11	UG/L		0		LA3S112	[redacted]
IL1975030	05-May-20	11	UG/L		0		LA3S116	[redacted]
IL1975030	05-May-20	11	UG/L		0		LP3S068	[redacted]
IL1975030	05-May-20	10	UG/L		0		LP3S074	[redacted]
IL1975030	05-May-20	8.2	UG/L		0		LP3S048	[redacted]
IL1975030	05-May-20	7.6	UG/L		0		LP3S018	[redacted]
IL1975030	05-May-20	6.4	UG/L		0		LA3S107	[redacted]
IL1975030	05-May-20	5.9	UG/L		0		LA3S093	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	05-May-20	5.7	UG/L		0		LA3S091	[redacted]
IL1975030	05-May-20	5.5	UG/L		0		LA3S089	[redacted]
IL1975030	05-May-20	5.2	UG/L		0		LA3S087	[redacted]
IL1975030	05-May-20	4.9	UG/L		0		LP3S054	[redacted]
IL1975030	05-May-20	4.5	UG/L		0		LA3S118	[redacted]
IL1975030	05-May-20	4.4	UG/L		0		LP3S056	[redacted]
IL1975030	05-May-20	4.3	UG/L		0		LP3S046	[redacted]
IL1975030	05-May-20	3.9	UG/L		0		LP3S027	[redacted]
IL1975030	05-May-20	3.5	UG/L		0		LP1A119	[redacted]
IL1975030	05-May-20	3.3	UG/L		0		LA3S086	[redacted]
IL1975030	05-May-20	2.2	UG/L		0		LP3S078	[redacted]
IL1975030	05-May-20	1.9	UG/L		0		LA3S097	[redacted]
IL1975030	05-May-20	1.8	UG/L		0		LA3S088	[redacted]
IL1975030	05-May-20	1.4	UG/L		0		LP3S071	[redacted]
IL1975030	05-May-20	1.3	UG/L		0		LP3S055	[redacted]
IL1975030	05-May-20	1.2	UG/L		0		LA3S094	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S104	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S040	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S058	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S070	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	05-May-20	0		Y	1	UG/L	LP3S081	[redacted]
IL1975030	04-May-20	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	17-Mar-20	89	UG/L		0		LA3S094	[redacted]
IL1975030	17-Mar-20	10	UG/L		0		LP3S078	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-Mar-20	2.2	UG/L		0		LA3S108	[redacted]
IL1975030	16-Mar-20	43	UG/L		0		LP3S042	[redacted]
IL1975030	16-Mar-20	9.4	UG/L		0		LP3S054	[redacted]
IL1975030	16-Mar-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	11-Feb-20	38	UG/L		0		LP3S058	[redacted]
IL1975030	11-Feb-20	19	UG/L		0		LP1A119	[redacted]
IL1975030	11-Feb-20	7.3	UG/L		0		LA3S116	[redacted]
IL1975030	11-Feb-20	6.2	UG/L		0		LP3S074	[redacted]
IL1975030	10-Feb-20	690	UG/L		0		LA3R109	[redacted]
IL1975030	10-Feb-20	270	UG/L		0		LP3S044	[redacted]
IL1975030	10-Feb-20	160	UG/L		0		LP3S048	[redacted]
IL1975030	10-Feb-20	12	UG/L		0		LP3S046	[redacted]
IL1975030	10-Feb-20	2.6	UG/L		0		LP3S028	[redacted]
IL1975030	10-Feb-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	30-Jan-20	1100	UG/L		0		LP3S018	[redacted]
IL1975030	28-Jan-20	180	UG/L		0		LA3R109	[redacted]
IL1975030	28-Jan-20	4.1	UG/L		0		LA3S099	[redacted]
IL1975030	28-Jan-20	1.9	UG/L		0		LP3S066	[redacted]
IL1975030	24-Jan-20	2700	UG/L		0		LP3S049	[redacted]
IL1975030	21-Jan-20	28	UG/L		0		LP3S037	[redacted]
IL1975030	21-Jan-20	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	20-Jan-20	5.4	UG/L		0		LP3S054	[redacted]
IL1975030	20-Jan-20	1.4	UG/L		0		LA3S093	[redacted]
IL1975030	20-Jan-20	0		Y	1	UG/L	LP3S050	[redacted]
IL1975030	17-Jan-20	370	UG/L		0		LA3S091	[redacted]
IL1975030	17-Jan-20	75	UG/L		0		LA3S114	[redacted]
IL1975030	17-Jan-20	36	UG/L		0		LA3S085	[redacted]
IL1975030	16-Jan-20	16	UG/L		0		LP3S042	[redacted]
IL1975030	16-Jan-20	6.8	UG/L		0		LP3S013	[redacted]
IL1975030	16-Jan-20	1.5	UG/L		0		LP3S002	[redacted]
IL1975030	16-Jan-20	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	16-Jan-20	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	15-Jan-20	140	UG/L		0		LA3S117	[redacted]
IL1975030	15-Jan-20	78	UG/L		0		LA3S092	[redacted]
IL1975030	15-Jan-20	4.7	UG/L		0		LP3S035	[redacted]
IL1975030	15-Jan-20	4.6	UG/L		0		LP3S040	[redacted]
IL1975030	15-Jan-20	4.5	UG/L		0		LA3S089	[redacted]
IL1975030	15-Jan-20	3.4	UG/L		0		LA3S112	[redacted]
IL1975030	15-Jan-20	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	15-Jan-20	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	15-Jan-20	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	15-Jan-20	0		Y	1	UG/L	LP3S033	[redacted]
IL1975030	14-Jan-20	130	UG/L		0		LA3S095	[redacted]
IL1975030	14-Jan-20	110	UG/L		0		LP3S068	[redacted]
IL1975030	14-Jan-20	35	UG/L		0		LA3S104	[redacted]
IL1975030	14-Jan-20	35	UG/L		0		LP3S008	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	14-Jan-20	29	UG/L		0		LA3S118	[redacted]
IL1975030	14-Jan-20	23	UG/L		0		LP3S048	[redacted]
IL1975030	14-Jan-20	22	UG/L		0		LA3S102	[redacted]
IL1975030	14-Jan-20	8.1	UG/L		0		LA3S116	[redacted]
IL1975030	14-Jan-20	6.6	UG/L		0		LP3S070	[redacted]
IL1975030	14-Jan-20	2.5	UG/L		0		LA3S108	[redacted]
IL1975030	14-Jan-20	2.5	UG/L		0		LP3S020	[redacted]
IL1975030	14-Jan-20	2	UG/L		0		LA3S094	[redacted]
IL1975030	14-Jan-20	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	14-Jan-20	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	14-Jan-20	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	13-Jan-20	350	UG/L		0		LA3S098	[redacted]
IL1975030	13-Jan-20	100	UG/L		0		LP3S058	[redacted]
IL1975030	13-Jan-20	98	UG/L		0		LP3S074	[redacted]
IL1975030	13-Jan-20	65	UG/L		0		LA3S110	[redacted]
IL1975030	13-Jan-20	9.6	UG/L		0		LP3S071	[redacted]
IL1975030	13-Jan-20	8.3	UG/L		0		LA3S087	[redacted]
IL1975030	13-Jan-20	5.5	UG/L		0		LP1A121	[redacted]
IL1975030	13-Jan-20	3.2	UG/L		0		LP1A119	[redacted]
IL1975030	13-Jan-20	2.5	UG/L		0		LA3S096	[redacted]
IL1975030	13-Jan-20	1.1	UG/L		0		LP3S078	[redacted]
IL1975030	13-Jan-20	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	13-Jan-20	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	13-Jan-20	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	13-Jan-20	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	13-Jan-20	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	18-Dec-19	210	UG/L		0		LP3S018	[redacted]
IL1975030	18-Dec-19	1.2	UG/L		0		LP3S080	[redacted]
IL1975030	18-Dec-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	18-Dec-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	17-Dec-19	5300	UG/L		0		LA3S117	[redacted]
IL1975030	17-Dec-19	720	UG/L		0		LP3S049	[redacted]
IL1975030	17-Dec-19	85	UG/L		0		LA3S091	[redacted]
IL1975030	17-Dec-19	69	UG/L		0		LA3S095	[redacted]
IL1975030	17-Dec-19	62	UG/L		0		LA3S093	[redacted]
IL1975030	17-Dec-19	56	UG/L		0		LA3S102	[redacted]
IL1975030	17-Dec-19	53	UG/L		0		LP3S058	[redacted]
IL1975030	17-Dec-19	51	UG/L		0		LP3S048	[redacted]
IL1975030	17-Dec-19	50	UG/L		0		LA3S092	[redacted]
IL1975030	17-Dec-19	44	UG/L		0		LA3S104	[redacted]
IL1975030	17-Dec-19	38	UG/L		0		LA3R109	[redacted]
IL1975030	17-Dec-19	30	UG/L		0		LP3S082	[redacted]
IL1975030	17-Dec-19	27	UG/L		0		LP3S054	[redacted]
IL1975030	17-Dec-19	26	UG/L		0		LP3S068	[redacted]
IL1975030	17-Dec-19	24	UG/L		0		LP3S008	[redacted]
IL1975030	17-Dec-19	23	UG/L		0		LP3S044	[redacted]

NUMBER0	mple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	ENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-Dec-19	22	UG/L		0		LA3S118	[redacted]
IL1975030	17-Dec-19	20	UG/L		0		LA3S116	[redacted]
IL1975030	17-Dec-19	20	UG/L		0		LP3S056	[redacted]
IL1975030	17-Dec-19	18	UG/L		0		LP1A119	[redacted]
IL1975030	17-Dec-19	15	UG/L		0		LA3S094	[redacted]
IL1975030	17-Dec-19	12	UG/L		0		LP3S040	[redacted]
IL1975030	17-Dec-19	9.1	UG/L		0		LA3S086	[redacted]
IL1975030	17-Dec-19	6.4	UG/L		0		LP1A121	[redacted]
IL1975030	17-Dec-19	6.4	UG/L		0		LP3S035	[redacted]
IL1975030	17-Dec-19	5.7	UG/L		0		LP3S027	[redacted]
IL1975030	17-Dec-19	4.9	UG/L		0		LA3S112	[redacted]
IL1975030	17-Dec-19	4.6	UG/L		0		LP3S070	[redacted]
IL1975030	17-Dec-19	4	UG/L		0		LA3S098	[redacted]
IL1975030	17-Dec-19	2.6	UG/L		0		LP3S042	[redacted]
IL1975030	17-Dec-19	2.4	UG/L		0		LA3S107	[redacted]
IL1975030	17-Dec-19	2.3	UG/L		0		LA3S087	[redacted]
IL1975030	17-Dec-19	2.3	UG/L		0		LA3S101	[redacted]
IL1975030	17-Dec-19	2	UG/L		0		LP3S071	[redacted]
IL1975030	17-Dec-19	1.8	UG/L		0		LP3S051	[redacted]
IL1975030	17-Dec-19	1.7	UG/L		0		LA3S089	[redacted]
IL1975030	17-Dec-19	1.4	UG/L		0		LA3S096	[redacted]
IL1975030	17-Dec-19	1.4	UG/L		0		LP3S074	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S015	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S019	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	17-Dec-19	0		Y	1	UG/L	LP3S081	[redacted]
IL1975030	16-Dec-19	12	UG/L		0		LA3S099	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	04-Dec-19	2.5	UG/L		0		LP3S035	[redacted]
IL1975030	04-Dec-19	2.2	UG/L		0		LP3S027	[redacted]
IL1975030	03-Dec-19	470	UG/L		0		LP3S070	[redacted]
IL1975030	03-Dec-19	140	UG/L		0		LA3S107	[redacted]
IL1975030	03-Dec-19	110	UG/L		0		LA3S114	[redacted]
IL1975030	03-Dec-19	110	UG/L		0		LA3S117	[redacted]
IL1975030	03-Dec-19	68	UG/L		0		LA3S091	[redacted]
IL1975030	03-Dec-19	52	UG/L		0		LP3S044	[redacted]
IL1975030	03-Dec-19	50	UG/L		0		LA3R109	[redacted]
IL1975030	03-Dec-19	45	UG/L		0		LP3S018	[redacted]
IL1975030	03-Dec-19	34	UG/L		0		LA3S104	[redacted]
IL1975030	03-Dec-19	30	UG/L		0		LA3S092	[redacted]
IL1975030	03-Dec-19	29	UG/L		0		LA3S110	[redacted]
IL1975030	03-Dec-19	29	UG/L		0		LP3S058	[redacted]
IL1975030	03-Dec-19	25	UG/L		0		LA3S118	[redacted]
IL1975030	03-Dec-19	25	UG/L		0		LP3S049	[redacted]
IL1975030	03-Dec-19	24	UG/L		0		LP3S048	[redacted]
IL1975030	03-Dec-19	20	UG/L		0		LP3S054	[redacted]
IL1975030	03-Dec-19	15	UG/L		0		LP3S008	[redacted]
IL1975030	03-Dec-19	9.1	UG/L		0		LP3S056	[redacted]
IL1975030	03-Dec-19	8.5	UG/L		0		LP3S082	[redacted]
IL1975030	03-Dec-19	7.6	UG/L		0		LA3S095	[redacted]
IL1975030	03-Dec-19	7.6	UG/L		0		LP1A119	[redacted]
IL1975030	03-Dec-19	7.1	UG/L		0		LP3S068	[redacted]
IL1975030	03-Dec-19	6.3	UG/L		0		LA3S093	[redacted]
IL1975030	03-Dec-19	5.7	UG/L		0		LA3S087	[redacted]
IL1975030	03-Dec-19	5.7	UG/L		0		LP3S015	[redacted]
IL1975030	03-Dec-19	5.5	UG/L		0		LP3S040	[redacted]
IL1975030	03-Dec-19	4.4	UG/L		0		LA3S089	[redacted]
IL1975030	03-Dec-19	4.2	UG/L		0		LA3S112	[redacted]
IL1975030	03-Dec-19	3.9	UG/L		0		LA3S086	[redacted]
IL1975030	03-Dec-19	3.7	UG/L		0		LP3S074	[redacted]
IL1975030	03-Dec-19	3	UG/L		0		LP3S078	[redacted]
IL1975030	03-Dec-19	2.8	UG/L		0		LA3S102	[redacted]
IL1975030	03-Dec-19	2.3	UG/L		0		LA3S094	[redacted]
IL1975030	03-Dec-19	2.2	UG/L		0		LP3S042	[redacted]
IL1975030	03-Dec-19	2.2	UG/L		0		LP3S079	[redacted]
IL1975030	03-Dec-19	1.7	UG/L		0		LA3S098	[redacted]
IL1975030	03-Dec-19	1.7	UG/L		0		LA3S113	[redacted]
IL1975030	03-Dec-19	1.7	UG/L		0		LP3S071	[redacted]
IL1975030	03-Dec-19	1.5	UG/L		0		LP3S019	[redacted]
IL1975030	03-Dec-19	1.4	UG/L		0		LA3S116	[redacted]
IL1975030	03-Dec-19	1.4	UG/L		0		LP3S046	[redacted]
IL1975030	03-Dec-19	1.2	UG/L		0		LA3S101	[redacted]
IL1975030	03-Dec-19	1.1	UG/L		0		LA3S099	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S088	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S013	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S050	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	03-Dec-19	0		Y	1	UG/L	LP3S081	[redacted]
IL1975030	02-Dec-19	2.2	UG/L		0		LA3S097	[redacted]
IL1975030	24-Nov-19	36	UG/L		0		LA3S093	[redacted]
IL1975030	20-Nov-19	140	UG/L		0		LA3S107	[redacted]
IL1975030	20-Nov-19	28	UG/L		0		LP3S037	[redacted]
IL1975030	20-Nov-19	8.8	UG/L		0		LP3S054	[redacted]
IL1975030	20-Nov-19	5.9	UG/L		0		LP3S056	[redacted]
IL1975030	20-Nov-19	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	20-Nov-19	0		Y	1	UG/L	LP3S027	[redacted]
IL1975030	20-Nov-19	0		Y	1	UG/L	LP3S033	[redacted]
IL1975030	20-Nov-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	20-Nov-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	19-Nov-19	270	UG/L		0		LA3S087	[redacted]
IL1975030	19-Nov-19	260	UG/L		0		LA3S089	[redacted]
IL1975030	19-Nov-19	150	UG/L		0		LA3S114	[redacted]
IL1975030	19-Nov-19	110	UG/L		0		LA3S110	[redacted]
IL1975030	19-Nov-19	100	UG/L		0		LA3S117	[redacted]
IL1975030	19-Nov-19	77	UG/L		0		LP3S044	[redacted]
IL1975030	19-Nov-19	70	UG/L		0		LP3S082	[redacted]
IL1975030	19-Nov-19	59	UG/L		0		LP3S048	[redacted]
IL1975030	19-Nov-19	58	UG/L		0		LA3S104	[redacted]
IL1975030	19-Nov-19	58	UG/L		0		LP3S018	[redacted]
IL1975030	19-Nov-19	54	UG/L		0		LA3S085	[redacted]
IL1975030	19-Nov-19	45	UG/L		0		LA3S086	[redacted]

