DBS&A
a Geo-Logic Company

May 30, 2024

Emily Worthen
New Mexico Environment Department
Drinking Water Bureau
1190 St. Francis Drive
P.O. Box 5469
Santa Fe, New Mexico 87502
emily.worthen@nm.env.gov

Re: Bench Test Report
Town of Springer Water Treatment Plant
WIIN Grant Project 2024-4
Public Water System #NM3526604

Dear Ms. Worthen:

Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to provide this bench test report under Contract ID #24-667-2080-27685 for assistance to small public water systems, PO #66700-0000041185.

Under our contract, DBS&A is providing engineering design assistance to the Town of Springer (the Town) for additional treatment of drinking water at the existing surface water treatment plant (WTP) to reduce the potential for disinfection by-product (DBP) formation. The Town supplies water to one consecutive system, the French Mutual Domestic Water Consumer Association (MDWCA), and also to the Springer Correctional Facility, which used to be classified as a consecutive system, but is now considered a Town customer. All three public water systems have historically had violations of the federal maximum contaminant limits (MCLs) for DBPs.

The source water for the WTP is surface water from Eagle Nest Lake, which is conveyed to Springer via the Cimarron River and an irrigation ditch. The raw water flows through two reservoirs. Reservoir 1 allows for particulate settling and Reservoir 2 provides approximately a full year of raw water storage. Figure 1 shows the area surrounding and including the reservoirs and WTP. Figure 2 provides a schematic of the water system.

DBS&A prepared a preliminary engineering report (PER) in 2021 for French MDWCA. As part of that analysis, we collected information on the Town's WTP, and one of the alternatives we examined was improvements at the WTP to convert chlorine to chloramines, thus reducing the formation of DBPs. This alternative includes pH adjustment, enhanced coagulation, and addition of ammonia after the clearwell at the WTP. The Town currently disinfects in the clearwell.

Enhanced coagulation will require pH adjustment through injection of acid, chemical dosing with ferric chloride or aluminum sulfate (alum) for reduction of turbidity, total organic carbon (TOC), and dissolved organic carbon (DOC), and injection of ammonia to convert chlorine to chloramines to reduce the formation of DBPs. The Springer WTP currently uses alum and polymer for coagulation and removal of turbidity, TOC, and DOC, and uses liquid sodium hypochlorite, delivered in bulk to the plant, for disinfection.

Figure 3 provides a flow schematic of the existing treatment plant. Figure 4 provides a plan view of the treatment system.

DBS&A and Howe Water Science (HWS), our subconsultant, visited the Springer WTP on April 22, 2024 and collected water samples. HWS subsequently performed bench testing with the following objectives:

- Evaluate whether alum or ferric chloride is more effective for turbidity, TOC, and DOC removal.
- Evaluate the preferred pH for optimal TOC and DOC removal during enhanced coagulation.
- Evaluate the rate of chlorine decay before ammonia is added to facilitate contact time (CT) credit calculations and ammonia dosing requirements.
- Evaluate the rate of trihalomethane (THM) formation before ammonia is added to determine maximum acceptable free chlorine CT and corresponding THM formation.
- Evaluate the rate of chloramine decay after ammonia is added to assess potential for loss of combined chlorine residual in the distribution system.

The results of the bench testing are summarized in the HWS report (Attachment 1), which includes recommendations.

Findings and Recommendations

Enhanced coagulation and residual disinfection by chloramines were shown in the bench tests to be effective strategies for reducing DBP formation in Springer's drinking water. Enhanced coagulation increases TOC removal substantially, and DBP formation was shown to cease with ammonia addition after primary disinfection is achieved. However, there are operational and physical improvements that must be implemented to adequately address compliance with both the Disinfectant/Disinfection Byproduct Rule and the Surface Water Treatment Rule.

Additional Information

We reviewed the sanitary survey report for the Springer water system dated October 24, 2023. The sanitary survey identifies 19 significant deficiencies that must be corrected at the plant. Significant deficiencies related to disinfection and DBPs include the following issues:

- The WTP has inadequate process control, including the lack of removal of TOC. The WTP meets the requirements of the Disinfection Byproducts Rule with the alternate compliance option of specific ultraviolet absorption (SUVA). Although this avoids violations of the Disinfection Byproducts Rule, compliance with SUVA does nothing to remove TOC and nothing to reduce DBPs.
- The WTP is not providing adequate inactivation of pathogens due to inadequate CT measurements. The water system is not evaluating CT to include treatment plant flows, piping, and storage between the chlorine injection point and first service connection in each of the water systems. Monthly operating reports reveal that CT is not being met on days of low free chlorine residual.

The CT issue is relevant to this project because the ammonia to form chloramines must be added after primary disinfection is achieved. Without adequate primary disinfection, the ammonia system cannot be designed. The sanitary survey report also noted other significant deficiencies, including lack of water audit or water loss assessment, insufficient operation and maintenance plan, insufficient emergency response plan, inadequate record keeping, and inadequate process control, among others.

Closing

Our current scope of work is to address treatment facility modifications needed to protect against DBP formation. However, reducing DBP formation must be coupled with providing adequate disinfection of pathogens. Based on the information provided in the sanitary survey report, it appears that a full evaluation of the operation of the plant, and design improvements that will provide better process control, are warranted. We have not performed sufficient analysis at this time to troubleshoot, but if you agree this should be part of the project, we will consider whether there will be additional effort to the design to perform this analysis and make recommendations.

DBS&A can also assist the Town with a corrective action plan and with items noted as significant deficiencies.

We look forward to discussing this report with you. If you have questions or need further information, please call us at (505) 822-9400.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

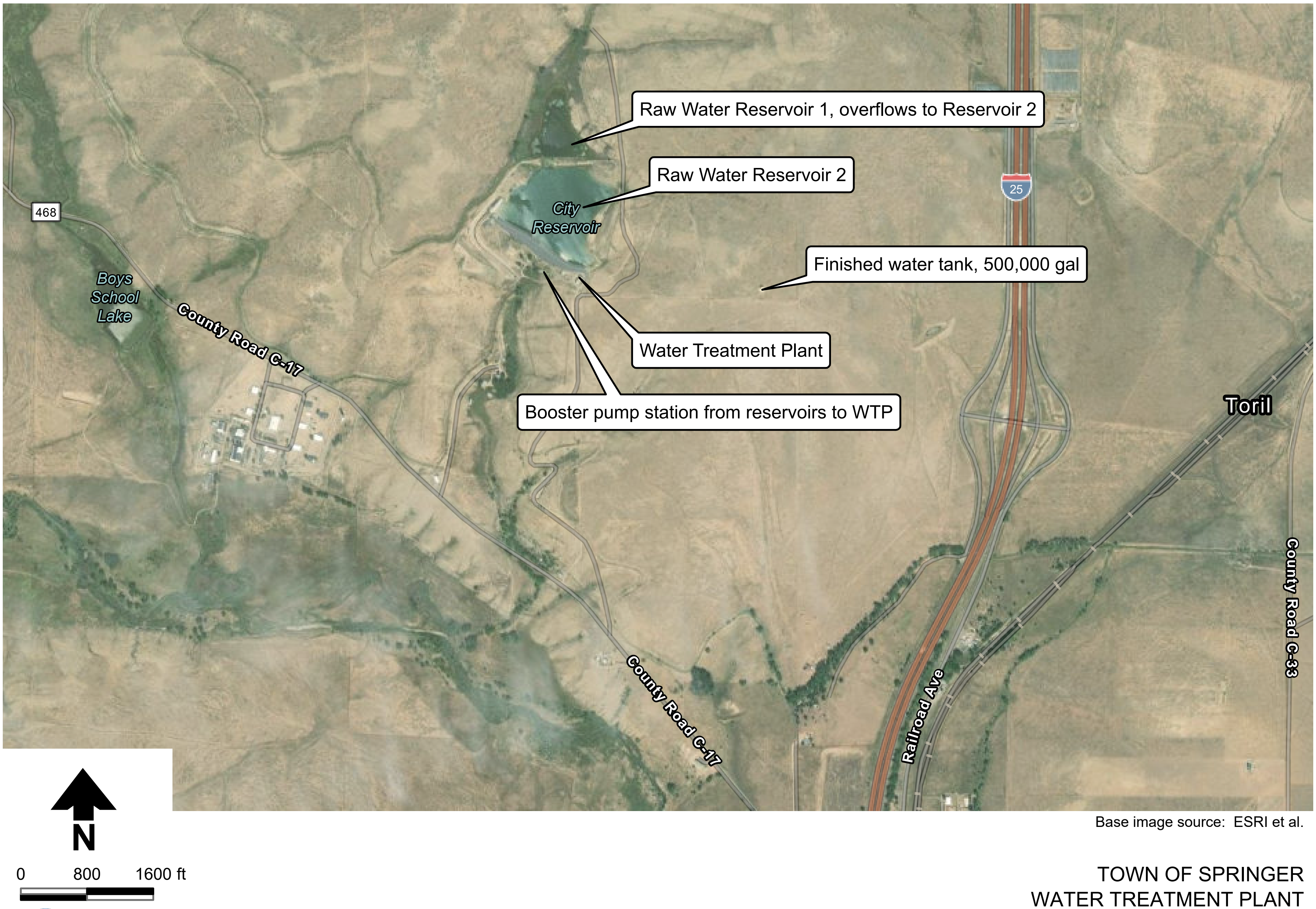
Jennifer Hill, P.E.
Senior Engineer

Chase Stearnes, P.E.
Water Resources Engineer

JH/CS/rpf
Attachments
cc: Kerry Howe, Howe Water Science
Elaine Howe, Howe Water Science
Craig Eppler, Town of Springer
Joe Savage, NMED DWB

Figures

S:\PROJECTS\DB24.1150_NMED_SPRINGER_DBPS\GIS\ARCGIS_PRO\SPRINGER_DBPS\SPRINGER_DBPS.APRX

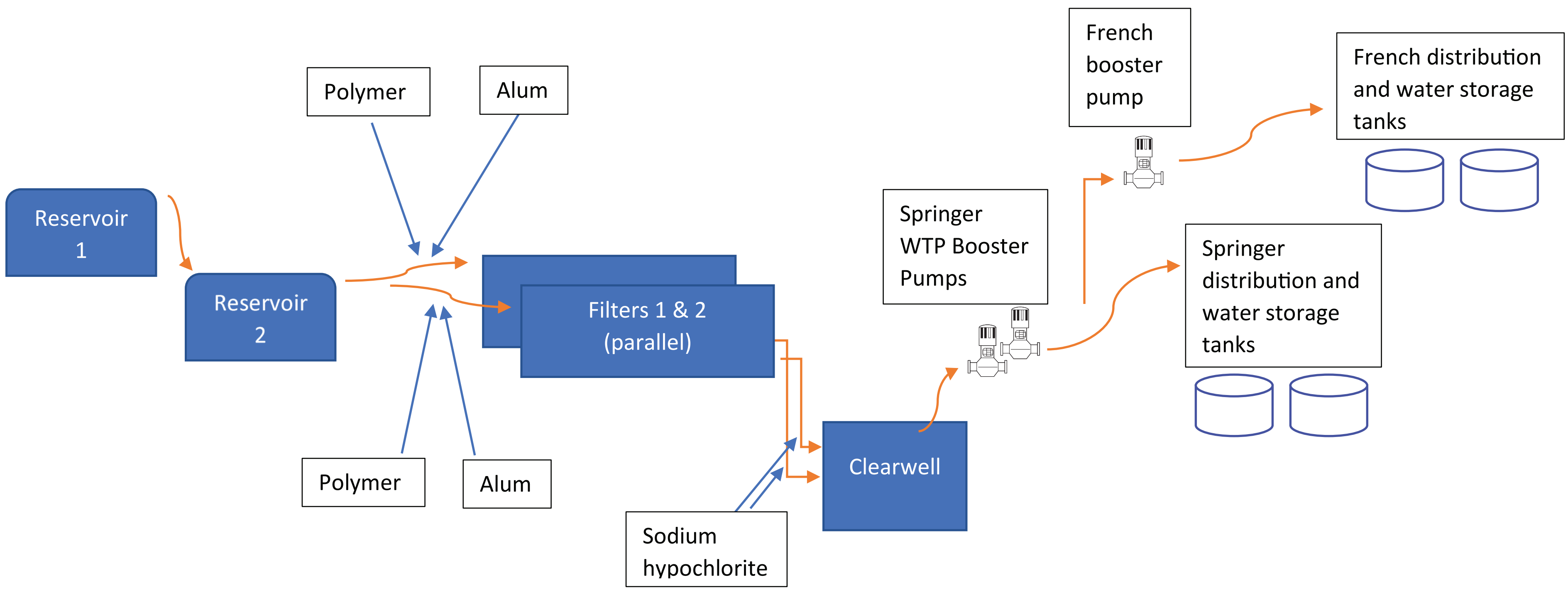


Base image source: ESRI et al.

TOWN OF SPRINGER
WATER TREATMENT PLANT
Site Map

DBS&A a Geo-Logic Company
5/29/2024 DB24.1150

Figure 1

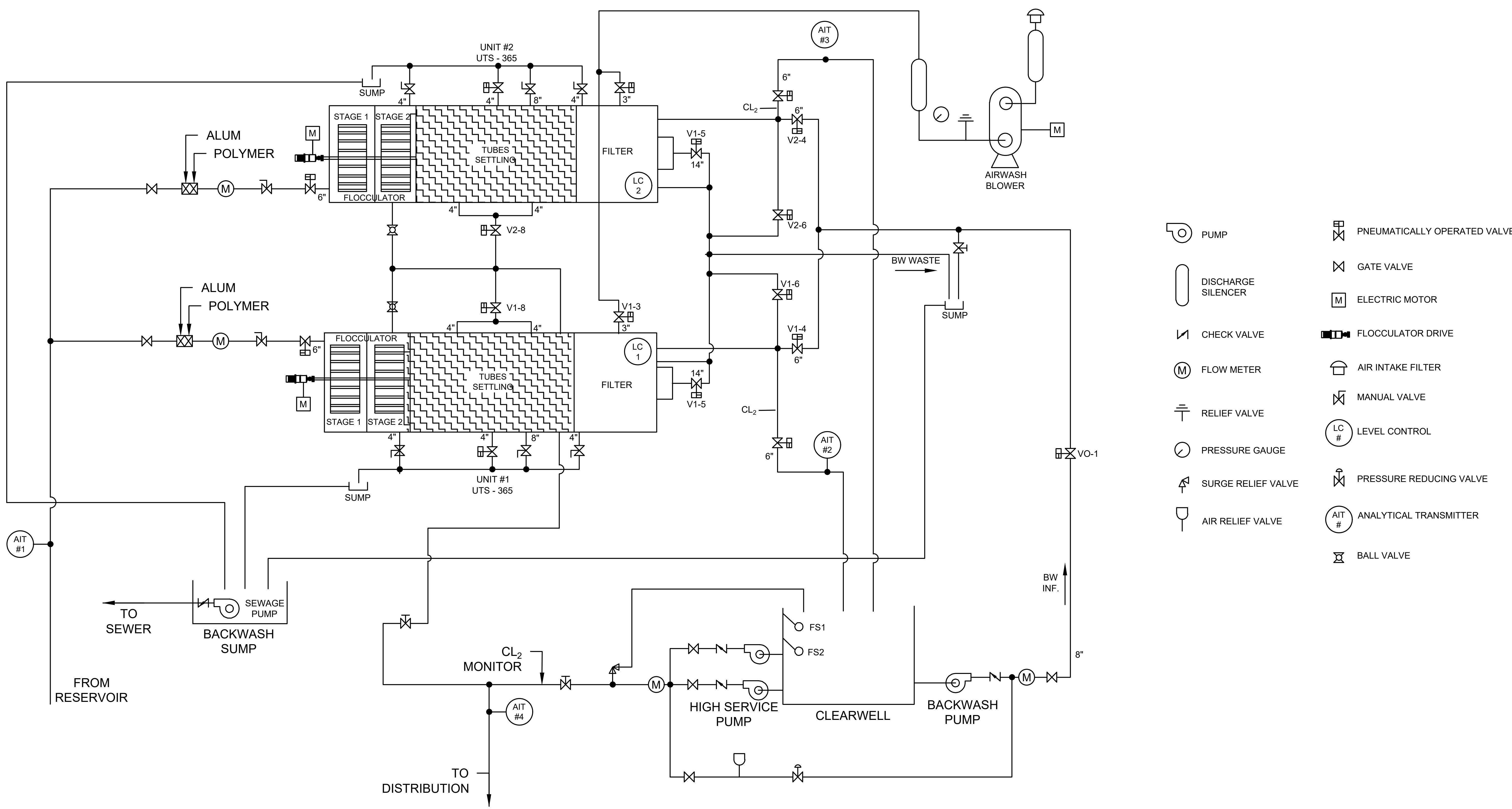


Note: The above schematic does not include backwash system.

