City of Aurora, Illinois

Corrosion Control Treatment Optimization Study

Qualifications Based Selection (QBS)
QBS 22-53

June 21, 2022

Prepared by:
City of Aurora – Water Production Division
44 East Downer Place
Aurora, IL 60507

I. General Information

The City of Aurora (City), Water Production Division (WPD) requires the services of a qualified and experienced professional consulting firm to perform the engineering services necessary to complete a comprehensive corrosion control treatment optimization study as recently required by the Illinois Environmental Protection Agency (IEPA). The IEPA has requested a corrosion control study be completed in accordance with 35 IAC 611.351 (c)(3) for the optimization of lead corrosion in water conveyed through lead service lines in the City's potable water distribution system.

In their brief correspondence, the IEPA references Appendix F of the publication titled "Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems (March 2019)" (Guidance Document) for additional information on conducting a corrosion control study. Water quality and other system-specific information must be submitted to the Agency to ensure system optimization pursuant to 35 IAC 611.350 (d)(1).

The City must recommend to the IEPA, in writing, the treatment option that the corrosion control study indicates and that constitutes optimal corrosion control treatment for the system. The City must provide a rationale for its recommendation, along with all supporting documentation specified in 35 IAC 611.352 (c)(1) through (c)(5).

The corrosion control study, water quality information, and treatment option recommendation must be submitted to the IEPA by October 10, 2023. It is anticipated that an extension will need to be requested and will be granted by the IEPA.

The City of Aurora intends to enter into a professional services agreement covering all phases of the work on a time and materials, not-to-exceed basis.

As part of the selection process the City is requesting that interested firms submit a Statement of Qualifications (SOQ) to perform the requested services. The SOQ shall be submitted in pdf format **VIA E-MAIL**, no later than 4:00 pm (local time) on Friday, August 5, 2022, and as noted in Section VI.

II. Background

The City of Aurora is located in northeast Illinois within Kane, DuPage, Kendall, and Will Counties. The City's current population estimate is about 200,000 (2020 U.S. Census value is in dispute). The City's potable water system began over 100 years ago and currently consists of a lime-softening water treatment plant, 21 remote wells or wellhouses, six finished water storage sites, one booster station, and several other buildings used to perform various pumping and raw water collection tasks. The potable water distribution system consists of pipes that range in size from 4-inch diameter up to 36-inch dimeter and are made of various materials. The approximate total length of the distribution system is 750 miles. Currently, the City is estimating that about 20,000 privately owned lead service lines exist in the City.

The drinking water delivered from the City of Aurora Water Treatment Plant (WTP) contains no detectable lead. The Aurora water supply (IL0894070) has been compliant with the federal Lead & Copper Rule since 2004, always maintaining a 90th percentile lead concentration less than the action level of 15 ug/L.

The WTP is a fully conventional, lime-softening treatment facility and the sole source of treated (potable) water for the City. Source water is derived from both surface water (Fox River) and deep and shallow groundwater aquifers. All source water is blended as a common influent at the head of the treatment plant. Raw source water undergoes coagulation with ferric chloride and cationic polymer coagulant, is dosed with anionic polymer and calcium hydroxide, and subsequently softened and clarified through an up-flow solids contact clarifier (Claricone). Water is softened within a typical pH range of 10.5 – 11.0, followed by recarbonation with carbon dioxide to a pH of approximately 9.0. Recarbonated water is dosed with a cationic filter aid and filtered through twelve dual media filters consisting of granular activated carbon and sand. Filter effluent water is post-chlorinated with sodium hypochlorite, achieves CT disinfection through clearwell contact time, and is ammoniated prior to high service discharge to the distribution system. Chloraminated water is provided to the entire water distribution system. The WTP does NOT impart any type of supplementary corrosion inhibitor to the finished water.

Supplemental Information

1. The original Corrosion Control Study report (Clark Dietz, Inc.; June 1994) which was completed for the City is included in Appendix 1 of this document. The report includes information obtained from analogous systems and corrosion inhibition studies.
2. The current optimized corrosion control parameters (as identified by the 1994 Corrosion Control Study and as currently recognized by the IEPA) are the following:
    - Total Alkalinity $\geq$ 35 mg/L
    - Calcium $\geq$ 10 mg/L
    - pH $\geq$ 8.6

   These parameters are consistently met by the WTP.
3. Due to fairly high background chloride levels in the Fox River (100 – 140 mg/L seasonally), finished water consistently has a chloride to sulfate ratio greater than 2, which may negatively affect scale formation in the distribution system.
4. As a result of softening and recarbonation treatment steps, the WPD believes that the City currently falls into Treatment Scenario 1-C of the Guidance Document, but without the use of orthophosphate.

Background/Historical Information

Select information included for the firm's use in preparing their responses is included in this document within Appendix 1 and is listed below:

1. IEPA letter dated April 15, 2022, indicating that a corrosion control study is mandated
2. The original Corrosion Control Study report (Clark Dietz, Inc.; June 1994)
3. City's Lead and Copper Rule formal sampling results since 2004
4. Sequential sampling of five residences with lead service lines (March 2022, December 2021 & September 2021)
5. Copy of the 2021 Consumer Confidence Report (annual water quality report)

III. Selection Procedures and Evaluation Criteria

Selection of the successful firm will be based upon the SOQ submittal required under Section VI and a maximum 45 minute presentation to WPD staff. Site visits, questions/responses, SOQ submittal, and presentations will be scheduled on the dates listed in Section V. Consulting firms interested in visiting the WTP site should schedule a date and time for the site visit by contacting Mr. David Schumacher, P.E., by Friday, July 8, 2022, 4:00 pm (local time) at schumacherd@aurora.il.us.

A site visit is NOT required.

SOQ submittals, firm presentations, and any subsequent agreements will be evaluated and negotiated by City WPD staff. The City may seek advice on the evaluation of the SOQ from others. Said advisors may be present at internal discussions or evaluation sessions at the request of the City. The City shall at its own discretion determine the qualifications, responsibility, availability, economic feasibility, and capabilities of firms, and other factors. Other factors which may be considered will include, but may not be limited to, firm's understanding of the project, scheduling, services to be provided, project team, firm status, and communication skills and style. The City reserves the right to consider any SOQ or agreement and to reject any or all SOQ's or agreements if doing so best serves the interest of the City.

The selection procedure will generally adhere to the following:

1. Firms may visit the WTP site in advance of preparing their SOQ.
2. SOQ's from interested firms will be delivered to the WPD.
3. SOQ's will be reviewed, evaluated, and scored by WPD staff.
4. Presentations from the **top three** SOQ scored firms will be made to City staff.
5. City staff will evaluate and rank the top three firms based on their SOQ and presentation, and designate the top selected firm, without consideration of engineering fees or compensation.
6. The top selected firm will be notified.
7. The City will then enter into negotiations with the top selected firm to establish the final detailed scope of services, value of compensation, and other relevant issues.
8. In the event the City is unable to negotiate a mutually acceptable agreement with the top selected firm, it reserves the right to terminate negotiations and undertake negotiations with the next highest ranked firm.

The selection criteria and weightings are indicated below:

SOQ

- Firm (10%). The firm's location, general experience, number of staff available for the project, stability, general current workload.
- Experience (20%). Firm's relevant experience on studies similar in scope and size to the one under consideration. Demonstrated experience with detailed corrosion control treatment investigations, IEPA potable water regulations and permitting, federal Lead and Copper Rule regulations (as well as any upcoming and future revisions to those regulations), lead service line harvesting, and scale testing is essential.
- Staff Capabilities (20%). The education, experience, expertise, licenses, and certifications of the firm's key employees to be assigned to the project.
- Technical Approach (10%). Work understanding and the firm's approach to the initial analyses, planning, organizing, management, and completion of the study effort.
- Schedule (10%). Quality of the firm's schedule, including how expeditiously the work can be realistically completed.
- References (10%). Quality of references for work similar in scope and size to the one under consideration.

Presentation

- Presentation (10%). The firm's overview presentation highlighting their understanding of the most critical components of the study and the experience and resources the firm offers.
- Communication (10%). The firm's communication ability, skill, style, content, and effectiveness during the presentation.

IV. Preliminary Scope of Services

The City is seeking professional engineering services for the preliminary list of general tasks noted below.

The City of Aurora intends to enter into a professional engineering services agreement covering all tasks of the study on a time and materials, not-to-exceed basis.

A detailed Scope of Services will be developed with the selected firm during compensation negotiations.

General Tasks

- Providing necessary personnel, materials, equipment, and transportation to make all necessary investigations, measurements, computations, analysis, design, and testing to perform the services required for the completion of the study, including the services of necessary sub-consultants.
- Attending kick-off and subsequent progress update meetings, including preparation of required agenda, exhibits, and minutes.
- Manage the scope, schedule, and budget of the work and perform administrative tasks as needed for the successful completion of the study within the deadlines provided by the IEPA (including any granted extension). Provide quality assurance and quality control of the work performed by all staff and subcontractors. Maintain regular communication with WPD staff with periodic progress updates.
- The selected firm shall review and ensure that all aspects of the comprehensive corrosion control treatment optimization study meet any current and/or future requirements of the federal Lead and Copper Rule (LCR), the federal Lead and Copper Rule Revisions (LCRR), and the upcoming federal Lead and Copper Rule Improvements (LCRI).
- If orthophosphate is determined and selected to be the best option to further optimize the City's corrosion control treatment, any downstream effects of adding orthophosphate shall be preliminarily investigated and addressed in the final report. This includes any impacts on the successful operations of the wastewater treatment provided by the Fox Metro Water Reclamation District and its NPDES permit requirements as well as any impacts on the aquatic environment of the receiving stream (Fox River).
- Consideration must be given to how water quality varies within the City's potable water distribution system as well as for challenges that may exist when considering the addition of corrosion control inhibitors to a chloraminated water.
- Provide Preliminary (70%), Pre-Final (90%), and Final (100%) reports, letters, technical memoranda, preliminary designs, Engineer's Opinion of Probable Construction Costs, and contract documents for City review and comment.
- Preparation of an opinion of probable construction cost for the conceptual design of any physical infrastructure improvements that may be required as part of the determined optimal corrosion control treatment process.

Task 1 – Project Kickoff Meeting

Conduct an initial meeting with the City to review the project objectives, the firm's work plan and schedule, roles and responsibilities of the firm's and City staff, points of contact, communications, and other relevant matters.

Task 2 – Operational and Existing Data Review

Perform data analysis of pertinent parameters based on existing/historical water quality data. Report on the efficacy, applicability, or detriment that key water quality parameters have on optimized corrosion control. Parameters to include but not limited to:

- Total alkalinity
- pH
- Calcium or calcium hardness
- Lead
- Copper
- Conductivity
- Chloride to Sulfate Ratio
- Water Temperature
- Dissolved inorganic carbon (DIC)
- Orthophosphate as a potential corrosion inhibitor
- Distribution system hydraulic modeling and predicted water age

Develop a Corrosion Control Study Project Plan to include all applicable Guidance Document science and industry best practices, including Appendix F, to describe the consultant's approach for developing a revised, optimized corrosion control program for minimizing lead solubility (concentrations) in water sampling required by IEPA or USEPA protocols, i.e., fifth liter and/or sequential sampling of lead service lines.

The City will provide as much data as possible as requested by the selected firm. This data will be provided in Excel spreadsheet format if possible.

Task 3 – Perform Desk-Top Study Modeling

Utilization of desk-top modeling software should assist the consultant in identifying chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment. Report on the modeling results, both advantageous and deleterious. Modeling should include the predicted outcomes of 1) the City's current corrosion control practices and summarize findings as to why the incumbent methodology is or is not considered optimized, and 2) model findings as to predicted sustainable water chemistry for minimal lead corrosion and compliance with IEPA and USEPA standards with respect to lead. Chapter 3 of the Guidance Document contains significant background information on corrosion control treatment.

Task 4 – Harvesting Lead Service Lines

The firm shall define the quantity and characteristics of lead service lines to be harvested, including proper field handling and preservation, for use in required pipe loop testing and pipe scale analyses. The City shall be responsible for excavation and handling per the firm-defined protocols.

Task 5 – Demonstration Study Tools (Reference Guidance Document Appendix F)

Pipe Loop Testing

The firm shall design and prepare a Pipe Loop Study to evaluate optimal corrosion control treatment for reducing lead solubility. The firm is fully responsible for the design, build, operation, and maintenance of the pipe loop system. The number of individual pipe test loops constructed shall be enough to simultaneously evaluate the various water quality scenarios likely to achieve optimal corrosion control treatment. The firm shall determine and recommend whether continuous flow-through or recirculating systems shall be employed. It is envisioned that pipe loops will be constructed at a WPD facility, however, off site experimentation at a consultant laboratory facility may also be considered. The Pipe Loop Study must include sampling and testing procedures, QA/QC protocols, and a schedule for assessing water quality changes and performance over time. The Pipe Loop Study shall be developed in cooperation with the WPD.

WPD personnel **may** be available to collect samples per established sampling protocols and/or perform various basic water quality testing in the WPD wet chemistry laboratory to facilitate smooth study performance. The WPD can facilitate this testing or the consultant may prefer to manage this task. Lead and/or copper analyses will require the services of an external, certified laboratory. Specific task details regarding pipe loop testing and analytical services will be developed with the selected firm during compensation negotiations.

The IEPA has informed the City that a pipe loop demonstration study is required to determine lead solubility for different orthophosphate doses and possibly different pH targets. At least three alternatives should be compared.

Pipe Scale Analysis
The analysis of actual pipe scale and solids released from pipe scales can provide understanding of their composition and role in release of lead and/or copper to the water. The firm shall use best available science and technologies to characterize pipe scale as it relates to current corrosion control performance and as an indicator to predictive changes of corrosion control practices toward optimization. The firm shall be responsible for collection of scale samples from harvested lead service lines and facilitation of laboratory analyses.