NUMBER0	nple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	19-Nov-19	25	UG/L		0		LA3S092	[redacted]
IL1975030	19-Nov-19	25	UG/L		0		LP3S008	[redacted]
IL1975030	19-Nov-19	21	UG/L		0		LP3S040	[redacted]
IL1975030	19-Nov-19	20	UG/L		0		LP3S070	[redacted]
IL1975030	19-Nov-19	14	UG/L		0		LP3S035	[redacted]
IL1975030	19-Nov-19	13	UG/L		0		LA3S116	[redacted]
IL1975030	19-Nov-19	13	UG/L		0		LA3S118	[redacted]
IL1975030	19-Nov-19	12	UG/L		0		LP3S068	[redacted]
IL1975030	19-Nov-19	9.5	UG/L		0		LA3S102	[redacted]
IL1975030	19-Nov-19	9.1	UG/L		0		LA3S113	[redacted]
IL1975030	19-Nov-19	8.2	UG/L		0		LA3S094	[redacted]
IL1975030	19-Nov-19	8.2	UG/L		0		LP3S071	[redacted]
IL1975030	19-Nov-19	8.2	UG/L		0		LP3S074	[redacted]
IL1975030	19-Nov-19	7.5	UG/L		0		LP3S049	[redacted]
IL1975030	19-Nov-19	5.3	UG/L		0		LA3S112	[redacted]
IL1975030	19-Nov-19	5.2	UG/L		0		LP3S013	[redacted]
IL1975030	19-Nov-19	4.9	UG/L		0		LA3S098	[redacted]
IL1975030	19-Nov-19	4.1	UG/L		0		LP1A119	[redacted]
IL1975030	19-Nov-19	3.7	UG/L		0		LA3S099	[redacted]
IL1975030	19-Nov-19	3.7	UG/L		0		LP3S046	[redacted]
IL1975030	19-Nov-19	2.6	UG/L		0		LP3S058	[redacted]
IL1975030	19-Nov-19	2.5	UG/L		0		LA3S096	[redacted]
IL1975030	19-Nov-19	2.4	UG/L		0		LP3S081	[redacted]
IL1975030	19-Nov-19	1.8	UG/L		0		LP3S015	[redacted]
IL1975030	19-Nov-19	1.8	UG/L		0		LP3S019	[redacted]
IL1975030	19-Nov-19	1.5	UG/L		0		LA3S090	[redacted]
IL1975030	19-Nov-19	1.5	UG/L		0		LP3S055	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S042	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S078	[redacted]

NUMBER0	nple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	19-Nov-19	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	18-Nov-19	360	UG/L		0		LA3R109	[redacted]
IL1975030	18-Nov-19	6.8	UG/L		0		LA3S095	[redacted]
IL1975030	11-Nov-19	5.5	UG/L		0		LA3S097	[redacted]
IL1975030	07-Nov-19	130	UG/L		0		LP3S049	[redacted]
IL1975030	06-Nov-19	45	UG/L		0		LA3S116	[redacted]
IL1975030	06-Nov-19	7.7	UG/L		0		LP1A121	[redacted]
IL1975030	06-Nov-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	06-Nov-19	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	05-Nov-19	430	UG/L		0		LP3S075	[redacted]
IL1975030	05-Nov-19	160	UG/L		0		LA3R109	[redacted]
IL1975030	05-Nov-19	120	UG/L		0		LA3S117	[redacted]
IL1975030	05-Nov-19	120	UG/L		0		LP3S037	[redacted]
IL1975030	05-Nov-19	85	UG/L		0		LA3S104	[redacted]
IL1975030	05-Nov-19	56	UG/L		0		LA3S114	[redacted]
IL1975030	05-Nov-19	48	UG/L		0		LP3S040	[redacted]
IL1975030	05-Nov-19	34	UG/L		0		LA3S092	[redacted]
IL1975030	05-Nov-19	34	UG/L		0		LP3S035	[redacted]
IL1975030	05-Nov-19	23	UG/L		0		LA3S085	[redacted]
IL1975030	05-Nov-19	22	UG/L		0		LP3S044	[redacted]
IL1975030	05-Nov-19	19	UG/L		0		LP3S082	[redacted]
IL1975030	05-Nov-19	18	UG/L		0		LP3S068	[redacted]
IL1975030	05-Nov-19	15	UG/L		0		LP3S048	[redacted]
IL1975030	05-Nov-19	13	UG/L		0		LP3S008	[redacted]
IL1975030	05-Nov-19	9	UG/L		0		LA3S089	[redacted]
IL1975030	05-Nov-19	7.1	UG/L		0		LA3S099	[redacted]
IL1975030	05-Nov-19	6.9	UG/L		0		LP3S056	[redacted]
IL1975030	05-Nov-19	6.7	UG/L		0		LP3S042	[redacted]
IL1975030	05-Nov-19	6.2	UG/L		0		LP1A119	[redacted]
IL1975030	05-Nov-19	6	UG/L		0		LP3S074	[redacted]
IL1975030	05-Nov-19	5.8	UG/L		0		LA3S087	[redacted]
IL1975030	05-Nov-19	5.8	UG/L		0		LP3S054	[redacted]
IL1975030	05-Nov-19	5.5	UG/L		0		LA3S110	[redacted]
IL1975030	05-Nov-19	5.3	UG/L		0		LP3S046	[redacted]
IL1975030	05-Nov-19	5.1	UG/L		0		LA3S096	[redacted]
IL1975030	05-Nov-19	3.2	UG/L		0		LA3S095	[redacted]
IL1975030	05-Nov-19	3.1	UG/L		0		LP3S013	[redacted]
IL1975030	05-Nov-19	3	UG/L		0		LP3S015	[redacted]
IL1975030	05-Nov-19	2.4	UG/L		0		LA3S102	[redacted]
IL1975030	05-Nov-19	2.4	UG/L		0		LP3S018	[redacted]
IL1975030	05-Nov-19	2	UG/L		0		LA3S086	[redacted]
IL1975030	05-Nov-19	1.9	UG/L		0		LP3S071	[redacted]
IL1975030	05-Nov-19	1.7	UG/L		0		LA3S112	[redacted]
IL1975030	05-Nov-19	1.7	UG/L		0		LP3S073	[redacted]
IL1975030	05-Nov-19	1.6	UG/L		0		LP3S019	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	05-Nov-19	1.5	UG/L		0		LA3S118	[redacted]
IL1975030	05-Nov-19	1.4	UG/L		0		LP3S011	[redacted]
IL1975030	05-Nov-19	1.4	UG/L		0		LP3S058	[redacted]
IL1975030	05-Nov-19	1.4	UG/L		0		LP3S081	[redacted]
IL1975030	05-Nov-19	1.3	UG/L		0		LP3S027	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S093	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S105	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S107	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	05-Nov-19	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	04-Nov-19	1.9	UG/L		0		LP3S070	[redacted]
IL1975030	04-Nov-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	21-Oct-19	22	UG/L		0		LP3S042	[redacted]
IL1975030	18-Oct-19	6	UG/L		0		LP3S037	[redacted]
IL1975030	17-Oct-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	17-Oct-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	16-Oct-19	580	UG/L		0		LA3R109	[redacted]
IL1975030	16-Oct-19	520	UG/L		0		LA3R109	[redacted]
IL1975030	16-Oct-19	1.1	UG/L		0		LP3S013	[redacted]
IL1975030	16-Oct-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	16-Oct-19	0		Y	1	UG/L	LP3S077	[redacted]
IL1975030	15-Oct-19	84	UG/L		0		LP3S018	[redacted]
IL1975030	15-Oct-19	54	UG/L		0		LA3S085	[redacted]
IL1975030	15-Oct-19	50	UG/L		0		LP3S070	[redacted]
IL1975030	15-Oct-19	49	UG/L		0		LP3S049	[redacted]
IL1975030	15-Oct-19	47	UG/L		0		LA3S104	[redacted]
IL1975030	15-Oct-19	37	UG/L		0		LP3S035	[redacted]
IL1975030	15-Oct-19	35	UG/L		0		LP1A119	[redacted]