TOWN OF SPRINGER WATER TREATMENT PLANT

Springer Water Treatment Plant Schematic

Figure 2



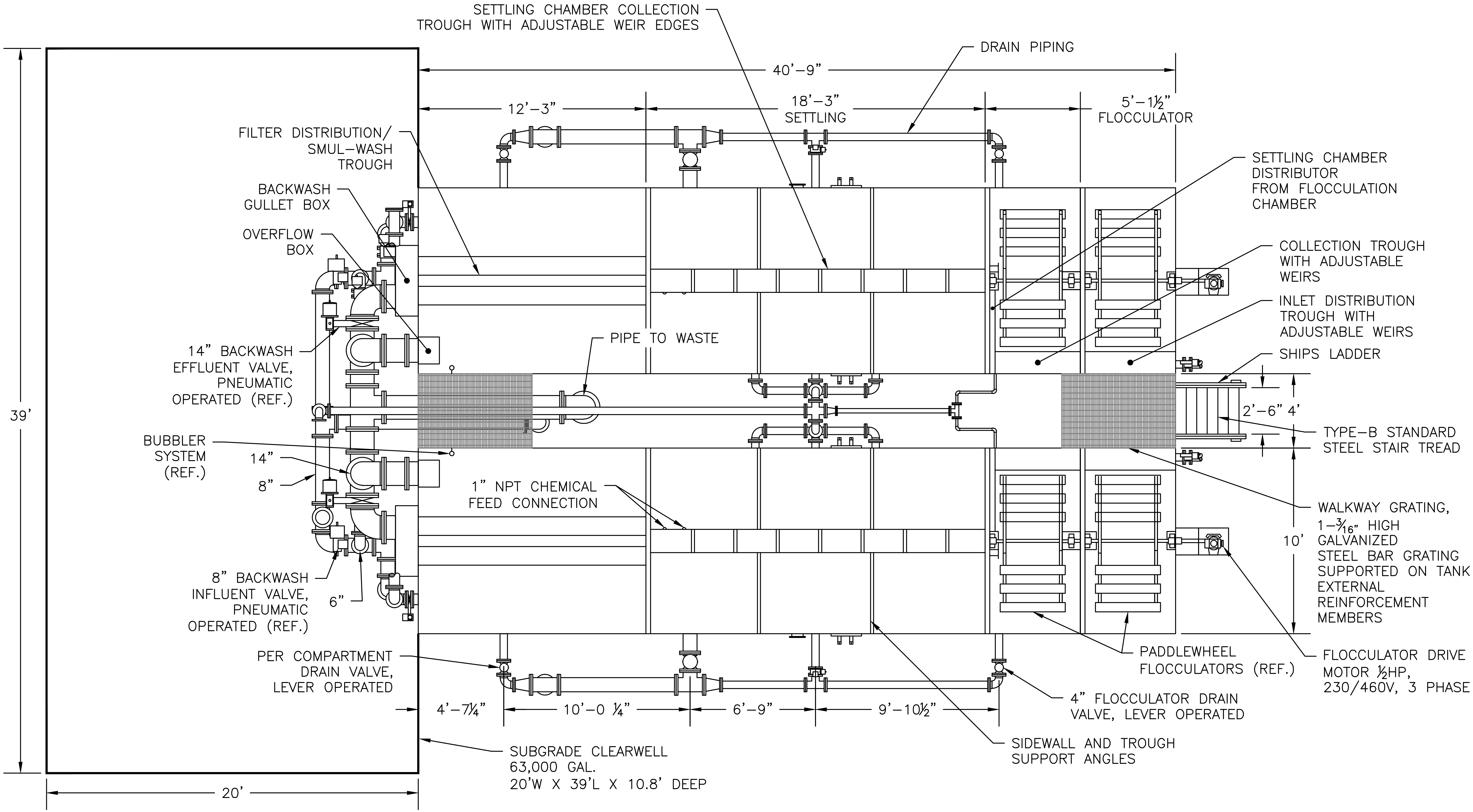
Notes:
1. This schematic is based on the Tonka Equipment Company Drawings, dated 7/23/2003, and may not exactly match existing conditions at the plant today.

TOWN OF SPRINGER
WATER TREATMENT PLANT
Flow Schematic

Figure 3

DBS&A
a Geo-Logic Company

5/30/2024 DB24.1150



Notes:
1. This drawing is based on the Tonka Equipment Company Drawings, dated 7/23/2003, and may not exactly match existing conditions at the plant today.

DBS&A a Geo-Logic Company

5/30/2024 DB24.1150

TOWN OF SPRINGER
WATER TREATMENT PLANT
Plan View

Figure 4

Attachment 1

Howe Water Science Report

DBS&A
a Geo-Logic Company

Draft Report

Springer Water System DBP Removal Project

Bench Test Results

Prepared for:
Town of Springer
New Mexico Environment Department

Prepared by:
Howe Water Science

In cooperation with:
DBS&A a Geo-Logic Company

Authors: Elaine W. Howe, P.E., BCEE
Kerry J. Howe, Ph.D., P.E., BCEE

May 29, 2024

Springer Water System DBP Removal Project
Bench Test Results

Table of Contents

Executive Summary

Disinfection with chlorine is necessary to destroy bacteria and viruses and make water safe to drink. However, chlorine also reacts with naturally occurring organic matter to form disinfection by-products (DBPs), including trihalomethanes (THMs) and haloacetic acids (HAAs). DBPs can contribute to cancer when consumed in excessive concentrations for long periods of time. The Environmental Protection Agency's (EPA's) Disinfectants and Disinfection By-Product Rule (D/DBP Rule) is designed to protect public health by ensuring adequate disinfection while simultaneously reducing long-term cancer risk from DBPs. The Town of Springer Water System has been in violation of the D/DBP Rule because of THM concentrations above the maximum contaminant level (MCL), which is 80 µg/L.

Minimizing DBP exposure and meeting the MCL can be accomplished several ways:

- Reduce the amount of natural organic matter (measured as total organic carbon, TOC) in the water prior to adding free chlorine.
- Reduce the concentration of free chlorine and/or the duration of time that chlorine reacts with the TOC.
- Use a disinfectant other than free chlorine for primary disinfection (inactivating *Giardia lamblia*, *Cryptosporidium*, and viruses) and/or secondary disinfection (maintaining a residual in the distribution system).
- Remove the DBPs from the water after they have been formed.

Bench tests were conducted to identify ways for the Town of Springer to achieve compliance with the D/DBP Rule. The following conclusions can be drawn from the site visit, experimental results, communications with NMED, and other knowledge on disinfection and DBP formation:

Enhanced coagulation:

- Enhanced coagulation is designed to increase TOC removal before chlorine addition, thereby reducing DBP formation. Enhanced coagulation involves performing coagulation with higher coagulant doses and lower pH values.
- Very little TOC removal is achieved at the plant's current alum dose of 10 mg/L. In these tests, less than 5% TOC removal was achieved. TOC removals at the WTP between 2018 and 2024 ranged from 4% to 20%.
- Increasing the alum dose to 30 mg/L, at ambient pH, increased TOC removal to about 15% in these tests.
- At an alum dose of 30 mg/L, decreasing the coagulation pH to 6.0 increased TOC removal to over 25%.
- Alum and ferric chloride remove similar amounts of TOC at the same molar concentrations, but ferric chloride can remove more TOC than alum when the pH is reduced to 5.5.
- Although enhanced coagulation improved TOC removal, it is not adequate for reducing THM formation to below the MCL.
- The D/DBP Rule requires enhanced coagulation to achieve specific TOC removal goals unless the treatment plant meets one of several avoidance criteria. The Town of Springer

meets the avoidance criteria of having raw water with a Specific Ultraviolet Absorbance (SUVA) value below 2.0 L/mg-m. Thus, the Town of Springer is not required to meet the target TOC removal goals, although they are still required to meet the THM MCLs.

Disinfection and disinfectant decay:

- Maintaining a detectable disinfectant residual throughout the distribution system is one of the requirements of the Safe Drinking Water Act.
- The initial chlorine demand (1-hour) was about 1 mg/L as Cl_2. This is the amount of chlorine consumed rapidly as soon as chlorine is added.
- With a 1 mg/L free chlorine residual after 1 hour (2 mg/L chlorine dose), the chlorine residual was completely lost after about 2 days.
- With 3.1 mg/L free chlorine residual after 1 hour (4.2 mg/L chlorine dose), the chlorine residual was 0.34 mg/L as Cl_2 after 10 days.
- Chloramines will help Springer maintain a positive chlorine residual throughout the distribution system. The chloramine residual lasted much longer than the free chlorine residual. With a 1 mg/L chloramine dose (ammonia added when the free chlorine residual was 1 mg/L), the chloramine residual was 0.66 mg/L as Cl_2 after 10 days. With a 3.1 mg/L chloramine dose, the chloramine residual was 1.8 mg/L as Cl_2 after 10 days.

THM Formation:

- The THMs formed during the first hour of chlorine contact was 32 to 39 µg/L.
- After 24 hours of contact, the THMs with free chlorine ranged from 75 µg/L for the 2 mg/L chlorine dose to 90 µg/L for the 4.2 mg/L chlorine dose. Thus, the THMs can exceed the MCL in as little as 1 day.
- For the 2 mg/L chlorine dose, the THMs were 86 µg/L after 2 days. At that point, the chlorine residual was nearly gone so almost no additional THMs were formed.
- For the 4.2 mg/L chlorine dose, the THMs were 110 µg/L after 2 days. The chlorine residual remained over the entire 10 day holding period so THMs continued to form, reaching 170 µg/L after 10 days.
- For chloramines, nearly all of the THMs measured were formed during the 1-hour initial free chlorine contact period.
- The THM regulations can be met with chloramines. The measured THMs with the 3.1 mg/L chloramine dose was 39 µg/L after 1 hour, 44 µg/L after 4 days, and 47 µg/L after 10 days.

Operational Considerations:

- The plant is operated intermittently. If chlorine is added at the entrance to the clearwell and ammonia is added at the exit of the clearwell, water will sit stagnant in contact with free chlorine when the plant is not in operation, which can be as long as 20 to 24 hours. THM formation could exceed the MCL of 80 µg/L during this stagnation period at some times of the year (when source water TOC and temperature is higher than in these bench tests).
- The configuration of the filter effluent discharges and the chlorine injection point into the clearwell causes poor chlorine contact that is probably detrimental for both effective primary disinfection and minimizing THM formation.

- The lack of baffling in the clearwell means that the disinfection CT requirements (primary disinfection) cannot be met if chlorine is added at the entrance to the clearwell and ammonia is added at the exit to the clearwell. Thus, the THM violations cannot be addressed without simultaneously addressing the inadequate disinfection conditions.

Recommendations:
The following are the primary recommendations from the bench tests:

- **Enhanced coagulation:** Enhanced coagulation using a higher dose of alum and sulfuric acid to reduce the pH to approximately 6.0 will remove additional TOC, reducing the THM formation and creating a more stable water which should result in less chlorine decay in the distribution system.
- **Chloramines for residual maintenance:** Using chloramines for maintenance of a disinfectant residual in the distribution system will reduce THM formation to below the MCL and provide a longer-lasting chlorine residual.

Implementation of the recommendations from the bench tests will be obstructed by the lack of effective primary disinfection at the plant and the intermittent operation. Ammonia for secondary disinfection has to be added after primary disinfection (CT requirements) has been achieved. Thus, the recommended improvements for addressing the DBP issue cannot be designed without simultaneously addressing the primary disinfection issue.

Primary disinfection was not within the scope of this project, and thus definitive recommendations cannot be provided. Several alternatives for simultaneously addressing primary disinfection and DBP formation could include the following:

- Use free chlorine for primary disinfection and chloramines for secondary disinfection. To do this, it is necessary to reconfigure the clearwell (or construct a new chlorine contact system) to achieve the following (a) provide a well-defined point where chlorine can be added to the combined filter effluent, (b) baffle the clearwell to prevent short-circuiting so adequate CT credit can be achieved, (c) revise plant operation so that chlorinated water is not sitting stagnant in the clearwell for many hours before ammonia is added, and (d) provide a well-defined point where ammonia and sodium hydroxide (for pH adjustment) can be added to the disinfected water prior to leaving the WTP site.
- Use an alternate disinfectant, such as UV light, for primary disinfection, followed by chloramines for secondary disinfection. Adding ammonia prior to chlorine to form chloramines or injecting pre-formed chloramines into the process stream would prevent THM formation.
- Continue using free chlorine for both primary and secondary disinfection, and provide air stripping for THM removal and chlorine booster stations in the distribution system for residual maintenance.

1 Introduction

1.1 Background

The New Mexico Environment Department (NMED) Drinking Water Bureau (DWB) received federal funding through the FY22 WIIN-SUDC grant funding from the U.S. Environmental Protection Agency (USEPA) to assist public water systems return to safe drinking water compliance through engineering design services. NMED provided a Work Order for Daniel B. Stephens & Associates, Inc. (DBS&A) to provide engineering design assistance to the Town of Springer for additional treatment at the existing surface water treatment plant (WTP) to reduce the potential for disinfection by-product (DBP) formation.

Howe Water Science, LLC (HWS) was subcontracted to conduct bench-scale tests to support the design and construction of improvements at the Springer Water System to bring the system into compliance with DBP regulations. The proposed improvements include a transition to enhanced coagulation to improve DBP precursor removal and a transition to chloramines for secondary disinfection to reduce DBP formation in the distribution system. These bench tests compared the effectiveness of two primary coagulants, evaluated improved total organic carbon (TOC) removal with enhanced coagulation at reduced coagulation pHs, and compared free chlorine with chloramines for trihalomethane (THM) formation and disinfectant residual decay.

1.2 Water Treatment Plant Overview and Historical Data

The Springer WTP is a Tonka Equipment Company package conventional surface water treatment plant operating with two parallel trains. The source water for the WTP is surface water from Eagle Nest Lake via the Cimarron River and an irrigation ditch. The raw water flows through two reservoirs. Reservoir 1 allows for particulate settling and Reservoir 2 provides approximately a full year of raw water storage.

Because of the long hydraulic residence time through Reservoir 2, the influent water to the WTP generally has consistent and low turbidity levels, except when monsoon storms stir up the reservoirs (Adam Steen, personal communication). The temperature of the raw water ranges from 3 ºC to 23 ºC, and the temperature of the combined filter effluent (CFE) ranges from 5 ºC to 23 ºC. As will be discussed in Section 5.1, water temperature is important for calculating disinfection credit for inactivation of viruses and Giardia with free chlorine. The raw water TOC and alkalinity vary seasonally, and ranged from 3.9 mg/L to 6.3 mg/L for TOC and 95 mg/L as $CaCO_3$ to 177 mg/L as $CaCO_3$ for alkalinity. As will be discussed in Section 1.3, raw water alkalinity and TOC determine the percentage of TOC to be removed through treatment per federal drinking water regulations. A summary of the raw water quality is provided in Table 1.

A process flow diagram for the WTP is shown in Figure 1. Each of the two treatment trains is rated at a capacity of 365 gpm but normally operated at 300 gpm. The WTP is operated intermittently, typically four hours per day. Aluminum sulfate (alum) is used as the primary coagulant along with a low dose of polymer to enhance floc formation and improve settling. Settling occurs as the coagulated water flows through tube settlers, rated at 2 gpm/sf. Following sedimentation, the water flows through tri-media granular media filters, rated at 3 gpm/sf. As designed, the filter bed is made up of 12 inches of anthracite, 18 inches of sand, 3 inches of garnet sand, and 3 inches torpedo garnet. However, as noted in the site walk observations from April 22, 2024 (Appendix C), a substantial amount of filter media was seen in the backwash settling ponds, and likely lost during the backwash process–possibly due to damaged or malfunctioning underdrains.