Partial System Testing
The City may consider full-scale testing of a select portion of the distribution system should this investigation/study point toward the use of orthophosphate. The City would likely require IEPA approval and/or a permit to install and begin dosing orthophosphate. This may also be an option in lieu of pipe loop testing if other corrosion control options are not viable, such as hypothetical adjustments to pH and/or alkalinity. Any partial system testing shall be developed in cooperation with the IEPA and the WPD. If this option is viable, the firm shall coordinate all aspects of the planning, design, and actual testing.

Task 6 – Final Report
The final report must provide all supporting information, water quality data, and analysis for the treatment option that constitutes optimal corrosion control treatment for the system. In addition, treatment options that are not viable should be addressed and included for reference. A written submittal to the IEPA, which includes all supporting documentation specified in 35 IAC 611.352 (c)(1) through (c)(5) must be completed. The City shall have the opportunity to review and comment on the Final Report prior to submission to the IEPA.

Task 7 – Conceptual preliminary design of Optimized Corrosion Control Program
Develop a conceptual design of any physical infrastructure improvements that may be required as determined by the final report for an optimal corrosion control treatment process. This shall include quantification of major equipment items needed, preliminary layout drawings of needed equipment within the WTP, and an engineer's opinion of probable construction cost of the required elements of the optimal corrosion control treatment process determined by the study.

Note: Although the City has attempted to outline the major tasks required for a complete and comprehensive corrosion control treatment optimization study as recently required by the IEPA, this should not constrain the selected firm in the development of the final scope they believe to be proper and necessary to meet the City's objectives. The City is receptive to alternate scopes of services and different ideas, experiences, and perspectives.

V. Preliminary Project Schedule

A final project schedule will be established with the selected firm based on the detailed scope of services. The following is an anticipated schedule for the project:

Request for SOQ published	June 21, 2022
Site visit scheduling deadline	July 8, 2022, 4 p.m. (local time)
Firm site visits	Week of July 18, 2022
Questions on SOQ due from Firms	July 22, 2022, 4 p.m. (local time)
Question responses sent by City	July 27, 2022
SOQ submittal due from Firms	August 5, 2022, 4 p.m. (local time)
Firm presentations	Week of August 22, 2022
Firm selection/notification	Week of September 5, 2022
Draft Agreement from Selected Firm	September 30, 2022
Final Agreement from Selected Firm	October 28, 2022
Anticipated Approved Firm Agreement	November 11, 2022
Anticipated City Council Approval	December 2022
Kick-Off Meeting for project – Start of Work	January 2023
Submittals to IEPA (current deadline without extension)	October 10, 2023

VI. SOQ Submittals

SOQ submittals shall be no longer than twelve (12) pages in length (not including resumes). The SOQ shall be sent by the date and time noted in Section V, **VIA E-MAIL** to purchasingDL@aurora.il.us, with **Subject line: "22-53 SOQ Corrosion Control Treatment Optimization Study – *FIRM NAME*",** and addressed as follows:

Attn:Purchasing
City of Aurora, Illinois
44 East Downer Place
Aurora, IL 60507

Questions on the SOQ shall be submitted via email to purchasingDL@aurora.il.us by the date and time listed in Section V. Responses will be provided by the date listed in Section V.

The firm is requested to provide the following information within the SOQ:

1. The name of the firm, principal place of business, and local office which will provide the services for the project if different from the principal office.
2. The size of the firm's staff and current workload.
3. Identification of the firm's managing principal(s) and designated Project Manager for the study and role of key individuals in the engineering team that would be providing services and communicating with the City as part of this effort. Provide an organizational chart or list for the engineering team that clearly shows the function that each team member will be expected to perform, along with a concise one (1) page resume for each team member.
4. A record of previous relevant experience performing the engineering services necessary to complete a comprehensive corrosion control treatment optimization study in accordance with 35 IAC 611.351 (c)(3) for the optimization of lead corrosion in water conveyed through lead service lines and any other similar projects or studies within the past eight (8) years.
5. A list of at most four (4) references for similar corrosion control treatment optimization studies including name, job title, address, contact names, phone numbers, project name, and project cost.
6. A concise statement of the firm's understanding of the technical approach required to successfully complete the project.
7. Documentation of the firm's experience with lead service line harvesting, drinking water pipe scale analysis, and pipe loop construction and testing for corrosion control considerations.
8. A list of any sub-consultants which may be used.

9. A flow chart or Gantt chart depicting typical project activities, requirements, sequences, deadlines, and timing of major project milestones.
10. A brief list of any projects performed for the City over the last eight (8) years.
11. Any other information believed to be pertinent, but not specifically mentioned elsewhere.

VII. General Conditions

1. Selection will be made by the City subject to approval by the Aurora City Council. The successful firm will be required to enter into a written agreement in a form acceptable to the City.
2. The City reserves the right at any time and for any reason to cancel this professional consulting firm procurement process, to reject any or all proposals, or to accept an alternative proposal. The City reserves the right to reject any non-responsive proposal. The City may seek clarification on a SOQ at any time.
3. The City reserves the right to waive any irregularity, informality, or technicality in the selection process in the City's best interest.
4. All costs related to the preparation of the SOQ and any related activities are the sole responsibility of the firm submitting a SOQ. The City assumes no liability for any costs incurred by firms throughout the entire selection process.
5. All SOQ's, including attachments, supplementary materials, renderings, sketches, addenda, etc., shall, upon submission, become the property of the City, and will not be returned to the submitting firm.
6. The selected firm's written services agreement shall include a statement of indemnification to hold the City, its officers, agents, servants, and employees, and each of them harmless from any and all lawsuits, claims, demands, liabilities, damages and losses including all costs, expenses and attorney's fees incurred in connection therewith, for or on account of any injury to any person, or any death at any time resulting from such injury, or any damage to property, which may arise or which may be alleged to have arisen out of or in connection with, or as a result of any negligence of the firm in performing the work for this project.
7. The selected firm shall furnish and deliver prior to commencement of services, a completed Certificate of Insurance satisfactory to the City meeting the following requirements:
    a. Provision that coverage cannot be canceled without a thirty-day notice to the City.
    b. Compliance with statutory limits of the State of Illinois for Worker's Compensation and Employer's Liability and the minimum amount of this type of insurance shall be $1,000,000 each accident/disease.
    c. The minimum amounts of Commercial general liability insurance (occurrence; project) shall be the following:
        i. Each occurrence: $1,000,000
        ii. Damage to rented premises: $50,000
        iii. Medical expenses: $5,000
        iv. Personal injury: $1,000,000
        v. General aggregate: $2,000,000
    d. The minimum amount of Product Liability insurance shall be $2,000,000, combined single limit per person for each occurrence. No restriction on occurrence limits will be permitted.
    e. The minimum amount of Automobile Liability insurance on any autos, hired autos, and non-owned autos shall be $1,000,000.
    f. The minimum amount of Excess/umbrella liability shall be $5,000,000, each occurrence/aggregate.
    g. The minimum amount of Professional Liability Insurance shall be $1,000,000 per occurrence and in the aggregate covering the Consultant against all sums which the Consultant may become legally obligated to pay on account of any professional liability arising out of the performance of this project.

   A current certificate of insurance covering the outside agency and any sub-consultants or agents thereof shall be provided and maintained with the Water Production Division, listing the City of Aurora and its officials, employees, and agents, as "primary, non-contributory, additional insured." The selected firm shall furnish a copy of the Endorsement showing City as an additional named insured on the General Liability policy and Professional Liability policy; or provide separate coverage, in the amounts enumerated above, with an Owner's Protective policy. The City reserves the right to request and receive a copy of the firm's insurance policies referenced herein. The firm shall cease operations on the work if the insurance is canceled or reduced below the required amount of coverage.

8. Equal Employment Opportunity Clause, Section 6.1 of the Illinois Department of Human Rights Rules and Regulations shall be a material term of any resulting agreement.
9. In case of default by the firm, the City may procure the services from other sources and hold the firm responsible for any excess cost resulting therefrom.
10. The selected firm will be exclusively responsible for all services scheduled during the development of a detailed Scope of Services. The City will consider the firm to be the sole point of contact with regard to contractual matters that relate to this project which includes the payment of any and all charges resulting from an agreement. Subcontracts will be permitted only upon specific, written permission of the City.
11. Firms shall promptly notify the City of any ambiguity, inconsistency or error, which they may discover upon examination of this request for a SOQ. The firm may obtain written clarification from the City as noted in Section VI. The firm shall include a copy of the written clarification with its submission. If it becomes necessary to revise any part of this request for a SOQ, addenda will be provided to all recipients.
12. All SOQ's submitted by firms will remain confidential and will not be distributed to parties outside of the City unless authorized by the firm.
13. Failure to read this request for a SOQ and comply with its instructions will be at the firm's own risk.
14. Corrections and/or modifications to submittals received after the completion of the firm's scheduled presentation will not be accepted.

Appendix 1

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

April 15, 2022

received
4-21-22
WPD

Attn: David Schumacher
City of Aurora
44 East Downer Place
Aurora, IL 60507

Re: City of Aurora (IL0894070)
Lead and Copper Rule
Corrosion Control Study for Large System
Log Number 2021-0022

Dear Mr. Schumacher:

The Illinois Environmental Protection Agency (Agency) has reviewed the corrosion control requirements for the Aurora community water supply and determined that a corrosion control study must be completed in accordance with 35 IAC 611.351 (c)(3). Although 90th percentile results for lead have consistently been below the action level of 15 ug/L, the Agency is questioning if the supply is optimized as required by 35 IAC 611.350(d)(l) based upon the lead profile data submitted to the Agency on October 5, 2021 and January 4, 2022.

For additional information on conducting the corrosion control study please refer to Appendix F of the Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primary Agencies and Public Water Systems guidance manual, updated March 2019. Water quality and other system-specific information must be submitted to the Agency in order to ensure system optimization pursuant to 35 IAC 611.350(d)(l).

Aurora community water supply must recommend to the Agency, in writing, the treatment option that the corrosion control study indicates constitutes optimal corrosion control treatment for its system. The supplier must provide a rational for its recommendation, along with all supporting documentation specified in 35 IAC 611.352 (c)(l) through (c)(5).

The corrosion control study, water quality information and treatment option recommendation must be submitted to the Agency by October 10, 2023. If you have any questions regarding this determination, please contact Jenny Larsen at 217/782-1724.

Sincerely,

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

DCC:JML

cc: Robert Leible, Certified Operator
Elgin Regional Office
DPWS/CAS

City of Aurora

Water Treatment Plant • 44 E. Downer Place • Aurora, Illinois 60507-2067 • (708) 844-3632

Arnold W. Eggleston
Superintendent
Water Production

July 6, 1994

TO: Environmental & Water Quality Committee

FROM: Arnold Eggleston, Supt. of Water Production /;

SUBJECT: Corrosion Control Study Update

In July of 1993 the City of Aurora contracted the engineering services of Clark Dietz, Inc. to complete a corrosion control study as required by the Environmental Protection Agency's "Lead and Copper" rule. The Water Production staff and Clark Dietz consultants have completed the required (attached) study. I have submitted the study to the Illinois Environmental Protection Agency for their review.

Although data supports that water produced during the past year has been "non-corrosive", the study concludes that we could achieve an optimum level of corrosion control by maintaining finished water goals as stated in the Executive Summary. Producing water of this quality should, with time, deposit a slight layer of calcium carbonate on the inside of water mains and, most importantly, lead service lines.. This deposit will serve as a barrier between the lead and the water, thereby not permitting the lead to leach into the water. Further lead sampling is planned to begin in January 1995 and continue through the year.

The Water Production personnel and Clark Dietz plan to continue testing and collecting data to support this report through the end of 1994. I will forward any additions to this study to you when available.

I am available to answer any questions you may have of the Corrosion Control study at your request.

AE/dw

attachments

cc: Mayor Pierce
R. Rieser
W. Kearney
L. Tatar

CDI

CORROSION CONTROL STUDY

CITY OF AURORA, ILLINOIS

Prepared by:

Clark Dietz, Inc.

June 1994

CORROSION CONTROL STUDY

CITY OF AURORA, ILLINOIS

EXECUTIVE SUMMARY

The City of Aurora proposes adjusting finished water pH, alkalinity and calcium concentrations in order to provide optimal corrosion control as required by the Lead and Copper Rule. The plant normally produces a non-corrosive water; however, at low alkalinity, calcium and pH values, both Langlier and CCPP indices predict an aggressive water. At high values, large precipitation potentials could mean excessive calcite deposition near the plant. Computer modeling indicates optimal calcium carbonate precipitation potential (CCPP) can be maintained by establishing the following finished water goals:

pH	9.1 - 9.2
alkalinity	60 - 90 mg CaC03/1
calcium	40 - 60 mg Ca/I

These water quality goals are near the 1993 average values of 9.1 pH, 75 mg CaC03/l alkalinity and 45 mg Ca/I calcium and can be achieved by optimizing existing plant processes. These operating changes will be simple to implement and reduce plant lime and carbon dioxide consumption, resulting in cost savings. After the proposed water quality changes are implemented, co.mparative corrosion rate data will be collected and the system will be monitored to ensure potential adverse effects such as increased trihalomethane (THM) production and excessive scale formation are minimized.

Chemical inhibition using ortho-, polyphosphate blended formulations was also evaluated. Although other lime softening plants have reduced lead corrosion using these products, the literature indicates Aurora's finished water pH is outside the optimum range of these chemicals. The City is currently conducting coupon rack testing of three inhibitors. Results from the first three months of testing indicate these chemicals do not reduce lead corrosion and may even increase lead corrosion rates. The City plans to continue the coupon rack testing for several more months to ensure that the results to-date are not a startup phenomenon, as claimed by the chemical suppliers.

CORROSION CONTROL .STUDY

CITY OF AURORA, ILLINOIS

BACKGROUND

The Lead and Copper Rule, promulgated by the U.S. EPA on June 7, 1991, requires public water systems to sample consumer taps to demonstrate compliance with action level concentrations (ALs) for lead and copper. If more than ten percent of the taps exceed an AL, the utility must conduct a public education program and implement optimal corrosion control treatment.