NUMBER0	nple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	15-Oct-19	25	UG/L		0		LP3S044	[redacted]
IL1975030	15-Oct-19	23	UG/L		0		LA3S112	[redacted]
IL1975030	15-Oct-19	22	UG/L		0		LA3S091	[redacted]
IL1975030	15-Oct-19	20	UG/L		0		LP3S071	[redacted]
IL1975030	15-Oct-19	19	UG/L		0		LA3S086	[redacted]
IL1975030	15-Oct-19	19	UG/L		0		LP3S082	[redacted]
IL1975030	15-Oct-19	18	UG/L		0		LA3S117	[redacted]
IL1975030	15-Oct-19	18	UG/L		0		LP3S008	[redacted]
IL1975030	15-Oct-19	17	UG/L		0		LP3S054	[redacted]
IL1975030	15-Oct-19	14	UG/L		0		LA3S089	[redacted]
IL1975030	15-Oct-19	14	UG/L		0		LA3S118	[redacted]
IL1975030	15-Oct-19	13	UG/L		0		LP3S068	[redacted]
IL1975030	15-Oct-19	11	UG/L		0		LA3S095	[redacted]
IL1975030	15-Oct-19	10	UG/L		0		LA3S110	[redacted]
IL1975030	15-Oct-19	8.5	UG/L		0		LP3S080	[redacted]
IL1975030	15-Oct-19	8.2	UG/L		0		LP3S055	[redacted]
IL1975030	15-Oct-19	8.1	UG/L		0		LP3S048	[redacted]
IL1975030	15-Oct-19	7	UG/L		0		LA3S116	[redacted]
IL1975030	15-Oct-19	5.9	UG/L		0		LP3S056	[redacted]
IL1975030	15-Oct-19	5.5	UG/L		0		LA3S087	[redacted]
IL1975030	15-Oct-19	5	UG/L		0		LA3S098	[redacted]
IL1975030	15-Oct-19	4.3	UG/L		0		LP3S015	[redacted]
IL1975030	15-Oct-19	3.9	UG/L		0		LP3S074	[redacted]
IL1975030	15-Oct-19	3.7	UG/L		0		LA3S092	[redacted]
IL1975030	15-Oct-19	3.6	UG/L		0		LP3S081	[redacted]
IL1975030	15-Oct-19	3.4	UG/L		0		LA3S102	[redacted]
IL1975030	15-Oct-19	2.9	UG/L		0		LP3S078	[redacted]
IL1975030	15-Oct-19	2.3	UG/L		0		LP3S058	[redacted]
IL1975030	15-Oct-19	1.9	UG/L		0		LA3S094	[redacted]
IL1975030	15-Oct-19	1.5	UG/L		0		LA3S113	[redacted]
IL1975030	15-Oct-19	1.4	UG/L		0		LA3S097	[redacted]
IL1975030	15-Oct-19	1.4	UG/L		0		LA3S101	[redacted]
IL1975030	15-Oct-19	1.1	UG/L		0		LA3S096	[redacted]
IL1975030	15-Oct-19	1.1	UG/L		0		LP3S046	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S093	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S027	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S040	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	15-Oct-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	04-Oct-19	2.9	UG/L		0		LA3S097	[redacted]
IL1975030	03-Oct-19	45	UG/L		0		LA3S095	[redacted]
IL1975030	03-Oct-19	19	UG/L		0		LA3R109	[redacted]
IL1975030	03-Oct-19	0		Y	1	UG/L	LP3S013	[redacted]
IL1975030	03-Oct-19	0		Y	1.1	UG/L	LP3S047	[redacted]
IL1975030	03-Oct-19	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	02-Oct-19	36	UG/L		0		LP3S042	[redacted]
IL1975030	02-Oct-19	24	UG/L		0		LP3S068	[redacted]
IL1975030	02-Oct-19	14	UG/L		0		LP1A121	[redacted]
IL1975030	02-Oct-19	5.6	UG/L		0		LA3S086	[redacted]
IL1975030	02-Oct-19	2.9	UG/L		0		LP3S081	[redacted]
IL1975030	02-Oct-19	2.6	UG/L		0		LP3S055	[redacted]
IL1975030	02-Oct-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	01-Oct-19	1300	UG/L		0		LA3S091	[redacted]
IL1975030	01-Oct-19	240	UG/L		0		LP3S070	[redacted]
IL1975030	01-Oct-19	86	UG/L		0		LP3S049	[redacted]
IL1975030	01-Oct-19	81	UG/L		0		LA3S117	[redacted]
IL1975030	01-Oct-19	79	UG/L		0		LP3S035	[redacted]
IL1975030	01-Oct-19	47	UG/L		0		LP3S044	[redacted]
IL1975030	01-Oct-19	32	UG/L		0		LP3S040	[redacted]
IL1975030	01-Oct-19	31	UG/L		0		LA3S118	[redacted]
IL1975030	01-Oct-19	28	UG/L		0		LA3S098	[redacted]
IL1975030	01-Oct-19	25	UG/L		0		LP3S048	[redacted]
IL1975030	01-Oct-19	22	UG/L		0		LA3S104	[redacted]
IL1975030	01-Oct-19	21	UG/L		0		LP3S056	[redacted]
IL1975030	01-Oct-19	18	UG/L		0		LA3S116	[redacted]
IL1975030	01-Oct-19	18	UG/L		0		LP3S008	[redacted]
IL1975030	01-Oct-19	17	UG/L		0		LA3S110	[redacted]
IL1975030	01-Oct-19	15	UG/L		0		LA3S085	[redacted]
IL1975030	01-Oct-19	15	UG/L		0		LP3S054	[redacted]
IL1975030	01-Oct-19	12	UG/L		0		LP3S058	[redacted]
IL1975030	01-Oct-19	9.9	UG/L		0		LA3S096	[redacted]
IL1975030	01-Oct-19	8.5	UG/L		0		LA3S089	[redacted]
IL1975030	01-Oct-19	7.5	UG/L		0		LP3S082	[redacted]
IL1975030	01-Oct-19	7.1	UG/L		0		LP3S074	[redacted]
IL1975030	01-Oct-19	6.8	UG/L		0		LP1A119	[redacted]
IL1975030	01-Oct-19	6.7	UG/L		0		LP3S080	[redacted]
IL1975030	01-Oct-19	5.3	UG/L		0		LP3S015	[redacted]
IL1975030	01-Oct-19	3.8	UG/L		0		LA3S092	[redacted]
IL1975030	01-Oct-19	3.8	UG/L		0		LA3S107	[redacted]
IL1975030	01-Oct-19	3.3	UG/L		0		LA3S102	[redacted]
IL1975030	01-Oct-19	2.1	UG/L		0		LP3S019	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	01-Oct-19	1.4	UG/L		0		LA3S094	[redacted]
IL1975030	01-Oct-19	1.4	UG/L		0		LA3S099	[redacted]
IL1975030	01-Oct-19	1.3	UG/L		0		LP3S071	[redacted]
IL1975030	01-Oct-19	1.2	UG/L		0		LA3S112	[redacted]
IL1975030	01-Oct-19	1.1	UG/L		0		LP3S078	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S027	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	01-Oct-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	30-Sep-19	16	UG/L		0		LP3S018	[redacted]
IL1975030	30-Sep-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	28-Sep-19	2.4	UG/L		0		LP1A121	[redacted]
IL1975030	25-Sep-19	0		Y	1	UG/L	LP3S071	[redacted]
IL1975030	23-Sep-19	0		Y	1	UG/L	LA3S090	[redacted]
IL1975030	23-Sep-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	22-Sep-19	11	UG/L		0		LA3S087	[redacted]
IL1975030	20-Sep-19	8.3	UG/L		0		LA3S099	[redacted]
IL1975030	19-Sep-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	18-Sep-19	25	UG/L		0		LP3S044	[redacted]
IL1975030	18-Sep-19	13	UG/L		0		LA3S086	[redacted]
IL1975030	18-Sep-19	8.4	UG/L		0		LP3S037	[redacted]
IL1975030	18-Sep-19	0		Y	1	UG/L	LP3S013	[redacted]
IL1975030	18-Sep-19	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	18-Sep-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	18-Sep-19	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	17-Sep-19	740	UG/L		0		LP3S049	[redacted]
IL1975030	17-Sep-19	42	UG/L		0		LA3S117	[redacted]
IL1975030	17-Sep-19	33	UG/L		0		LP3S042	[redacted]
IL1975030	17-Sep-19	25	UG/L		0		LP3S056	[redacted]
IL1975030	17-Sep-19	25	UG/L		0		LP3S068	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	17-Sep-19	23	UG/L		0		LP3S058	[redacted]
IL1975030	17-Sep-19	22	UG/L		0		LA3S092	[redacted]
IL1975030	17-Sep-19	22	UG/L		0		LA3S097	[redacted]
IL1975030	17-Sep-19	21	UG/L		0		LA3S096	[redacted]
IL1975030	17-Sep-19	21	UG/L		0		LA3S104	[redacted]
IL1975030	17-Sep-19	20	UG/L		0		LP3S035	[redacted]
IL1975030	17-Sep-19	17	UG/L		0		LP3S008	[redacted]
IL1975030	17-Sep-19	15	UG/L		0		LA3S085	[redacted]
IL1975030	17-Sep-19	15	UG/L		0		LA3S091	[redacted]
IL1975030	17-Sep-19	14	UG/L		0		LA3S116	[redacted]
IL1975030	17-Sep-19	13	UG/L		0		LP3S070	[redacted]
IL1975030	17-Sep-19	13	UG/L		0		LP3S074	[redacted]
IL1975030	17-Sep-19	11	UG/L		0		LA3S110	[redacted]
IL1975030	17-Sep-19	11	UG/L		0		LP3S048	[redacted]
IL1975030	17-Sep-19	10	UG/L		0		LA3S118	[redacted]
IL1975030	17-Sep-19	7.8	UG/L		0		LP1A119	[redacted]
IL1975030	17-Sep-19	6.2	UG/L		0		LA3S107	[redacted]
IL1975030	17-Sep-19	5.1	UG/L		0		LP3S054	[redacted]
IL1975030	17-Sep-19	4.3	UG/L		0		LA3S089	[redacted]
IL1975030	17-Sep-19	4.1	UG/L		0		LP3S018	[redacted]
IL1975030	17-Sep-19	3.6	UG/L		0		LP3S081	[redacted]
IL1975030	17-Sep-19	2.8	UG/L		0		LP3S051	[redacted]
IL1975030	17-Sep-19	2.6	UG/L		0		LP3S040	[redacted]
IL1975030	17-Sep-19	2.1	UG/L		0		LP3S015	[redacted]
IL1975030	17-Sep-19	1.4	UG/L		0		LP3S011	[redacted]
IL1975030	17-Sep-19	1.2	UG/L		0		LA3S094	[redacted]
IL1975030	17-Sep-19	1.1	UG/L		0		LA3S102	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S112	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S078	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	17-Sep-19	0		Y	1	UG/L	LP3S082	[redacted]
IL1975030	16-Sep-19	1.6	UG/L		0		LA3S098	[redacted]
IL1975030	10-Sep-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	08-Sep-19	8.6	UG/L		0		LA3S087	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	06-Sep-19	1.5	UG/L		0		LP3S013	[redacted]
IL1975030	06-Sep-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	05-Sep-19	180	UG/L		0		LP3S035	[redacted]
IL1975030	05-Sep-19	110	UG/L		0		LP3S042	[redacted]
IL1975030	05-Sep-19	3.5	UG/L		0		LP3S080	[redacted]
IL1975030	05-Sep-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	05-Sep-19	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	04-Sep-19	380	UG/L		0		LP3S049	[redacted]
IL1975030	04-Sep-19	210	UG/L		0		LA3S117	[redacted]
IL1975030	04-Sep-19	46	UG/L		0		LP3S082	[redacted]
IL1975030	04-Sep-19	43	UG/L		0		LA3S091	[redacted]
IL1975030	04-Sep-19	43	UG/L		0		LA3S116	[redacted]
IL1975030	04-Sep-19	38	UG/L		0		LA3S086	[redacted]
IL1975030	04-Sep-19	38	UG/L		0		LA3S100	[redacted]
IL1975030	04-Sep-19	34	UG/L		0		LA3S098	[redacted]
IL1975030	04-Sep-19	34	UG/L		0		LP3S058	[redacted]
IL1975030	04-Sep-19	32	UG/L		0		LP3S040	[redacted]
IL1975030	04-Sep-19	30	UG/L		0		LA3S114	[redacted]
IL1975030	04-Sep-19	27	UG/L		0		LA3S110	[redacted]
IL1975030	04-Sep-19	27	UG/L		0		LA3S118	[redacted]
IL1975030	04-Sep-19	26	UG/L		0		LP3S056	[redacted]
IL1975030	04-Sep-19	24	UG/L		0		LA3S089	[redacted]
IL1975030	04-Sep-19	23	UG/L		0		LA3S104	[redacted]
IL1975030	04-Sep-19	21	UG/L		0		LA3S096	[redacted]
IL1975030	04-Sep-19	20	UG/L		0		LP3S048	[redacted]
IL1975030	04-Sep-19	17	UG/L		0		LA3S085	[redacted]
IL1975030	04-Sep-19	15	UG/L		0		LP3S018	[redacted]
IL1975030	04-Sep-19	13	UG/L		0		LP1A119	[redacted]
IL1975030	04-Sep-19	13	UG/L		0		LP3S054	[redacted]
IL1975030	04-Sep-19	12	UG/L		0		LA3S092	[redacted]
IL1975030	04-Sep-19	11	UG/L		0		LP3S074	[redacted]
IL1975030	04-Sep-19	9.4	UG/L		0		LP3S070	[redacted]
IL1975030	04-Sep-19	8.9	UG/L		0		LP3S008	[redacted]
IL1975030	04-Sep-19	7.3	UG/L		0		LP3S055	[redacted]
IL1975030	04-Sep-19	4.9	UG/L		0		LA3S107	[redacted]
IL1975030	04-Sep-19	4.5	UG/L		0		LP3S081	[redacted]
IL1975030	04-Sep-19	3.7	UG/L		0		LA3S102	[redacted]
IL1975030	04-Sep-19	3.6	UG/L		0		LP3S015	[redacted]
IL1975030	04-Sep-19	2.3	UG/L		0		LP3S027	[redacted]
IL1975030	04-Sep-19	2.1	UG/L		0		LP3S078	[redacted]
IL1975030	04-Sep-19	1.9	UG/L		0		LA3S090	[redacted]
IL1975030	04-Sep-19	1.9	UG/L		0		LA3S112	[redacted]
IL1975030	04-Sep-19	1.6	UG/L		0		LP3S011	[redacted]
IL1975030	04-Sep-19	1.5	UG/L		0		LP3S073	[redacted]
IL1975030	04-Sep-19	1.2	UG/L		0		LP3S019	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S088	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S094	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LA3S113	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S046	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	04-Sep-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	03-Sep-19	3.7	UG/L		0		LA3S097	[redacted]
IL1975030	02-Sep-19	13	UG/L		0		LA3S087	[redacted]
IL1975030	29-Aug-19	4.7	UG/L		0		LA3S093	[redacted]
IL1975030	28-Aug-19	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	25-Aug-19	21	UG/L		0		LA3S097	[redacted]
IL1975030	25-Aug-19	1.6	UG/L		0		LA3S099	[redacted]
IL1975030	25-Aug-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	24-Aug-19	410	UG/L		0		LA3S114	[redacted]
IL1975030	24-Aug-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	22-Aug-19	0		Y	1	UG/L	LP3S033	[redacted]
IL1975030	21-Aug-19	10	UG/L		0		LA3S089	[redacted]
IL1975030	21-Aug-19	6.3	UG/L		0		LA3S107	[redacted]
IL1975030	21-Aug-19	0		Y	1	UG/L	LA3S101	[redacted]
IL1975030	21-Aug-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	21-Aug-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	20-Aug-19	430	UG/L		0		LP3S049	[redacted]
IL1975030	20-Aug-19	200	UG/L		0		LA3S091	[redacted]
IL1975030	20-Aug-19	160	UG/L		0		LA3S117	[redacted]
IL1975030	20-Aug-19	85	UG/L		0		LP3S035	[redacted]
IL1975030	20-Aug-19	83	UG/L		0		LP3S042	[redacted]
IL1975030	20-Aug-19	76	UG/L		0		LP3S074	[redacted]
IL1975030	20-Aug-19	70	UG/L		0		LA3S118	[redacted]
IL1975030	20-Aug-19	53	UG/L		0		LP3S044	[redacted]
IL1975030	20-Aug-19	49	UG/L		0		LP3S082	[redacted]
IL1975030	20-Aug-19	41	UG/L		0		LP3S070	[redacted]
IL1975030	20-Aug-19	34	UG/L		0		LP3S056	[redacted]
IL1975030	20-Aug-19	31	UG/L		0		LA3S104	[redacted]
IL1975030	20-Aug-19	31	UG/L		0		LA3S110	[redacted]
IL1975030	20-Aug-19	29	UG/L		0		LP3S018	[redacted]
IL1975030	20-Aug-19	29	UG/L		0		LP3S040	[redacted]
IL1975030	20-Aug-19	26	UG/L		0		LP3S048	[redacted]
IL1975030	20-Aug-19	25	UG/L		0		LA3S116	[redacted]
IL1975030	20-Aug-19	22	UG/L		0		LA3S086	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	20-Aug-19	22	UG/L		0		LP3S058	[redacted]
IL1975030	20-Aug-19	21	UG/L		0		LP3S037	[redacted]
IL1975030	20-Aug-19	18	UG/L		0		LA3S096	[redacted]
IL1975030	20-Aug-19	18	UG/L		0		LA3S102	[redacted]
IL1975030	20-Aug-19	16	UG/L		0		LP1A119	[redacted]
IL1975030	20-Aug-19	16	UG/L		0		LP3S008	[redacted]
IL1975030	20-Aug-19	13	UG/L		0		LP3S054	[redacted]
IL1975030	20-Aug-19	10	UG/L		0		LP3S011	[redacted]
IL1975030	20-Aug-19	9.3	UG/L		0		LP3S013	[redacted]
IL1975030	20-Aug-19	9.2	UG/L		0		LP3S081	[redacted]
IL1975030	20-Aug-19	8	UG/L		0		LA3S090	[redacted]
IL1975030	20-Aug-19	6.6	UG/L		0		LA3S092	[redacted]
IL1975030	20-Aug-19	6	UG/L		0		LA3S112	[redacted]
IL1975030	20-Aug-19	5.9	UG/L		0		LA3S088	[redacted]
IL1975030	20-Aug-19	5.2	UG/L		0		LP3S059	[redacted]
IL1975030	20-Aug-19	5	UG/L		0		LP3S015	[redacted]
IL1975030	20-Aug-19	4.5	UG/L		0		LP3S046	[redacted]
IL1975030	20-Aug-19	4.2	UG/L		0		LA3S094	[redacted]
IL1975030	20-Aug-19	3.4	UG/L		0		LP3S055	[redacted]
IL1975030	20-Aug-19	3.2	UG/L		0		LP3S078	[redacted]
IL1975030	20-Aug-19	1.7	UG/L	N	1		CC01	[redacted]
IL1975030	20-Aug-19	1.1	UG/L		0		LA3S099	[redacted]
IL1975030	20-Aug-19	1.1	UG/L		0		LP3S027	[redacted]
IL1975030	20-Aug-19	1	UG/L		0		LA3S113	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LA3S103	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S073	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	20-Aug-19	0		Y	1	UG/L	LP3S080	[redacted]
IL1975030	10-Aug-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	09-Aug-19	24	UG/L		0		LP3S015	[redacted]
IL1975030	09-Aug-19	0		Y	1	UG/L	LP1A122	[redacted]
IL1975030	08-Aug-19	61	UG/L		0		LA3S089	[redacted]
IL1975030	07-Aug-19	180	UG/L		0		LA3S104	[redacted]
IL1975030	07-Aug-19	61	UG/L		0		LA3S086	[redacted]
IL1975030	07-Aug-19	14	UG/L		0		LA3S087	[redacted]
IL1975030	07-Aug-19	4.7	UG/L		0		LA3S106	[redacted]
IL1975030	07-Aug-19	2.8	UG/L		0		LP3S019	[redacted]
IL1975030	07-Aug-19	1.4	UG/L		0		LA3S096	[redacted]

NUMBER0	mple Collection D	Concentratior	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	07-Aug-19	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	07-Aug-19	0		Y	1	UG/L	LP3S055	[redacted]
IL1975030	07-Aug-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	07-Aug-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	07-Aug-19	0		Y	1	UG/L	LP3S068	[redacted]
IL1975030	06-Aug-19	200	UG/L		0		LP3S035	[redacted]
IL1975030	06-Aug-19	200	UG/L		0		LP3S059	[redacted]
IL1975030	06-Aug-19	180	UG/L		0		LP3S042	[redacted]
IL1975030	06-Aug-19	170	UG/L		0		LA3S117	[redacted]
IL1975030	06-Aug-19	160	UG/L		0		LP3S049	[redacted]
IL1975030	06-Aug-19	130	UG/L		0		LA3S091	[redacted]
IL1975030	06-Aug-19	100	UG/L		0		LP3S074	[redacted]
IL1975030	06-Aug-19	87	UG/L		0		LP3S082	[redacted]
IL1975030	06-Aug-19	78	UG/L		0		LP3S070	[redacted]
IL1975030	06-Aug-19	65	UG/L		0		LA3S116	[redacted]
IL1975030	06-Aug-19	60	UG/L		0		LA3S110	[redacted]
IL1975030	06-Aug-19	54	UG/L		0		LA3S085	[redacted]
IL1975030	06-Aug-19	54	UG/L		0		LP3S037	[redacted]
IL1975030	06-Aug-19	51	UG/L		0		LP3S081	[redacted]
IL1975030	06-Aug-19	44	UG/L		0		LP3S008	[redacted]
IL1975030	06-Aug-19	44	UG/L		0		LP3S058	[redacted]
IL1975030	06-Aug-19	43	UG/L		0		LA3S092	[redacted]
IL1975030	06-Aug-19	40	UG/L		0		LP3S044	[redacted]
IL1975030	06-Aug-19	37	UG/L		0		LP3S040	[redacted]
IL1975030	06-Aug-19	35	UG/L		0		LP3S048	[redacted]
IL1975030	06-Aug-19	34	UG/L		0		LP3S078	[redacted]
IL1975030	06-Aug-19	30	UG/L		0		LA3S102	[redacted]
IL1975030	06-Aug-19	25	UG/L		0		LP3S028	[redacted]
IL1975030	06-Aug-19	19	UG/L		0		LP3S013	[redacted]
IL1975030	06-Aug-19	19	UG/L		0		LP3S056	[redacted]
IL1975030	06-Aug-19	15	UG/L		0		LA3S090	[redacted]
IL1975030	06-Aug-19	14	UG/L		0		LA3S118	[redacted]
IL1975030	06-Aug-19	9.6	UG/L		0		LA3S107	[redacted]
IL1975030	06-Aug-19	9.6	UG/L		0		LP3S027	[redacted]
IL1975030	06-Aug-19	9.2	UG/L		0		LA3S112	[redacted]
IL1975030	06-Aug-19	7.7	UG/L		0		LA3S113	[redacted]
IL1975030	06-Aug-19	6.5	UG/L		0		LP3S050	[redacted]
IL1975030	06-Aug-19	6.4	UG/L		0		LA3S094	[redacted]
IL1975030	06-Aug-19	5.2	UG/L		0		LP3S046	[redacted]
IL1975030	06-Aug-19	3.6	UG/L		0		LP1A119	[redacted]
IL1975030	06-Aug-19	2.9	UG/L		0		LA3S103	[redacted]
IL1975030	06-Aug-19	2	UG/L		0		LA3S101	[redacted]
IL1975030	06-Aug-19	1.9	UG/L		0		LP3S063	[redacted]
IL1975030	06-Aug-19	1.5	UG/L		0		LP3S080	[redacted]
IL1975030	06-Aug-19	1.3	UG/L		0		LA3S096	[redacted]
IL1975030	06-Aug-19	1.1	UG/L		0		LP3S073	[redacted]