The Springer WTP uses a consistent alum dose of approximately 10 mg/L, without SCADA adjustment for changes in raw water turbidity or TOC[1]. A consistent polymer dose of 0.23 mg/L is added during flocculation.

Table 1. Summary of Raw Water Quality for the Springer WTP

Parameter	Source of Data	Period of Review	Maximum	Minimum	Approximate[1] Average
Temperature (ºC)	Springer Logs	1/2023 – 12/2023	23	3	13.7
pH	Springer Logs	1/2023 – 12/2023	8.68	7.88	8.31
Alkalinity (mg/L as $CaCO_3$)	NMED Drinking Water Watch	5/2018 – 4/2023	177	95	126
Alkalinity (mg/L as $CaCO_3$)	Hall Env. Data Sheets from Springer	12/2022 – 2/2024	177	96	123
Total Organic Carbon (mg/L)	NMED Drinking Water Watch	5/2018 – 4/2023	6.3	3.9	5.3
Total Organic Carbon (mg/L)	Hall Env. Data Sheets from Springer	12/2022 – 2/2024	5.6	4.9	5.3
Dissolved Organic Carbon (mg/L)	Hall Env. Data Sheets from Springer	12/2022 – 2/2024	5.4	4.8	5.1
SUVA (L/mg•m)	Hall Env. Data Sheets from Springer	12/2022 – 2/2024	1.44	1.29	1.36

[1] Average is considered approximate because the dataset includes gaps for the Period of Review.

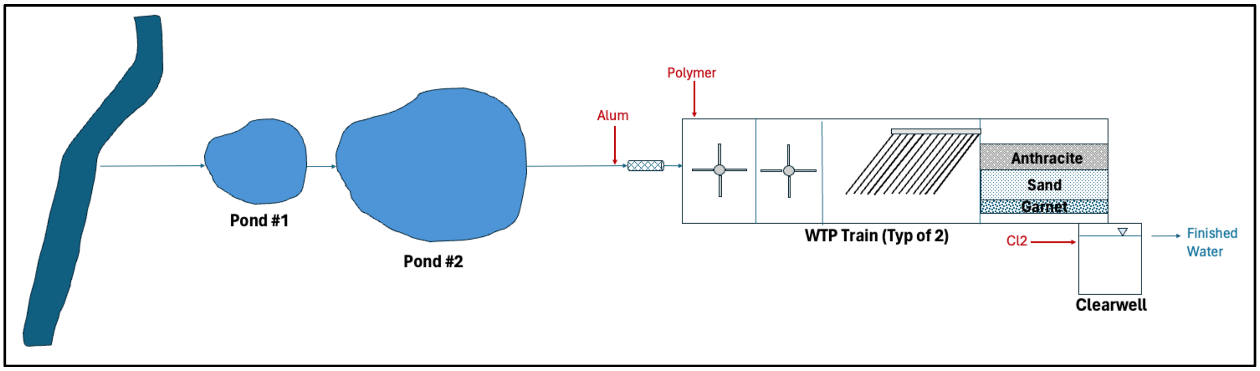


Figure 1. Process Flow Diagram of the Springer WTP

[1] Continuous TOC measurements can be made with an on-line TOC analyzer or estimated based on continuous measurement of the surrogate parameter, UV-254, with a less expensive on-line UV Spectrophotometer.

1.3 Regulatory Requirements for Disinfection Byproducts

The Federal Disinfectants and Disinfection Byproducts (D/DBP) Rule regulates the formation of DBPs through drinking water treatment and distribution. A maximum residual disinfectant level was established for free or combined chlorine at 4.0 mg/L as Cl_2. Compliance with MCLs established for THM and five haloacetic acids (HAA_5) is determined based on locational running annual average (LRAA) values at select compliance monitoring sites in the distribution system. The MCL for THMs is 0.080 mg/L, and the MCL HAA_5 is 0.060 mg/L.

The enhanced coagulation requirement that is a part of the D/DBP Rule requires the removal of DBP precursor material based on the source water concentrations of TOC and alkalinity, as indicated in Table 2. Six years of historical raw water TOC and alkalinity concentrations (Figure 2), for the period 2018 – 2024, show how the concentrations varied seasonally and also indicate that the Springer WTP would have been required to achieve 25% or 35% TOC removal. For the raw water sample collected for these bench tests, the required removal would be 25%. The actual percentage TOC removals achieved at the WTP during this period of record ranged from 4% to 20%, with an average of only 12% removal.

Table 2. TOC Removal Requirements of the D/DBP Rule

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0 to 60	>60 to 120	>120
>2.0 – 4.0	35.0%	25.0%	15.0%
>4.0 – 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

Compliance with the enhanced coagulation requirements also can be demonstrated using one of the following Alternative Compliance Criteria:

- Source water TOC is less than 2.0 mg/L;
- Treated water TOC is less than 2.0 mg/L;
- Source water TOC is less than 4.0 mg/L and alkalinity is greater than 60 mg/L as $CaCO_3$, and the system's THM and HAA_5 compliance samples are less than 40 µg/L and less than 30 µg/L, respectively;
- LRAA THM concentration is less than 40 µg/L and HAA_5 concentration is less than 30 µg/L, with only free chlorine for primary disinfection and residual maintenance;
- Source water specific ultraviolet absorption (SUVA) prior to any treatment is less than or equal to 2.0 L/mg•m; or
- Treated water SUVA is less than or equal to 2.0 L/mg•m.

Review of one year of SUVA data (Table 1) the average raw water SUVA value was 1.36 L/mg•m, so the Springer WTP was in compliance with the enhanced coagulation requirements by applying the Alternative Compliance Criteria of source water SUVA less than 2.0 L/mg•m. As discussed in the USEPA's Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual (May 1999), SUVA is an indicator of the humic content of the water which, in turn, indicates how amenable the natural organic matter (NOM) in the water is to removal through enhanced coagulation. Water with a low SUVA (i.e., ≤ 2.0 L/mg•m) contains primarily non-humic compounds which are poorly removed through conventional coagulation treatment.

Regardless of the approach used to meet the enhanced coagulation requirements, compliance with the THM and HAA5 MCLs is still required. Six years (2018 – 2024) of locational running annual average (LRAA) THM and HAA5 concentrations are shown in Figure 3. During this time period, the Springer WTP has exceeded the THM MCL (0.080 mg/L) at the High School sampling location 81% of the time, and has exceeded the THM MCL at the New Shop location 62% of the time. The LRAA HAA5 concentrations, on the other hand, have been below the MCL (0.060 mg/L) at both locations 100% of the time.

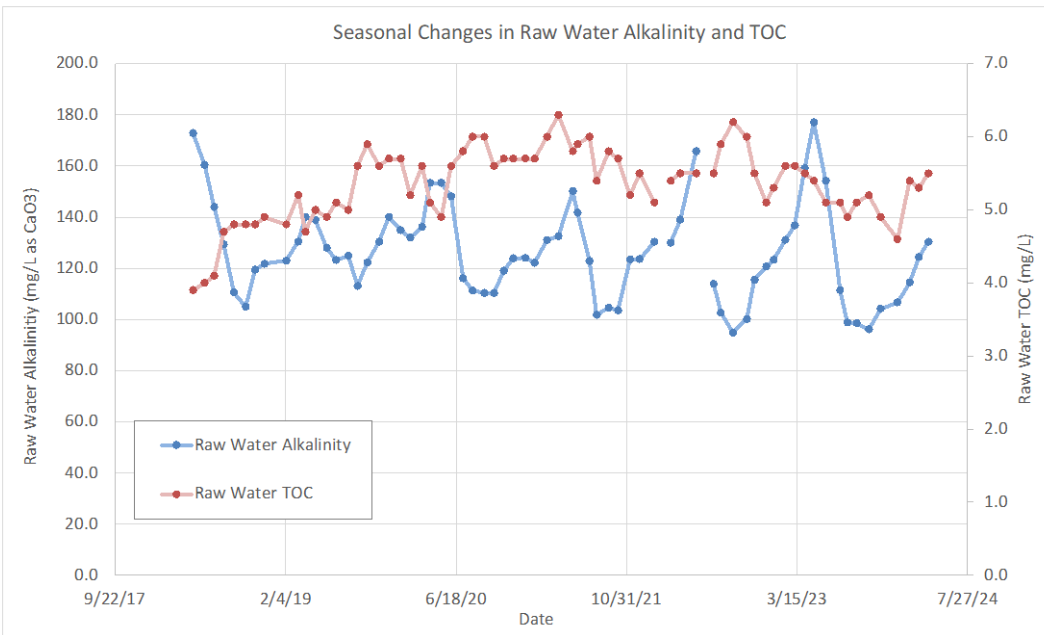


Figure 2. Seasonal Changes in Springer WTP's Raw Water Quality

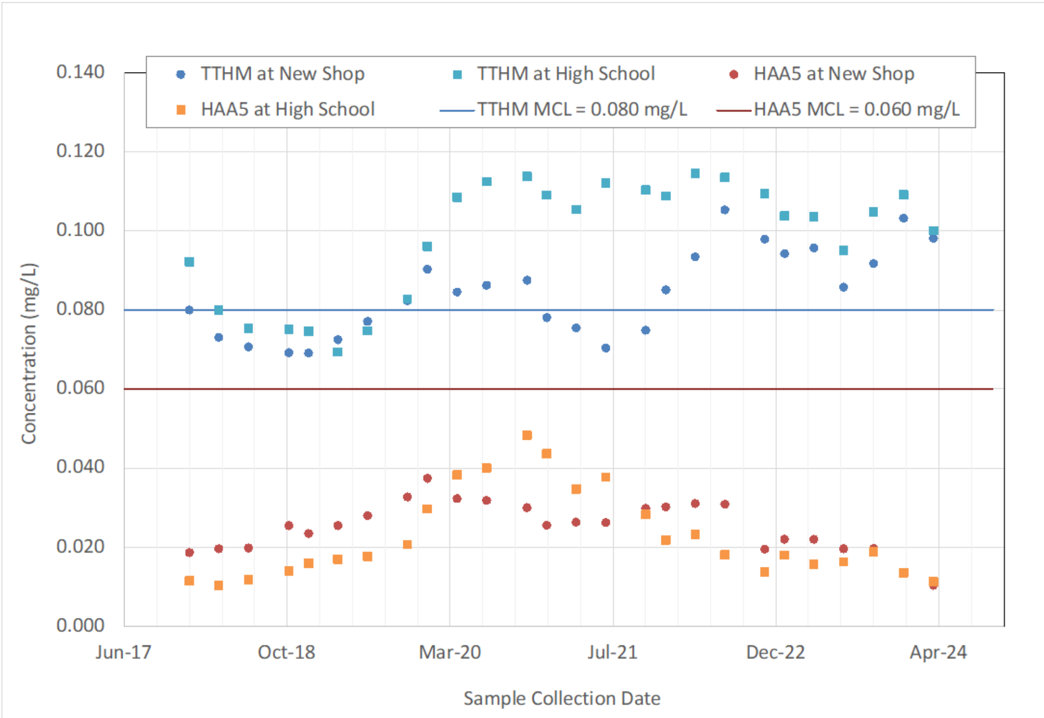


Figure 3. Locational Running Annual Average THM and HAA5 Concentrations from the Springer Distribution System

1.4 Objectives of Bench Testing

The purpose of this study was to conduct bench-scale tests to support the design and construction of improvements at the Springer Water System to bring the system into compliance with the DBP regulations. The proposed improvements include a transition to enhanced coagulation to improve DBP precursor removal and a transition to chloramines for secondary disinfection to reduce DBP formation in the distribution system. Enhanced coagulation involves a potential change to a different coagulant and the addition of acid to conduct coagulation at reduced and optimal pH conditions. If enhanced coagulation is employed at the WTP, the plant will need to add a base (e.g., sodium hydroxide) after treatment to restore the pH to stable conditions. The plant will continue to use free chlorine for primary disinfection to achieve the required log inactivation for viruses and *Giardia Lamblia*. Ammonia will be added to the water after the required CT credit has been achieved with free chlorine, converting the free chlorine residual to a combined chlorine (i.e., chloramine) residual.

Objectives for the bench tests were the following:

1. Evaluate whether aluminum sulfate (alum) or ferric chloride (ferric) is more effective for turbidity, TOC and dissolved organic carbon (DOC) removal.
2. Evaluate the preferred pH for optimal TOC and DOC removal during enhanced coagulation.
3. Evaluate the rate of chlorine decay before ammonia is added, to facilitate disinfection concentration x time (CT) credit calculations and ammonia dosing requirements.
4. Evaluate the rate of THM formation before ammonia is added, to determine maximum acceptable free chlorine contact time and corresponding THM formation.

5. Evaluate the rate of chloramine decay after ammonia is added, to assess potential for loss of chloramine residual in the distribution system.
6. Evaluate the rate of THM formation with chloramines.

1.5 Experimental Methods Used for Bench Tests

A detailed test plan for the bench tests was prepared April 1, 2024, and submitted to Springer for review and comment prior to the start of testing. A copy of this Test Plan is provided in Appendix A, updated to include modifications that were made during testing.

In brief, several targeted bench tests were conducted to evaluate (a) whether enhanced coagulation (i.e., adding acid ahead of the coagulation process to reduce the coagulation pH) could be applied to improve TOC removal, thereby reducing the concentrations of DBPs formed when chlorine is applied for disinfection, and (b) the ability of chloramines, which would serve as a residual disinfectant through the distribution system, to halt the DBP formation reaction and remain at detectable levels throughout the distribution system. The following sequence of bench tests were performed on raw water collected on April 22, 2024, from the influent to the WTP:

- Task 1 – Compare the effectiveness of aluminum sulfate and ferric chloride for turbidity, TOC, and DOC removal.
- Task 2 – Using the preferred dose for each coagulant, determine if greater TOC removals can be achieved under reduced pH conditions, between pHs 5.5 and 6.5.
- Task 3 – Determine the 1-hour free chlorine demand of the coagulated/settled (C/S) water, which would be representative of disinfection in the clearwell.
- Task 4 – Develop chlorine decay curves and associated THM formation curves using the optimal coagulant, coagulant dose, and coagulation pH. When developing the THM formation curves, the pH of the C/S water was increased to simulate an appropriate stabilized water pH for the distribution system.
- Task 5 – Develop chloramine decay curves and associated THM formation curves, representative of adding ammonia at the exit of the clearwell for maintaining a chloramine residual throughout the distribution system.

2 Comparison of Alum and Ferric as Primary Coagulants

Raw water collected from the raw water sample tap at the Springer WTP on April 22, 2024. Water quality from the raw water sample is shown in Table 3.

The Springer WTP has historically used a constant alum dose of 10 mg/L for coagulation. These jar tests compared the effectiveness of alum with ferric on an equal molar metal ion (i.e., Fe^{3+} and Al^{3+}) basis and concentration (i.e., mg/L) basis. Coagulant concentrations between 0.034 mM and 0.135 mM metal ion were tested, which corresponds to aluminum sulfate ($Al_2(SO_4)_3 \cdot 14H_2O$) doses of 10 mg/L to 40 mg/L and ferric chloride ($FeCl_3$) doses of 5.5 to 21.9 mg/L. The relationship between the molar and mass doses is presented in Table 4.

Ferric is effective for coagulation over a wider pH range than alum. The optimum pH range for ferric coagulation is from 5.0 to 8.5, while the optimum pH range for alum coagulation is from 5.5 to 7.7. Ferric has been shown to achieve somewhat greater TOC removal for a comparable dose in many cases, although the performance of the two coagulants depends on site-specific organic matter.

Table 3. Water Quality from the Springer WTP Raw Water Sample Collected on April 22 Site Visit

Parameter	Value
Turbidity (NTU	3.92
pH	8.2
Alkalinity (mg/L as $CaCO_3$)	148
TOC (mg/L)	5.3
DOC (mg/L)	5.1
UV-254 (cm^{-1})	0.0741
SUVA (L/mg-m)	1.4

Table 4. Relationship between Coagulant Molar and Mass Doses

Molar Dose of Metal Ion (Al^{3+} or Fe^{3+}) (mM)	Corresponding Mass Dose of Alum (mg/L)	Corresponding Mass Dose of Ferric Chloride (mg/L)
0.034	10.0	5.5
0.067	20.0	10.9
0.084	25.0	13.6
0.101	30.0	16.4
0.118	35.0	19.1
0.135	40.0	21.9

2.1 Turbidity Removal

Figure 4 compares the effectiveness of these two coagulants for turbidity removal. The performance of both coagulants was comparable, and both successfully produced a settled water with turbidity less than 1 NTU. Increasing the ferric dose resulted in consistently decreasing settled water turbidities while with alum the turbidity increased at the highest alum doses, probably because ferric produces a heavier and stronger floc than alum.