Although results from the first round sampling for the City of Aurora were below action levels, the 90th percentile lead concentration of the second set was 15.7 ppb - just above the 15 ppb limit. Copper concentrations for both data sets were well below the action level of 1300 ppb. As a large system, the Aurora water system must submit a corrosion control study to the Illinois EPA by July 1, 1994.

The City of Aurora serves a population of approximately 99,000 with a combination of surface and groundwater in the ratio of 2:1. Treatment processes currently consist of aeration, lime softening, recarbonation, filtration, chlorine disinfection and fluoridation. Alum and activated carbon are also added to the raw water. The normal daily flow is about 14 mgd and the plant design rate is 28 mgd. Of the 30,550 service connections, it is estimated that 17,000 are copper and 13,550 are lead. The distribution system consists of 395 miles of cast iron and ductile iron pipe, 17 groundwater wells, four elevated storage tanks, four ground storage tanks and two booster pump stations.

Data from 1992-1994 was used to characterize Fox River, well, distribution and finished water quality. Typical values are presented in Table 1. Based on these data, the source waters are not contributing to the observed distribution system lead levels. Comparison of finished water and distribution system water quality indicate the distribution water is relatively stable.

A summary of the lead and copper tap sampling monitoring results is presented in the appended map and table. (See Table A-1 and Drawing A-1) There are no obvious areas of high lead concentration. Review of City records indicate lead service lines and in-home lead piping and lead solder are the only sources of lead in the Aurora water distribution system. Therefore, lead abatement alternatives will focus on distribution system corrosion. The primary lead abatement alternatives are: (1) remove and replace lead service lines or (2) implement corrosion control treatment.

LEAD LINE REPLACEMENT

The cost to replace the lead service lines was calculated assuming a 10-year replacement program, replacing 1355 services per year. At a pipe installed cost of $50 per LF and an average service line length of 50 feet, the cost of replacement is $2500 per service. Annual costs would be:

1,355 * $2500 = $3,390,000 per year

TABLE 1

City of Aurora

Water Quality Characteristics

	Fox River	Wells	Finished Water minimum	Finished Water average	Finished Water maximum	Distribution Water
pH	8.4	7.38	7.98	9.1	10.1	9.1
Calcium, mg Ca/l	160	202	30	44	82	33
Total Hardness, mg CaC03/l	259	330		134		
Alkalinity, mg CaC03/l	200	282	32	73	135	75
Conductivity, uohm/cm				498		526
Copper, mg/l	<0.01	0.013		0.022		
Lead, mg/l	<.005	<.005		<.005		
Temperature (oC)			6.3	13.1	21.6	

The present worth of costs assuming a 4% interest rate over the 10-year replacement period is:

$$\$3,390,000 * (P/A,4\%,10 = 8.111) = \$27,500,000$$

POTENTIAL TREATMENT STRATEGIES

The three primary means of corrosion control are:

- o pH/alkalinity adjustment
- o Calcium hardness adjustment
- o Chemical inhibition

First, other lime softening plants were surveyed for their experiences with corrosion control. Then implementation of each corrosion control method was evaluated based on the following criteria:

- o Effectiveness
- o Feasibility
- o Potential for Adverse Impact
- o Capital and Operating Costs

Effective treatment is defined as meeting the objectives of maintaining lead and copper concentrations below the action level. The degree of effectiveness can be assessed by the ability to meet the standards under varying temperature, pH and alkalinity conditions. Feasibility of implementing a treatment means the practicality of installing and operating the new equipment in the existing water system. Adverse impacts are conflicts between lead corrosion control measures and other water quality or operating criteria. Finally, capital and operating costs were estimated for each corrosion control alternative. .

SIMILAR WATER TREATMENT SYSTEMS

Although lime softening plants experiencing corrosion problems are rare, a few were located and surveyed for information concerning their experiences with corrosion control. The characteristic water quality of these water treatment plants is summarized in Table 2.

(1) Johnson County Kansas Water Treatment Plant

This facility treats 130 to 170 mgd of water. from the Missouri and Kansas Rivers. Lime softening was installed in 1974 and the system operated at a pH of 8.5 until red water problems occurred and pH was raised to 9.2. The iron corrosion complaints resumed two to three years ago because the distribution system area had more than doubled. The City implemented a line cleaning and replacement program, but the red water persisted. The City has passed all lead and copper rule monitoring analysis, therefore, their corrosion control objective was limited to iron.

TABLE 2

LIME SOFTENING SYSTEMS

	Aurora, IL	Johnson Co., MO	Charleston, IL	Miami-Dade Co., FL
Water Source	Surface/Well	Surface	Surface	Well
pH	9.1	9.7	9.0	9.0
Alkalinity, mg/l $CaCO_3$	73	90	90	
Calcium, mg/l Ca	44	55	50	60
Conductivity, ug/cm3	490	550		
Inhibitor Used		(1)	Aqua Mag	Calciquest
Dosage, mg/l product			0.5	0.5
Lead before, ug/l			17.6	
Lead after, ug/l			5.1	
Reduction, %			71	(2)
Lead Data Source		System Testing	System Testing	System Testing

(1) Lime addition was increased to raise pH and encourage calcium precipitation in the distribution sytem. A polyphosphate is added for sequestering calcium to both decrease filter sedimentation and promote calcium precipitation further out in the distribution system. Lead was not a concern, therefore, it was not specifically tracked in the corrosion study. However, the system has not exceeded any action levels during LCR monitoring. The corrosion rate of coupons in the distribution system dropped in half after corrosion control measures were instituted.

(2) Prior to adding inhibitor, tap samples in 50-60% of the homes surveyed exceeded the lead action level. Following inhibitor use, less then 10% failed.

To assess the problem, Johnson County conducted coupon testing to locate areas of acute corrosion. As suspected, the corrosion rate was highest in the farthest sectors of the distribution system where pH and alkalinity had dropped significantly. The finished water pH was raised to 9.4, calcium to *55* mg Call and alkalinity to 80-100 mg CaC03/l. Three months after the pH was raised, the coupon tests were repeated and the rate of corrosion had dropped from 10.69 to 3.17 mils per year. The City currently operates with a distribution system pH of 9.5, alkalinity of 200-400 mg CaC03/l, 120-150 mg CaC03/l hardness and DIC of 15-20 mg/I. In order to maintain a high pH in the system, plant finished water pH runs from 9.6 to 9.8.

A sodium polyphosphate inhibitor is added on top of the filters to minimize filter sedimentation and hold the calcium in solution so it precipitates further out in the distribution system lines. Follow up coupon testing and distribution pipe examination have confirmed effective corrosion control and deposition of a calcium carbonate scale.

Johnson County has not experienced an increase in trihalomethane concentrations due to the increase in pH. Their total THM concentration averages 30 ug/l, with occasional peaks of 50 ug/1. The use of chloramine disinfectant rather than chlorine helps minimize organic complexing. Increasing the contact clarifier pH from 10.2 to 10.8 has resulted in an increase in lime use and blowdown waste. Lime use has increased by about 10 ppm/0.1 pH unit increase.

(2) Charleston, Illinois

The City of Charleston treats approximately 2 mgd of water from the Embarras River. The treatment system includes lime softening, alum and carbon addition, recarbonation, filtration and disinfection. The contact clarifiers are typically operated at a pH of 10.5 and the finished water pH averages 9.0 pH, 90 mg CaC03/l alkalinity and 50 mg Call calcium. In anticipation of lead exceedances, Charleston added soda ash to buffer the water and raise its alkalinity for nearly a year in advance of the first monitoring. Despite these measures, the City failed the first round of lead and copper testing. Soda ash addition was increased in response to the first exceedance but Charleston still failed the second round of sampling. Charleston began feeding Aqua Mag, an ortho-, polyphosphate blend inhibitor, at 0.5 mg/I as orthophosphate in September of 1992. Although the plant operates outside the optimum pH range of 7.5-8.5 for orthophosphate use, the inhibitor appears to be working. Since beginning phosphate addition, tap sample monitoring ninetieth percentile lead concentrations have dropped 71 % - from 17.6 ug/l to 5.1 ug/l. Furthermore, the inhibitor is cheaper and easier to handle than soda ash. Soda ash addition has been discontinued and pH in the distribution system allowed to revert to 8.2 to 8.8.

(3) Miami-Dade County Water Department

The Miami-Dade County Water Department operates three plants which lime soften 300 mgd of groundwater. The Miami-Dade plants have a typical finished water quality of 8.8 to 9.2 pH and a calcium hardness of 60 mg Call. The utility conducted a desk top corrosion study two years ago in anticipation of the Lead and Copper Rule. Increased softening to promote further calcium carbonate precipitation was rejected because Miami-Dade's corrosion problems have been traced to in-home faucets which would be left unprotected by scale formation.

Other testing has proven calcium carbonate scale does not adhere well to copper piping, leaving in-home lead solder unprotected.

The inhibitors considered include: sodium silicate, orthophosphates, zinc phosphates, sodium polyphosphates, sodium hexametaphosphates and blended ortho-, polyphosphates. Because the Miami-Dade plants recalcine lime, several of the inhibitors were eliminated due to potential for contaminating the recycled lime. Sodium silicates were omitted from consideration for lack of data on its use for lead corrosion control. Pure orthophosphate was rejected because it is quickly expended, leaving piping at the boundaries of the distribution system unprotected. Since polyphosphates revert to orthophosphates over time, a combination of ortho-, polyphosphate was chosen for use in this large distribution system.

Miami-Dade chose to test on a system-wide basis due to the inaccuracies inherent to loop testing. During startup, an inhibitor was fed at a concentration of 1.5 mg/l as orthophosphate. The current maintenance dosage is 0.5 mg/I. The only adverse effect of the phosphate addition has been increased algal growth in the filter. The algae is scrubbed off during filter backwashing and increased backwashing has not been necessary. Before using ortho-, polyphosphate inhibitor, over 50% of homes sampled failed to meet the lead action level. Currently only about 5% of homes sampled exceed the action level. According to Dr. Dick Auston of the Miami-Dade County Water Department, many lime softening plants in Southern Florida add a blended phosphate inhibitor for lead corrosion control.

pH/ALKALINITY/CALCIUM HARDNESS ADJUSTMENT

The purpose of adjusting alkalinity and pH is to minimize lead solubility. Alkalinity and pH adjustment are most often accomplished by addition of a hydroxide. For the City of Aurora, the logical method of increasing distribution system pH is to modify existing lime softening process parameters. These changes will also effect calcium concentration. Thus, the first two corrosion control methods, pH/alkalinity adjustment and calcium hardness adjustment will be considered together.

Finished water pH can be increased by adjusting the recarbonation set point pH. Alkalinity and calcium content can be increased by decreasing claricone pH, e.g., softening less. Although increasing pH alone has an effect on formation of protective calcium carbonate

scale, increasing alkalinity and calcium concentrations further improves the scaling potential. The average plant effluent is non-corrosive, however, at the minimum finished water pH, alkalinity, calcium and temperature, both the CCPP and Langlier Index are negative. Using the calculation spreadsheet presented as Table A-2 of the appendix, CCPPs were calculated over the normal range of Aurora water quality. (See Table 3.) Based on this modeling, the plant could maintain CCPPs near the optimum range of 4-8 mg CaC03/l by operating with the following water quality goals:

pH	9.1 - 9.2
alkalinity	60 - 90 mg CaC03/l
calcium	40 - 60 mg Ca/I.

TABLE 3

Calcium Carbonate Precipitation Potential Summary

Aurora Water Quality Parameters - 1993

	average	maximum	minimum	
pH	9.1	10.1	7.98	units
Alkalinity	73	135	32	mg CaC03/I
Calcium	44	82	30	mg Ca/I
Temperature	13.1	21.6	6.3	oC
summer - minimum			10	

CCPP Goal = 4-8 mg CaC03/I

pH	Alkalinity	Calcium	Temperature	CCPP	Description
7.98	32	30	5	-4.1	Minimum pH, alkalinity, calcium, temp
9.1	73	44	15	5.9	Average pH, alkalinity, calcium, temp
10.1	135	82	20	71	Maximum pH, alkalinity, calcium, temp
8.8	32	30	5	-1.5	STEP 1: Establishing minimum values
9.7	32	30	5	4.9	
9.5	32	30	10	3.7	pH above 9.2 impractical goal
8.8	75	45	10	1.7	
9.2	75	45	5	4.7	
9.1	75	45	10	4.6	
9.2	60	40	5	3.3	Minimum alkalinity, calcium, temp at pH 9.2
9.1	135	82	20	19	STEP 2: 'Establishing maximum values
9.1	100	80	20	13	
9.1	100	70	20	12	
9.f	90	60	20	10	Maximum alkalinity, calcium, temp at pH 9.1

Due to temperature effects, the plant should be operated at the upper end of the range during the winter months. The proposed water quality changes will result in cost savings since less lime and carbon dioxide will be consumed. Assuming a claricone pH drop from 10.2 to 10.0 will achieve the desired calcium and alkalinity concentrations, 1.2 tons per day of lime will be saved based on a decrease of 10 ppm per 0.1 pH unit.

Lime = 1.2 ton/day * $60/ton * 365 days/yr = $26,300 per year

Waste = 1.2 ton/day * 2.5 * $32/DT (for land application) * 365 days/yr
= $35,000 per year

Some C02 savings will result, but at $0.25/lb, these savings will be insignificant in comparison to the lime cost reduction.

PW = $61,300(P/A,4%,20 = 13.59) = $833,000

Raising the distribution system pH has several potential adverse effects, including:

- Lower disinfection efficiency
- Increase in THM (trihalomethane) compound formation
- Potential for black water due to manganese precipitation
- Increase in catcium carbonate scaling, reducing distribution and filtration capacity

Since eliminating prechlorination, Aurora finished water THM concentrations have been less than the proposed guideline of SO ppb. Calculations indicate the incremental increase in pH proposed by this treatment option will not significantly effect disinfection. According to CCPP calculations, formation of lime scale should be controlled at the proposed water

al. .

Since only slight changes in water quality are proposed, adverse effects will be minimized. The system will be monitored for potential problems following any water quality change. If necessary, water quality parameters will be modified to optimize between conflicting goals.