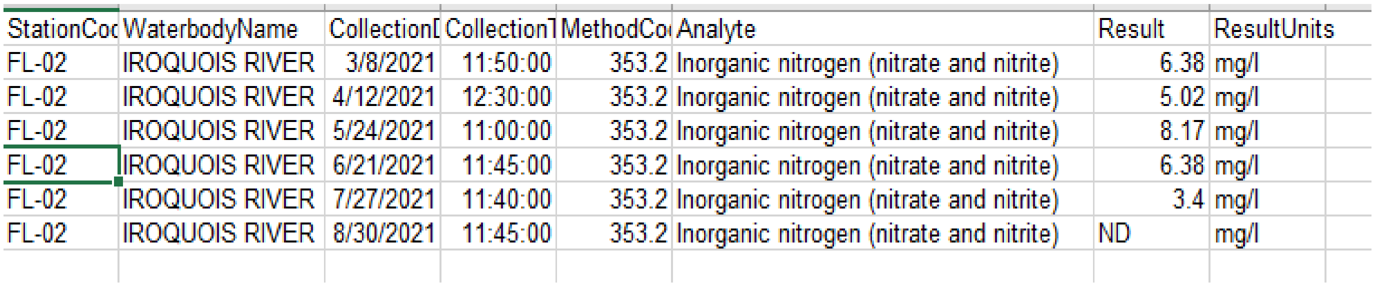
NUMBER0	nple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	06-Aug-19	1	UG/L		0		LP3S013	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	CC01	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LA3S097	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LA3S100	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LA3S108	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S011	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S051	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S077	[redacted]
IL1975030	06-Aug-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	30-Jul-19	120	UG/L		0		LP3S037	[redacted]
IL1975030	26-Jul-19	800	UG/L		0		LP3S042	[redacted]
IL1975030	26-Jul-19	0		Y	1	UG/L	LA3S095	[redacted]
IL1975030	25-Jul-19	23	UG/L		0		LA3S086	[redacted]
IL1975030	25-Jul-19	5.1	UG/L		0		LP3S071	[redacted]
IL1975030	24-Jul-19	460	UG/L		0		LA3S098	[redacted]
IL1975030	24-Jul-19	110	UG/L		0		LA3S110	[redacted]
IL1975030	24-Jul-19	37	UG/L		0		LA3S107	[redacted]
IL1975030	24-Jul-19	32	UG/L		0		LA3S087	[redacted]
IL1975030	24-Jul-19	27	UG/L		0		LA3S092	[redacted]
IL1975030	24-Jul-19	16	UG/L		0		LA3S089	[redacted]
IL1975030	24-Jul-19	14	UG/L		0		LA3S117	[redacted]
IL1975030	24-Jul-19	14	UG/L		0		LP3S013	[redacted]
IL1975030	24-Jul-19	4.7	UG/L		0		LA3S116	[redacted]
IL1975030	24-Jul-19	2.3	UG/L		0		LP3S055	[redacted]
IL1975030	24-Jul-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	24-Jul-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	23-Jul-19	3100	UG/L		0		LP3S049	[redacted]
IL1975030	23-Jul-19	220	UG/L		0		LA3S091	[redacted]
IL1975030	23-Jul-19	190	UG/L		0		LA3S085	[redacted]
IL1975030	23-Jul-19	170	UG/L		0		LA3S097	[redacted]
IL1975030	23-Jul-19	150	UG/L		0		LP3S081	[redacted]
IL1975030	23-Jul-19	130	UG/L		0		LP3S074	[redacted]
IL1975030	23-Jul-19	120	UG/L		0		LP3S015	[redacted]
IL1975030	23-Jul-19	120	UG/L		0		LP3S040	[redacted]
IL1975030	23-Jul-19	120	UG/L		0		LP3S059	[redacted]
IL1975030	23-Jul-19	110	UG/L		0		LP3S082	[redacted]
IL1975030	23-Jul-19	89	UG/L		0		LP3S044	[redacted]
IL1975030	23-Jul-19	87	UG/L		0		LP3S008	[redacted]
IL1975030	23-Jul-19	86	UG/L		0		LA3S118	[redacted]
IL1975030	23-Jul-19	85	UG/L		0		LP3S035	[redacted]
IL1975030	23-Jul-19	84	UG/L		0		LA3S113	[redacted]
IL1975030	23-Jul-19	77	UG/L		0		LA3S094	[redacted]
IL1975030	23-Jul-19	74	UG/L		0		LP3S058	[redacted]

NUMBER0	mple Collection D	Concentration	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	23-Jul-19	60	UG/L		0		LA3S104	[redacted]
IL1975030	23-Jul-19	60	UG/L		0		LP3S048	[redacted]
IL1975030	23-Jul-19	54	UG/L		0		LP3S054	[redacted]
IL1975030	23-Jul-19	48	UG/L		0		LA3S101	[redacted]
IL1975030	23-Jul-19	46	UG/L		0		LP3S070	[redacted]
IL1975030	23-Jul-19	44	UG/L		0		LA3S100	[redacted]
IL1975030	23-Jul-19	43	UG/L		0		LA3S102	[redacted]
IL1975030	23-Jul-19	39	UG/L		0		LP3S078	[redacted]
IL1975030	23-Jul-19	31	UG/L		0		LP3S056	[redacted]
IL1975030	23-Jul-19	23	UG/L		0		LP3S051	[redacted]
IL1975030	23-Jul-19	22	UG/L		0		LP3S011	[redacted]
IL1975030	23-Jul-19	17	UG/L		0		LP3S046	[redacted]
IL1975030	23-Jul-19	12	UG/L		0		LA3S112	[redacted]
IL1975030	23-Jul-19	7.3	UG/L		0		LP3S068	[redacted]
IL1975030	23-Jul-19	6.9	UG/L		0		LP1A119	[redacted]
IL1975030	23-Jul-19	6	UG/L		0		LP3S080	[redacted]
IL1975030	23-Jul-19	4.7	UG/L		0		LP3S019	[redacted]
IL1975030	23-Jul-19	3.9	UG/L		0		LA3S103	[redacted]
IL1975030	23-Jul-19	3	UG/L		0		LP3S062	[redacted]
IL1975030	23-Jul-19	2.6	UG/L		0		LA3S108	[redacted]
IL1975030	23-Jul-19	2.4	UG/L		0		LA3S093	[redacted]
IL1975030	23-Jul-19	1.4	UG/L		0		LP3S073	[redacted]
IL1975030	23-Jul-19	1.2	UG/L		0		LP3S050	[redacted]
IL1975030	23-Jul-19	1.1	UG/L		0		LP3S076	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LA3S096	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S027	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	23-Jul-19	0		Y	1	UG/L	LP3S079	[redacted]
IL1975030	16-Jul-19	18	UG/L		0		LP1A119	[redacted]
IL1975030	14-Jul-19	22	UG/L		0		LP1A121	[redacted]
IL1975030	13-Jul-19	16	UG/L		0		LA3S112	[redacted]
IL1975030	13-Jul-19	0		Y	1	UG/L	LA3S106	[redacted]
IL1975030	12-Jul-19	34	UG/L		0		LA3S087	[redacted]
IL1975030	11-Jul-19	55	UG/L		0		LA3S092	[redacted]
IL1975030	11-Jul-19	0		Y	1	UG/L	LP3S077	[redacted]
IL1975030	10-Jul-19	460	UG/L		0		LA3S091	[redacted]
IL1975030	10-Jul-19	130	UG/L		0		LA3S104	[redacted]
IL1975030	10-Jul-19	85	UG/L		0		LP3S071	[redacted]
IL1975030	10-Jul-19	55	UG/L		0		LA3S110	[redacted]
IL1975030	10-Jul-19	13	UG/L		0		LP3S050	[redacted]
IL1975030	10-Jul-19	3.7	UG/L		0		LP3S076	[redacted]
IL1975030	10-Jul-19	0		Y	1	UG/L	LP3S062	[redacted]

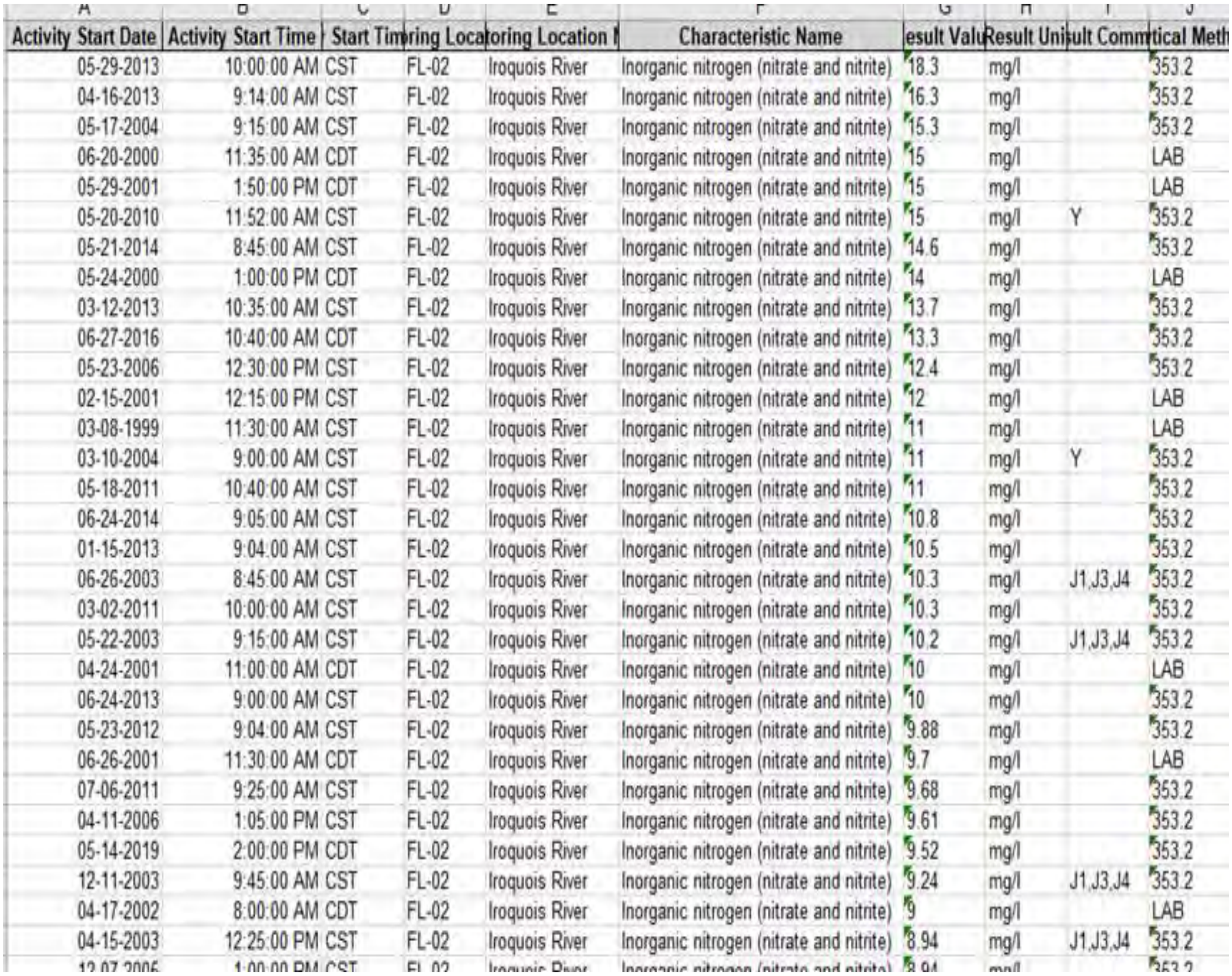
NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	ENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	09-Jul-19	3900	UG/L		0		LP3S042	[redacted]
IL1975030	09-Jul-19	1800	UG/L		0		LP3S081	[redacted]
IL1975030	09-Jul-19	860	UG/L		0		LP3S049	[redacted]
IL1975030	09-Jul-19	370	UG/L		0		LP3S059	[redacted]
IL1975030	09-Jul-19	230	UG/L		0		LP3S044	[redacted]
IL1975030	09-Jul-19	210	UG/L		0		LA3S085	[redacted]
IL1975030	09-Jul-19	200	UG/L		0		LP3S035	[redacted]
IL1975030	09-Jul-19	190	UG/L		0		LA3S113	[redacted]
IL1975030	09-Jul-19	180	UG/L		0		LP3S028	[redacted]
IL1975030	09-Jul-19	140	UG/L		0		LP3S070	[redacted]
IL1975030	09-Jul-19	140	UG/L		0		LP3S074	[redacted]
IL1975030	09-Jul-19	140	UG/L		0		LP3S082	[redacted]
IL1975030	09-Jul-19	120	UG/L		0		LP3S054	[redacted]
IL1975030	09-Jul-19	110	UG/L		0		LA3S096	[redacted]
IL1975030	09-Jul-19	110	UG/L		0		LP3S040	[redacted]
IL1975030	09-Jul-19	110	UG/L		0		LP3S048	[redacted]
IL1975030	09-Jul-19	89	UG/L		0		LP3S058	[redacted]
IL1975030	09-Jul-19	84	UG/L		0		LP3S008	[redacted]
IL1975030	09-Jul-19	81	UG/L		0		LP3S068	[redacted]
IL1975030	09-Jul-19	77	UG/L		0		LP3S078	[redacted]
IL1975030	09-Jul-19	76	UG/L		0		LP3S015	[redacted]
IL1975030	09-Jul-19	63	UG/L		0		LP3S011	[redacted]
IL1975030	09-Jul-19	55	UG/L		0		LP3S056	[redacted]
IL1975030	09-Jul-19	41	UG/L		0		LA3S089	[redacted]
IL1975030	09-Jul-19	24	UG/L		0		LA3S117	[redacted]
IL1975030	09-Jul-19	18	UG/L		0		LP3S046	[redacted]
IL1975030	09-Jul-19	12	UG/L		0		LA3S107	[redacted]
IL1975030	09-Jul-19	12	UG/L		0		LP3S027	[redacted]
IL1975030	09-Jul-19	9.5	UG/L		0		LA3S097	[redacted]
IL1975030	09-Jul-19	7.5	UG/L		0		LP3S055	[redacted]
IL1975030	09-Jul-19	7.3	UG/L		0		LP3S079	[redacted]
IL1975030	09-Jul-19	7.1	UG/L		0		LA3S098	[redacted]
IL1975030	09-Jul-19	5	UG/L		0		LP3S073	[redacted]
IL1975030	09-Jul-19	2.3	UG/L		0		LA3S101	[redacted]
IL1975030	09-Jul-19	2	UG/L		0		LA3S116	[redacted]
IL1975030	09-Jul-19	1.6	UG/L		0		LP3S080	[redacted]
IL1975030	09-Jul-19	1.5	UG/L		0		LA3S090	[redacted]
IL1975030	09-Jul-19	1.5	UG/L		0		LP3S009	[redacted]
IL1975030	09-Jul-19	1.5	UG/L		0		LP3S066	[redacted]
IL1975030	09-Jul-19	1.4	UG/L		0		LA3S108	[redacted]
IL1975030	09-Jul-19	0		Y	1	UG/L	LA3S088	[redacted]
IL1975030	09-Jul-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	09-Jul-19	0		Y	1	UG/L	LP3S047	[redacted]
IL1975030	09-Jul-19	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	08-Jul-19	440	UG/L		0		LP3S074	[redacted]
IL1975030	08-Jul-19	100	UG/L		0		LP3S037	[redacted]

NUMBER0	mple Collection D	Concentratio	f Measu	Indicato	N_LIM	N_LIM_	DENTIFICATION_C	DESCRIPTION_TEXT
IL1975030	08-Jul-19	5.3	UG/L		0		LP3S013	[redacted]
IL1975030	03-Jul-19	92	UG/L		0		LP1A005	[redacted]
IL1975030	03-Jul-19	55	UG/L		0		LP3S011	[redacted]
IL1975030	03-Jul-19	5.2	UG/L		0		LP3S073	[redacted]
IL1975030	03-Jul-19	3.4	UG/L		0		LP3S055	[redacted]
IL1975030	03-Jul-19	1.2	UG/L		0		LP3S013	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP1A052	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP3S009	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP3S020	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP3S050	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP3S063	[redacted]
IL1975030	03-Jul-19	0		Y	1	UG/L	LP3S076	[redacted]
IL1975030	02-Jul-19	480	UG/L		0		LP3S049	[redacted]
IL1975030	02-Jul-19	350	UG/L		0		LP3S081	[redacted]
IL1975030	02-Jul-19	240	UG/L		0		LP3S070	[redacted]
IL1975030	02-Jul-19	220	UG/L		0		LP3S044	[redacted]
IL1975030	02-Jul-19	170	UG/L		0		LP3S082	[redacted]
IL1975030	02-Jul-19	150	UG/L		0		LP3S042	[redacted]
IL1975030	02-Jul-19	130	UG/L		0		LP3S059	[redacted]
IL1975030	02-Jul-19	130	UG/L		0		LP3S078	[redacted]
IL1975030	02-Jul-19	83	UG/L		0		LP3S058	[redacted]
IL1975030	02-Jul-19	73	UG/L		0		LP3S084	[redacted]
IL1975030	02-Jul-19	66	UG/L		0		LP3S048	[redacted]
IL1975030	02-Jul-19	52	UG/L		0		LP3S008	[redacted]
IL1975030	02-Jul-19	52	UG/L		0		LP3S056	[redacted]
IL1975030	02-Jul-19	35	UG/L		0		LP3S080	[redacted]
IL1975030	02-Jul-19	22	UG/L		0		LP3S068	[redacted]
IL1975030	02-Jul-19	19	UG/L		0		LP3S054	[redacted]
IL1975030	02-Jul-19	18	UG/L		0		LP3S015	[redacted]
IL1975030	02-Jul-19	8	UG/L		0		LP3S027	[redacted]
IL1975030	02-Jul-19	7.2	UG/L		0		LP3S046	[redacted]
IL1975030	02-Jul-19	5.4	UG/L		0		LP3S035	[redacted]
IL1975030	02-Jul-19	3.3	UG/L		0		LP3S079	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S002	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S028	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S062	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S066	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S077	[redacted]
IL1975030	02-Jul-19	0		Y	1	UG/L	LP3S083	[redacted]
IL1975030	01-Jul-19	40	UG/L		0		LP3S037	[redacted]