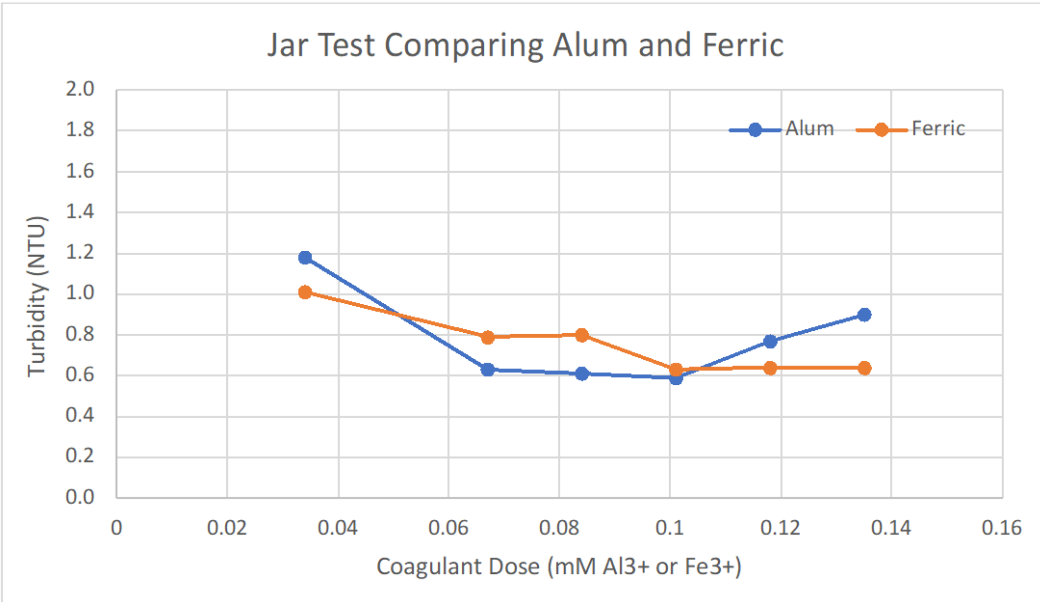


Figure 4. Comparison of Alum and Ferric for Turbidity Removal

2.2 TOC and UV-254 Removal

UV-254 is known to correlate well with TOC and is therefore a convenient measurement when evaluating enhanced coagulation for NOM removal. UV-254 measurements can be made in just a few minutes, whereas the turn-around-time for TOC or DOC is several hours when a TOC analyzer is readily available or a week or more when relying on a commercial lab. Thus, initial decisions regarding whether one coagulant outperformed the other were based on UV-254 measurements and then confirmed once TOC/DOC analyses were available from the commercial laboratory (i.e., Eurofins, Albuquerque).

Figure 5 shows that UV-254 of the settled water decreased as the coagulant dose increased, indicating a reduction in NOM concentration in relation to increasing coagulant dose, and that alum and ferric performed almost identically. The same general trend is seen for TOC removal in Figure 6, although ferric, on an equal molar basis, seemed to provide slightly greater TOC removal than alum.

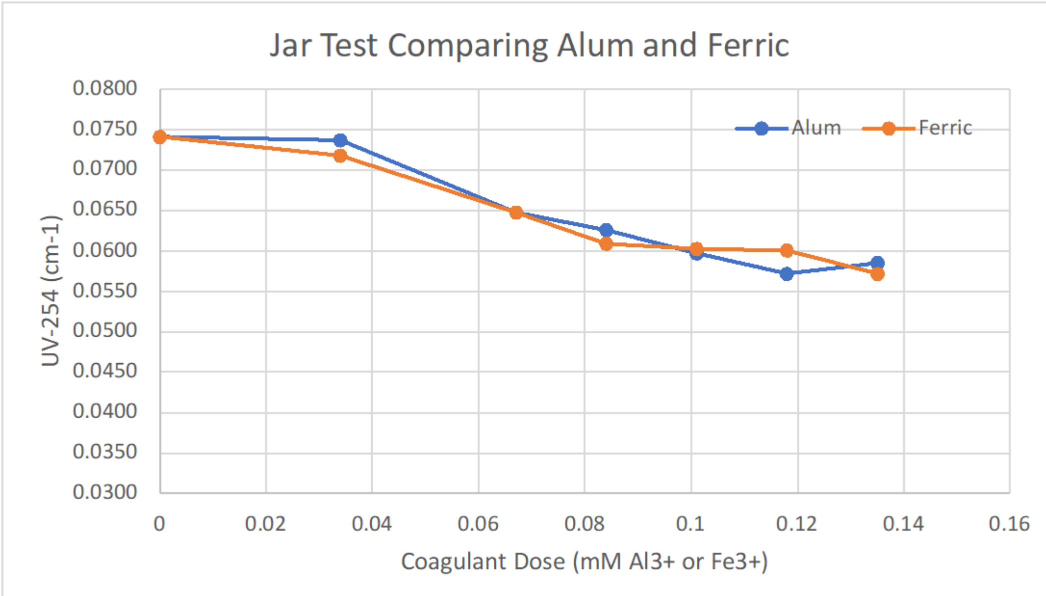


Figure 5. Comparison of Alum and Ferric for UV-254 Removal

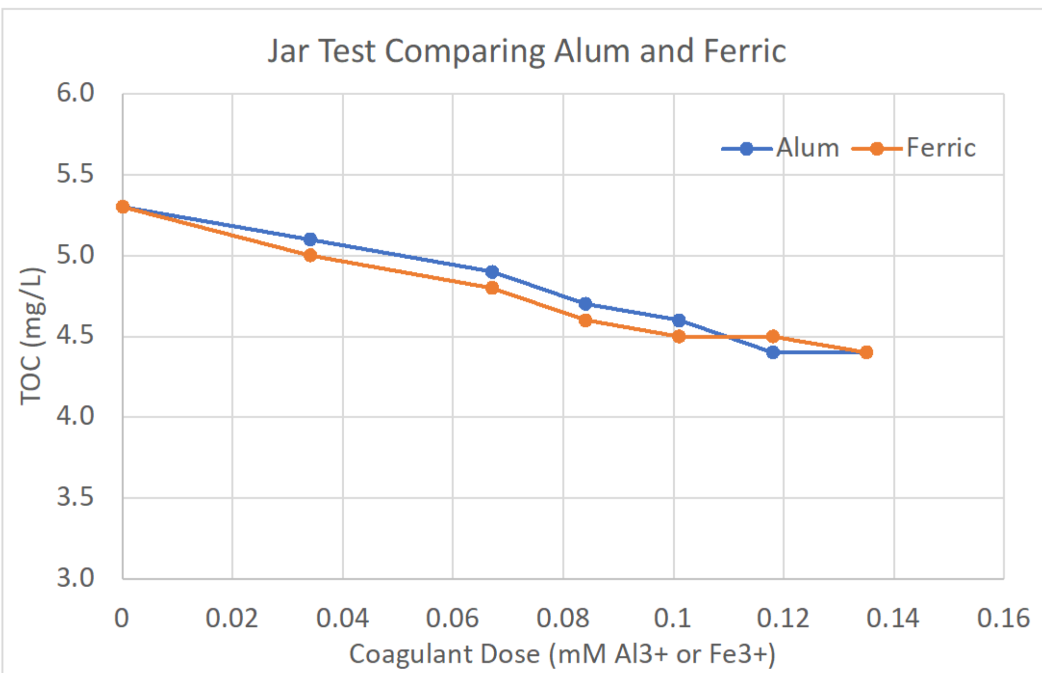


Figure 6. Comparison of Alum and Ferric, on an Equal Molar Metal Ion Basis, for TOC Removal

The effectiveness of these two coagulants for TOC removal is also compared on a mg/L basis–a more common unit of measure in the water industry–in Figure 7. This figure suggests that a greater amount of alum is required to provide the same amount of TOC removal as ferric chloride. However, reviewing the data in units of mg/L is somewhat deceptive because it is not an equal point of comparison. For both alum and ferric chloride, it is the metal ions (Al^{3+} and Fe^{3+}) that are precipitating as aluminum hydroxide or ferric hydroxide, which provides the floc that removes NOM through mechanisms of entrapment, adsorption, and complexation. The misleading comparison in Figure 7 is the result of alum having a larger molar mass than ferric (i.e., $Al_2(SO_4)_3 \cdot 14H_2O$ = 594.37 g/mol and $FeCl_3$ = 162.21 g/mol). Figure 6 demonstrates that the same amount of Al^{3+} and Fe^{3+} metal ions will achieve similar amounts of TOC removal for this particular water source.

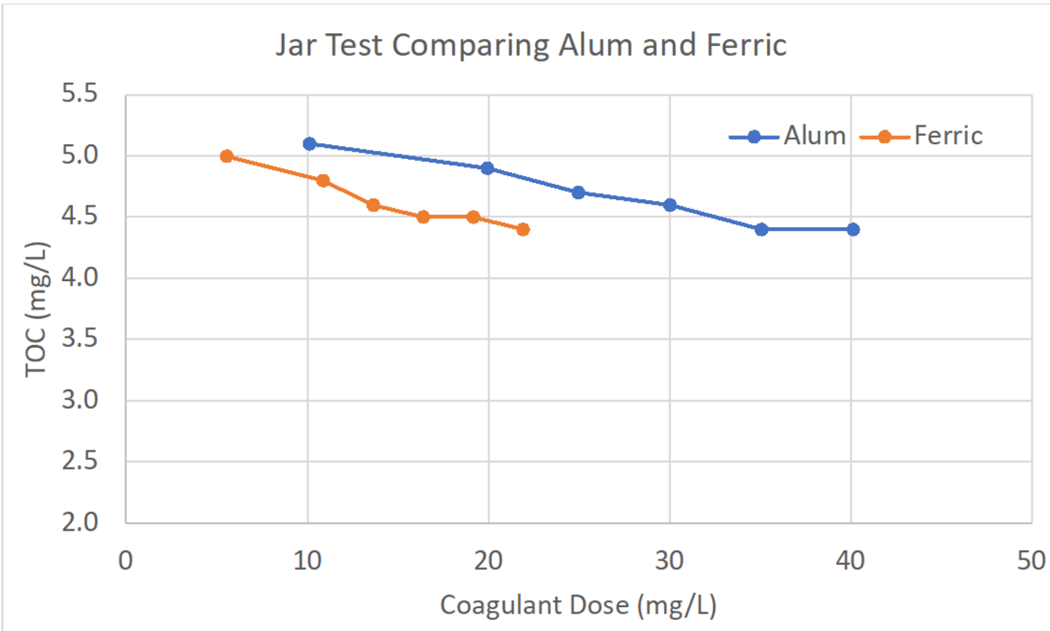


Figure 7. Comparison of Alum and Ferric, on a mg/L of Coagulant Basis, for TOC Removal

2.3 Comparison With Historical WTP Data

The Springer WTP has historically used a consistent 10 mg/L alum dose (i.e., 0.034 mM Al^{3+}) for coagulation, which resulted in between 4% and 20% TOC removal, with an average of 12% TOC removal between the raw water intake and the finished water leaving the WTP (2018-2024 data from NMED Drinking Water Watch). These jar tests (without pH reduction of enhanced coagulation) resulted in TOC removals between 2% and 17% with alum and between 7% and 18% with ferric. This comparison with historical performance is shown in Figure 8. One note of caution, however, is that while bench scale jar tests are excellent for assessing treatment options, they should not be expected to exactly mimic a full scale WTP. One significant difference is that TOC removals reported for the WTP include granular media filtration, while the bench tests are representative only of the coagulation and sedimentation processes.

Take away points from Figure 8 are the following:

- Average TOC removal at the WTP was in the range of TOC removals measured in the jar tests.
- Ferric provided slightly better TOC removal than alum.
- Neither the WTP nor the bench tests, with substantially higher coagulant doses, were able to meet the TOC removal requirements of the enhanced coagulation requirements of the D/DBP Rule.

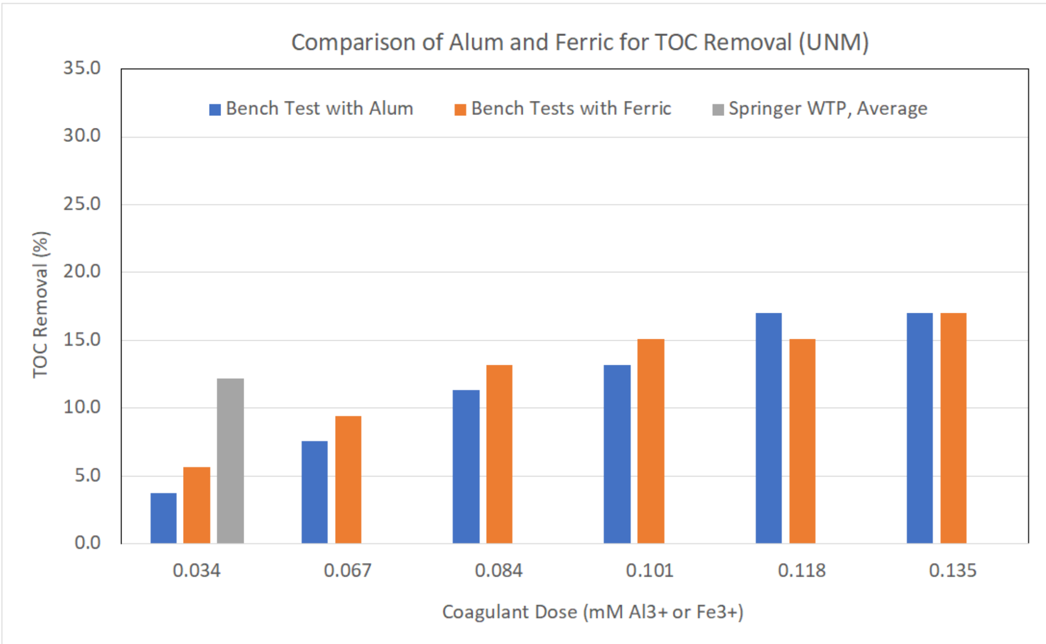


Figure 8. Comparison of WTP with Bench Tests for TOC Removal

2.4 Conclusions

One of the primary objectives for this first phase of testing was to select the preferred coagulant and coagulant dose for the enhanced coagulation jar tests. Based on the UV-254 and TOC removals discussed in this Section, it was decided to test both alum and ferric at a dose of 0.101 mM Al^{3+} or Fe^{3+} with reduced pH values of 6.5, 6.0 and 5.5. The similarity in performance between alum and ferric chloride indicates that it may not be beneficial for the Springer WTP to switch primary coagulants without further investigation.

3 Comparison between Alum and Ferric with Enhanced Coagulation

This phase of bench testing was designed to assess whether reducing the pH of coagulation would improve DBP precursor removal during clarification process. As discussed in the USEPA's Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual (May 1999), reducing the pH of the water during coagulation results in greater NOM removal, particularly if the source water NOM has a high fraction of humic organic material.

Based on the standard jar test results presented in Section 2, it was decided to test both alum and ferric at dose of 0.101 mM Al^{3+} or Fe^{3+} at coagulation pHs of 6.5, 6.0 and 5.5. The pH of the water was reduced using sulfuric acid. The "coagulation pH" is the pH of the water after both coagulant addition and sulfuric acid addition. In other words, the coagulation pH is the pH of the settled water. The results of the enhanced coagulation jar tests are presented below.

Chemical doses and corresponding TOC removal results are provided in Appendix B.

3.1 Turbidity Removal

Settled water turbidities for all pH conditions are shown in Figure 9. All coagulation conditions produced effectively clarified settled water with turbidities less than, or just slightly above, 1 NTU. With ferric, the coagulated/settled (C/S) water turbidity was very consistent at approximately 0.65 NTU. With alum the C/S water turbidities were higher at pHs of 5.5 and 6.0, possibly because these pHs are on the lower edge of the effective operating region for alum. As noted in Section 2, ferric has a wider optimal pH range than alum.