CHEMICAL INHIBITION

The types of formulated chemical corrosion inhibitors most commonly used are: orthophosphates, zinc phosphates, polyphosphates and silicates. There have been conflicting results concerning use of polyphosphates for lead corrosion control. Some researchers have found lead solubility can actually increase in the presence of polyphosphates without orthophosphates, while others indicate polyphosphates can have a positive effect on lead leaching. EPA's Lead and Copper Rule Guidance Document. Volume 2 states, "EPA believes that polyphosphates should be used with caution because: 'Applying chemicals whose effects are not well understood may be viewed in the extreme sense as an uncontrolled toxicological experiment on the general population.'(Holm and Schock, 1991b)" Successful use of silicates for lead inhibition has not been documented either. Furthermore, silicates do not perform well in a scaling environment and can cause plugging and high turbidity. Although not at risk of exceeding zinc limits, it is advisable to avoid adding metallic chemicals if effective alternatives are available.

Orthophosphates have proven to be the most effective inhibitor for lead control, particularly at elevated pHs. The most effective pH range for orthophosphate lead inhibition is 7.4 to 7.8; however, AWWA test results indicate orthophosphate is as effective at a pH of 8.5 as at 8.0. Although there are no published laboratory studies of orthophosphate effectiveness at elevated pHs, theoretical calculations conducted by EPA indicate significant lead reduction can be realized by addition of 0.5 mg/I orthophosphate to waters with a pH of 7-9.

Theoretical diagrams of the impact of orthophosphates on lead solubility indicate a maximum lead level of 0.070 mg Pb/l is possible at present pH and DIC levels with an orthophosphate dosage of 1-2 mg P04/l. This represents a 43% reduction from the current untreated theoretical lead level of 0.123 mg/l. (See appended Figures A-1 and A-2) Thus orthophosphate addition appears to be a potentially effective lead control option.

The primary potential adverse effects of orthophosphate treatment is deterioration in bacterial quality due to addition of nutrients. Biological grown can usually be controlled by routine cleaning and maintaining adequate chlorine residual in the distribution system.

Orthophosphates and blended ortho-, polyphosphates are available in either 55 gallon drums or in bulk. Although inhibitor addition could be started from drums, bulk handling is preferable due to lower chemical cost and less operator attention. The equipment necessary to feed inhibitor includes: a low flow chemical metering pump and either drums of inhibitor or a bulk storage tank. A transparent day tank would be necessary to visually monitor phosphate addition.

Costs associated with inhibitor addition include capital, chemical and operations and maintenance. For an inhibitor dosage of 3.7 gallons per million gallons treated, the chemical costs would be:

3.7 gal/mgal * 28 mgd * 365 days/yr * $6.50/gal = $246,000 Peak
3.7 gal/ngal * 14 mgd * 365 days/yr * $6.50/gal = $123,000 Average

Construction cost (see appended Figure A-3) = $29,000 to $33,000
1993/1979 Cost Indices = 100/57.5 = 1.74
Add 30% for piping and overhead
Add 50% for engineering, legal, contingency and administration

Total capital cost = $29,000 (1.3) (1.5) (1.74) = $98,500
= $33,000 (1.3) (1.5) (1.74) = $112,000

Based on cost information from Lead Control Strategies, Overhead and Maintenance costs are estimated to be $2/MG treated, so annual O&M costs total:

$2/MG * 28 mgd * 365 days/yr = $20,400

Present worth of costs using high end costs assuming a 20-year life and 4% interest rate is:

$112,000 + $246,000(P/A,4%,20 = 13.59) + $20,400(P/A,4% ,20 = 13.59)

= $3,730,000

Three ortho-, polyphosphate blend inhibitors, Kjell Aqua Mag F-25-S, Calciquest and Stiles Kem SK7641, are being evaluated in coupon loops to test their effectiveness in reducing lead corrosion in Aurora Water Plant effluent. Six coupon racks, one treated and one untreated for each chemical, were loaded with five lead, one copper and one mild steel coupon. Each chemical manufacturer supplied two test loops, chemical, chemical injection pumps and suggested dosages. Inhibitor flow was initiated March 8, 1994.

A 24-hour standing water sample is taken weekly from each loop. The plant chemist measures temperature and pH. National Environmental Testing (NET) Laboratory analyzes for lead, copper, iron, residual ortho- and total phosphates. Two lead, a copper and a mild steel coupon were removed from each loop after three months for corrosion rate measurement.

Results of the first twelve weeks of coupon loop "tap" water testing indicate no clear lead reduction trend. (See Table 5). Inhibitor delivery problems and failure to achieve ionic steady state are possible causes of the data variation. The results of coupon testing (See Table 4)

indicate ortho-, polyphosphate inhibitors may increase the rate of lead corrosion.

Each of the inhibitor injection systems have experienced problems, including loss of suction, periods of insufficient flow and pump failure, which contribute to the inconsistency of the data. The Calciquest inhibitor delivery system has experienced repeated pump failures and sporadic vendor repairs, invalidating the data.

Literature sources and inhibitor manufacturer's agree that three months or more may be required to establish effective phosphate passivation. Once ionic steady state is achieved, the phosphate residual should approachc!he initial dosage concentration. The lack of residual phosphate indicates the ion is currently being consumed, lending some credence to the theory that an initial passivation period is necessary. (See appended Tables A-3, A-4, A-5)

The City plans to continue testing for several more months to determine whether the initial results are due to startup phenomenon as claimed by the chemical suppliers. The data to-date indicates ortho-,polyphosphate blend inhibitors do not reduce corrosion in Aurora Water Plant finished water and may increase corrosion rates.

CONCLUSION AND RECOMMENDATION

Table 6 summarizes the comparison of treatment options versus lead service line replacement. Replacing existing lead services lines is by far the most expensive option and since in-home lead sources are unaffected, the distribution system could still fail LCR standards. Furthermore, service lines are owned by home owners and are not under City control.

Therefore, service line replacement can not be recommended.

TABLE 4
Corrosion Coupon Results

Location	Material	Corrosion Rate, mils/yr	Corrosion Rate Change, %
Kjell - Untreated	Lead	0.1173	
Kjell - Treated	Lead	0.1243	+6
Kjell - Untreated	Copper	0.2790	
Kjell - Treated	Copper	0.3231	+16
Kjell - Untreated	Steel	4.1895	
Kjell - Treated	Steel	4.2284	+1
Calciquest - Untreated	Lead	0.1127	
Calciquest - Treated	Lead	0.1085	-4
Calciquest - Untreated	Copper	0.3208	
Calciquest - Treated	Copper	0.2427	-24
Calciquest - Untreated	Steel	5.3044	
Calciquest - Treated	Steel	5.5873	+5
Stiles Kem 7641 - Untreated	Lead	0.0548	
Stiles Kem 7641 - Treated	Lead	0.0558	+2
Stiles Kem 7641 - Untreated	Copper	0.3647	
Stiles Kem 7641 - Treated	Copper	0.3256	-11
Stiles Kem 7641 - Untreated	Steel	4.9279	
Stiles Kem 7641 - Treated	Steel	5.5993	+14

Note: Lead coupon corrosion rates are the average for two coupons.

TABLE 5

Coupon Rack Water Sample Analyses

	Kjell F-25-S			Calciquest			SK 7641		
DATE	Untreated Pb mg/l	Treated Pb mg/l	% Reduction	Untreated Pb mg/l	Treated Pb mg/l	% Reduction	Untreated Pb mg/l	Treated Pb mg/l	% Reduction
15-Mar-94	0.0077	0.0113	-47	0.0132	0.0102	23	0.0162	0.0181	-12
22-Mar-94	0.0100	0.0106	-6	0.0099	0.0153	-55	0.0360	0.0140	61
30-Mar-94	0.0056	<0.0050	11 +	0.0066	0.0101	-53	0.0110	0.0138	-25
06-Apr-94	0.0170	0.0160	6	0.0180	0.0197	-9	0.0277	0.0233	16
13-Apr-94	0.0118	0.0094	20	0.0092	0.0101	-10	0.0103	0.0166	-61
20-Apr-94	0.0154	0.0171	-11	0.0151	0.0194	-28	0.0240	0.0182	24
27-Apr-94	0.0221	0.0259	-17	0.0173	<0.0050	71 +	0.0149	0.0202	-36
04-May-94	0.0091	0.0100	-10	0.0172	0.0076	56	0.0112	0.0150	-34
11-May-94	0.0202	0.0071	65	0.0126	0.0199	-58	0.0155	0.0200	-29
18-May-94	0.0228	0.0142	38	0.0126	0.0113	10	0.0140	0.0163	-16
25-May-94	0.0120	0.0140	-17	0.0210	0.0230	-10	0.0190	0.0210	-11
01-Jun-94	0.0228	0.0142	38	0.0126	O.Q113	10	0.0140	0.0163	-16

Althogh other lime softening plants have successfully reduced corrosion using ortho-,polyphosphate inhibitors, the results of loop testing are not encouraging. No clear reduction trend has been established after three months of operation and the results of coupon testing indicate the inhibited loops experience higher corrosion rates. Therefore, chemical inhibition can not be recommended.

Computer modeling indicates conditions conducive to forming calcium carbonate scale can be achieved by adjusting effluent pH, alkalinity and calcium concentrations to maintain the following finished water quality:

pH	9.1 - 9.2
alkalinity	60 - 90 mg $CaC03$/l
calcium	40 - 60 mg Ca/I

These water quality goals do not differ significantly from 1993 plant average parameters and can be attained by optimizing existing plant processes. Cost savings of over $60,000 per year can be realized due to reduced lime and carbon dioxide consumption. Therefore, it is recommended that the City of Aurora adjust pH, alkalinity and calcium concentrations for optimal corrosion control as required by the Leaq and Copper Rule.

Although there is some potential for increased THM production and excess scaling, the distribution system will be monitored following the proposed water quality changes to ensure there are no significant adverse effects and to verify corrosion rate reduction. Inhibitor coupon rack testing will be continued for several months to confirm that the apparent failure is not a startup phenomenon, as claimed by the chemical suppliers.

TABLE 6
City or Aurora
Comparison or Lead Corrosion Alternatives

	REMOVAi/REPLACEMENT	pH/ALKALINITY/CALCIUM ADJUSTMENT	INHIBITOR
EFFECTIVENESS	100% reduction for lead services No effect on in-home lead sources	Calculation Indicate calcium carbonate precipitation will occur	Theoretically possible, but loop testing has railed to confirm any decrease in corrosion rate
REGULATORY ASPECTS	Regulatory limits will probably not be met in all homes since lead solder is still in place	Based on calculations and similar system experience it will sufficiently reduce lead	Appears to be unable to meet the standard
COST 20-year Present Worth @ 4%	$27,500,000	-$830,000 (savings)	$3,730,000
FEASIBILITY	Program will require 10-years to complete	Program can be Implemented within the regulatory deadlines	Program can be Implemented within the regulatory deadlines
SECONDARY IMPACTS	Disturbance or service during replacement Brier high solids episode possible Trame and lawn disturbances	Potential Increase In THM concentration above standards Lower dlslnrectlon efficiency Potential for black water due to managanese precipitation Potential for red water due to Iron precipitation Increase In calcium carbonate scaling, reducing distribution and filtration capacity	Potential Increase In biological growth Brier Increase In Iron due to sloughing