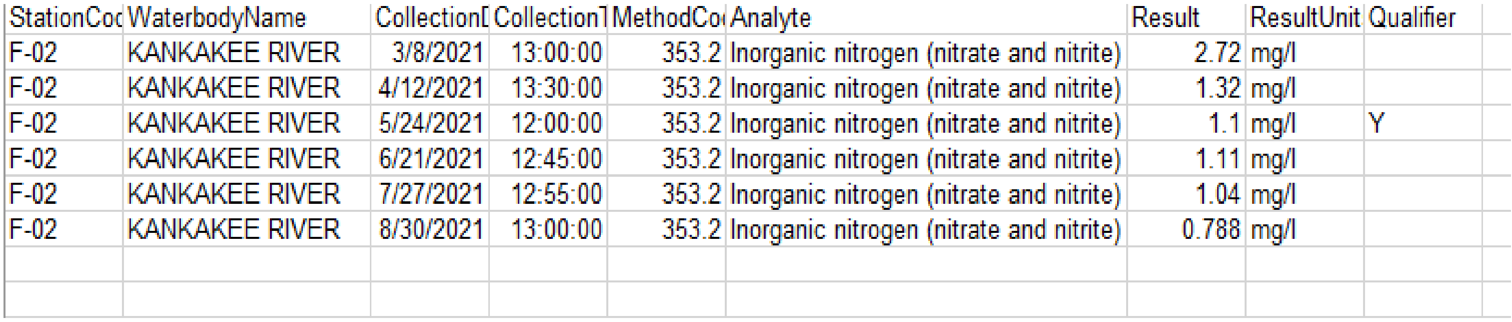
From: Cook, David
Sent: Friday, November 5, 2021 8:23 AM
To: Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>; Brown, Michael L. <Michael.L.Brown@Illinois.gov>; Vance, Steve <STEVE.VANCE@Illinois.gov>; Reed, Mary F <MARY.F.REED@Illinois.gov>; Roubitchek, Mike <Mike.Roubitchek@Illinois.gov>; Larsen, Jenny <Jenny.Larsen@illinois.gov>
Subject: FW: Aqua IL - Kankakee River nitrate data and Iroquois River nitrate data



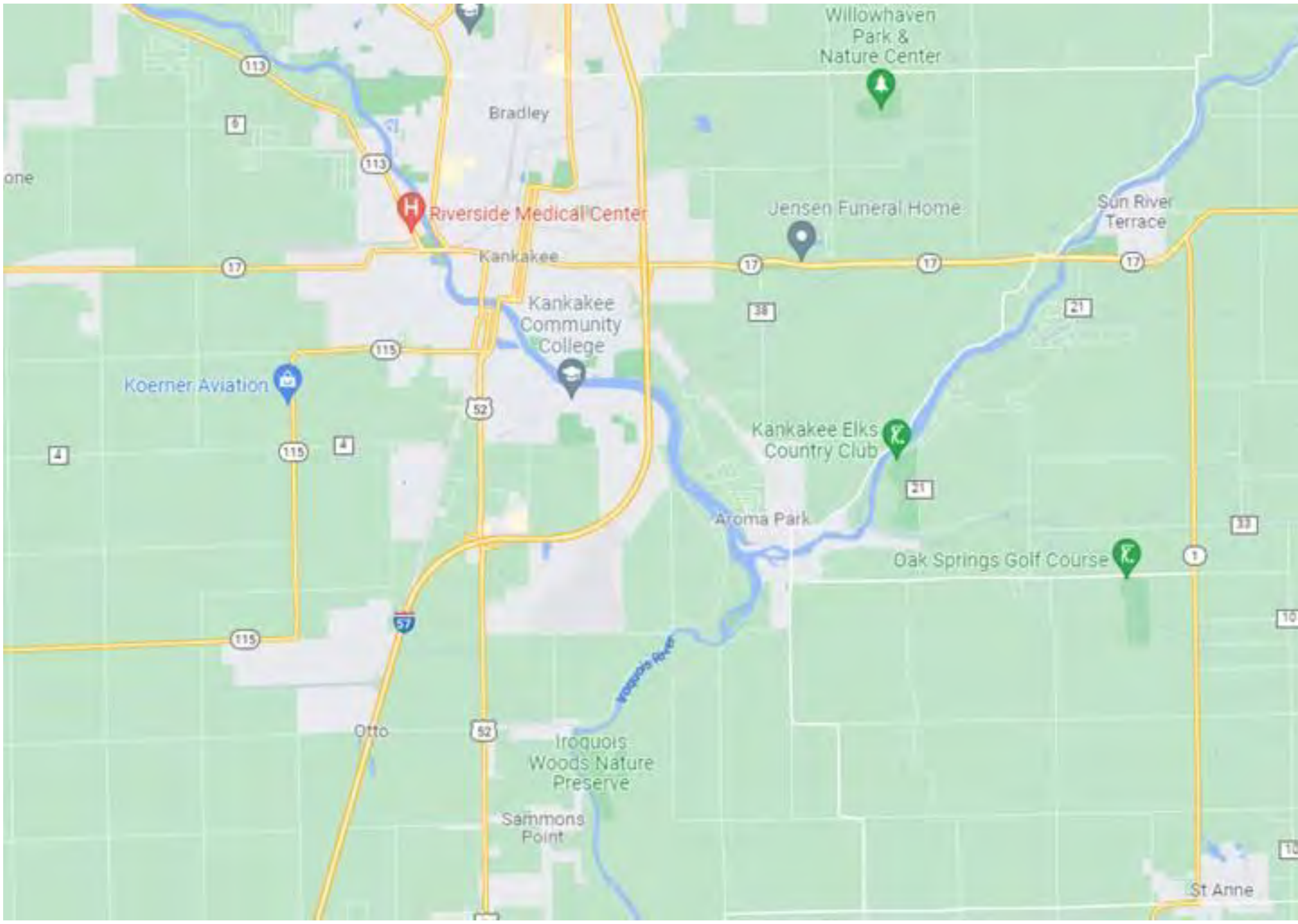
StationCoc	WaterbodyName	CollectionD	CollectionT	MethodCo	Analyte	Result	ResultUnits
FL-02	IROQUOIS RIVER	3/8/2021	11:50:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	4/12/2021	12:30:00	353.2	Inorganic nitrogen (nitrate and nitrite)	5.02	mg/l
FL-02	IROQUOIS RIVER	5/24/2021	11:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	8.17	mg/l
FL-02	IROQUOIS RIVER	6/21/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	7/27/2021	11:40:00	353.2	Inorganic nitrogen (nitrate and nitrite)	3.4	mg/l
FL-02	IROQUOIS RIVER	8/30/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	ND	mg/l



A	B	C	D	E	F	G	H	I	J
Activity Start Date	Activity Start Time	Start Tim	ring Loca	toring Location	Characteristic Name	esult Valu	Result Uni	sult Comm	tical Meth
05-29-2013	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	18.3	mg/l		353.2
04-16-2013	9:14:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	16.3	mg/l		353.2
05-17-2004	9:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15.3	mg/l		353.2
06-20-2000	11:35:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l		LAB
05-29-2001	1:50:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l		LAB
05-20-2010	11:52:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l	Y	353.2
05-21-2014	8:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	14.6	mg/l		353.2
05-24-2000	1:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	14	mg/l		LAB
03-12-2013	10:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	13.7	mg/l		353.2
06-27-2016	10:40:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	13.3	mg/l		353.2
05-23-2006	12:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	12.4	mg/l		353.2
02-15-2001	12:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	12	mg/l		LAB
03-08-1999	11:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l		LAB
03-10-2004	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l	Y	353.2
05-18-2011	10:40:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l		353.2
06-24-2014	9:05:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.8	mg/l		353.2
01-15-2013	9:04:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.5	mg/l		353.2
06-26-2003	8:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.3	mg/l	J1,J3,J4	353.2
03-02-2011	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.3	mg/l		353.2
05-22-2003	9:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.2	mg/l	J1,J3,J4	353.2
04-24-2001	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10	mg/l		LAB
06-24-2013	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10	mg/l		353.2
05-23-2012	9:04:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.88	mg/l		353.2
06-26-2001	11:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.7	mg/l		LAB
07-06-2011	9:25:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.68	mg/l		353.2
04-11-2006	1:05:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.61	mg/l		353.2
05-14-2019	2:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.52	mg/l		353.2
12-11-2003	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.24	mg/l	J1,J3,J4	353.2
04-17-2002	8:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9	mg/l		LAB
04-15-2003	12:25:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.94	mg/l	J1,J3,J4	353.2
12-07-2006	1:00:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.94	mg/l		353.2

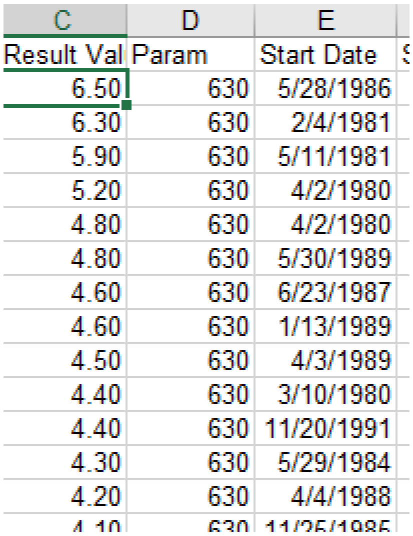


StationCod	WaterbodyName	CollectionD	CollectionT	MethodCo	Analyte	Result	ResultUnit	Qualifier
F-02	KANKAKEE RIVER	3/8/2021	13:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	2.72	mg/l	
F-02	KANKAKEE RIVER	4/12/2021	13:30:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.32	mg/l	
F-02	KANKAKEE RIVER	5/24/2021	12:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.1	mg/l	Y
F-02	KANKAKEE RIVER	6/21/2021	12:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.11	mg/l	
F-02	KANKAKEE RIVER	7/27/2021	12:55:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.04	mg/l	
F-02	KANKAKEE RIVER	8/30/2021	13:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	0.788	mg/l	

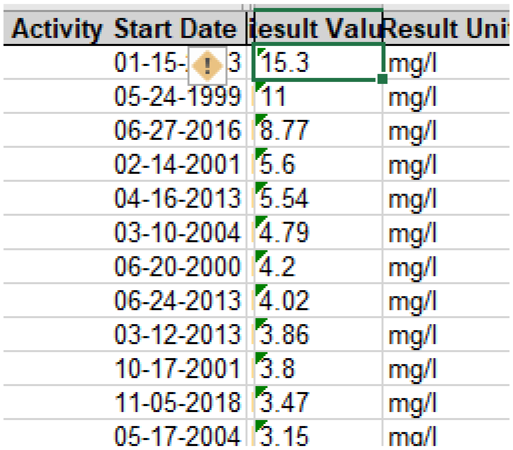


From: Cook, David
Sent: Thursday, November 4, 2021 12:25 PM
To: Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>; Brown, Michael L. <Michael.L.Brown@Illinois.gov>; Vance, Steve <STEVE.VANCE@Illinois.gov>; Reed, Mary F <MARY.F.REED@Illinois.gov>; Roubitchek, Mike <Mike.Roubitchek@Illinois.gov>; Larsen, Jenny <Jenny.Larsen@illinois.gov>
Subject: Aqua IL - Kankakee River nitrate data

I added the first two tabs and copied just the nitrate data for the Kankakee River. Looking at Google Earth, the sample point is approximately 14.5 river miles upstream of the water plant. There are 400 total data points for nitrate. The highest ones are copied below.



C	D	E
Result Val	Param	Start Date
6.50	630	5/28/1986
6.30	630	2/4/1981
5.90	630	5/11/1981
5.20	630	4/2/1980
4.80	630	4/2/1980
4.80	630	5/30/1989
4.60	630	6/23/1987
4.60	630	1/13/1989
4.50	630	4/3/1989
4.40	630	3/10/1980
4.40	630	11/20/1991
4.30	630	5/29/1984
4.20	630	4/4/1988
4.10	630	11/25/1985



Activity Start Date	esult Valu	Result Uni
01-15-[illegible]3	15.3	mg/l
05-24-1999	11	mg/l
06-27-2016	8.77	mg/l
02-14-2001	5.6	mg/l
04-16-2013	5.54	mg/l
03-10-2004	4.79	mg/l
06-20-2000	4.2	mg/l
06-24-2013	4.02	mg/l
03-12-2013	3.86	mg/l
10-17-2001	3.8	mg/l
11-05-2018	3.47	mg/l
05-17-2004	3.15	mg/l

From: Good, Gregg <Gregg.Good@Illinois.gov>
Sent: Thursday, November 4, 2021 9:01 AM
To: Cook, David <DAVID.COOK@Illinois.gov>
Cc: Cain, Missy <Missy.Cain@Illinois.gov>
Subject: FW: F-02 data

David, before looking too much at the legacy (pre-1999) dataset, see my note to the lab below. I just want to make sure that what I'm telling you below is 100%accurate. I'm 99% sure it is, but…..

Tom responded and said he'd get us an answer tomorrow.

Gregg Good, Manager
Surface Water Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
Work Phone: 217/782-7028
Cell Phone: 217/816-4555
E-mail: Gregg.Good@Illinois.gov

From: Good, Gregg
Sent: Thursday, November 4, 2021 8:48 AM
To: Weiss, Tom <Tom.Weiss@illinois.gov>; Turpin, Kelly <Kelly.Turpin@Illinois.gov>
Cc: Cain, Missy <Missy.Cain@Illinois.gov>
Subject: FW: F-02 data

Tom or Kelly, please see my response below and the attached table.

Question. Would you agree that the current parameter name *"Inorganic Nitrogen (nitrate and nitrite)"* (used in our 1999 to present data set) equates to the pre-1999 legacy data set parameter code 630, *"NO2&NO3, N-TOTAL"*?

Just wanting to make 100% sure those two parameters names and analyses are essentially synonymous with each other.

Thanks.

Gregg Good, Manager
Surface Water Section
Division of Water Pollution Control
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P.O. Box 19276
Springfield, Illinois 62794-9276
Work Phone: 217/782-7028

Cell Phone: 217/816-4555
E-mail: Gregg.Good@Illinois.gov

From: Good, Gregg
Sent: Thursday, November 4, 2021 8:39 AM
To: Cain, Missy <Missy.Cain@Illinois.gov>; Cook, David <DAVID.COOK@Illinois.gov>; Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>
Cc: Twait, Scott <Scott.Twait@Illinois.gov>
Subject: RE: F-02 data

I was just about to hit the "send" button, but Missy beat me to it. My response was going to be:

- In the "Data Table" tab (data from 1999 to present), see Column CI. Search on "Inorganic Nitrogen (nitrate and nitrite)."
- In the "Legacy Data Table" tab (data prior to 1999), see Column L. Search on Parameter Code 630. In the "Legacy Parameter Code List" tab, note that in Column A (row 428), Parameter Code 630 = "NO2&NO3, N-TOTAL."

____

Gregg Good, Manager
Surface Water Section
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Work Phone: 217/782-7028
Cell Phone: 217/816-4555
E-mail: Gregg.Good@Illinois.gov

From: Cain, Missy <Missy.Cain@Illinois.gov>
Sent: Thursday, November 4, 2021 8:32 AM
To: Cook, David <DAVID.COOK@Illinois.gov>; Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>
Cc: Good, Gregg <Gregg.Good@Illinois.gov>; Twait, Scott <Scott.Twait@Illinois.gov>
Subject: RE: F-02 data

David,

I'm sorry. I know these tables are not straight-forward. I'll try to help as much as I can.

I included all parameter data in these tables so you could see what we have and pick and choose what you would like to use.

In the Data Table tab, the Characteristic Name column (column CL) is where you would look for the parameter name nitrate or any other variations of that name that may have been used.

The legacy data isn't as clear. In the Legacy Data Table tab, the Param column (column L) contains a pcode which represents a parameter name. The definitions of the pcodes can be found in the Legacy Parameter Code List tab under the Parameter No. column (column A).

Again, I didn't filter the data for any particular analytes for the data in either tab so that I could give you what we have stored and not miss anything you might be interested in. Also, I'm not totally familiar with all the variations of the analyte names that could mean the same thing.

I hope this helps.

Missy

From: Cook, David <DAVID.COOK@Illinois.gov>
Sent: Thursday, November 4, 2021 8:07 AM
To: Cain, Missy <Missy.Cain@Illinois.gov>; Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>
Cc: Good, Gregg <Gregg.Good@Illinois.gov>; Twait, Scott <Scott.Twait@Illinois.gov>
Subject: RE: F-02 data

Which tab and column have the nitrate data?

From: Cain, Missy <Missy.Cain@Illinois.gov>
Sent: Wednesday, November 3, 2021 2:40 PM
To: Sofat, Sanjay <Sanjay.Sofat@Illinois.gov>
Cc: Good, Gregg <Gregg.Good@Illinois.gov>; Twait, Scott <Scott.Twait@Illinois.gov>; Cook, David <DAVID.COOK@Illinois.gov>
Subject: F-02 data

Sanjay,

I've attached an Excel file of data for site F-02. The Data Table worksheet has data from 1999 to 2021 and the Legacy Data Table worksheet has data prior to 1999. The Legacy Parameter Code List will help cross-reference the parameter codes (pcodes) that are used in the Legacy Data Table with parameter names. You will notice that the station referenced in The Legacy Data Table is sometimes F-02 or 05520500, which is an alternate ID that was used at that time for F-02.

I hope this helps. I am here until 3:00 if you need anything else.