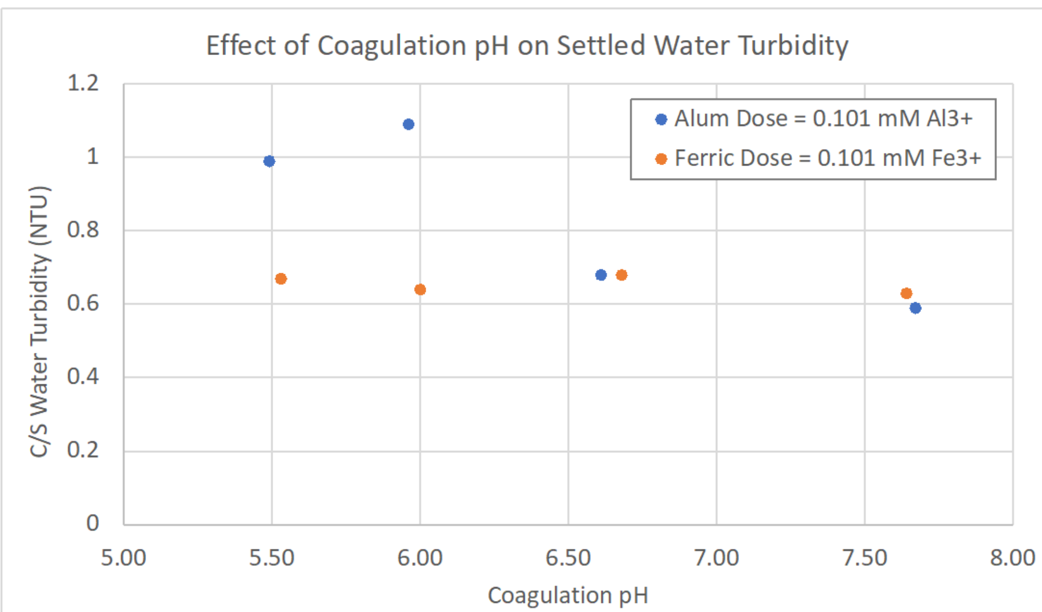


Figure 9. Comparison of Alum and Ferric for Turbidity Removal at Reduced pH Conditions

3.2 TOC Removal

TOC concentrations of C/S water and percent TOC removal from the standard jar tests and the enhanced coagulation jar tests are shown in Figure 10 and Figure 11, respectively. In considering the actual TOC concentrations (Figure 10), the data indicate:

- Greater TOC removal occurred as the pH was reduced, for both alum and ferric.
- Alum and ferric performed similarly, except at pH 5.5 the ferric achieved greater TOC removal.
- None of the enhanced coagulation conditions tested achieved a TOC of less than 2 mg/L in the settled water, which experience has shown to be low enough to prevent THM MCL exceedances when free chlorine is used for final disinfection and residual maintenance in the distribution system.

In terms of percentage TOC removal (Figure 11), the data show:

- Alum and ferric performed similarly, except at pH 5.5 where ferric achieved the highest percentage TOC removal.
- Greater percentages of TOC were achieved, with both alum and ferric, as the coagulation pH was reduced.
- Enhanced coagulation at pH 6.0 was able to achieve ≥ 25% TOC removal, which is the removal required by the enhanced coagulation requirements of the D/DBP Rule for these raw water TOC and alkalinity conditions.

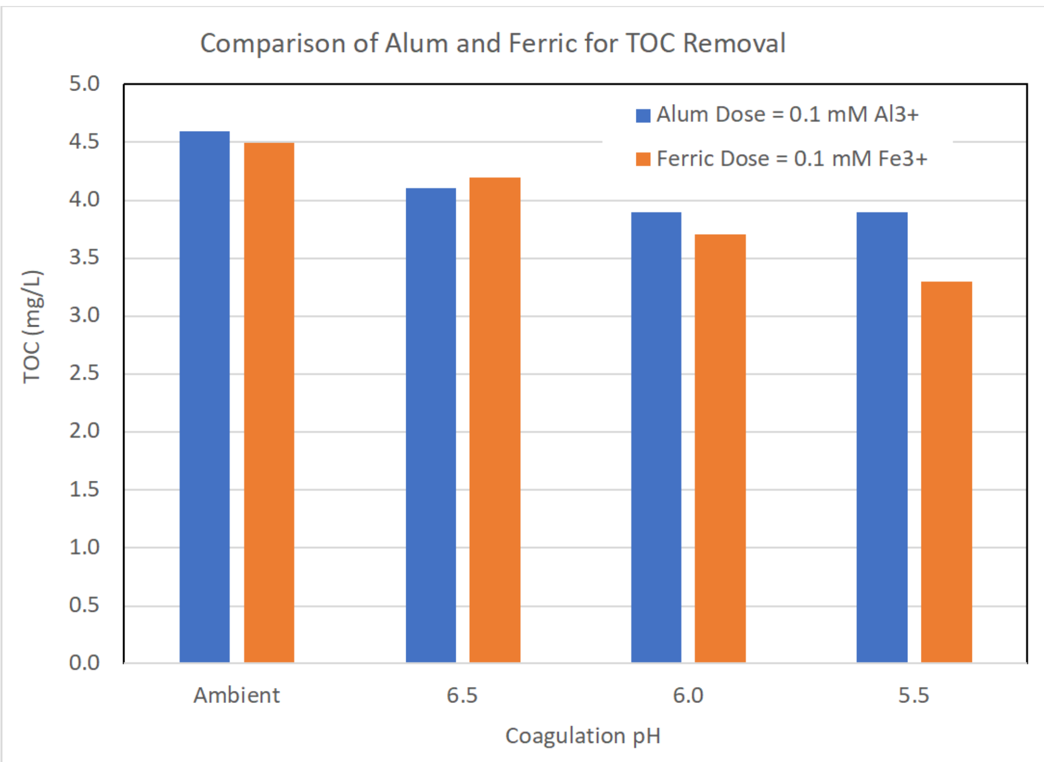


Figure 10. Comparison of Alum and Ferric for TOC Removal, Using Enhanced Coagulation

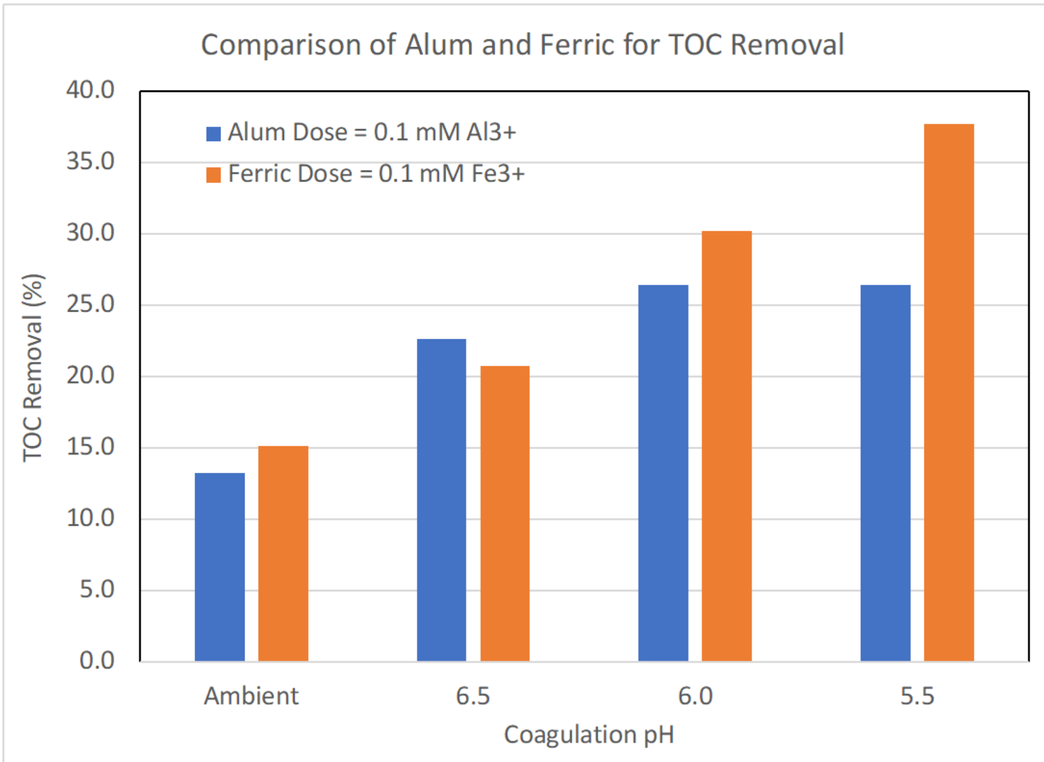


Figure 11. Percent TOC Removal with Alum and Ferric, Using Enhanced Coagulation

3.3 Optimum Coagulation Conditions for THM Formation Tests

The primary objective for the enhanced coagulation jar tests was to decide on the preferred set of coagulation conditions (i.e., coagulant, coagulant dose, pH) to use for preparing C/S water for the 1-hour and 10-day chlorine decay curves and for the THM formation curves. Based on the data discussed above, it was decided to prepare C/S water using ferric at:

- A coagulant dose of 0.101 mM Fe^{3+} (i.e., 16.4 mg/L $FeCl_3$)
- A coagulation pH of 6.0.

Ferric was selected over alum because it provided slightly greater TOC removal. A coagulation pH of 6.0 was selected over pH 5.5, which provided the greatest percentage TOC removal, because it met the 25% TOC removal required for enhanced coagulation at these raw water conditions. Decreasing the pH further to 5.5 would increase the acid and base doses, which would increase the chemical cost for the Town of Springer.

Six liters of C/S water was prepared for use in the free chlorine decay and THM formation bench tests. Three liters additional C/S water was prepared for use in the 10-day chloramine decay curves and the chloramine THM formation tests. For both batches of C/S water, the pH was increased using sodium hydroxide to pH 7.7 for the first batch and pH 7.6 for the second batch, where the target for finished water stabilization was pH 7.8. Finished water stabilization is needed at the full-scale to help prevent pipeline corrosion in the distribution system. When enhanced coagulation is practiced at the full-scale WTP, however, the pH of the filter effluent should not be increased until after pathogen disinfection (i.e., after the clearwell) since free chlorine disinfection is more effective at lower pH values.

4 Chlorine Decay and Trihalomethane Formation Curves

THM formation testing was performed to assess the concentrations of THMs that would be expected to form over specified hold times, representative of the time required to meet primary disinfection requirements at the Springer WTP, prior to ammonia addition to form chloramines (i.e., combined chlorine). Using pH adjusted C/S water discussed in Section 3, a series of amber bottles were filled with sample water, spiked with chlorine, and held headspace free for a range of holding times in order to estimate (a) the approximate free chlorine loss in the first hour, representative of the Springer WTP clearwell, (b) the free chlorine decay rate over a 10-day period, (c) chloramine decay rate over a 10-day period, following ammonia addition after 1-hour free chlorine contact, (d) THM formation curves with free chlorine, and (e) THM formation following ammonia addition after 1-hour free chlorine contact.

Objectives for these tests were to:

- Assess whether it would be feasible for the Springer WTP to meet the THM MCLs while implementing enhanced coagulation and continuing to use free chlorine for both primary and secondary disinfection.
- Assess the levels of THMs that form through the clearwell and through the distribution system, as a function of hydraulic residence time (HRT), when practicing enhanced coagulation.
- Confirm that the addition of ammonia, to form chloramines, will halt further THM formation, allowing the Springer WTP to comply with the regulatory DBP MCLs by using chloramines for secondary disinfection.
- Evaluate how rapidly the chloramine residual will decay in the Springer distribution system as well as in the distribution systems of the consecutive water systems.

4.1 Test Conditions

Test conditions described below summarize the chlorine doses, timing for adding ammonia, and the number of THM samples collected for the (a) 1-hour free chlorine decay curve, (b) 10-day free chlorine decay curve and THM formation curve, and (c) THM formation with chloramines.

One Hour Free Chlorine Decay. Using pH adjusted C/S water (discussed in Section 3), three amber bottles were filled with sample water, spiked with chlorine at concentrations of 2 mg/L, 3 mg/L and 4 mg/L, and sampled for chlorine residual after 10 minutes, 30 minutes and 60 minutes. Per the French MDWCA report, the hydraulic residence time through the Springer clearwell is 76.4 minutes at a flowrate of 600 gpm and average water depth of 7.84 feet. For the purposes of these bench tests, a free chlorine contact time of 60 minutes was used.

Results from the 1-hr chlorine demand were used to select the appropriate chlorine doses for the THM formation tests that would provide a free chlorine residuals leaving the clearwell (≈ 60 minutes) of 1 mg/L and 3 mg/L. The 1-hour free chlorine decay curve is shown in Figure 12. For both the 2 mg/L and 3 mg/L chlorine doses, the 60-minute demand was 1.0 mg/L, and the chlorine demand for the 4 mg/L chlorine dose was 1.2 mg/L.

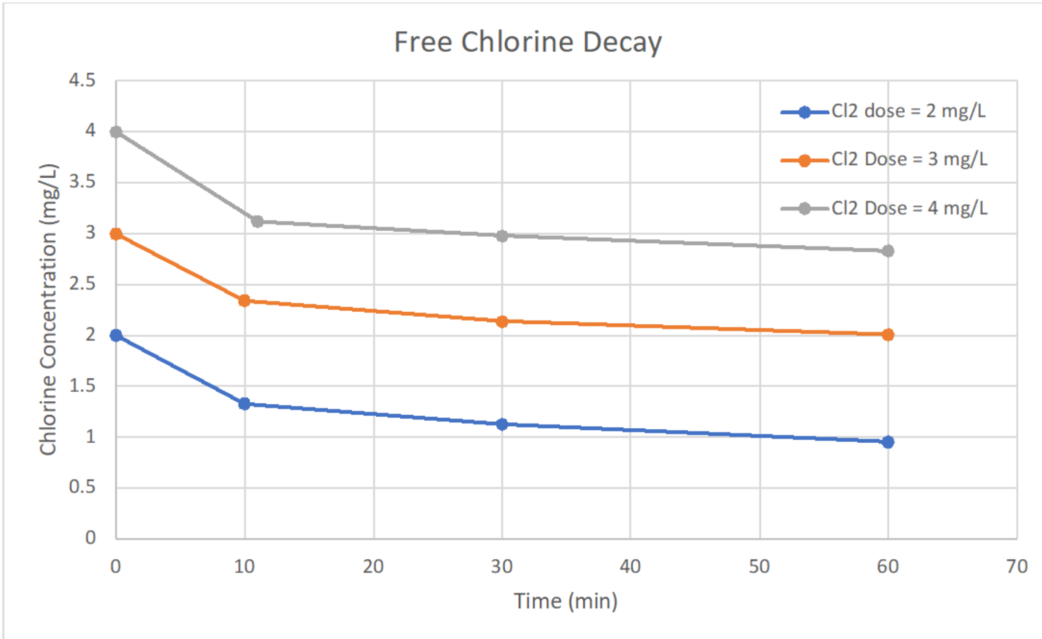


Figure 12. Simulated Free Chlorine Decay through the Springer Clearwell

10-Day Free Chlorine Decay and THM Formation Curves. For the THM formation curves with free chlorine, a series of 12 amber bottles were filled with pH adjusted C/S water and spiked with sufficient chlorine to leave free chlorine residuals of 1 mg/L and 3 mg/L after the 1-hour HRT of the clearwell. Six bottles were spiked with a 2 mg/L dose and six bottles with the 4.2 mg/L dose. The sample bottles were filled headspace free and stored in a dark location for holding times ranging from 30 minutes to 10 days, at which point the chlorine residual was determined and THM sample bottles (containing a chlorine quenching agent) were filled and taken to Eurofins (formerly Hall Environmental) for analysis.

10-Day Chloramine Decay and THM Formation. To evaluate whether using chloramines for residual maintenance through the distribution system would minimize THM formation while maintaining a chlorine residual for a longer period of time, a series of bottles were filled with pH adjusted C/S water, spiked with sufficient chlorine to leave free chlorine residuals of 1 mg/L and 3 mg/L after the 1-hour disinfection CT through the clearwell, and then spiked with ammonia to convert the free chlorine to chloramines. The optimum chlorine to ammonia weight ratio (Cl_2/NH_3-N) for chloramine is a weight ratio between 4.0 and 5.0 to minimize having excess free ammonia in the sample. Ammonia was spiked into the test bottles at a Cl_2/NH_3-N ratio of 4.0 based on the target Cl_2 residual after 1 hour. The sample bottles were filled headspace free and stored in a dark location for holding times ranging from 30 minutes to 10 days, at which point the monochloramine residual was determined. Three sample bottles with the highest chloramine dose of 3 mg/L were analyzed for THMs, for comparison with THM formation in samples containing free chlorine. THM sample bottles (containing a chlorine quenching agent) were filled and taken to Eurofins for analysis.