CORROSION CONTROL STUDY

CITY OF AURORA, ILLINOIS

SUPPLEMENTAL

TABLES, FIGURES AND DRAWINGS

TABLE A-1

No.	Sample Site Number	Address	Service Copper w/Lead Solder	Service Lead	Jan.Jun 1992 Results {ugLI)	Jul-Dec 1992 Results {ugLI)
1	LP1C 001 A	141 S. Commonwealth Ale.		x	5.0 K	10.3
2	LP1C 002 A	410 Howard Ale.		x	31.8	12.3
3	LA3S 003 A	2240 Jericho Rd.	x			
4	LP1C 004 A	1811 Kensington		x	10.7	6.2
5	LP1C 005 A	1956 P.oberts		x	5.0 K	5.0 K
6	LP1C 006 A	1220 Kennilworth		x	5.0 K	5.0 K
7	LP1C 007 A	155 S. Russell		x	5.0 K	5.0 K
8	LP1C 008A	427 N. Harrison		x	5.0 K	19.6
9	LP1C 009 A	942 W. Downer Pl.		x	5.0 K	5.0 K
10	LP1C 010 A	1371 Austin Ale.		x		5.0 K
11	LP1C 011 A	721 Calico		x	5.0 K	5.0 K
12	LP1C 012 A	1470 N. Elmwood Dr.		x	5.0 K	14.6
13	LP3S 013 A	432 S. Elmwood Dr.	x		5.0 K	5.0 K
14	LP1C 014 A	115 S. Evanslawn		x	5.0 K	5.0 K
15	LP3S 015 A	800 Fourth St.	x		5.0 K	5.0 K
16	LP1C 016 A	969 Front St.		x	5.0 K	17.3
17	LP1C 017 A	777 High St.		x	5.1	5.0 K
18	LP1C 018 A	1411 Illinois Ale.		x	5.0 K	5.0 K
19	LP1C 019 A	717 Jackson St.		x	5.0 K	5.0 K
20	LP1C 020 A	920 Lebanon St.		x	5.0 K	5.0 K
21	LP1C 021 A	1781 Lily St.		x	5.0 K	5.0 K
22	LP1C 022 A	930 North Ale.		x	5.0 K	5.0 K
23	LP3S 023 A	507 Oak Ale.	x		5.0 K	5.0 K
24	LP3S 024 A	522 Oak Ale.	x		5.0 K	5.0 K
25	LP1C 025 A	641 Oak Ale.		x	5.0 K	17.7
26	LP1C 026 A	1257 Post Rd.		x	5.0 K	5.0 K
27	LP1C 027 A	233 S. 'M!stlawn		x	5.0 K	5.0 K
28	LP1C 028 A	590 Sixth Ale.		x	5.0 K	5.0 K
29	LP1C 029 A	826 Lafayette		x	25,g	5.0 K
30	LP1C 030 A	703 Garfield Ale.		x	5.0 K	8.8
31	LP1C 031 A	737 High St.		x	6.7	5.2
32	LP1C 032 A	634 Lebanon St.		x	5.0 K	5.0 K
33	LP3S 033 A	2009 Blueberry Ln.	x		16.5	28.1
34	LP3S 034 A	2281 Bittersweet Ct.	x		7.7	10.7
35	LP1C 035 A	225 N. Evanslawn		x	5.0 K	5.0 K
36	LP1C 036 A	427 Grand Ale.		x	5.0 K	6.4
37	LP1C 037 A	319 S. LaSalle St.		x	5.0 K	5.0
38	LP1C 038 A	805 Gleason		x	5.0 K	5.0 K
39	LP1C 039 A	454 North Ale.		x	5.0 K	15.7
40	LP1C 040 A	543 Seneca Dr.		x	6.1	25.1
41	LP1C 041 A	647 'M!stgate Dr.		x	5.2	5.0 K
42	LP1C 042 A	209 S. 'M!stern Ale.		x	5.0 K	5.0 K
43	LP1C 043 A	420 Kingsway Dr.		x	5.0 K	5.0 K
44	LP1A 044 A	1035 Cypress Dr.	x		5.0 K	5.3
45	LP1C 045 A	607 Palace St.		x	5.0	7.6
46	LP1C 046 A	1315 W. Galena Blvd.		x	8.9	5.0 K
47	LP1C 047 A	841 Bowditch		x	5.0 K	5.0 K
48	LP1C 048 A	616 Claim St.		x	5.0 K	5.0 K
49	LP1C 049 A	621 Seneca Dr.		x	5.0 K	5.0 K
50	LP3S 050 A	1024 Jackson St.	x		5.0 K	5.0 K
51	LA3S 051 A	67 S. Lancaster St.	x			
52	LP1C 052 A	1343 Galena Blvd.		x	15.8	,5.0 K
53	LP3S 053 A	634 Cheyenne Ale.	x		5.0 K	5.0 K
54	LP1C 054 A	1026 S. 4th St.		x	5.0 K	5.0 K
55	LA3S 055 A	2430 Bradford Dr.	x			
56	LP1C 056 A	451 Bangs St.		x	5.0 K	5.0 K
57	LP1C 057 A	302 N. May St.		x	5.0 K	5.0 K
58	LP3S 058 A	2395 Golden P.od Ct.	x		14.2	29.1
59	LP1C 059 A	618 Simms		x	5.0 K	5.0 K
60	LP1C 060 A	421 Ingleside		x	5.0 K	5.0 K
61	LP1C 061 A	622 Lafayette St.		x	5.0 K	6.6
2	LP1C 062 A	720 Lafayette St.		x	5.0 K	5.0 K
63	LP1C 063 A	714 S. Spencer		x	5.0 K	5.0 K

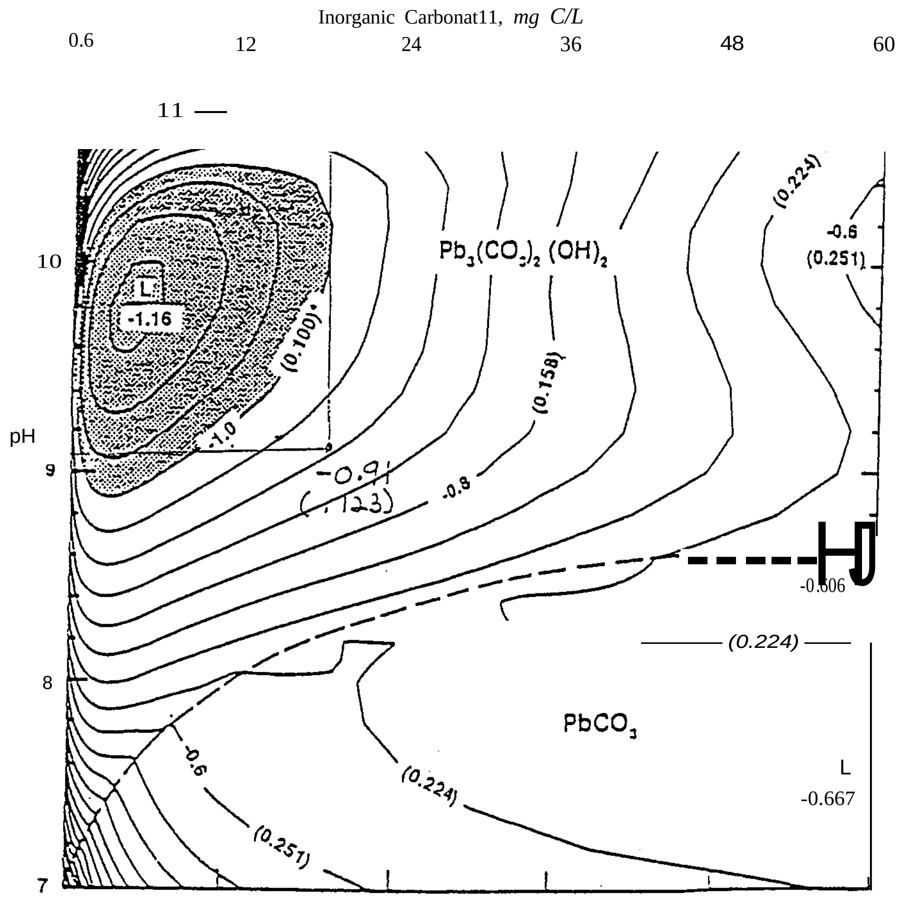
TABLE A-2

SPREADSHEET FOR CALCULATING CCPP

Given:	pH=	9.14	
	Alk=	73	mg/l as CaC03
	Cal=	44	mg/l as CaC03
	Temp=	15	deg C
	pK'sp=	8.21	
	pK'w=	14.35	
	pK'1=	6.419	
	pK'2=	10.43	

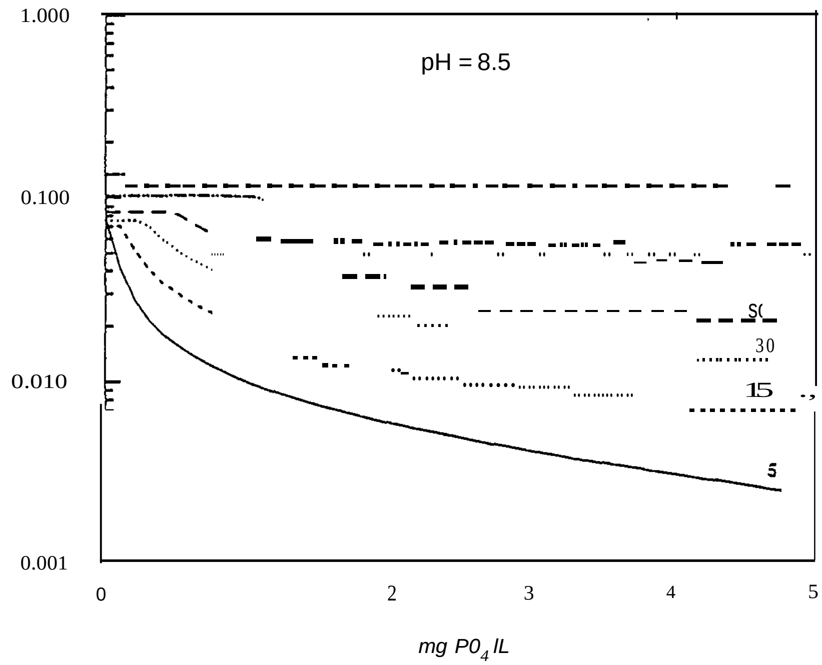
Ca=	Calcium	0.00044	mol/l
Alki=	Alkalinity	0.00146	eqiv/l
Hi=	Hydrogen Ion	7.24436E-10	mol/l
K'sp=	Solubility Const.	6.16595E-09	for CaC03
K'w=	Dissociation Const.	4.46684E-15	for Water
K'1=	1st Carbonic Dissoc. Const.	3.81066E-07	
K'2=	2nd Carbonic Dissoc. Const.	3.71535E-11	
Heq =	Equilibrium H	3.1000E-09	mol/l
Req=	(HEQ-2*K'2)/K'2	81.437578922	
Peq=	(2*HEQ+K'1)/K'1	1.016270155	
Teq=	(2*K'2+HEQ)/HEQ	1.0239700148	
Seq=	Heq-K'w/Heq	-1.43781 E-06	
Pi=	(2*HI+K'1)/K'1	1.0038021566	
Si=	Hi-K'w/Hi	-6.16523E-06	
Ti=	(2*K'2+HI)/HI	1.1025722768	
Acyi=	((ALKI+SI)ffI)*PI+SI)	0.0013174328	
Alkeq=	Teq/Peq*(Acyi-Seq)-Seq	0.001330301	
Term1=	2*K'sp*Req*Peqff/(Acyi-Seq))	0.0007557438	
Term2=	(Acyi-Seq)*Teq/Peq	0.0013288631	
TermO=	2*Ca-Alki	-0.00058	0.93842
Right=	Term1-Term2+Seq	-0.000574557	
CCPP=	Alki-Alkeq	6.4849518944	

FIGURE A-1

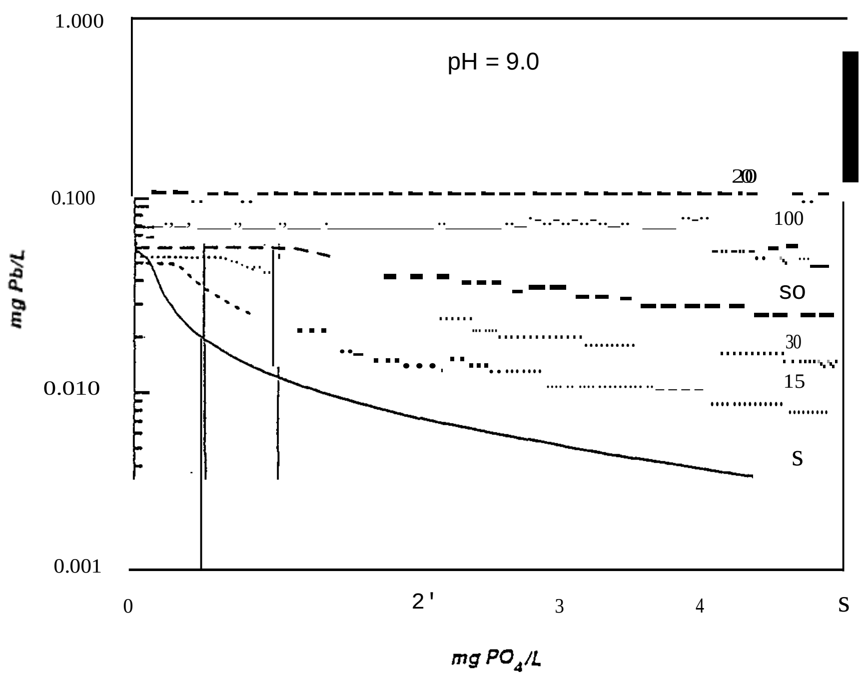


DIssolved inorganic carbonate versus pH: No phosphate, I = 0.01, T = 25°C

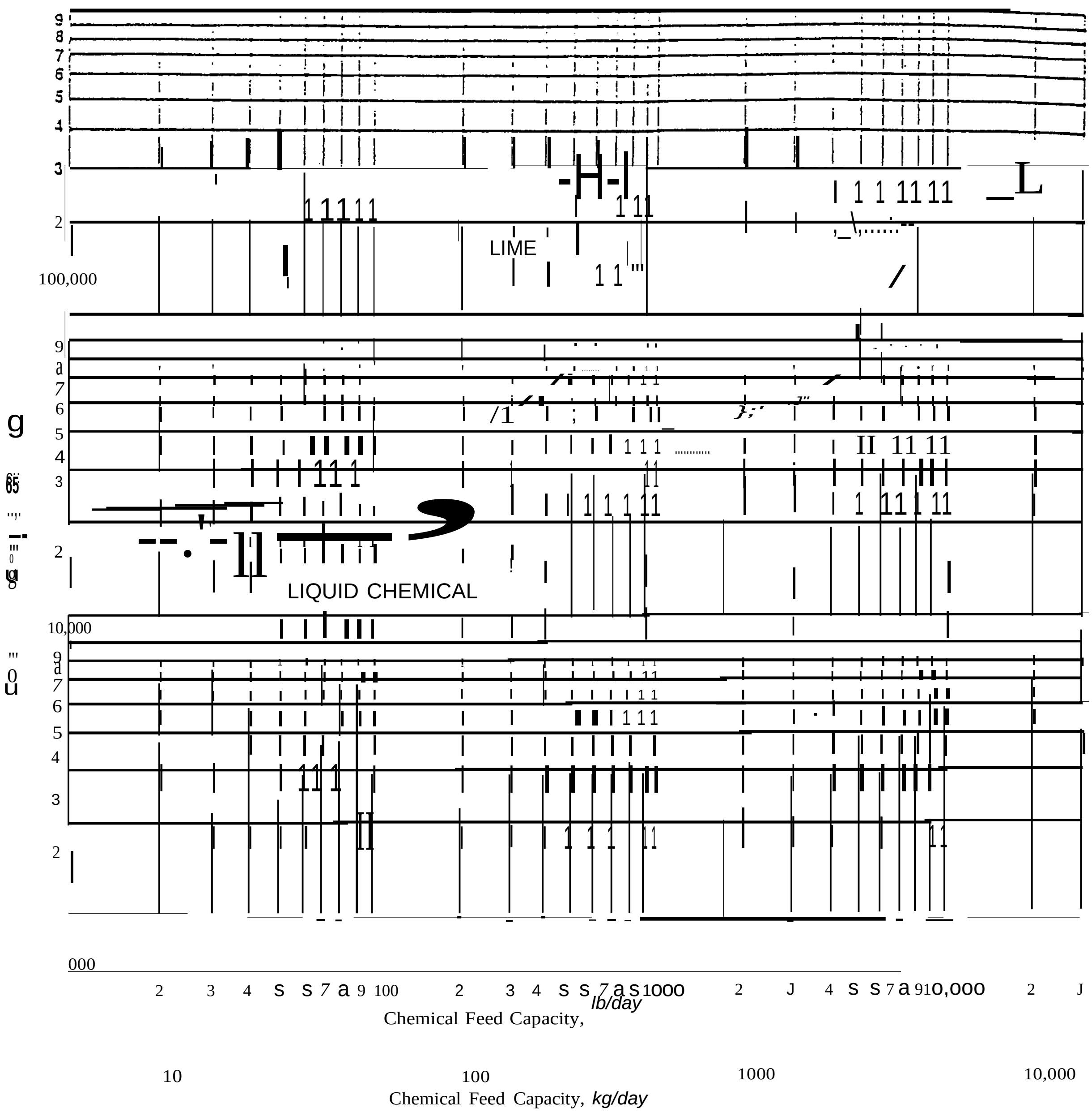
FIGURE A-2



Lead solubility versus orthophosphate at various alkalinities: pH = 8.5, I= 0.005, T = 25°C



Lead solubility versus orthophosphate at various alkalinities: pH = 9.0, I= 0.005, T = 25°C



Chemical feed facilities: Capital cost

Source: Hansen et al. 1979.