Thanks,

Missy

Activity Start Date	Activity Start Time	y Start Tim	oring Loca	toring Location N	Characteristic Name	esult Valu	Result Uni	sult Comm	ytical Method ID
05-29-2013	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	18.3	mg/l		353.2
04-16-2013	9:14:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	16.3	mg/l		353.2
05-17-2004	9:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15.3	mg/l		353.2
06-20-2000	11:35:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l		LAB
05-29-2001	1:50:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l		LAB
05-20-2010	11:52:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	15	mg/l	Y	353.2
05-21-2014	8:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	14.6	mg/l		353.2
05-24-2000	1:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	14	mg/l		LAB
03-12-2013	10:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	13.7	mg/l		353.2
06-27-2016	10:40:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	13.3	mg/l		353.2
05-23-2006	12:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	12.4	mg/l		353.2
02-15-2001	12:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	12	mg/l		LAB
03-08-1999	11:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l		LAB
03-10-2004	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l	Y	353.2
05-18-2011	10:40:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	11	mg/l		353.2
06-24-2014	9:05:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.8	mg/l		353.2
01-15-2013	9:04:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.5	mg/l		353.2
06-26-2003	8:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.3	mg/l	J1,J3,J4	353.2
03-02-2011	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.3	mg/l		353.2
05-22-2003	9:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10.2	mg/l	J1,J3,J4	353.2
04-24-2001	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10	mg/l		LAB
06-24-2013	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	10	mg/l		353.2
05-23-2012	9:04:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.88	mg/l		353.2
06-26-2001	11:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.7	mg/l		LAB
07-06-2011	9:25:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.68	mg/l		353.2
04-11-2006	1:05:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.61	mg/l		353.2
05-14-2019	2:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.52	mg/l		353.2
12-11-2003	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9.24	mg/l	J1,J3,J4	353.2
04-17-2002	8:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	9	mg/l		LAB
04-15-2003	12:25:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.94	mg/l	J1,J3,J4	353.2
12-07-2005	1:00:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.94	mg/l		353.2
04-11-2016	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.88	mg/l		353.2
06-24-2002	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.82	mg/l		LAB
06-28-2004	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.81	mg/l		353.2
05-30-2017	10:25:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.78	mg/l		353.2
05-13-2008	10:50:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.62	mg/l		353.2
03-08-2000	11:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.5	mg/l		LAB
01-21-2004	1:45:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.48	mg/l		353.2
01-18-2006	1:50:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.42	mg/l		353.2
05-13-2002	3:30:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.3	mg/l		LAB
04-16-2004	9:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.24	mg/l		353.2
07-05-2017	10:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.24	mg/l		353.2
04-10-2017	10:45:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.06	mg/l		353.2
03-07-2016	11:25:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8.02	mg/l		353.2
04-18-2000	11:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8	mg/l		LAB
12-11-2001	2:25:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	8	mg/l		LAB

07-08-2019	12:20:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.92	mg/l		353.2
06-08-2020	11:45:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.91	mg/l		353.2
06-08-2010	3:05:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.88	mg/l		353.2
03-04-2005	12:05:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.8	mg/l		353.2
05-10-2016	9:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.72	mg/l		353.2
03-01-2006	2:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.71	mg/l	Q	353.2
03-31-1999	1:00:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.7	mg/l		LAB
04-12-2011	9:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.67	mg/l		353.2
01-29-2017	2:25:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.48	mg/l		353.2
12-11-2018	7:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.31	mg/l		353.2
06-30-1999	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.3	mg/l		LAB
04-03-2019	6:45:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.3	mg/l		353.2
11-28-2006	1:20:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.19	mg/l		353.2
04-16-2014	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.03	mg/l		353.2
06-13-2005	9:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	7.01	mg/l		353.2
11-04-2004	1:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.96	mg/l		353.2
04-17-2018	5:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.91	mg/l		353.2
03-03-2009	11:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.84	mg/l		353.2
01-23-2002	2:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.7	mg/l		LAB
11-23-2015	1:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.7	mg/l		353.2
03-07-2017	11:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.7	mg/l		353.2
03-03-2020	11:40:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.59	mg/l		353.2
05-27-2015	11:15:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.55	mg/l		353.2
01-17-2007	1:05:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.49	mg/l		353.2
11-05-2019	11:20:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.39	mg/l		353.2
02-21-2019	11:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.29	mg/l		353.2
06-26-2018	12:30:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.25	mg/l		353.2
03-05-2012	9:20:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.16	mg/l		353.2
06-21-2010	12:00:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	6.03	mg/l		353.2
06-02-2009	12:58:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.88	mg/l		353.2
03-24-2015	10:20:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.88	mg/l		353.2
01-28-2020	11:10:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.85	mg/l		353.2
06-25-2008	11:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.84	mg/l		353.2
01-15-2003	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.82	mg/l	J1,J3,J4	353.2
10-30-2003	8:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.79	mg/l	J1,J3,J4	353.2
01-24-2018	3:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.79	mg/l		353.2
03-05-2018	2:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.76	mg/l		353.2
08-08-2003	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.73	mg/l	J1,J3,J4	353.2
12-13-2016	11:10:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.72	mg/l		353.2
04-13-2009	10:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.67	mg/l		353.2
10-17-2006	1:50:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.62	mg/l		353.2
03-15-2010	1:19:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.58	mg/l		353.2
12-17-2008	12:10:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.5	mg/l		353.2
12-13-2011	9:05:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.5	mg/l		353.2
11-01-2017	2:45:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.49	mg/l		353.2
02-01-2016	8:55:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.46	mg/l		353.2
01-17-2012	11:19:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.45	mg/l		353.2

01-27-2015	12:45:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.38	mg/l		353.2
01-22-2009	1:30:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.21	mg/l		353.2
12-18-2009	1:35:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.19	mg/l		353.2
11-06-2012	12:01:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.16	mg/l		353.2
07-22-2015	10:15:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.08	mg/l		353.2
11-06-2018	7:45:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.07	mg/l		353.2
02-10-2010	1:00:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	5.05	mg/l		353.2
04-14-2015	10:15:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.95	mg/l		353.2
12-16-2019	11:15:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.94	mg/l		353.2
01-13-2005	11:40:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.79	mg/l		353.2
03-24-2005	1:20:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.74	mg/l		353.2
12-11-2017	3:15:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.63	mg/l		353.2
05-20-2005	8:30:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.61	mg/l		353.2
04-20-2010	12:35:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.5	mg/l		353.2
10-17-2001	2:00:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.4	mg/l		LAB
07-29-2014	11:25:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.4	mg/l		353.2
12-18-2013	10:59:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.38	mg/l		353.2
09-14-2015	1:45:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.38	mg/l		353.2
07-07-2009	11:02:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.37	mg/l		353.2
08-05-2002	11:45:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.33	mg/l		LAB
01-26-2011	7:45:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.3	mg/l		353.2
09-13-2016	9:55:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.27	mg/l		353.2
12-09-2010	10:15:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.2	mg/l		353.2
05-24-1999	11:45:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	4.1	mg/l		LAB
05-15-2018	11:45:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.91	mg/l		353.2
04-17-2012	11:22:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.9	mg/l		353.2
08-07-2017	12:30:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.84	mg/l		353.2
09-16-2004	1:45:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.59	mg/l		353.2
11-04-2009	2:35:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.5	mg/l		353.2
11-02-2016	10:10:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.41	mg/l		353.2
08-06-2001	1:30:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.3	mg/l		LAB
02-26-2003	10:00:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.18	mg/l	J1,J3,J4	353.2
07-13-2020	2:15:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.13	mg/l		353.2
07-13-2020	11:30:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.11	mg/l		353.2
09-09-2014	10:05:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3.06	mg/l		353.2
11-02-2005	12:45:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	3	mg/l		352.1
11-18-2008	12:14:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.91	mg/l		353.2
08-11-2015	10:30:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.89	mg/l		353.2
08-08-2016	10:00:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.83	mg/l		353.2
10-26-2015	12:30:00 PM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.8	mg/l		353.2
09-12-2006	1:00:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.75	mg/l		353.2
08-16-2000	10:42:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.5	mg/l		LAB
09-19-2003	8:30:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.48	mg/l	J1,J3,J4	353.2
07-14-2015	11:15:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.45	mg/l		353.2
09-02-2015	10:45:00 AM CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.44	mg/l		353.2
08-09-2004	10:15:00 AM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.4	mg/l		353.2
09-24-2008	2:15:00 PM CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.38	mg/l		353.2

08-12-2008	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.3	mg/l		353.2
12-04-2012	9:04:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.29	mg/l		353.2
01-25-2021	8:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2.11	mg/l		353.2
03-11-2014	9:30:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	2	mg/l		353.2
11-08-2011	9:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.84	mg/l		353.2
09-11-2001	11:50:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.79	mg/l		LAB
09-09-2015	11:35:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.55	mg/l		353.2
07-28-1999			FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.48	mg/l		LAB
09-17-2019	11:20:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.41	mg/l		353.2
08-02-2010	12:35:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.4	mg/l		353.2
12-11-2002	12:45:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.3	mg/l	J1,J3,J4	LAB
11-06-2013	10:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.26	mg/l		353.2
08-10-2011	8:55:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.22	mg/l		353.2
12-21-2020	10:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.21	mg/l		353.2
09-26-2017	11:40:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.11	mg/l		353.2
07-28-2005	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	1.02	mg/l		353.2
09-24-2013	8:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.939	mg/l		353.2
08-09-2010	12:24:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.878	mg/l		353.2
08-12-2013	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.834	mg/l		353.2
09-20-2002	9:15:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.72	mg/l		LAB
07-23-2018	10:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.692	mg/l		353.2
09-20-2011	9:00:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.622	mg/l		353.2
08-20-2019	11:20:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.536	mg/l		353.2
09-21-2020	11:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.489	mg/l		353.2
08-17-2020	11:40:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.46	mg/l		353.2
09-11-2018	10:35:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.45	mg/l		353.2
11-02-2020	11:40:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.362	mg/l		353.2
09-13-2010	12:15:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.349	mg/l		353.2
09-13-2010	1:30:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.342	mg/l		353.2
10-23-2002	9:15:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.3	mg/l	J1,J3,J4	LAB
09-18-2012	8:55:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.296	mg/l		353.2
09-15-2000	9:45:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.29	mg/l		LAB
10-13-2020	1:30:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.197	mg/l		353.2
09-15-2005	9:45:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.16	mg/l		353.2
09-21-2009	11:20:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.11	mg/l		353.2
08-07-2012	8:49:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.084	mg/l	J	353.2
08-31-1999	11:30:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.08	mg/l		LAB
08-14-2009	12:41:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.06	mg/l	J	353.2
11-01-2010	9:15:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.049	mg/l	J	353.2
07-11-2012	10:35:00 AM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.041	mg/l	J	353.2
09-22-1999	12:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)	0.02	mg/l		LAB
10-26-1999	11:00:00 AM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)		mg/l	ND	LAB
11-02-2000	2:40:00 PM	CST	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)		mg/l	ND	LAB
09-03-2020	12:00:00 PM	CDT	FL-02	Iroquois River	Inorganic nitrogen (nitrate and nitrite)		mg/l	ND	353.2

StationCode	WaterbodyName	CollectionDate	CollectionTime	MethodCode	Analyte	Result	ResultUnits
FL-02	IROQUOIS RIVER	3/8/2021	11:50:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	4/12/2021	12:30:00	353.2	Inorganic nitrogen (nitrate and nitrite)	5.02	mg/l
FL-02	IROQUOIS RIVER	5/24/2021	11:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	8.17	mg/l
FL-02	IROQUOIS RIVER	6/21/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	7/27/2021	11:40:00	353.2	Inorganic nitrogen (nitrate and nitrite)	3.4	mg/l
FL-02	IROQUOIS RIVER	8/30/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	ND	mg/l

StationCode	WaterbodyName	CollectionDate	CollectionTime	MethodCode	Analyte	Result	ResultUnits
FL-02	IROQUOIS RIVER	3/8/2021	11:50:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	4/12/2021	12:30:00	353.2	Inorganic nitrogen (nitrate and nitrite)	5.02	mg/l
FL-02	IROQUOIS RIVER	5/24/2021	11:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	8.17	mg/l
FL-02	IROQUOIS RIVER	6/21/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	6.38	mg/l
FL-02	IROQUOIS RIVER	7/27/2021	11:40:00	353.2	Inorganic nitrogen (nitrate and nitrite)	3.4	mg/l
FL-02	IROQUOIS RIVER	8/30/2021	11:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	ND	mg/l

Additional Tabs labeled: Disclaimer, Data Table, Unreviewed
Data Table, Site Location Information
and Data Qualifiers redacted, as not relied upon

Activity Start Date	Activity Start Time	y Start Tim	Monitoring Location ID	ing Locatio	oring Location	Characteristic Name	Result Valu	Result Uni	sult Comm	Analytical Method ID
01-15-2013	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	15.3	mg/l		353.2
05-24-1999	10:45:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	11	mg/l		LAB
06-27-2016	12:35:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	8.77	mg/l		353.2
02-14-2001	3:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	5.6	mg/l		LAB
04-16-2013	10:14:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	5.54	mg/l		353.2
03-10-2004	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	4.79	mg/l	Y	353.2
06-20-2000	10:15:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	4.2	mg/l		LAB
06-24-2013	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	4.02	mg/l		353.2
03-12-2013	11:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.86	mg/l		353.2
10-17-2001	7:50:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.8	mg/l		LAB
11-05-2018	1:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.47	mg/l		353.2
05-17-2004	10:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.15	mg/l		353.2
03-07-2016	12:40:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.11	mg/l		353.2
05-24-2000	11:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.1	mg/l		LAB
05-23-2006	8:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.07	mg/l		353.2
06-26-2018	2:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.04	mg/l		353.2
12-14-2004	1:50:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3.02	mg/l		353.2
03-02-2011	8:50:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	3	mg/l		353.2
05-30-2017	11:42:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.96	mg/l		353.2
04-11-2016	12:25:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.91	mg/l		353.2
01-17-2007	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.9	mg/l		353.2
12-11-2003	10:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.82	mg/l	J1,J3,J4	353.2
05-14-2002	9:00:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.8	mg/l		LAB
04-03-2019	4:45:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.77	mg/l		353.2
03-08-1999	10:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.6	mg/l		LAB
05-29-2013	10:59:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.56	mg/l		353.2
11-05-2019	11:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.54	mg/l		353.2
01-13-2005	10:10:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.47	mg/l		353.2
05-18-2011	11:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.44	mg/l		353.2
06-24-2014	10:10:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.41	mg/l		353.2
04-10-2017	11:50:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.38	mg/l		353.2
03-07-2017	12:00:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.34	mg/l		353.2
05-29-2001	12:00:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.3	mg/l		LAB
11-06-2013	11:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.3	mg/l		353.2
05-22-2003	10:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.29	mg/l	J1,J3,J4	353.2
01-18-2006	8:35:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.27	mg/l		353.2
03-03-2009	1:00:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.26	mg/l		353.2
01-25-2018	7:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.21	mg/l		353.2
01-28-2020	12:20:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.2	mg/l		353.2
12-10-2018	2:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.17	mg/l		353.2
03-06-2018	7:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.12	mg/l		353.2
03-05-2012	10:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.09	mg/l		353.2
04-15-2003	11:25:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.07	mg/l	J1,J3,J4	353.2
03-15-2010	1:54:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.07	mg/l		353.2
01-30-2017	10:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.05	mg/l		353.2
05-20-2010	1:09:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.04	mg/l	Y	353.2
01-22-2004	1:00:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.03	mg/l		353.2
07-14-2015	12:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	2.03	mg/l		353.2
03-04-2005	10:50:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.98	mg/l		353.2
12-18-2013	12:00:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.98	mg/l		353.2
11-28-2006	9:10:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.97	mg/l		353.2
12-13-2011	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.97	mg/l		353.2
07-06-2011	10:25:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.95	mg/l		353.2
11-04-2009	3:58:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.94	mg/l		353.2
05-21-2014	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.93	mg/l		353.2
05-14-2019	4:00:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.92	mg/l		353.2
03-08-2000	12:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.86	mg/l		LAB