4.2 Regulatory Required Disinfection Credit

The USEPA's Surface Water Treatment Rules[2] require that conventional surface water treatment plants, such as the Springer WTP, achieve 2-log Cryptosporidium[3] removal, 3-log Giardia removal/inactivation, and 4-log virus removal/inactivation. A surface water treatment plant meeting the filter effluent turbidity requirements of the SWTR will achieve 2.5-log credit for Giardia removal and 2-log credit for virus removal. The additional 0.5-log credit for Giardia treatment and 2-log credit for virus treatment are to be achieved through disinfection.

Disinfection credit is a function of chlorine concentration, chlorine contact time, pH, and water temperature. To determine compliance with the SWTR's pathogen inactivation requirements, the "CT" for the water treatment system is calculated, where:

C = Residual disinfectant concentration measured at the point where CT is calculated (e.g., the exit of the clearwell)

T = Disinfectant contact time (during peak hourly flow) between the point of disinfectant application and the point where CT is calculated. The contact time used in the CT calculation is T_{10}, which is the residence time corresponding to the time at which 90 percent of the water has been in contact with the residual disinfectant concentration, C.

The USEPA's SWTR Guidance Manual (March 1991) provides tables of CT values for inactivation of Giardia and for inactivation of viruses with a variety of disinfectants. More detail about the required CT_{10} for the Springer WTP is provided in Section 5.1.

The Springer WTP uses free chlorine for final disinfection. For the purposes of these bench tests, a free chlorine contact time of 1 hour was assumed for CT disinfection credit before ammonia is added, which is consistent but slightly less than the estimated HRT through the Springer clearwell (reported as 76.4 minutes in the DBS&A report for the French MDWCA (February 2021)).

4.3 THM Formation with Free Chlorine

Chlorine decay and THM formation in relation to chlorine dose and sample holding time are shown in both tabular and graphical format in Table 5, Figure 13, and Figure 14. Figure 13 shows chlorine decay over the ten-day test period and Figure 14 shows corresponding THM formation for the two chlorine doses tested. For the low chlorine dose of 2.0 mg/L (which provided a 1.0 mg/L chlorine residual after the 1-hour approximate HRT of the clearwell), the water maintained a detectable chlorine residual for 2 days. A 1 mg/L chlorine residual leaving the clearwell is generally higher than current plant operations. Plant records for April 2024 indicated chlorine residuals leaving the WTP between 0.3 and 0.9 mg/L. After 2 days of time, the chlorine residual dropped to nearly 0 mg/L. With a 4.2 mg/L chlorine dose, a detectable chlorine residual was maintained through the end of these 10-day bench tests. It is important to note, though, that the chlorinated samples held in amber bottles do not accurately simulate the chlorine demand that occurs in a distribution system where other conditions such as biofilms and corrosion scale may exert additional chlorine demand.

---

[2] The Surface Water Treatment Rules (SWTRs) include (1) the original SWTR, (2) Interim Enhanced SWTR, (3) the Long-Term 1 Enhanced SWTR, and (4) the Long-Term 2 Enhanced SWTR.

[3] Greater log removal of Cryptosporidium is required depending on concentrations of Cryptosporidium measured during the required 2-years of source water monitoring.

Information is not available regarding the water age through the Springer distribution system. However, the water age for the French system (DBS&A, February 2021) was estimated to be more than 20 days at some locations. Clearly, maintaining a detectable chlorine residual throughout the distribution system with free chlorine is challenging without chlorine boosting–particularly for the consecutive systems.

In terms of THM formation (Figure 14), the higher chlorine dose (4.2 mg/L) caused THM concentrations to exceed the MCL after approximately 20 hours while with the lower chlorine dose (2 mg/L) the THMs exceeded the MCL after approximately 1.3 days.

Table 5. Chlorine Decay and THM Formation as a Function of Chlorine Dose and Sample Holding Time

Chlorine Dose (mg/L)	Holding Time (hrs)	Holding Time (days)	Chlorine Residual (mg/L)	THM Conc. (µg/L)
2.0	0.5	0.02	1.13	26
	1.0	0.04	1.01	32
	6.0	0.25	0.67	53
	24.3	1.01	0.21	75
	49.4	2.06	0.05	86
	242.5	10.10	0	90
4.2	0.5	0.02	3.16	32
	1.0	0.04	3.10	35
	6.0	0.25	2.58	61
	24.3	1.01	1.73	90
	49.3	2.05	1.45	110
	242.3	10.09	0.34	170

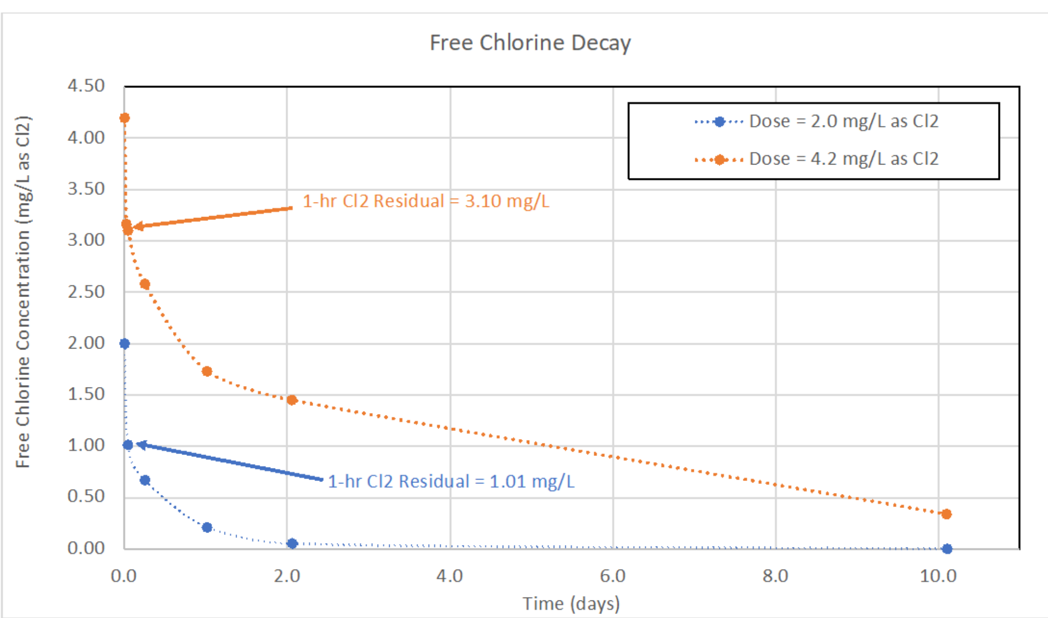


Figure 13. Free Chlorine Decay Curves

4.4 THM Formation with Chloramines

Chloramine decay curves are shown in Figure 15. Chloramines are not as strong of a disinfectant as free chlorine, and chloramines decay slowly and are able to maintain a detectable residual for a longer period of time in a large distribution system with a long water age. After 10 days of contact time the 1 mg/L chloramine concentration decreased only 0.35 mg/L, and over the same time period the 3 mg/L chloramine concentration decreased only 1.3 mg/L.

As a reminder, the ammonia was added to the samples one hour after chlorine was added. This contact time with free chlorine represents the required pathogen disinfection through the clearwell. Ammonia is not added until disinfection CT has been achieved.

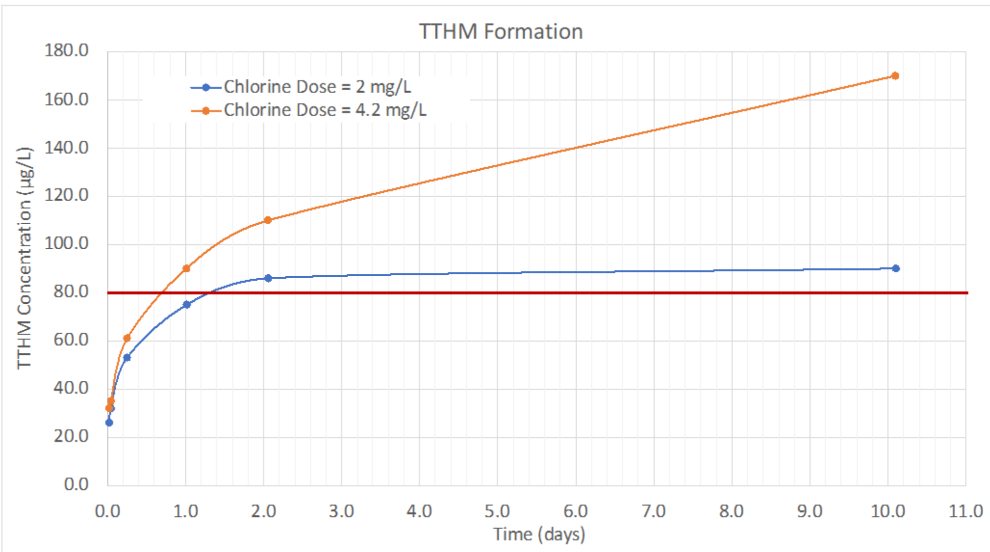


Figure 14. Total THM Formation Curves with Free Chlorine

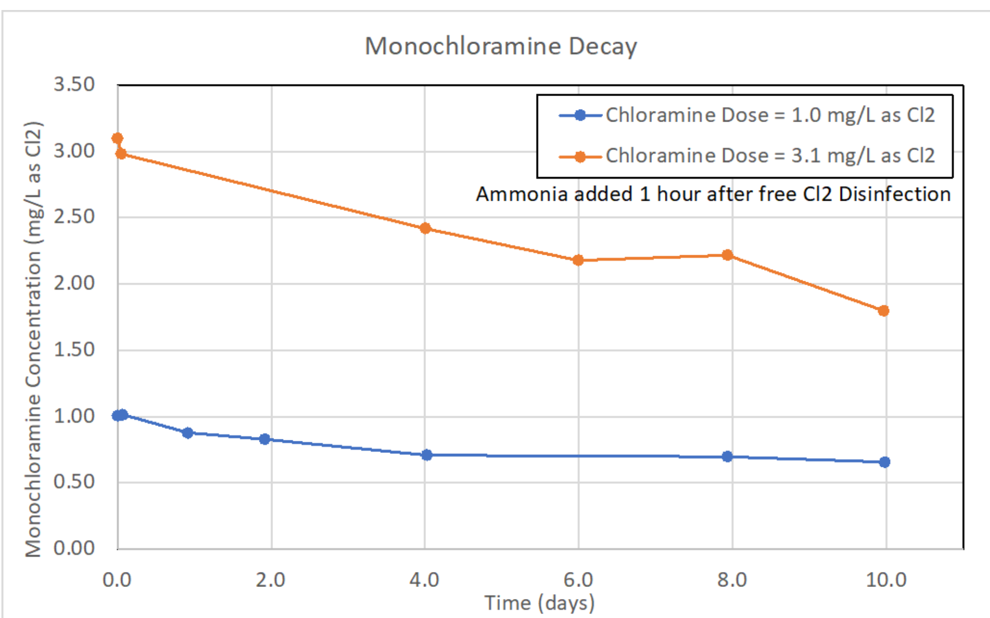


Figure 15. Chloramine Decay Curves

THM formation with chloramines is shown in Figure 16 relative to THM formation with free chlorine at the same dose. Because chloramines are not as strong an oxidant as free chlorine, THM concentrations increased only minimally after ammonia was added to form chloramines. Even after ten days, the THM concentrations were maintained below 50 µg/L, with enhanced coagulation and free chlorine primary disinfection. Free chlorine used for primary disinfection was responsible for almost all of the THM formation.

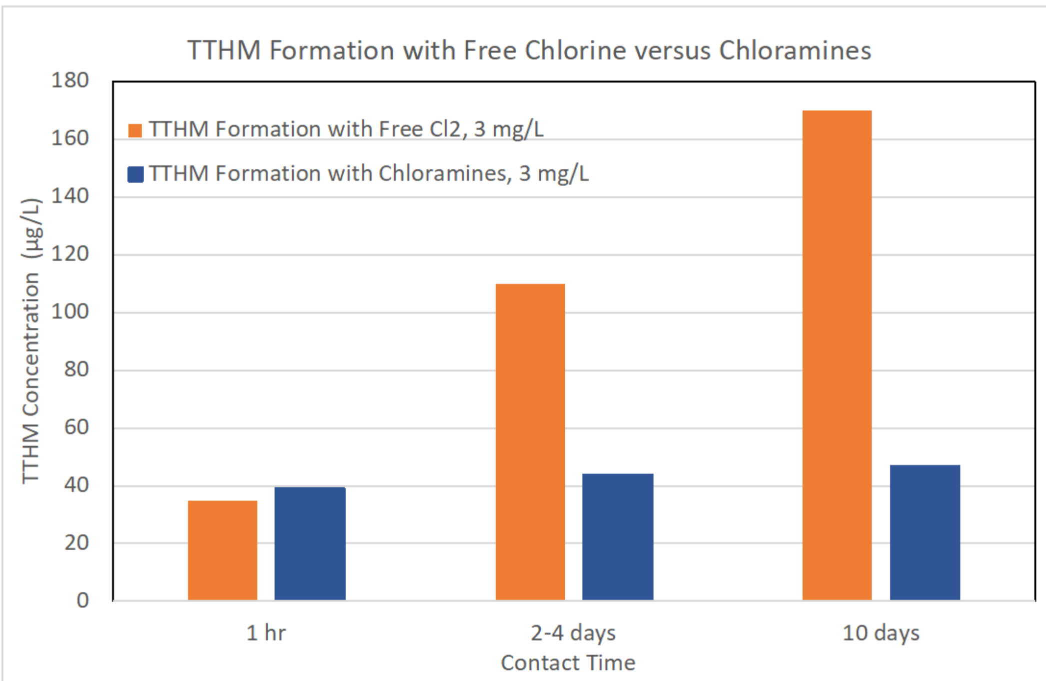


Figure 16. THM Formation with Free Chlorine Compared with Chloramines

4.5 Comparison with Historical DBP Data

DBP formation is a function of the following key water quality and operational practices: raw water TOC concentrations, finished water TOC concentrations which are impacted by effectiveness of the coagulation process, free chlorine doses used for disinfection, and chlorine contact time. As shown previously, in Figure 3, LRAA THM concentrations at the High School monitoring location were above the regulatory MCL (80 µg/L) the majority of the time (i.e., calculated to be 81% of the time). A summary of historical TOC and THM concentrations, along with TOC and THM concentrations from these bench tests, is provided in Table 6. These data indicate:

- The TOC concentration of the raw water used in the bench tests was typical of what the Springer WTP treats.
- Bench tests using the same alum dose as the WTP resulted in similar C/S TOC concentration as the WTP's average finished water TOC.
- The enhanced coagulation conditions applied in the bench tests achieved a lower TOC concentration, but when chlorinated with a higher dose so as to maintain a free chlorine

residual for 10 days, had higher THM concentrations compared to the Springer WTP's distribution system.

- Based on the bench test results, adding ammonia to convert the free chlorine residual to chloramines–after meeting the pathogen disinfection requirements–will effectively halt the THM formation reaction and allow Springer to comply with the THM MCL.

Table 6. Comparison of Historic Springer WTP TOC and THMs with Bench Test Results

Parameter	Springer WTP		Bench Tests	
TOC (mg/L)	Raw Water, Avg., (Range), 2018-2024	5.3 (3.9 – 6.3)	Raw Water	5.3
	Finished Water (10 mg/L Alum), Avg., (Range), 2018-2024	4.7 (3.4 – 5.5)	C/S Water (10 mg/L Alum)	5.1
			C/S Water (16.4 mg/L Ferric, pH 6.0)	3.7
Total THMs (µg/L)	High School, Average of LRAAs, 2018-2024	98.3	Free Cl2, 1-mg/L[A], 10 Days Contact	90
	High School, Max of LRAAs, 2018-2024	114.5	Free Cl2, 3-mg/L[A], 10 Days Contact	170
	High School, Min of LRAAs, 2018-2024	69.4	Chloramines, 3-mg/L[B], 10 Days Contact	47

[A] Enhanced Coagulation Ferric Dose of 16.4 mg/L and pH of 6.0. The stated chlorine dose was the chlorine residual after 1-hour of contact with free chlorine, representing the chlorine concentration leaving the clearwell.
[B] Enhanced Coagulation Ferric Dose of 16.4 mg/L and pH of 6.0. Ammonia was added to form chloramines one hour after free chlorine disinfection.