TABLE A-3

KJELL F-25-S

Coupons installed	12-21-93
Product	F-25-S
Product activity	31.5 - 32 %
Ortho/poly	40/60 %
Dilution	2 ml/gal
Feed rate	1 ppm as O-P04
Dosage	5.7 gal product/MG treated
Pump Settings	SO % stroke
	70 % speed
Inhibitor started	3-8-94

24-HOUR STANDING SAMPLES

DATE	SAMPLE	TEMP o C	pH	O-P04 mg/l	TOT-P04 mg/l	LEAD mg/l	COPPER mg/l	IRON mg/l
15-Mar-94	Untreated		8.8	<0.06	<0.06	0.0077	<0.01	0.034
	Treated		8.9	<0.06	0.18	0.0113	<0.01	0.074
22-Mar-94	Untreated	10.1	8.8	<0.06	<0.06	0.0100	<0.01	0.068
	Treated	10.2	8.7	0.07	0.23	0.0106	<0.01	0.465
30-Mar-94	Untreated	10.0	8.9	<0.06	<0.06	0.0056	<0.01	0.064
	Treated	9.9	8.9	<0.06	0.19	<0.0050	<0.01	0.057
06-Apr-94	Untreated	13.2	8.8	<0.06	<0.06	0.017	<0.01	0.033
	Treated			0.07	0.21	0.016	<0.01	0.056
13-Apr-94	Untreated	11.7	9.0	<0.06	<0.06	0.0118	<0.01	0.038
	Treated	11.7	9.1	0.08	0.25	0.0094	<0.01	0.04
20-Apr-94	Untreated	14.0	8.7	<0.06	0.07	0.0154	0.013	0.044
	Treated	14.0	8.7	0.09	6.28	0.0171	0.011	0.097
27-Apr-94	Untreated	16.2	9.0	<0.06	<0.06	0.0221	<0.01	0.104
	Treated	16.1	9.0	<0.06	0.08	0.0259	<0.01	0.091
04-May-94	Untreated	13.5	9.0	<0.06	<0.06	0.0091	0.014	0.050
	Treated	13.6	9.0	<0.06	<0.06	0.0100	0.021	0.123
11-May-94	Untreated	15.3	9.1	<0.06	<0.06	0.0202	0.012	0.024
	Treated	15.3	9.1	<0.06	0.09	0.0071	0.011	0.083
18-May-94	Untreated	16.0	8.9	<0.06	0.07	0.0228	0.028	0.196
	Treated	15.8	8.9	0.08	0.19	0.0142	0.026	0.117
25-May-94	Untreated	18.3	8.5	<0.06	<0.06	0.0120	<0.01	0.021
	Treated	18.3	8.5	<0.06	0.14	0.0140	<0.01	0.043
01-Jun-94	Untreated	18.5	9.0	<0.06	0.07	0.0228	0.028	0.196
	Treated	18.5	9.0	0.08	0.19	0.0142	0.026	0.117

TABLE A-4

CALCIQUEST

Coupons installed	12-21-93
Product	Calciquest
Product activity	40 %
Ortho/poly	50/50 %
Dilution	80 ml/gal
Feed rate	5 ppm as product
Dosage	3.7 gal product/MG treated
Pump Settings	45 % stroke
	22 % speed

Inhibitor started 3-8-94

24-HOUR STANDING SAMPLES

DATE	SAMPLE	TEMP o C	pH	O-P04 mg/l	TOT-P04 mg/l	LEAD mg/l	COPPER mg/l	IRON mg/l
15-Mar-94	Untreated	8.2	8.9	<0.06	0.07	0.0132	0.022	0.202
	Treated	8.1	6.6	0.12	0.48	0.0102	0.026	0.331
22-Mar-94	Untreated	10.6	8.7	<0.06	0.07	0.0099	<0.01	0.040
	Treated	10.7	8.7	<0.06	0.08	0.0153	<0.01	0.187
30-Mar-94	Untreated	10.1	9.0	<0.06	0.13	0.0066	0.021	0.333
	Treated	10.1	9.0	<0.06	0.10	0.0101	0.027	0.242
06-Apr-94	Untreated	13.2	8.8	<0.06	0.15	0.0180	0.020	0.238
	Treated			<0.06	0.09	0.0197	0.013	0.183
13-Apr-94	Untreated	11.7	9.1	0.06	0.20	0.0092	<0.010	0.367
	Treated	11.7	9.1	<0.06	0.08	0.0101	<0.010	0.319
20-Apr-94	Untreated	14.1	8.8	<0.06	0.11	0.0151	0.015	0.576
	Treated	14.1	8.7	<0.06	0.09	0.0194	0.016	1.270
27-Apr-94	Untreated	16.2	8.9	<0.06	0.11	0.0173	0.020	1.270
	Treated	16.2	8.9	<0.06	0.08	<0.0050	O.Q_14	0.385
04-May-94	Untreated	13.8	9.0	<0.06	0.07	0.0172	0.015	1.760
	Treated	13.8	9.0	<0.06	0.09	0.0076	0.016	0.562
11-May-94	Untreated	15.6	9.1	<0.06	0.11	0.0126	0.017	0.202 —
	Treated	15.6	9.1	<0.06	0.19	0.0199	0.030	1.040
18-May-94	Untreated	16.0	8.9 / 8.9	<0.06 / <0.06	<0.06 / 0.06	0.0126 / 0.0113	0.025 / 0.021	0.137 / 0.565
	Treated	16.0						
25-May-94	Untreated	19.2	8.4	<0.06	0.09	0.0210	<0.010	0.229
	Treated	19.2	8.4	<0.06	0.09	0.0230	0.012	0.215
01-Jun-94	Untreated	18.7	9.0	<0.06	<0.06	0.0126	0.025	0.137
	Treated	18.7	9.0	<0.06	0.06	0.0113	0.021	0.565

TABLE A-5

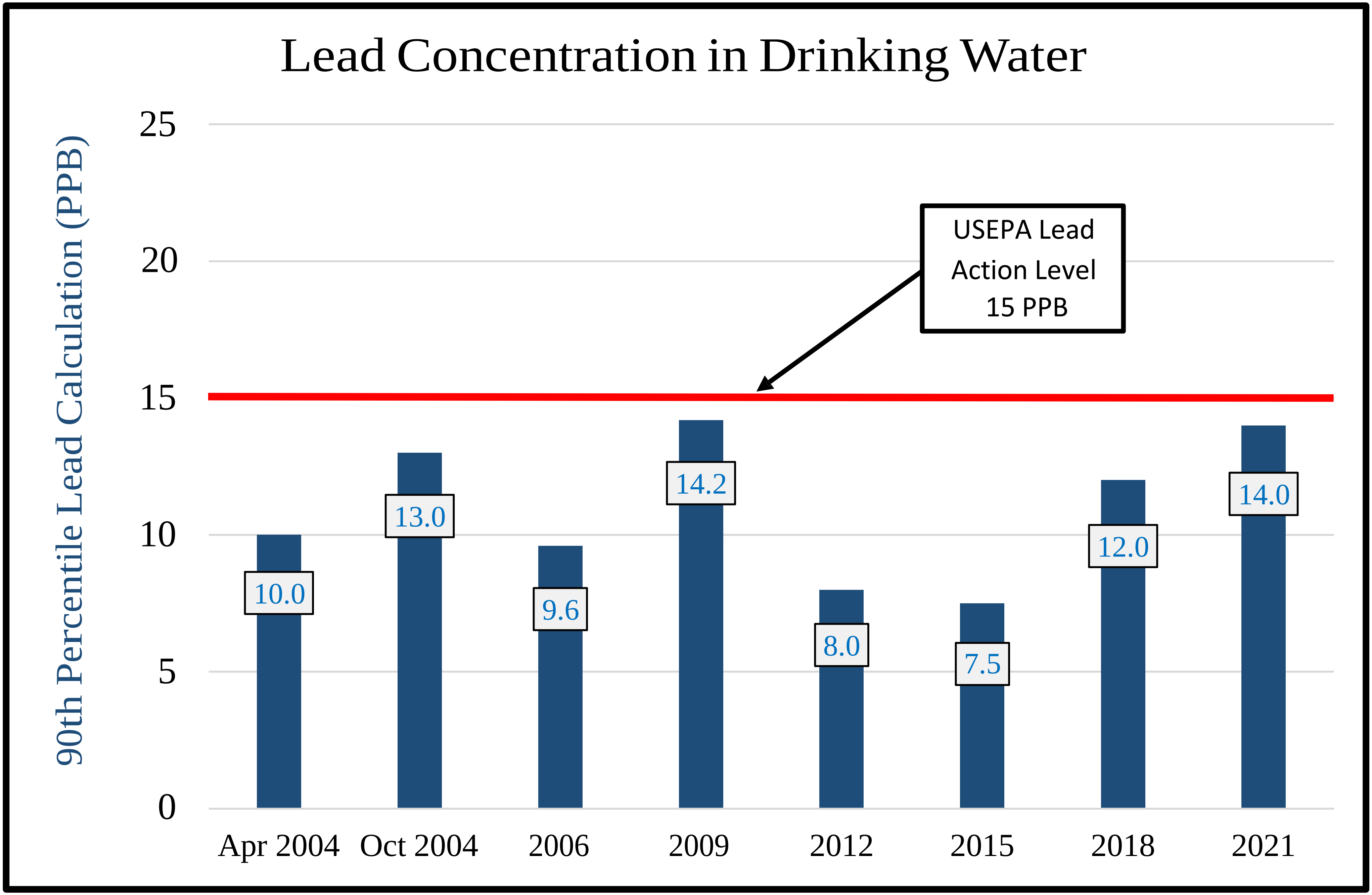
STILES KEM SK 7641

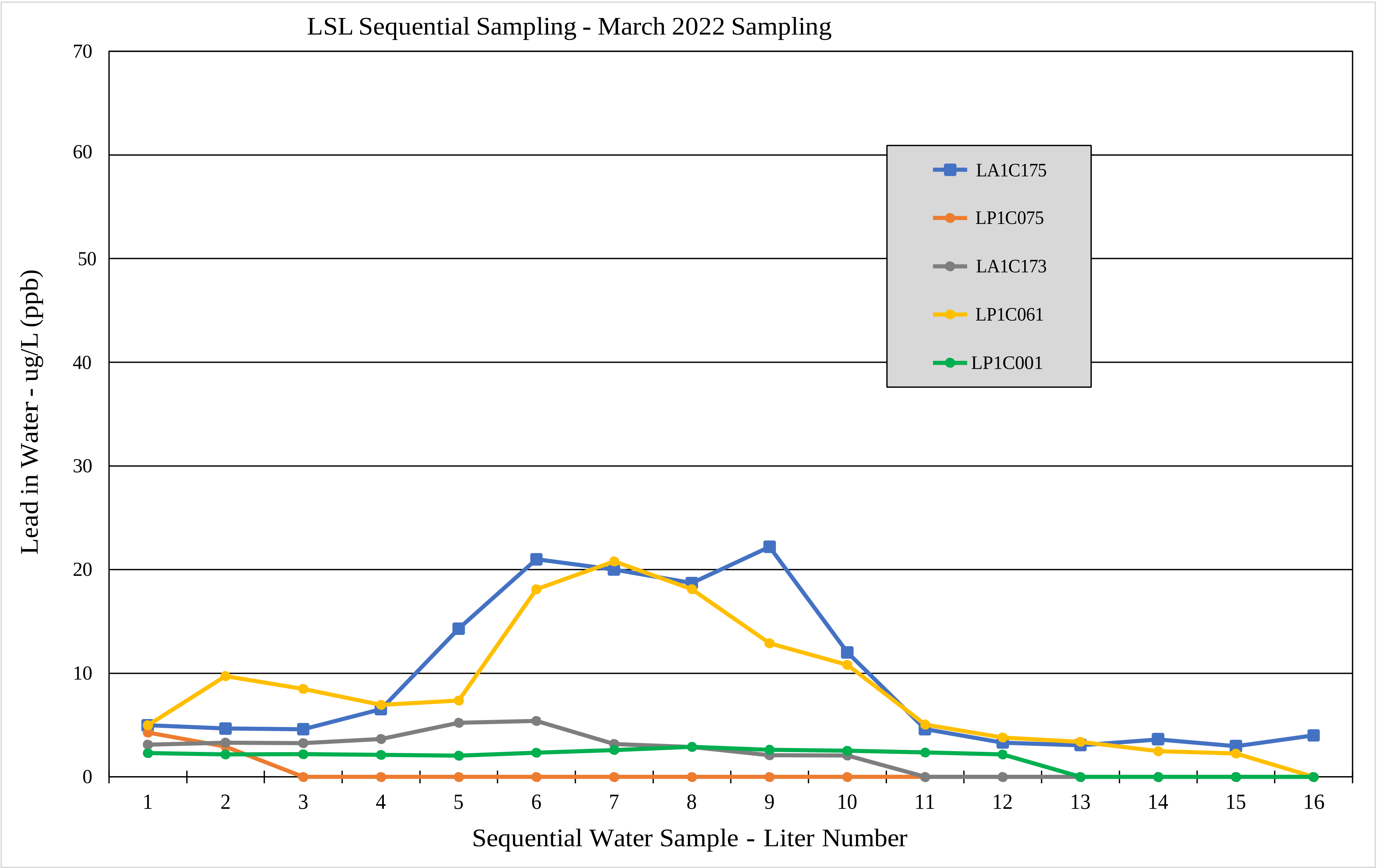
Coupons installed 12-21-93
Product SK-7641
Product activity 32 %
Ortho/poly 40/60 %
Dilution 18 ml/gal
Feed rate 1 GPD