04-17-2018	6:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.85	mg/l		353.2
02-21-2019	10:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.85	mg/l		353.2
04-16-2002	3:00:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.84	mg/l		LAB
11-06-2012	1:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.84	mg/l		353.2
03-01-2006	9:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.8	mg/l	Q	353.2
04-12-2011	10:35:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.8	mg/l		353.2
05-10-2016	11:00:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.8	mg/l		353.2
03-03-2020	12:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.8	mg/l		353.2
09-24-2013	9:50:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.78	mg/l		353.2
07-22-2015	12:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.78	mg/l		353.2
04-24-2001	12:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.76	mg/l		LAB
09-13-2016	11:10:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.76	mg/l		353.2
12-13-2016	12:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.76	mg/l		353.2
01-27-2015	4:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.69	mg/l		353.2
01-17-2012	12:40:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.66	mg/l		353.2
05-23-2012	9:54:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.66	mg/l		353.2
03-11-2014	10:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.66	mg/l		353.2
03-24-2005	12:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.65	mg/l		353.2
12-17-2008	1:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.65	mg/l		353.2
11-02-2016	11:05:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.62	mg/l		353.2
12-04-2012	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.61	mg/l		353.2
08-08-2017	9:20:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.6	mg/l		353.2
06-30-1999	10:00:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.57	mg/l		LAB
06-21-2010	1:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.57	mg/l		353.2
01-23-2002	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.54	mg/l		LAB
06-25-2001	11:40:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.52	mg/l		LAB
03-24-2015	11:40:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.47	mg/l		353.2
02-01-2016	10:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.46	mg/l		353.2
12-12-2017	7:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.46	mg/l		353.2
08-12-2013	9:54:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.44	mg/l	J3	353.2
12-18-2009	12:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.43	mg/l		353.2
06-01-2010	3:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.43	mg/l		353.2
04-03-2001	12:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.4	mg/l		LAB
12-16-2019	12:30:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.4	mg/l		353.2
04-11-2006	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.36	mg/l		353.2
06-28-2004	10:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.31	mg/l		353.2
11-08-2011	10:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.31	mg/l		353.2
04-17-2014	8:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.3	mg/l		353.2
10-30-2003	9:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.28	mg/l	J1,J3,J4	353.2
01-22-2009	2:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.28	mg/l		353.2
07-08-2019	1:35:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.28	mg/l		353.2
11-01-2017	4:15:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.26	mg/l		353.2
04-13-2009	12:16:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.24	mg/l		353.2
05-15-2018	1:15:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.24	mg/l		353.2
05-27-2015	12:30:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.22	mg/l		353.2
01-26-2021	1:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.22	mg/l		353.2
03-31-1999	10:56:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.21	mg/l		LAB
09-02-2015	12:00:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.21	mg/l		353.2
09-11-2018	12:15:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.19	mg/l		353.2
09-09-2015	4:40:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.18	mg/l		353.2
04-16-2004	10:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.15	mg/l		353.2
10-17-2006	9:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.14	mg/l		353.2
02-10-2010	11:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.14	mg/l		353.2
08-08-2003	10:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.13	mg/l	J1,J3,J4	353.2
06-08-2020	1:45:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.12	mg/l		353.2
07-22-2020	8:55:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.1	mg/l		353.2
04-17-2012	1:20:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.09	mg/l		353.2
07-05-2017	11:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.09	mg/l		353.2

07-13-2020	12:45:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.09	mg/l		353.2
12-07-2005	8:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.07	mg/l		353.2
08-11-2015	11:45:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.07	mg/l		353.2
12-21-2020	12:15:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.06	mg/l		353.2
11-23-2015	2:40:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.05	mg/l		353.2
06-24-2002	12:15:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.04	mg/l		LAB
11-04-2004	12:25:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.03	mg/l		353.2
05-20-2005	9:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.02	mg/l		353.2
01-25-2011	2:55:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.01	mg/l		353.2
08-10-2011	10:10:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1.01	mg/l		353.2
01-15-2003	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1	mg/l	J1,J3,J4	353.2
08-23-2005	11:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	1	mg/l		353.2
02-02-2000	10:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.99	mg/l		LAB
07-23-2018	1:00:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.99	mg/l		353.2
06-02-2009	2:23:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.989	mg/l		353.2
12-09-2010	9:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.985	mg/l		353.2
06-13-2005	10:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.98	mg/l		353.2
08-09-2004	11:15:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.97	mg/l		353.2
08-20-2019	12:50:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.961	mg/l		353.2
09-15-2000	11:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.96	mg/l		LAB
11-18-2008	1:39:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.952	mg/l		353.2
04-14-2015	11:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.944	mg/l		353.2
09-16-2004	12:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.93	mg/l		353.2
09-20-2011	10:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.923	mg/l		353.2
02-26-2003	9:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.92	mg/l	J1,J3,J4	353.2
09-21-2020	12:50:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.919	mg/l		353.2
09-17-2019	12:20:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.912	mg/l		353.2
09-09-2014	11:00:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.91	mg/l		353.2
04-18-2000	9:20:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.89	mg/l		LAB
10-27-2015	6:57:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.878	mg/l		353.2
09-26-2017	1:10:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.865	mg/l		353.2
08-06-2001	11:45:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.86	mg/l		LAB
04-20-2010	1:45:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.848	mg/l		353.2
11-02-2020	12:35:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.846	mg/l		353.2
09-19-2003	7:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.84	mg/l	J1,J3,J4	353.2
10-28-2020	11:45:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.837	mg/l		353.2
09-23-2020	11:00:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.823	mg/l		353.2
07-26-2000	10:10:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.82	mg/l		LAB
08-05-2002	1:15:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.82	mg/l		LAB
09-12-2006	8:30:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.797	mg/l		353.2
12-11-2002	11:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.79	mg/l	J1,J3,J4	LAB
06-26-2003	9:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.787	mg/l	J1,J3,J4	353.2
08-31-1999	9:10:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.76	mg/l		LAB
11-02-2005	8:10:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.75	mg/l		352.1
08-08-2016	11:15:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.741	mg/l		353.2
07-07-2009	12:25:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.737	mg/l		353.2
08-09-2010	1:39:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.731	mg/l		353.2
09-13-2010	1:40:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.727	mg/l		353.2
09-18-2012	9:54:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.722	mg/l		353.2
09-14-2010	11:50:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.717	mg/l		353.2
09-21-2009	12:39:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.712	mg/l		353.2
10-23-2002	8:15:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.71	mg/l	J1,J3,J4	LAB
08-17-2020	12:45:00 PM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.654	mg/l		353.2
07-20-2010	12:50:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.642	mg/l		353.2
11-02-2000	1:20:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.64	mg/l		LAB
09-20-2002	7:45:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.58	mg/l		LAB
09-15-2005	8:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.57	mg/l		353.2
07-28-1999			F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.56	mg/l		LAB

11-01-2010	10:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.548	mg/l		353.2
10-26-1999	9:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.52	mg/l		LAB
09-22-1999	10:30:00 AM	CDT	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.49	mg/l		LAB
07-29-2014	12:25:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.482	mg/l		353.2
08-07-2012	9:44:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.397	mg/l		353.2
08-14-2009	11:20:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.369	mg/l		353.2
07-28-2005	9:45:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.25	mg/l		353.2
07-11-2012	11:49:00 AM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)	0.02	mg/l	J	353.2
07-20-2005	12:40:00 PM	CST	F-02	Kankakee	River/Stream	Inorganic nitrogen (nitrate and nitrite)		mg/l	ND,Q	353.2

StationCode	WaterbodyName	CollectionDate	CollectionTime	MethodCode	Analyte	Result	ResultUnits	Qualifier
F-02	KANKAKEE RIVER	3/8/2021	13:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	2.72	mg/l	
F-02	KANKAKEE RIVER	4/12/2021	13:30:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.32	mg/l	
F-02	KANKAKEE RIVER	5/24/2021	12:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.1	mg/l	Y
F-02	KANKAKEE RIVER	6/21/2021	12:45:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.11	mg/l	
F-02	KANKAKEE RIVER	7/27/2021	12:55:00	353.2	Inorganic nitrogen (nitrate and nitrite)	1.04	mg/l	
F-02	KANKAKEE RIVER	8/30/2021	13:00:00	353.2	Inorganic nitrogen (nitrate and nitrite)	0.788	mg/l	

Additional Tabs labeled: Nitrate Pre-1999, Data Table, Legacy Data Table, Legacy Parameter Code List, Site Location Info., and Data Qualifiers redacted, as not relied upon

Kankakee WTP - TP01

Date	Nitrate (mg/l)
4/12/2000	1.6
7/18/2001	2.7
8/22/2001	0.038
4/17/2002	3.2
9/25/2002	0.56
10/10/2002	0.65
10/23/2002	0.6
1/15/2003	2.6
7/22/2003	5.8
7/23/2003	3.1
10/22/2003	2.5
7/21/2004	2.7
7/21/2004	2.7
10/20/2005	1.1
4/12/2006	4
4/18/2007	2.5
5/1/2008	1.3
5/15/2008	3.7
4/15/2009	2.4
5/12/2010	6.9
12/9/2010	1.3
12/9/2010	1.2
1/12/2011	1.6
4/5/2011	1.8
7/13/2011	2.3
11/10/2011	1.3
1/12/2012	2.4
4/11/2012	1.6
4/4/2013	4.4
6/5/2014	2.2
4/15/2015	1.5
4/14/2016	3.5
4/13/2017	2.9
4/12/2018	1.8
4/24/2019	2.6
4/8/2020	1.7
4/7/2021	2.9
	6.9

IN THE CIRCUIT COURT FOR THE TWELFTH JUDICIAL CIRCUIT
WILL COUNTY, ILLINOIS
CHANCERY DIVISION

PEOPLE OF THE STATE OF ILLINOIS)
ex rel. KWAME RAOUL, Attorney)
General of the State of Illinois, and *ex rel.*)
JAMES W. GLASGOW, State's Attorney)
for Will County, Illinois,)
)
Plaintiff,)
)
v.) No. 19 CH 1208
)
AQUA ILLINOIS, INC., an Illinois)
domestic corporation,)
)
Defendant.)

AGREED INTERIM ORDER

This cause coming before the Court on Plaintiff's Motion to Approve the Agreed Interim Order (the "Motion"), due notice having been given, the Court having jurisdiction over Plaintiff People of the State of Illinois ("Plaintiff") and Defendant Aqua Illinois, Inc. ("Aqua" and together with Plaintiff, the "Parties") and the subject matter herein, the Parties being represented in open court or having waived appearance, the Court having reviewed the Complaint for Injunctive Relief and Civil Penalties ("Complaint") and the Motion, and the Court otherwise being fully advised in the premises;

THE COURT HEREBY FINDS THAT:

1. Aqua is an Illinois domestic corporation, with its principal place of business located at 187 South Schuyler Avenue, in the City of Kankakee, Kankakee County, Illinois ("Site").

2. Aqua owns and operates the Village of University Park's ("Village") public water system ("Public Water System"), which consists of water mains, pumping stations, and other infrastructural components. The Village, located in Will and Cook Counties in Illinois, has a population of approximately 7,000 residents who are served through approximately 1,975 water

service connections.

3. In late May 2019, Aqua conducted the six-month required compliance sampling event on homes within the Village that utilize Aqua's Public Water System ("May 2019 Testing").

4. On August 16, 2019, the Illinois Attorney General's Office and the Will County State's Attorney's Office, on their own motion and at the request of the Illinois Environmental Protection Agency ("Illinois EPA"), filed the Complaint in this case against Aqua, alleging (a) Failure to Provide Assuredly Safe Water in violation of Section 18(a)(2) of the Illinois Environmental Protection Act ("Act"), 415 ILCS 5/18(a)(2) (2018), and Section 601.101 of the Illinois Pollution Control Board Public Water Supplies Regulations ("Board PWS Regulations"), 35 Ill. Adm. Code 601.101; (b) Violation of Drinking Water Monitoring Site Plan Requirements pursuant to Sections 18(a)(2) and 19 of the Act, 415 ILCS 5/18(a)(2) and 19 (2018), and Sections 611.356(a) and (c) of the Board PWS Regulations, 35 Ill. Adm. Code 611.356(a) and (c); (c) Violation of Construction Permit Requirements pursuant to Sections 15(a) and 18(a)(2) and (3) of the Act, 415 ILCS 5/15(a) and 18(a)(2) and (3) (2018), and Sections 602.101, 602.116, and 602.200 of the Board PWS Regulations, 35 Ill. Adm. Code 602.101, 602.116, and 602.200; (d) Operating Permit Violations pursuant to Sections 18(a)(2) and (3) of the Act, 415 ILCS 5/18(a)(2) and (3) (2018), and Sections 602.101 and 602.300 of the Board PWS Regulations, 35 Ill. Adm. Code 602.101 and 602.300; and (e) common law public nuisance.

5. Aqua has agreed to the entry of this Agreed Interim Order ("Order").

THEREFORE, IT IS HEREBY ORDERED THAT:

I. GENERAL PROVISIONS

1. The Court enters this Agreed Interim Order pursuant to Section 42(e) of the Act, 415 ILCS 5/42(e) (2018), which shall remain in effect until further order of this Court.

2. This Order is not a final resolution of the merits of the Plaintiff's Complaint, but rather addresses the Plaintiff's most immediate concerns regarding the allegations in the Complaint.

3. By entering into this Order and complying with its terms, Aqua does not affirmatively admit the allegations of violation within the Complaint and referenced above, and this Order and compliance therewith shall not be interpreted as including such admission.

II. INTERIM INJUNCTIVE RELIEF

A. Requirements for Provision of Alternative Sources of Water.

1. On June 14, 2019, as a result of the elevated lead levels found during the May 2019 Testing, Aqua, on its own, issued a "do not consume" notice to all of the residents of the Village of University Park ("Village"). Pursuant to this notice, Village residents were instructed not to consume water from their tap until the notice was lifted. On or about July 29, 2019, Aqua, on its own, lifted the "do not consume" notice and replaced it with a lead advisory. Since on or about June 15, 2019, Aqua has been providing alternative sources of drinking water, including bottled water, faucet filters certified by NSF/ANSI Standards 42 and 53, pitcher filters certified by NSF/ANSI Standards 42 and 53 (including replacement cartridges and filters), free of charge to customers of the Public Water System. Commencing upon the entry of this Order and subject to Paragraph 3 below, Aqua shall continue to provide customers of the Public Water System, free of charge, alternative sources of drinking water, including bottled water, faucet filters certified by NSF/ANSI Standards 42 and 53, pitcher filters certified by NSF/ANSI Standards 42 and 53 (including replacement cartridges and filters), and such other alternative sources of water as may be approved by the Illinois Attorney General's Office, the Will County State's Attorney's Office and the Illinois EPA (collectively, the "State") in writing (together, "Alternative Sources of Water").

2. Within fourteen (14) days of the date of the entry of this Order, Aqua shall submit to the State a narrative description of the procedure that Aqua utilized to provide Alternative Sources of Water to customers of the Public Water System prior to the entry of this Order.

3. Within fourteen (14) days of the date of the entry of this Order, Aqua shall submit to the State, for its review and comment, if any, a written plan that includes (a) the proposed residential and business customers to continue receiving Alternative Sources of Water, (b) how Aqua intends to provide the Alternative Sources of Water, (c) any changes in the types of Alternative Sources of Water to be provided to such customers from those provided prior to the entry of this Order, and (d) Aqua's procedures to educate, and be available to provide assistance to, customers regarding the timely replacement of cartridges and filters ("Alternative Water Source Plan"). Upon incorporation of all of the State's comments on the Alternative Water Source Plan, Aqua shall implement such Plan until the earlier to occur of (i) such time as the State notifies Aqua in writing otherwise or (ii) further order of this Court.

4. Commencing upon the entry of this Order, Aqua shall collect and record information related to its future distribution of the Alternative Sources of Water to customers of the Public Water System (the "Alternative Sources of Water Log"). The Alternative Sources of Water Log shall include, at a minimum:

a. The locations where Alternate Sources of Water are being and will be supplied;

b. The types of Alternate Sources of Water that are being and will be supplied to each location (i.e., bottled, faucet filter, or pitcher filter); and

c. The date(s) of each instance when an Alternate Source of Water is and will be provided.

The Alternative Sources of Water Log shall be made available to the State for inspection, upon request. Aqua shall maintain the Alternative Sources of Water Log until the earlier to occur of (a) such time as the State notifies Aqua in writing otherwise or (b) further order of this Court.

B. Aqua's Lead Advisory.

5. Commencing upon the entry of this Order and continuing until the earlier to occur of (a) the State's written authorization otherwise or (b) further order of this Court, Aqua shall not remove any residential or business customer from the lead advisory without the State's prior written authorization.

C. Corrosion Control Treatment Requirements.

6. On or about June 15, 2019, Aqua, after notification to Illinois EPA, changed the phosphate blend utilized to provide corrosion control treatment for the Public Water System in an effort to reestablish protective scaling on the plumbing and pipes. Within seven (7) days of the date of the entry of this Order, Aqua shall submit a written report to the State, pursuant to the Submittals Procedures set forth in Section IV herein, on the status of the corrosion control studies that Aqua has been conducting to identify the optimal corrosion control treatment for the Public Water System. Such written report must also identify how Aqua has satisfied the requirements of Section 611.352(c) of the Board PWS Regulations, 35 Ill. Adm. Code 611.352(c), in conducting the studies.

7. As expeditiously as possible, but in no event later than November 30, 2019, and consistent with the requirements of Section 611.352(c) of the Board PWS Regulations, 35 Ill. Adm. Code 611.352(c), Aqua shall: (a) complete the comprehensive corrosion control treatment studies; and (b) submit to Illinois EPA, for its review and approval in accordance with Paragraph C.9. below, a written corrosion control treatment recommendation that constitutes optimal corrosion control for the Public Water System (the "Corrosion Control

Recommendation"). The Corrosion Control Recommendation shall include a proposed schedule for implementation.