5 Operational Considerations

Removing greater percentages of TOC through enhanced coagulation is one consideration for managing DBP levels for Springer and its consecutive systems. Another approach being considered is the use of chloramines rather than free chlorine for residual disinfectant after leaving the WTP. While the results of the bench testing presented in the preceding sections indicate these two DBP mitigation options together as a potentially viable solution, there are also operational considerations at the WTP that must be evaluated and addressed before making final selection of the optimal DBP mitigation approach.

5.1 Disinfection CT Requirements

The USEPA's Surface Water Treatment Rules (SWTRs) have established treatment techniques, which impose additional treatment requirements for public water systems using surface water. The following treatment techniques apply to conventional treatment:

- Reduction of 4-log (99.99%) of viruses, 3-log (99.9%) of Giardia lamblia, and 2-log of Cryptosporidium (via filtration and based on Bin 1 classification[4]),
- Multi-barrier treatment to address microbial pathogens, with at least 0.5-log inactivation of Giardia and 2-log inactivation of virus via disinfection,
- Maintain at least 0.2 mg/L disinfectant concentration at the entrance to the distribution system and a detectable disinfectant residual throughout the distribution system,
- Continuous monitoring of individual filter effluent (IFE) and combined filter effluent (CFE) turbidity, and
- Achieving the following CFE turbidity standards:
    - Less than or equal to 0.3 NTU in 95% of measurements
    - Never in excess of 1 NTU.

Conventional treatment with granular media filtration, such as at the Springer WTP, that achieves the above treatment technique requirements is credited with pathogen log reduction values (LRVs) of 2-log *Cryptosporidium* (C), 2.5-log *Giardia* (G), and 2-log virus (V). The remaining required 2-log of virus credit and 0.5-log of *Giardia* credit must be achieved using disinfection.

The USEPA's Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Waters (March 1991) includes tables which equate disinfection "CT" with *Giardia* and virus LRV. The "T" in the USEPA's tables accounts for the degree of short circuiting by considering the time at which 10 percent of the water has exited the basin, known as T_{10}. CT_{10}, which accounts for short circuiting, is calculated as follows:

$$CT_{10} = (C)(T)(T_{10}/T)$$

where:

C = residual disinfectant concentration (mg/L) at the compliance monitoring location before the first customer.

[4] The WTP influent was used for the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) Round 1 and 2 monitoring periods, resulting in a Bin 1 classification. No additional treatment for *Cryptosporidium* removal is required for Bin 1 classification.

T = is the HRT of the water from the point of disinfectant addition to the compliance monitoring location.

T_{10} = is the time corresponding to the time at which 90 percent of the water has been in contact with the residual disinfectant concentration, C (also reflecting 10% of the water has exited the basin)

T_{10}/T = baffle factor (a measure of short circuiting)

The 2023 Sanitary Survey Report (NMED, October 2023), the Springer WTP must meet CT at (1) the treatment plant, (2) the first service connection in the distribution system in Springer, and (3) at the point of interconnection at the Springer Correctional Facility. For the purposes of this report, only the CT compliance point at the WTP is considered.

To estimate the required chlorine dose and resultant THM concentrations leaving the Springer clearwell, example CT calculations are provided below, which consider the following assumptions:

- **T_{10}/T for the clearwell** – The hydraulics of the clearwell are unknown at this time. However, based on the April 22, 2024, site visit, it is known the clearwell is not baffled so a baffle factor of 0.1 is assumed. According to the USEPA's SWTR Guidance Manual, a T_{10}/T of 0.1 is representative of "unbaffled" conditions.
- **Springer Clearwell HRT** – Per the French MDWCA report (DBS&A, February 2021), the HRT of the clearwell at 600 gpm and an average depth of 7.84 ft is 76 minutes.
- **Hours of WTP Operation** – The plant is operated intermittently, typically 4 hours/day (DBS&A, Feb. 2021). It is assumed the WTP may be off-line for as long as 24 hours.
- **Range of Water Temperatures** – Review of historical water quality data showed that the temperature of the raw water ranged from a low of 3 ºC to 23 ºC. For ease of calculating CT using the tables provided in the SWTR Guidance Manual, the minimum temperature is assumed to be 5 ºC and the maximum temperature is assumed to be 25 ºC.
- **Pathogen Inactivation** – The chlorine dose required for 0.5-log Giardia inactivation is greater than the chlorine dose required for 2-log virus inactivation. Therefore, the calculations shown in the examples below are for achieving 0.5-log Giardia inactivation.

Chlorine Residual Required to Meet CT. Considering the conditions tested in these bench tests–enhanced coagulation pH of 6.5 and free chlorine residual of 1.0 mg/L, the CT_{10} required to achieve 0.5-log Giardia inactivation at 25 ºC is 5 mg•min/L, and at 5 ºC the required CT_{10} is 21 mg•min/L. For the most challenging temperature of 5 ºC, the calculated CT_{10} is 7.6 mg•min/L, which is less than required.

$$CT_{10} = (1.0\ mg/L)(76\ min)(0.1) = 7.6\ mg\bullet min/L$$

At the maximum temperature of 25 ºC, this CT_{10} is greater than required.

To meet the required CT at the minimum temperature, either (1) the chlorine residual at the exit of the clearwell would have to be greater than 3 mg/L, (2) production flows would have to be reduced to 218 gpm to achieve a HRT of 210 min, or (3) the clearwell would need to be baffled. With a baffle factor of 0.3 and a chlorine residual of 1.0 mg/L, the required CT_{10} of 21 would be met over the entire temperature range.

$$CT_{10} = (1.0\ mg/L)(76\ min)(0.3) = 22.8\ mg\bullet min/L$$

5.2 Location of Chlorine Addition Point to Maintain a Chlorine Residual Through the Clearwell

The clearwell is a large, subgrade basin located under the floor at the end of the filters. The April 22, 2024, site walk of the Springer WTP indicated that filter effluent (FE) from Filter #1 empties into the clearwell on one side of the clearwell, and FE from Filter #2 empties into the clearwell on the other side. Chlorine is added to the clearwell near a side wall, not in a direct line between where the FE enters and the distribution pumps withdraw from the clearwell. No mixing is provided with chlorine addition. Although no analysis of the clearwell was done, it appears there would be short circuiting of Filter #1 FE to the finished water pump, and that FE from Filter #2 may be exposed to higher concentrations of free chlorine. It seems this single chemical addition location and FE flow scenario would negatively impact disinfection effectiveness and DBP formation. It is recommended that hydraulics and mixing through the clearwell be analyzed and improved.

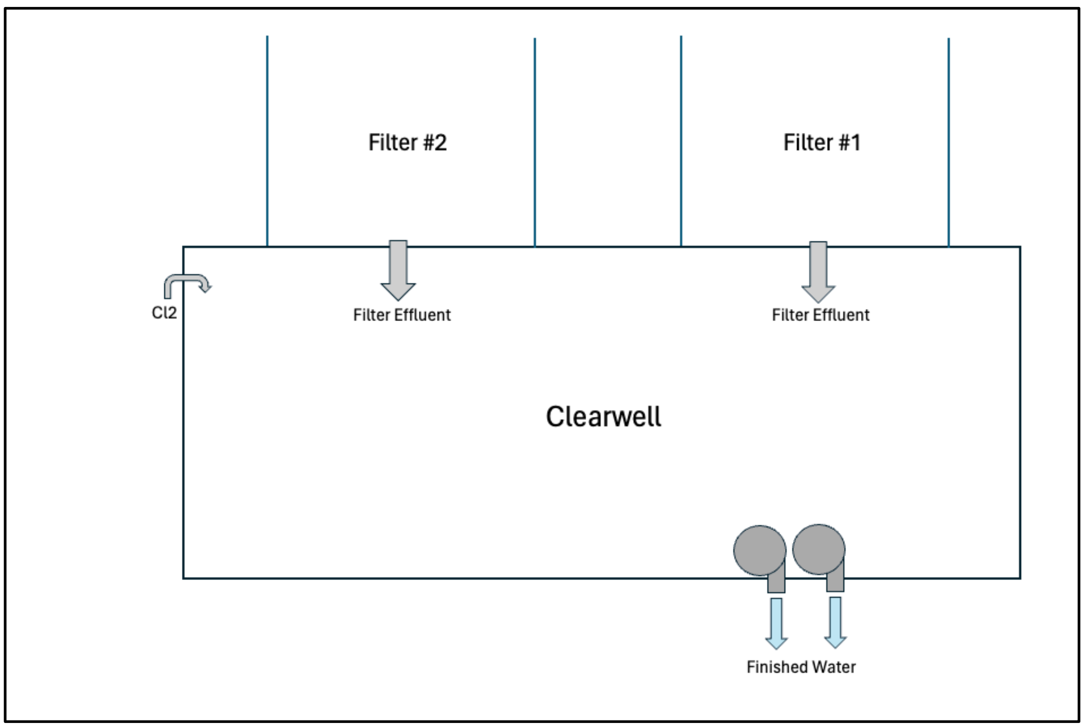


Figure 17. Schematic of Springer Clearwell

5.3 Intermittent Operation of Springer's WTP

Intermittent operation of the treatment plant affects the decay of chlorine and the formation of THMs in the clearwell when the plant is not in operation.

THM formation when the WTP is in operation. Assuming the Springer clearwell was baffled to achieve a T10/T of 0.3 or greater, as discussed in Section 5.1, and a chlorine dose of 2.0 mg/L was applied providing a free chlorine residual of approximately 1.0 mg/L at the exit of the clearwell, the THM concentration would be approximately 32 to 39 µg/L which is well below the

THM MCL. If ammonia was added after the clearwell, to provide a chloramine disinfectant residual through the distribution system, the THM concentrations could increase minimally through the distribution system but would not be expected the 80 µg/L MCL.

THM formation when the WTP is off-line. One of the challenges for Springer in controlling DBP formation is that the plant operates intermittently and could be off-line 20 to 24 hours. Based on the THM data collected in these bench tests, even with enhanced coagulation to remove a greater percentage of TOC than currently achieved, the THM concentration after 24 hours in the clearwell would be 75 µg/L which is only marginally below the MCL. Because these bench tests represent only one point in time, the THM concentrations in the water leaving the clearwell after a 24-hour hold time would likely be above the THM MCL during some periods of the year when the source water TOC is higher than in these bench tests. In this situation, converting the free chlorine to chloramines would not solve the THM compliance issue.

To provide a buffer for THM concentrations in the distribution system, the THM levels leaving the clearwell should be kept at 80% or less of the MCL (≈ 60 µg/L). The THM formation curves in Figure 14 suggest that even with enhanced coagulation and ammonia addition after the clearwell, the off-line time should be no more than roughly 10 hours.

Chlorine decay when the WTP is off-line. When the water is sitting stagnant in the clearwell when the plant is not in operation, the chlorine residual will continue to decay. As noted in Section 4.1, ammonia has to be added in a specific ratio to the chlorine residual. When the chlorine residual is lower due to the plant being off-line overnight (residual as low as 0.6 – 0.8 mg/L), the ammonia dose will need to be reduced and ramped up as the as the water in the clearwell is refreshed. Varying the ammonia feed rate over the first hour of operation every day may cause operational challenges. SCADA control of the ammonia feed system is critical to avoid overfeeding ammonia, which is a nutrient that can lead to microbial growth and nitrification in the distribution system and storage tanks. Nitrification in the distribution system can cause problems with residual maintenance and is difficult to control once it has started.

6 Conclusions and Recommendations

Key conclusions from these enhanced coagulation and THM formation bench tests are summarized in Section 6.1 and recommendations THM compliance are discussed in Section 6.2.

6.1 Bench Tests Conclusions

- On a molar concentration basis, alum and ferric performed similarly for both turbidity removal and TOC removal (Figure 6). At low pH's, ferric produced floc that settled better than alum (Figure 9), likely because ferric is an effective coagulant over a wider pH range than alum.
- Reducing the pH for enhanced coagulation resulted in a greater percentage TOC removal (Figure 11). A coagulation pH of 5.5 resulted in the highest percentage TOC removal with ferric (Figure 11), but the maximum TOC removal with alum was achieved at pH 6.0. Therefore, THM formation tests were conducted with enhanced coagulation at pH 6.0.
- In these tests, enhanced coagulation was able to remove > 25% TOC as required for the source water TOC and alkalinity at the time of sampling. Nevertheless, TOC of the C/S water never dropped below 3 mg/L with enhanced coagulation and a "rule of thumb" for controlling DBP formation is a settled water TOC < 2 mg/L. Also, historic raw water SUVA, as well as the raw water collected for these bench tests, was consistently less than 2 L/mg•m, indicating a water that is less amenable to TOC removal. Thus, free chlorine should not be used for providing a disinfectant residual through the distribution system, unless a means of stripping the volatile THMs is also provided.
- Chloramines decayed slowly, while the free chlorine decay rate was relatively fast (Figure 13 and Figure 15). Thus, chloramines are able to provide a stable chlorine residual in the distribution system for a much longer period of time than is free chlorine.
- With chloramines, THM formation essentially ceased once ammonia was added to the water following pathogen disinfection with free chlorine. With free chlorine, THM concentrations increased as the holding time increased, and the THM MCL was quickly exceeded, even with the enhanced coagulation and the lowest effective chlorine dose. With chloramines, though, THM concentrations remained at a consistent level once ammonia was added–well below the THM MCL.

6.2 Recommendations

Improvements are needed at the Springer WTP to address both the SWTR regulations and the D/DBP regulations. The DBP compliance issue cannot be resolved without addressing both regulations. Recommendations for D/DBP Rule compliance include the following:

- Continue using alum as the primary coagulant.
- Practice enhanced coagulation by substantially increasing the alum dose (e.g., 3 times the current dose) and adding acid to reduce the coagulation pH to approximately 6.
- Increase hours of plant operation in order to reduce water age in the clearwell in order to reduce THM formation with free chlorine before ammonia is added.
- Add sodium hydroxide after the clearwell and before ammonia addition, to raise the pH of the finished water to the historical pH of water in the distribution system (approximately 7.8 to 8.0).

- Add ammonia at a 4:1 $Cl_2:NH_3$-N mass ratio to form chloramines for maintaining a chlorine residual throughout the distribution system.
- Enhance SCADA monitoring, and maintain instrument calibration, to meet disinfection requirements and in order to avoid nitrification issues in storage tanks.

Implementation of the recommendations from the bench tests for D/DBP Rule compliance will be obstructed by the lack of effective primary disinfection at the plant and the intermittent operation. Ammonia for secondary disinfection must be added after primary disinfection (CT requirements) has been achieved. Thus, the recommended improvements for addressing the DBP issue cannot be designed without simultaneously addressing the primary disinfection issue.

Primary disinfection was not within the scope of this project and additional investigation is warranted, and thus definitive recommendations cannot be provided. Several alternatives for simultaneously addressing primary disinfection and DBP formation could include the following:

- Continue using free chlorine as the primary disinfectant for meeting pathogen CT requirements and use chloramines for disinfectant residual in the distribution system to meet the SWTR requirement of a detectable residual throughout the distribution system. To do this, is will be necessary to reconfigure the clearwell (or construct a new chlorine contact system) to achieve the following (a) provide a well-defined point where chlorine can be added to the combined filter effluent, (b) baffle the clearwell to prevent short-circuiting and achieve a baffle factor (T10/T) of at least 0.3 so adequate CT credit can be achieved, (c) revise plant operation so that chlorinated water is not sitting stagnant in the clearwell for many hours before ammonia is added, and (d) provide a well-defined point where ammonia and sodium hydroxide can be added to the disinfected water prior to leaving the WTP site.
- Use an alternate disinfectant, such as UV light, for primary disinfection, followed by chloramines for secondary disinfection. Adding ammonia prior to chlorine to form chloramines or injecting pre-formed chloramines into the process stream would prevent THM formation.
- Continue with free chlorine for both primary and secondary disinfection, and provide air stripping for THM removal and chlorine booster stations in the distribution system for residual maintenance.