Dosage 1.6 gal product/MG treated
Pump Settings % stroke
% speed

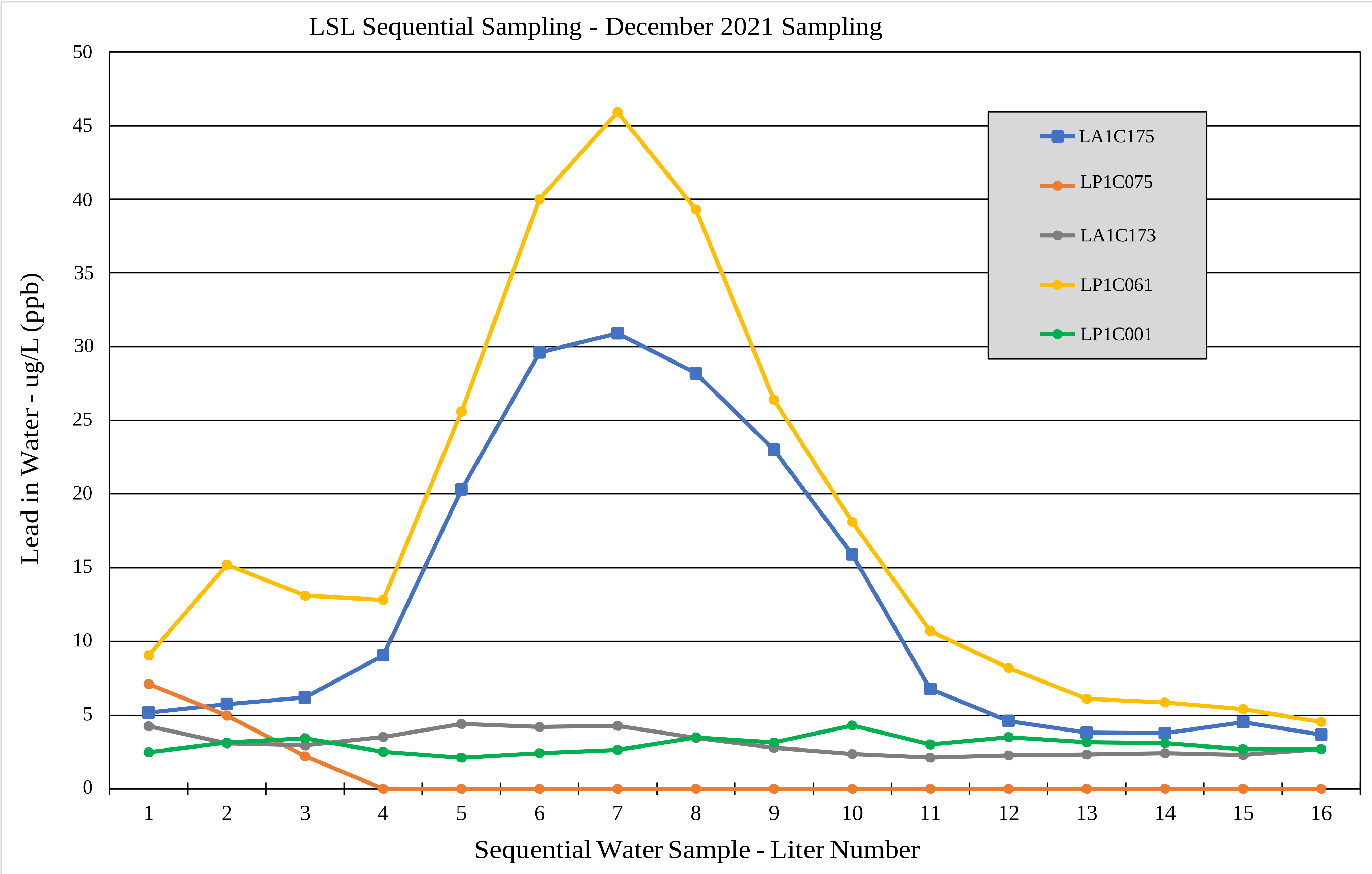
Inhibitor started 3-8-94
24-HOUR STANDING SAMPLES

DATE	SAMPLE	TEMP o C	pH	O-P04 mg/l	TOT-P04 mg/l	LEAD mg/l	COPPER mg/l	IRON mg/l
15-Mar-94	Untreated	8.1	8.9	<0.06	<0.06	0.0162	<0.01	0.458
	Treated	8.1	8.9	<0.06	0.08	0.0181	<0.01	0.574
22-Mar-94	Untreated	10.4	8.5	0.07	0.22	0.0360	<0.01	0.214
	Treated	10.2	8.2	0.20	0.56	0.0140	<0.01	1.470
30-Mar-94	Untreated	10.0	9.0	<0.06	<0.06	0.0110	<0.01	0.493
	Treated	10.0	9.0	<0.06	0.13	0.0138	<0.01	0.634
06-Apr-94	Untreated	13.2	8.8	<0.06	<0.06	0.0277	<0.01	0.685
	Treated			<0.06	<0.06	0.0233	<0.01	0.756
13-Apr-94	Untreated	11.9	9.1	<0.06	<0.06	0.0103	<0.01	0.692
	Treated	11.9	9.1	<0.06	<0.06	0.0166	0.01	0.823
20-Apr-94	Untreated	14.2	8.7	<0.06	<0.06	0.0240	0.0.16	1.31
	Treated	14.2	8.8	<0.06	<0.06	0.0182	0.017	0.847
27-Apr-94	Untreated	16.2	9.0	<0.06	<0.06	0.0149	0.014	0.829
	Treated	16.2	9.0	<0.06	<0.06	0.0202	<0.01	0.804
04-May-94	Untreated	13.6	9.0	<0.06	<0.06	0.0112	0.015	0.966
	Treated	13.6	9.0	0.92	1.81	0.0150	0.015	0.996
11-May-94	Untreated	15.5	9.1	<0.06	0.07	0.0155	0.014	0.791
	Treated	15.5	9.1	0.44	1.39	0.0200	0.014	0.770
18-May-94	Untreated	16.0	8.9	<0.06	<0.06	0.0140	0.019	0.738
	Treated	16.0	8.9	0.43	1.28	0.0163	0.016	0.763
25-May-94	Untreated	20.1	8.3	<0.06	0.06	0.0190	<0.01	1.08
	Treated	19.5	8.3	0.38	1.14	0.0210	0.011	0.025
01-Jun-94	Untreated	18.5	9.0	<0.06	0.06	0.0140	0.019	0.738
	Treated	18.5	9.0	0.43	1.28	0.0163	0.016	0.763

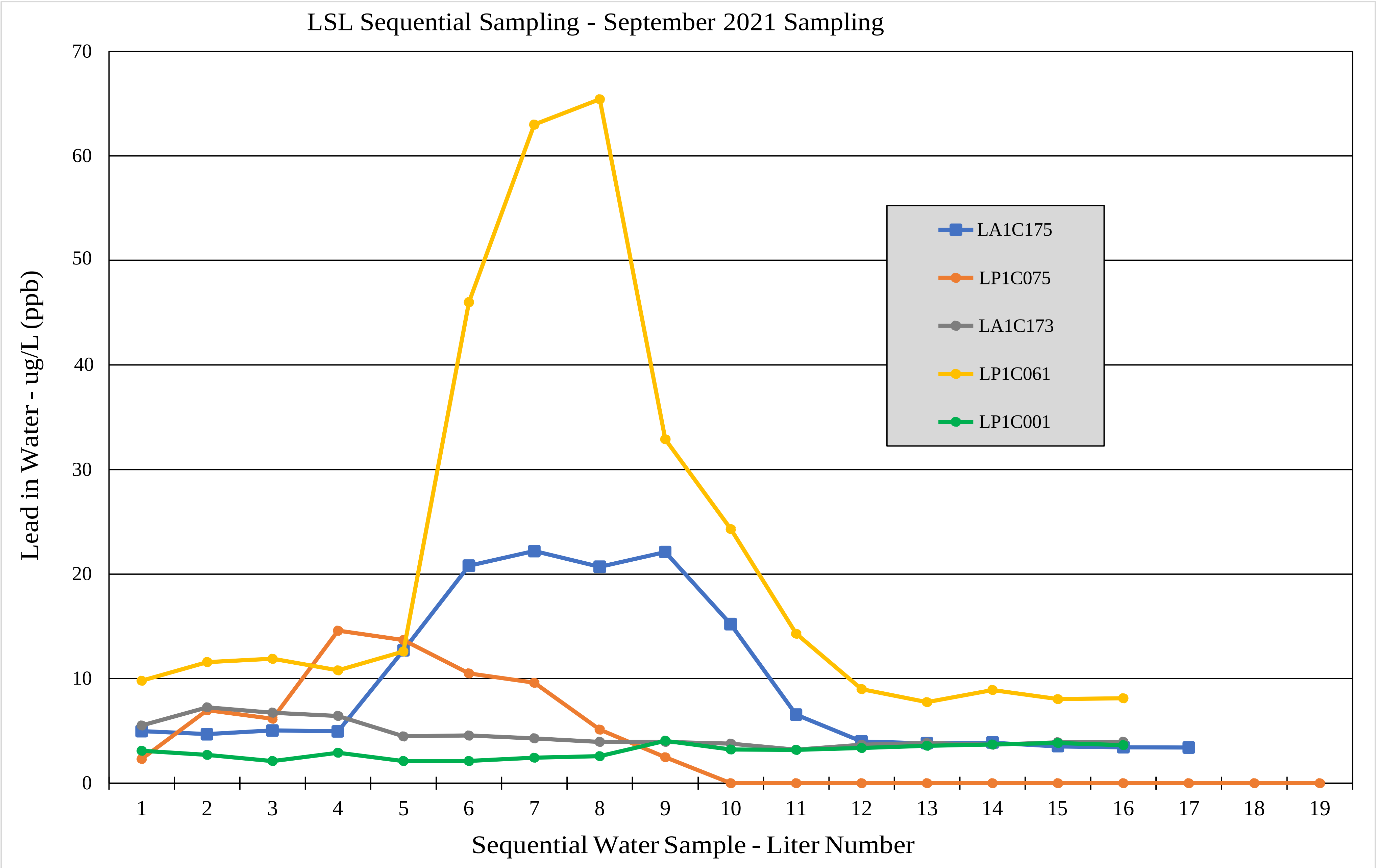

Lead Concentration in Drinking Water
90th Percentile Lead Calculation (PPB)
25
20
15
10
5
0
USEPA Lead Action Level 15 PPB
10.0
13.0
9.6
14.2
8.0
7.5
12.0
14.0
Apr 2004
Oct 2004
2006
2009
2012
2015
2018
2021



LSL Sequential Sampling - March 2022 Sampling
Lead in Water - ug/L (ppb)
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Sequential Water Sample - Liter Number
LA1C175
LP1C075
LA1C173
LP1C061
LP1C001



LSL Sequential Sampling - December 2021 Sampling
Lead in Water - ug/L (ppb)
Sequential Water Sample - Liter Number
LA1C175
LP1C075
LA1C173
LP1C061
LP1C001
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16



LSL Sequential Sampling - September 2021 Sampling
Lead in Water - ug/L (ppb)
Sequential Water Sample - Liter Number
0
10
20
30
40
50
60
70
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
LA1C175
LP1C075
LA1C173
LP1C061
LP1C001

2021 WATER QUALITY REPORT

CITY OF AURORA, ILLINOIS

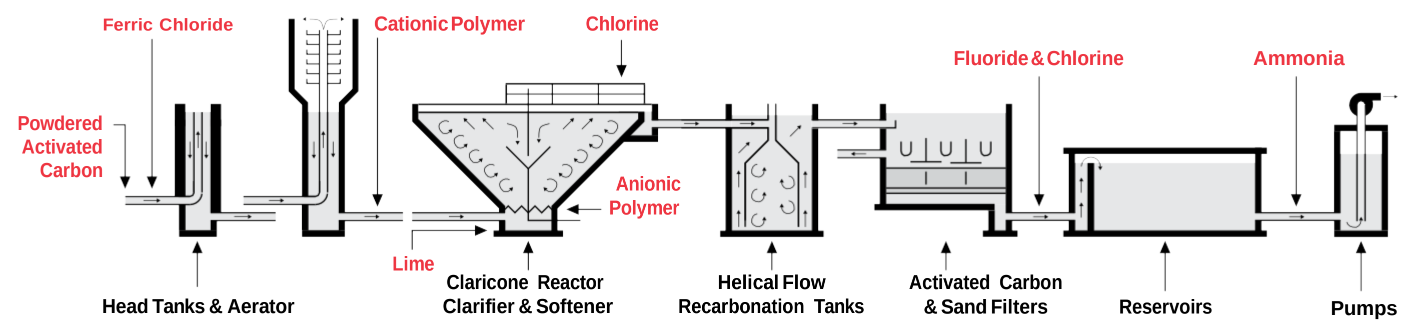
Water Production Division - Reporting Year 2021
David Schumacher, P.E., Superintendent of Water Production | Robert Leible, Assistant Superintendent
Phone Number: (630) 256-3250 | Fax Number: (630) 256-3259 | Website: www.aurora-il.org

Una versión en español este informe está disponible en www.aurora-il.org/950/water-production

This report is intended to provide you with important information about your drinking water and the efforts made by the City of Aurora Water Production Division to provide safe drinking water.