8. Illinois EPA shall use its best efforts to review the Corrosion Control Recommendation as expeditiously as possible. Upon its completion of its review of the Corrosion Control Recommendation, Illinois EPA shall, in writing: (a) approve the submission; (b) approve the submission upon specified conditions; (c) approve part of the submission and disapprove the remainder; or (d) disapprove the submission.

a. If Illinois EPA approves the submission, (i) Aqua shall take all actions required by the submission in accordance with the Illinois EPA-approved schedule and requirements of such submission.

b. If Illinois EPA conditionally approves, or approves only part of, any submission, Aqua shall, upon written direction from Illinois EPA, implement all approved actions of the submission that Illinois EPA determines are technically severable from any disapproved portions of the submission.

c. If Illinois EPA disapproves the submission, in whole or in part, Aqua shall, within thirty (30) days of the date of disapproval or such other time as Illinois EPA agrees in writing, correct all of the deficiencies and resubmit the revised Corrosion Control Recommendation, for Illinois EPA's review and approval in accordance with this Paragraph C.9. If the resubmission is approved in whole or in part, Aqua shall comply with Paragraph C.9..a. and b. herein, as applicable.

d. If a resubmission is disapproved, in whole or in part, Illinois EPA may require Aqua to correct any deficiencies in accordance with the preceding subparagraphs, or Aqua may invoke the Dispute Resolution procedures set forth in Section VIII.

9. Within thirty (30) days of the date of Illinois EPA's written approval of the Corrosion Control Recommendation, Aqua shall submit to Illinois EPA any permit applications that may be necessary to implement the construction and operation of the Corrosion Control Recommendation.

10. Following Illinois EPA's issuance of all necessary permits or approval of Aqua's Corrosion Control Recommendation if no additional permits are necessary, as applicable, Aqua shall implement the Illinois EPA-approved Corrosion Control Recommendation in accordance with the Illinois EPA-approved schedule for implementation.

D. Response Team Participation.

11. As a result of the elevated lead levels found during the May 2019 Testing, a response team was created, including Aqua, Illinois EPA, the United States Environmental Protection Agency ("USEPA") Region V, USEPA Office of Research and Development, and industry experts (collectively, the "Response Team"). Among other things, the Response Team was developed to provide direction and recommendations to Aqua as it responds to elevated levels of lead in the Village's drinking water. Upon entry of this Order, Aqua shall continue, in good faith, to participate in, and coordinate with, the Response Team, including but not limited to funding the necessary studies being conducted by industry experts to identify the optimal corrosion control treatment for the Public Water System discussed in Paragraph C above.

E. No Modification of Corrosion Control Treatment without Prior Authorization of Illinois EPA.

12. Effective immediately upon entry of this Order, Aqua agrees that it shall not change its method of corrosion control treatment in the Public Water System unless and until it receives prior written authorization from Illinois EPA.

F. Requirements for Compliance Sampling

13. Beginning on or about June 14, 2019, Aqua conducted weekly water sampling consistent with the sampling procedures set forth in Section 611.356 of the Board PWS Regulations, 35 Ill. Adm. Code 611.356. During the week of July 1, 2019, Aqua expanded the compliance sampling pool to include additional homes from the Public Water System. During the week of July 22, 2019, Aqua began conducting compliance sampling on an every-other week basis.

14. In order to determine compliance with the lead action level pursuant to Section 611.350 of the Board's PWS Regulations, Aqua is required to conduct lead compliance sampling on a six-month basis pursuant to 35 Ill. Adm. Code 611.356(d), and is required to report the compliance sampling results to Illinois EPA within ten days after the end of each applicable six-month sampling period pursuant to 35 Ill. Adm. Code 611.360(a). Upon entry of this Order, and unless or until further directed in writing by Illinois EPA, Aqua shall remain subject to the six-month lead compliance monitoring periods and reporting requirements, and shall continue to conduct compliance sampling of the Public Water System in accordance with all requirements of Section 611.356 of the Board PWS Regulations, 35 Ill. Adm. Code 611.356; provided, however, that (a) Aqua shall collect additional compliance samples on a monthly basis until such time as Aqua receives written approval from Illinois EPA that such additional sampling is no longer necessary, and (b) in addition to uploading all compliance sampling results electronically to the Illinois EPA, Aqua shall also include a copy of all sampling results in the Progress Reports submitted following receipt of the sample results, pursuant to Section L herein. Pursuant to 35 Ill. Adm. Code 611.356(e), Aqua must utilize the results of all lead compliance samples it collects during the applicable six-month monitoring period in making any compliance determination under Subpart G of Part 611 of the Board's PWS regulations (i.e., all compliance samples collected during the July-December 2019 six-month monitoring period shall be utilized to determine

compliance with the lead action level and reported to the Illinois EPA within ten days of the end of that monitoring period). Any compliance determination with the lead action level under Subpart G of Part 611 of the Board's PWS regulations shall be made at the end of the applicable six-month monitoring period.

G. Requirements for Customer-Requested Sampling of Water

15. Upon request of any customer of the Public Water System, Aqua, on its own or through a third party, shall collect and analyze that customer's tap water for the presence of lead, without charge to the customer. Customers may request this service as often as once per month. Aqua shall continue to offer this customer-requested sampling until the earlier to occur of (a) Illinois EPA otherwise advises Aqua in writing or (b) further order of this Court.

16. Commencing upon the entry of this Order, Aqua shall maintain a log of all customer-requested sampling that it conducts ("Customer Sampling Log"). The Customer Sampling Log shall include, at a minimum, for each customer:

a. The date on which the customer initially contacted Aqua to request sampling of his/her tap water;

b. The date that Aqua initially sampled the customer's tap water;

c. The company that conducted the lab analysis;

d. The results of such sampling;

e. The dates and results of all subsequent sampling events at the customer's residence or business; and

f. A summary of any issues that occurred with respect to any sampling event at the customer's residence or business; and

g. The sampling protocol used to conduct such sampling.

Aqua shall maintain the Customer Sampling Log until the earlier to occur of (a) such time as it receives written approval from Illinois EPA that such log does not need to continue to be maintained and (b) further order of this Court. Aqua shall make the Customer Sampling Log available to Illinois EPA upon request.

H. Requirements for Addressing Customer Complaints.

17. Since on or about June 30, 2019, Aqua has maintained a Customer Service Center (877-987-2872) to accept any customer complaints and handle customer questions and concerns relating to the Public Water System. Commencing upon the entry of this Order and continuing until the earlier to occur of (a) Illinois EPA's written authorization otherwise or (b) further order of this Court, Aqua shall maintain a log of all customer complaints it receives (whether through the Customer Service Center or otherwise) related to the compliance measures set forth in this Order and the actions taken to address such complaints. ("Customer Complaint Log"). The Customer Complaint Log shall include, at a minimum:

a. The name and address of the customer;

b. The date the complaint was received;

c. A description of the complaint;

d. A summary of the actions taken to resolve the customer's complaint; and

e. The date(s) such actions were taken.

Aqua shall make the Customer Complaint Log available to the State upon request.

I. Requirements for Public Education.

18. Commencing upon entry of this Order, Aqua shall continue to comply with the public education requirements set forth in 35 Ill. Adm. Code 611.355(b)(3).

19. Commencing upon entry of this Order, Aqua shall continue to maintain its dedicated website, WaterFactsIL.com, until the earlier to occur of (a) the Illinois EPA authorizes otherwise in writing and (b) further order of this Court.

J. Requirements for Customer-Requested Blood Lead Level Testing.

20. Between the date of the entry of this Order until December 31, 2019, Aqua shall continue to provide, without charge to the customer, blood lead level testing, including confirmatory testing when necessary, to customers of the Public Water System. Customers may contact Aqua's Customer Service Center at 877-987-2872 for blood lead level testing.

K. Material Service Line Inventory Update.

21. Within thirty (30) days of the date of the entry of this Order, Aqua shall provide to the State a written report on the status of its comprehensive material service line inventory specifically for homes and businesses within the Village.

22. Within sixty (60) days of the date of the entry of this Order, Aqua shall submit a comprehensive plan to Illinois EPA, for its review and comment, if any, to reduce and eliminate the number of service lines reported as "Unknown Material" in https://www2.illinois.gov/epa/topics/drinking-water/public-water-users/Pages/lead-service-line-information.aspx located in the Village (the "Service Line Plan"). The Service Line Plan shall include, at a minimum, short-term goals for identifying the material type of each service line (as indicated by the annual Materials Inventory submittal), as well as long-term plans for identifying all lead or copper service lines with lead solder.

23. Upon incorporation of any comments of Illinois EPA to the Service Line Plan, Aqua shall implement the Service Line Plan in accordance with the schedule contained within the Service Line Plan.

L. Progress Reports.

24. Commencing on the second Monday after the date of the entry of this Order, and continuing on every other Monday thereafter, Aqua shall submit to the State a written progress report on each of the foregoing compliance items for the corresponding prior two weeks. Aqua shall continue to submit the written progress reports until the earlier to occur of (a) the State's written confirmation that Aqua can discontinue the submittal of the written progress reports and (b) further order of this Court.

III. RIGHT OF ENTRY

In addition to any other authority, the Illinois EPA, its employees and representatives, the Illinois Attorney General, his employees and representatives, and the Will County State's Attorney, his employees and representatives, shall have the right of entry into and upon the Site and the Public Water System, at all reasonable times, for the purposes of carrying out inspections and/or verifying compliance with this Order. In conducting such inspections, the Illinois EPA, its employees and representatives, the Illinois Attorney General, his employees and representatives, and the Will County State's Attorney, his employees and representatives, may take photographs and samples, collect information and remove material from the Site and the Public Water System as they deem necessary. For the sake of clarity, Public Water System as used in this Section III does not include any residences or businesses that receive water from the Public Water System.

IV. SUBMITTALS

All submittals and correspondence relating to the requirements of this Order shall be directed to the following persons:

FOR THE PLAINTIFF
EVAN J. McGINLEY
KATHRYN A. PAMENTER
Senior Assistant Attorneys General
Environmental Bureau

69 W. Washington, Suite 1800
Chicago, Illinois 60602
Phone: (312) 814-3153
Email: emcginley@atg.state.il.us
Second email: kpamenter@atg.state.il.us
(Submissions to be sent via email only)

MARY M. TATROE
Civil Division Chief
Office of the Will County State's Attorney
57 N. Ottawa Street
Joliet, Illinois 60432
(815) 727-8872
Email: mtatroe@willcountyillinois.com
(Submissions to be sent via email only)

FOR ILLINOIS EPA
Michael Roubitchek
Division of Legal Counsel
Illinois Environmental Protection Agency
P.O. Box 19276
1021 North Grand Avenue East
Springfield, IL 62794-9276
Mike.Roubitchek@Illinois.gov
(Submissions to be sent via email, with one hard copy also mailed)

Rick Cobb
Division of Water
Illinois Environmental Protection Agency
P.O. Box 19276
1021 North Grand Avenue East
Springfield, IL 62794-9276
Rick.Cobb@Illinois.gov
(Submissions to be sent via email, with one hard copy also mailed)

FOR DEFENDANT
Aqua Illinois, Inc.
Renee Cipriano
Schiff Hardin, LLP
233 South Wacker Drive
Suite 6600
Chicago, IL 60606-6473

Craig Blanchette
Aqua Illinois Inc.
1000 S. Schuyler Avenue
Kankakee, IL, 60901

V. DUTY TO COOPERATE

The Parties shall cooperate with each other in the implementation of this Order.

VI. COMPLIANCE WITH OTHER LAWS AND REGULATIONS

This Order in no way affects the responsibilities of Aqua to comply with any other federal, state or local laws or regulations, including but not limited to the Illinois Environmental Protection Act, 415 ILCS 5/1 *et seq.*, and the Board Regulations, 35 Ill. Adm. Code 101 *et seq.*

VII. STIPULATED PENALTIES

1. If Aqua fails to complete any activity or fails to comply with any response or reporting requirement by the date specified in this Order, Aqua shall provide notice to the Plaintiff of each failure to comply with this Order and shall pay stipulated penalties in the amount of $400.00 per day per violation for up to the first fifteen (15) days of violation, $500.00 per day per violation for the next fifteen (15) days of violation, and $1,000.00 per day per violation thereafter until such time that compliance is achieved. The Plaintiff may make a demand for stipulated penalties upon Aqua for its noncompliance with this Order. However, failure by the Plaintiff to make this demand shall not relieve Aqua of the obligation to pay stipulated penalties. All stipulated penalties shall be payable within thirty (30) calendar days of the date Aqua knows or should have known of its noncompliance with any provision of this Order.

2. Pursuant to Section 42(g) of the Act, interest shall accrue on any penalty amount owed by Aqua not paid within the time prescribed herein. Interest on unpaid penalties shall begin to accrue from the date such are due and continue to accrue to the date full payment is received. Where partial payment is made on any penalty amount that is due, such partial payment shall be first applied to any interest on unpaid penalties then owing.

3. The stipulated penalties shall be enforceable by the Plaintiff and shall be in addition to, and shall not preclude the use of, any other remedies or sanctions arising from the failure to comply with this Order.

4. All stipulated penalty and interest payments shall be made by certified check, cashier's check or money order payable to Illinois EPA for deposit into the Environmental Protection Trust Fund. Payments shall be sent by first class mail and delivered to:

Illinois Environmental Protection Agency
Fiscal Services
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

The case name and case number shall appear on the face of the certified check, cashier's check or money order. A copy of the certified check, cashier's check or money order and any transmittal letter shall be sent to:

Evan J. McGinley
Senior Assistant Attorney General
Environmental Bureau
Illinois Attorney General's Office
69 W. Washington Street, Suite 1800
Chicago, Illinois 60602

VIII. DISPUTE RESOLUTION

The Parties shall use their best efforts to resolve any and all disputes or differences of opinion arising with regard to this Order, informally and in good faith, within seven (7) days of a Party providing notice to the other Parties of such a dispute. If, however, a dispute arises concerning this Order that the Parties are unable to resolve informally, either Party may, by written motion, within three (3) days of conclusion of the informal resolution efforts, request that an evidentiary hearing be held before the Circuit Court for Will County, Illinois, Chancery Division to resolve the dispute between the Parties.

IX. EXTENSIONS AND MODIFICATIONS

The Parties may, by mutual consent, extend any compliance dates or modify the terms of this Order without leave of Court. Any such agreed modification shall be in writing, signed by authorized representatives of each Party and incorporated into this Order by reference. Any request for modification shall be made by Aqua in writing and shall be independent of any other submittal made pursuant to this Order. Moreover, notice of a request for any proposed modification shall be provided to the Plaintiff's representatives in Paragraph __ of this Order.

X. RETENTION OF JURISDICTION

This Court shall retain jurisdiction of this matter and shall consider any motion by Plaintiff or Aqua for the purposes of interpreting and enforcing the terms and conditions of this Order.

XI. RESERVATION OF RIGHTS

Nothing contained herein shall be deemed an admission of any wrongful conduct or violation of any applicable statute, law or regulations thereunder by Aqua, nor a finding of fact or adjudication by this Court of any of the facts or claims contained in the Complaint. Plaintiff reserves the right to seek additional technical relief and civil penalties in this matter.

XII. EFFECT OF ORDER

This Order remains in effect until superseded by further order of this Court.

XIII. BINDING ON SUCCESSORS, ASSIGNS AND FUTURE OWNERS/OPERATORS

This Order shall be binding upon Aqua, and its successors, assigns and future owners and/or operators of the Site and Public Water System.

XIV. SIGNATURE

This Order may be signed in counterparts, all of which shall be considered one agreement.

XV. STATUS CONFERENCE WITH THE COURT

This matter is set for a status conference on ___________, 2019, at _______ a.m. at the Will County Courthouse, _______________, ____________, Illinois in Courtroom ____, without further notice.

[Remainder of Page Blank; Text Continues on Page 18]

WHEREFORE the parties, by their representatives, enter into this Agreed Interim Order and submit it to the Court that it may be approved and entered.

AGREED:

PEOPLE OF THE STATE OF ILLINOIS
ex rel. KWAME RAOUL, Attorney General
of the State of Illinois,

MATTHEW J. DUNN, Chief
Environmental/Asbestos Litigation Division

By: Elizabeth Wallace
ELIZABETH WALLACE, Chief
Environmental Bureau
Assistant Attorney General

Date: 10/29/19

ex rel. JAMES W. GLASGOW
State's Attorney for Will County

By:____________________
MARY M. TATROE
Civil Division Chief
Office of the Will County State's Attorney

Date: ____________________

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

JOHN J. KIM, Director
Illinois Environmental Protection Agency

BY: Dana Vetterhoffer
DANA VETTERHOFFER
Acting Chief Legal Counsel

DATE: 10-29-19

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PEOPLE OF THE STATE OF ILLINOIS
ex rel. KWAME RAOUL, Attorney General
of the State of Illinois,

MATTHEW J. DUNN, Chief
Environmental/Asbestos Litigation Division

By: ____________________________
ELIZABETH WALLACE, Chief
Environmental Bureau
Assistant Attorney General

Date: ____________________________

ex rel. JAMES W. GLASGOW
State's Attorney for Will County

By: Mary M. Tatroe
MARY M. TATROE
Civil Division Chief
Office of the Will County State's Attorney

Date: ____________________________

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

JOHN J. KIM, Director
Illinois Environmental Protection Agency

BY: ____________________________
DANA VETTERHOFFER
Acting Chief Legal Counsel

DATE: ____________________________

FOR DEFENDANT AQUA ILLINOIS, INC.

BY: C Blanchette
CRAIG BLANCHETTE
President

DATE: October 28, 2019

ENTERED: ______________________
JUDGE

DATE: 11/1/19

COPY