In order to ensure that tap water is safe to drink, the Water Production Division staff works around the clock to maintain the high quality and safety of Aurora's award-winning tap water. The U.S. Environmental Protection Agency (U.S. EPA) prescribes regulations which limit the amount of certain contaminants in water provided by public water supply systems. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water, which must provide the same protection for public health. To confi that your tap water meets U.S. EPA regulations, water samples are regularly submitted for laboratory analysis. This report summarizes contaminants found in testing during 2021. No drinking water quality violations were recorded during 2021 for the City of Aurora. All monitoring and reporting requirements were also met.

PROCESS FLOW DIAGRAM - AURORA WATER TREATMENT FACILITY



SOURCE WATER

Assessment Summary

The source water assessment for the City of Aurora was completed by the Illinois Environmental Protection Agency (IEPA) in 2003. This assessment, and other informational requests, can be addressed by calling the Water Production Division at (630) 256-3250. To view a summary of the completed Source Water Assessment, including: Importance of Source Water; Susceptibility to Contamination Determination; and documentation/ recommendation of Source Water Protection Efforts, you may access the IEPA website at www. epa.state.il.us/cgi-bin/wp/swap-fact-sheets.pl. The Fox River water source is considered vulnerable to contamination. IEPA considers all surface water sources of community water supply to be susceptible to potential contamination. Therefore certain treatment processes are mandatory for all surface water supplies in Illinois. These include coagulation, sedimentation, fi ation, and disinfection, all of which are provided by Aurora.

IEPA has determined Aurora's shallow well water source is susceptible to volatile organic chemical (VOC) and synthetic organic chemical (SOC) contamination based on the unconfi nature of the sand and gravel aquifer and proximity of potential sources of contamination. As such, the IEPA has provided a 5-year capture zone delineation for this source. The deep well water source is not susceptible to inorganic chemicals (IOC), VOC, or SOC contamination. This determination is based on monitoring conducted at the wells, monitoring conducted at the entry point to the distribution system, and the available hydrogeologic data for the wells.

CITY OF AURORA

Water Production Division

Sources of water for the Aurora Water Treatment Plant include surface water from the Fox River and a blend of water from several shallow wells and deep wells, which draw from the Cambrian-Ordovician Aquifer system.

Plant Capacity: The Aurora Water Treatment Plant is capable of fully treating 36.5 million gallons of water per day.

Treatment and Distribution System: Well water is pumped to the plant through a collector line where it is combined with Fox River water. The water is then lime-softened, fl fi disinfected and discharged into reservoirs with a total storage capacity of 6 million gallons. From there, the water is pumped into the distribution system by pumps located at the plant. Next, the water travels through a series of pipes ranging in size from 4 inches to 36 inches in diameter on its way to your tap. Nine storage tanks located throughout the city provide 17.5 million gallons of storage and maintain adequate pressure.

Tap Water Information

- Has a pH level of 8.9-9.2 and a chloramine disinfectant residual of 2-3 mg/liter
- Has a hardness range of 110-160 mg/liter (6-10 grains per gallon)
- Has a fluoride content of 0.7 mg/liter as required by the Illinois Department of Public Health

DEFINITION OF TERMS*

for Water Quality Test Results

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not refl the benefi of the use of disinfectants to control microbial contaminants.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Action Level Goal (ALG): The level of a contaminant in drinking water below which there is no known or expected risk to health. ALGs allow for a margin of safety.

Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

ppm or mg/L: one ounce in 7,350 gallons of water – or parts per million or milligrams per liter.

ppb or ug/L: one ounce in 7,350,000 gallons of water – or parts per billion or micrograms per liter.

ppt or ng/L: one ounce in 7,350,000,000 gallons of water - parts per trillion or nanograms per liter.

pCi/L: picoCuries per Liter - measurement of radioactivity.

NTU: Nephelometric Turbidity Unit - measurement of solids in water.

N/A: not applicable.

Oocysts/L: The number of Cryptosporidium organisms per Liter of water tested.

Treatment Technique: A required process intended to reduce the level of a contaminant in drinking water.

**shown on next page*

PARTNERSHIP FOR SAFE WATER

Presidents Award

The City of Aurora is proud to recognize the achievement of the Aurora Water Production Division in providing some of the nation's safest, cleanest drinking water to the city's residents.

The Aurora Water Production Division has been honored with the Presidents Award from the Partnership for Safe Water, a national initiative to improve the quality of drinking water. The Aurora Water Treatment Facility is one of a limited number of surface water treatment plants nationwide to achieve and document the exceptional water quality required to earn the Presidents Award. This places the Aurora Water Treatment Facility in the top 1 percent of surface water treatment plants in the United States.

The optimization of individual fi performance is a key water quality performance goal of the Partnership for Safe Water's Treatment Plant Optimization program. The Presidents Award recognizes the highest possible and most stringent level of individual fi performance and is an outstanding achievement.

WATERSENSE PROGRAM

United States EPA

The City of Aurora is a partner in the U.S. EPA's WaterSense program, which is a voluntary nationally recognized program that promotes water conservation and effi The program also provides reliable information on water effi products and practices. Look for the WaterSense label on products which will be 20% more effi and perform as well or better than conventional products. To fi more information go to the WaterSense website at http://www.epa.gov/watersense.

CONTAMINANTS THAT MAY BE PRESENT IN SOURCE WATER

Sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and in some cases, radioactive material. Water can also pick up substances resulting from the presence of animals or from human activity.

Pesticides and herbicides which may come from a variety of sources such as agriculture, urban storm water runoff, and residential uses.

Microbial contaminants such as viruses, protozoa, and bacteria, which may come from wastewater treatment plants, septic systems, agricultural livestock operations, and wildlife.

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and may also come from gas stations, urban storm water runoff, and septic systems.

Inorganic contaminants, such as salts and metals, which may occur naturally or result from urban storm runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Radioactive contaminants, which may occur naturally or result from oil and gas production and mining activities.

More information about contaminants and potential health effects can be obtained by calling the U.S. Environmental Protection Agency's SAFE DRINKING WATER HOTLINE (800) 426-4791.

We want our valued customers to be informed about their water quality. If you would like to learn more, please contact the Water Production Division at 630-256-3250, visit the Water Production Division's webpage: www.aurora-il.org/950/water-production, or attend a regularly scheduled city committee meeting.

2021 WATER QUALITY TEST RESULTS

The following tables contain scientifi terms and measures, some of which may require explanations. Defi of terms used below are listed on the previous page.

LEAD AND COPPER

Lead & Copper	Date Sampled	MCLG	Action Level (AL)	90th Percentile	# Sites Over AL	Units	Violation	Likely Source of Contamination
Copper	2021	1.3	1.3	0.067	0	ppm	N	Erosion of natural deposits; Leaching from wood preservatives; Corrosion of household plumbing.
Lead	2021	0.0	15	14	4	ppb	N	Corrosion of household plumbing systems; Erosion of natural deposits.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Aurora cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours in your home's pipes, you can minimize the potential for lead exposure by flushing your tap for 30 seconds before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (800 426-4791) or at http://www.epa.gov/safewater/lead. For detailed information on lead in drinking water, please visit the city's webpage on lead in drinking water at https://www.aurora-il.org/960/Lead-in-Drinking-Water.

REGULATED CONTAMINANTS

Disinfectants & By-Products	Date Collected	Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Likely Source of Contamination
Chloramines	2021	3	2.8 - 3	MRDLG=4	MRDL=4	ppm	N	Water additive used to control microbes.
Haloacetic Acids (HAA5)	2021	11	6.1 - 19.9	No goal for the total	60	ppb	N	By-product of drinking water disinfection.
(TTHM) Total Trihalomethanes	2021	42	27.6 - 56.4	No goal for the total	80	ppb	N	By-product of drinking water disinfection.
Inorganic Contaminants	**Date Collected**	**Highest Level Detected**	**Range of Levels Detected**	**MCLG**	**MCL**	**Units**	**Violation**	**Likely Source of Contamination**
Barium	2021	0.0073	0.0073 - 0.0073	2	2	ppm	N	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits.
Chromium	2021	3	2.7 - 2.7	100	100	ppb	N	Discharge from steel and pulp mills; Erosion of natural deposits.
Fluoride	2021	0.67	0.63 - 0.74	4	4.0	ppm	N	Erosion of natural deposits; Water additive which promotes strong teeth; Dischargefrom fertilizer and aluminum factories.
Nitrate (Measured as Nitrogen)	2021	1	0.8 - 0.8	10	10	ppm	N	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.
Sodium*	2021	70	70 - 70			ppm	N	Erosion from naturally occuring deposits; Used in water softener regeneration.

**There is not a state or federal MCL for sodium. Monitoring is required to provide information to consumers and health officials that are concerned about sodium intake due to dietary precautions. If you are on a sodium restricted diet, you should consult a physician about this level of sodium in the water.*

COLIFORM BACTERIA

MCLG	Total Coliform MCl	Highest Number of Positive	Fecal Coliform or E. Coli MCL	Total Number of Positive E. Coli or Fecal Coliform Samples	Violation	Likely Source of Contamination
0	5% of monthly samples are positive	0		0	N	Naturally present in the environment.

TURBIDITY

	Limit (Treatment Technique)	Level Detected	Violation	Likely Source of Contamination
Highest single measurement	1 NTU	0.061 NTU	N	Soil runoff.
Lowest monthlty % meeting limit	0.3 NTU	100%	N	Soil runoff.

Turbidity is a measurement of the cloudiness of the water caused by suspended particles. Turbidity is monitored because it is a good indicator of water quality and the effectiveness of our filtration system and disinfectants.

Total Organic Carbon: The percentage of Total Organic Carbon (TOC) removal was measured each month and the system met all TOC removal requirements set, unless a TOC violation is noted in the violations section.

RAW WATER MONITORING

Contaminant	Date Sampled	Average level Detected	Units	Raw Source Water Informational Statement
Cryptosporidium	2021	0.151	0ocysts	Cryptosporidium is a microbial parasite found in surface water throughout the U.S. Although filtration removes cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Aurora's monitoring of the Fox River indicates the presence of these organisms. Current test methods do not permit determination of the organisms viability; the ability to cause disease. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immunocompromised people are at greater risk of developing life-threatening illness. Immunocompromised individuals are encouraged to consult their doctors regarding appropriate precautions to avoid infections. Cryptosporidium must be ingested to cause disease and it may be spread through means other than drinking water.

The IEPA requires Aurora to monitor for certain contaminants less than once per year because the concentrations of these compounds do not change frequently. Thus, some data, though accurate, is more than one year old.

LAWN WATERING PERMITTED

6-9 AM AND 6-9 PM

Odd Addresses on Odd Days
Even Addresses on Even Days

UNREGULATED CONTAMINANT MONITORING

The City of Aurora was required to sample and test for all the contaminants listed in the Unregulated Contaminant Monitoring Rules (UCMR2, UCMR3 and UCMR4) from 2009 to 2019. The results of this monitoring are not included in this report, but are available upon request by contacting the Water Production Division at (630) 256-3250. The purpose of unregulated contaminant monitoring is to assist the U.S. EPA in determining the occurrence of unregulated contaminants in drinking water and whether future regulation is warranted.

2021 ADDITIONAL VOLUNTARY UNREGULATED CONTAMINANT MONITORING

The City of Aurora also samples for many other compounds on a voluntary basis that are not regulated. Some of the general categories of data collected include inorganic compounds, volatile organic compounds, synthetic organic compounds, bacteria levels, pharmaceuticals and personal care products, algal toxins, and several others. This data is not included in this report, but is available upon request by contacting the Water Production Division at (630) 256-3250.

2021 EMERGENCY BACK-UP WELL MONITORING

The City of Aurora maintains emergency back-up wells. These wells are sampled and tested monthly. This data is not included in this report, but is available upon request by contacting the Water Production Division at (630) 256-3250.

HEALTH INFORMATION

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of contaminants. The mere presence of contaminants in drinking water does not necessarily represent a health risk.

Some people may be more vulnerable to certain contaminants in drinking water than the general population. Immunocompromised people, such as cancer patients undergoing chemotherapy, organ transplant recipients, people with HIV/AIDS or other immune system disorders, and some senior citizens and infants can be particularly at risk of infections. These people should seek advice about drinking water from their health care providers.

U.S. EPA/Center for Disease Control guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the **SAFE DRINKING WATER HOTLINE (800) 426-4791.**

For more detailed information on lead in drinking water, please visit the city's webpage on lead in drinking water at http://www.aurora-il.org/960/Lead-in-Drinking-Water.

2020 & 2021 UNREGULATED PER- AND POLYFLUOROALKYL SUBSTANCE (PFAS) MONITORING

PFAS are a group of approximately 5,000 human-made substances that have been manufactured in the United States since the 1940s for their unique oil and water-resistant properties. This has resulted in PFAS being released into the air, water, and soil. Neither the state IEPA nor the federal U.S.EPA have developed enforceable drinking water standards for PFAS.

As part of the State of Illinois's PFAS Statewide Investigation, the City of Aurora's water was initially sampled in 2020 for eighteen PFAS compounds. Results from this and additional follow up sampling in 2021 indicated PFAS were detected in the city's drinking water. One compound (PFOA) has been detected above the health advisory level established by the IEPA. All other detected PFAS compounds were below the health advisory levels established by the IEPA. Results are shown in the table below and follow up monitoring is being conducted.

UNREGULATED CONTAMINANTS

PFAS Compound	Date Collected	Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units
PFOA	2021	3.1	<2.0-3.1	N/A	N/A	ppt
PFBS	2021	4.5	<2.0-4.5	N/A	N/A	ppt
PFHxA	2021	10	4.3-10.0	N/A	N/A	ppt

More information about PFAS in Drinking Water can be found at the following website: https://www.aurora-il.org/2257/PFAS-in-Drinking-Water or by contacting the Water Production Division at (630) 256-3250.

More information about PFAS health advisories is available at the following website: https://www2.illinois.gov/epa/topics/water-quality/pfas/Pages/pfashealthadvisory.aspx.