7 References

Daniel B. Stephens & Associates, Inc. (2021). Preliminary Engineering Report for Control of Disinfection Byproducts. Report for French Mutual Domestic Water Consumers Association.

NMED. (2023). Sanitary Survey Report for the Springer Water System (NM3526604), New Mexico Environment Department.

USEPA. (1991). Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources. Contract No. 68-01-6989.

USEPA. (1999). Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA 815-R-99-012.

8 Appendices

Appendix A – Amended Test Plan for Bench Tests

Appendix B – Bench Test Data

Appendix C – Water Treatment Plant Site Walk Observations

Appendix D – Eurofins Lab Reports for Bench Tests

APPENDIX A
BENCH-SCALE DBP PRECURSOR REMOVAL TEST PLAN

Prepared for the
Town of Springer

Draft Date: April 1, 2024
Amended Date: May 27, 2024

Prepared By: Elaine Howe, P.E., BCEE
Kerry Howe, Ph.D., P.E., BCEE

Howe Water Science

Subject: **AMENDED - Test Plan for DBP Mitigation Bench Tests**

Table of Contents

1 Introduction

The purpose of this study is to conduct bench-scale tests to support the design and construction of improvements at the Springer Water System to bring the system into compliance with disinfection by-product (DBP) regulations. The proposed improvements include a transition to enhanced coagulation to improve DBP precursor removal and a transition to chloramines for secondary disinfection to reduce DBP formation in the distribution system. Enhanced coagulation will involve a potential change to a different coagulant and the addition of acid to conduct coagulation at optimal pH conditions. The plant will need to add a base after treatment to restore the pH to stable conditions. The plant will continue to use free chlorine for primary disinfection to achieve the required log inactivation for viruses and *Giardia Lamblia*. Ammonia will be added to the water after the required CT credit has been achieved with free chlorine, converting the free chlorine residual to a combined chlorine (i.e., chloramine) residual.

2 Objectives

The proposed bench testing has the following objectives:

1. Evaluate whether aluminum sulfate (alum) or ferric chloride (ferric) is more effective for turbidity, total organic carbon (TOC) and dissolved organic carbon (DOC) removal.
2. Evaluate the preferred pH for optimal TOC and DOC removal during enhanced coagulation.
3. Evaluate the rate of chlorine decay before ammonia is added, to facilitate disinfection concentration x time (CT) credit calculations and ammonia dosing requirements.
4. Evaluate the rate of trihalomethane (THM) formation before ammonia is added, to determine maximum acceptable free chlorine contact time and corresponding THM formation.
5. Evaluate the rate of chloramine decay after ammonia is added, to assess potential for loss of chloramine residual in the distribution system.

3 Experimental Methods and Materials

3.1 Raw Water Collection

The source water for the Springer WTP is surface water from Eagle Nest Lake via the Cimarron River and an irrigation ditch.

Raw water will be collected from the influent to the Springer WTP, prior to any chemical addition. The exact location for sample collection will be determined during the first site visit. **Twenty (20) gallons** of water will be collected in cubitainers, which includes excess to account for spillage and possible need to repeat a jar test. The cubitainers will be stored in coolers with ice packs to transport back to UNM Environmental Engineering Laboratory and stored in a refrigerator until the day prior to jar testing. The cubitainers must be removed from the refrigerator the day prior to testing in order to let the water temperature equilibrate to room temperature.

3.2 Coagulants

Effectiveness of two coagulants – aluminum sulfate (alum), and ferric chloride (ferric) – will be evaluated for removal of turbidity and natural organic matter (measured at TOC and DOC). The Springer WTP currently uses alum as its primary coagulant. Samples of the bulk alum and bulk ferric will be obtained from Kemira. Specifications of each coagulant are shown in Table 1. A 0.1M (based on metal ion (i.e., Al^{3+} or Fe^{3+})) stock solution of each coagulant will be prepared using lab-grade deionized (DI) water in a volumetric flask. To confirm the appropriate stock concentration used for dosing during jar testing, samples of each stock solution, diluted to approximately 5 mg/L metal ion (e.g., 5 mg/L Fe^{3+}), will be sent to Eurofins Albuquerque (formerly Eurofins Environmental Labs) for aluminum or iron analysis to confirm the stock metal ion concentration.

Table 1. Bulk Coagulant Chemical Specifications*.

Property	Ferric Chloride	Alum
Chemical Formula	$FeCl_3$	$Al_2(SO_4)_3$•$14H_2O$
Specific Gravity	1.417	1.332
% as Al_2O_3	--	8.2
% as Ferric Chloride	38.29	--

* Will be updated based on specifications provided by Kemira.

3.3 Water Quality Analyses

As part of these bench tests, the raw water and settled water will be analyzed for the parameters indicated in Table 2, using the analytical methods indicated in Section 3.4. Using the optimum enhanced coagulation coagulant dose and pH, coagulated/settled (C/S) treated water will be prepared using the jar testerand used to develop free chlorine decay curves and THM formation curves, as well as chloramine decay curves to assess maximum detention time through the Springer and consecutive system distribution systems.

Table 2. Water quality parameters to be tested.

Water	Parameter
Raw Water	pH, temperature, turbidity, alkalinity, filtered UV-254, TOC, DOC
Coagulated/settled water	Turbidity, pH, filtered UV-254, TOC, DOC
Cl_2 decay/THM formation	Temperature, Cl_2 residual, THM (4 THM species)
Chloramine decay	Temperature, monochloramine residual, THM (3 samples only)

3.4 Analytical Methods

For this DBP mitigation study, many analyses will be done by experienced analysists either at UNM's Environmental Engineering Laboratory or at Eurofins. A summary of the analyses, analytical methods and laboratory performing the analyses is presented in Table 3. TOC and DOC samples will be analyzed at both the UNM Lab, which can provide next-day sample turnaround, and at Eurofins, which is a nationally accredited lab, for QA/QC since the test results may be submitted to NMED. Samples for developing the chlorine and chloramine demand/decay curves will be spiked with disinfectant in the UNM Lab, held the appropriate amount of time, and analyzed for chlorine residual at the end of each sample hold time. The THM samples will be spiked with chlorine and held the appropriate length of time at the UNM Lab, while THM analyses will be performed at Eurofins.

Table 3. Analytical methods used during bench testing.

Parameter	Method*	Lab	Comments
pH	SM 4500-H+	UNM	Standard pH probe
Temperature	SM 2550	UNM	Digital thermometer
Turbidity	SM 2130	UNM	HACH 2100P Turbidimeter
UV-254	SM 5910 B	UNM	Varian Cary 50 UV/VIS Spectrophotometer. Samples will be filtered using 0.45-µm Cole Parmer polyethersulfone (PES) membrane filter before analysis.
Alkalinity	SM 2320	UNM	Thermo-Fisher Gallery Discrete Analyzer
TOC	SM 5310B	Eurofins and UNM	Teledyne Tekmar Fusion TOC Analyzer (UV/Persulfate) at UNM
DOC	SM 5310B	UNM and UNM	Teledyne Tekmar Fusion TOC Analyzer (UV/Persulfate) at UNM. Sample will be filtered through a 0.45-µm Cole Parmer PES membrane filter prior to analysis.
THM Formation	SM 5710C	UNM	
THM	EPA 524.2 by GCMS	Eurofins	
Free Chlorine	HACH 10245 (DPD Method)	UNM	HACH DR900
Monochloramine	HACH 10200 (Indophenol Method)	UNM	HACH DR900
Ammonia Nitrogen	HACH 10245 (DPD Method)	UNM	HACH DR900 or Thermo-Fisher Gallery Discrete Analyzer
Iron	EPA 200.7	Eurofins	Used as a check for stock concentration
Aluminum	EPA 200.7	Eurofins	Used as a check for stock concentration

* SM = Standard Methods for the Examination of Water and Wastewater, 23rd edition, (APHA, 2017); EPA = Environmental Protection Agency.

4 Coagulation Jar Testing Procedures

The night before starting the jar tests, the water samples will be taken out of the refrigerator and allowed to reach ambient room temperature. All jar tests will be conducted at ambient room temperature. The test procedures for the jar tests follow generally accepted procedures as described in (Kawamura, 2000) and (AWWA, 2011), using square 'Gator Jars'—which Phipps & Bird calls the B-KER^2—depicted in Figure 1.

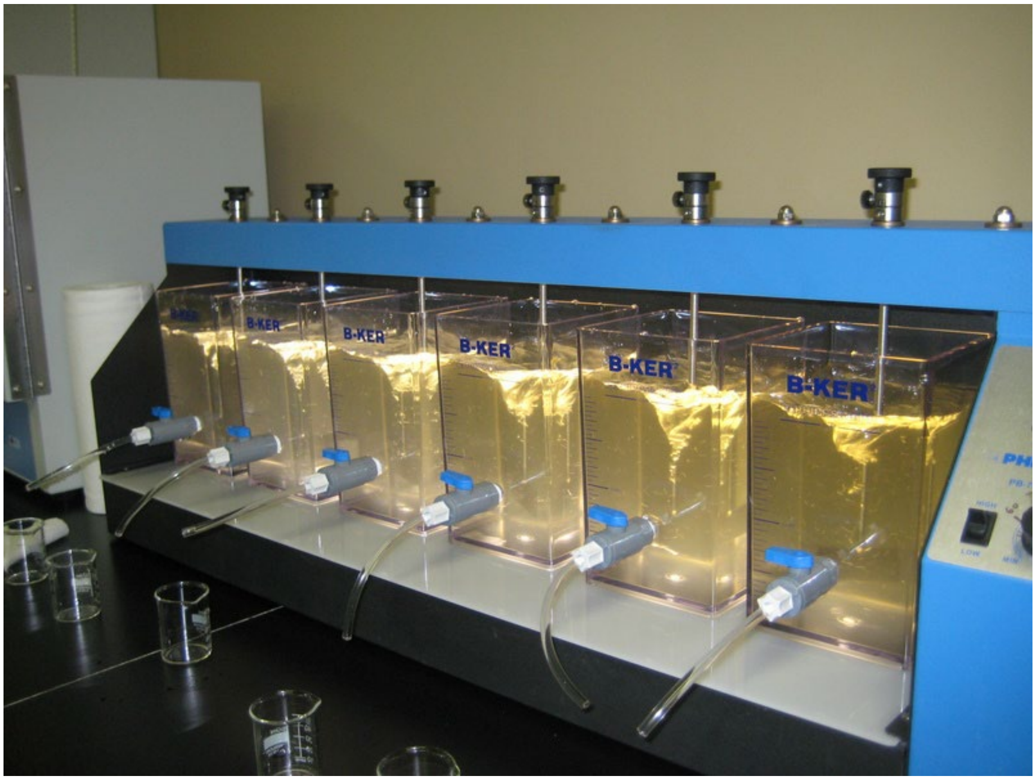


Figure 1. Phipps & Bird jar testing apparatus with B-KER2 jars.

The mixing regime for all tests will include rapid mix followed by three steps of tapered flocculation. The relationship between velocity gradient (G) and impeller speed for the Phipps & Bird mixer with square Gator Jars is shown in Figure 2. The maximum speed of the mixer (300 rpm) will be used for rapid mix, which will last approximately 1 minute. When pH suppression using sulfuric acid is required, the pre-determined acid doses will be added and allowed to mix for approximately 30 seconds before coagulant addition. The velocity gradients used during tapered flocculation will be 60, 40 and 20 sec^{-1}, which correspond to mixing speeds of 60, 45 and 28 rpm, respectively. Each step of tapered flocculation will have a duration of 10 minutes, for a total flocculation time of 30 minutes. Following coagulation, the water will be allowed to settle for 30 minutes prior to sample collection. The jar test procedures are summarized in Table 4.

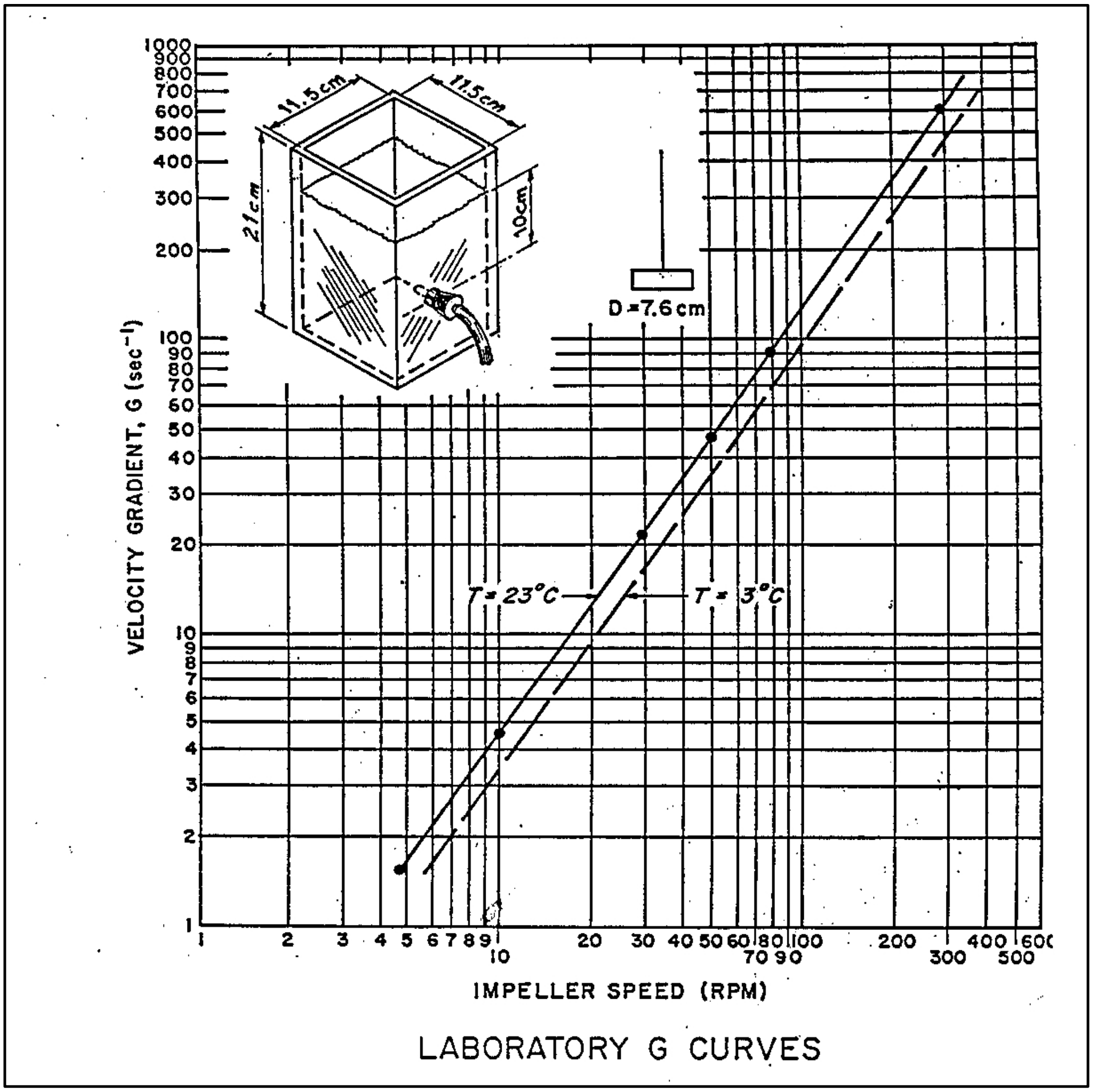


Figure 2. G curves for Phipps & Bird 7.6-cm paddles and 2-liter B-KER2 (AWWA, 2011).

Table 4. Timing and Steps for Jar Test Procedure.

Time (min:sec)	Step
	Start mixer at 300 rpm
	Add sulfuric acid. Mix for 30 seconds
Start timer	Add coagulant
1:00	Reduce mixing speed to 60 rpm
11:00	Reduce mixing speed to 45 rpm
21:00	Reduce mixing speed to 28 rpm
31:00	Stop mixing and let floc settle
61:00	Collect settled water samples

4.1 Jar Tests to Compare Alum with Ferric

The first set of jar tests compare the effectiveness of alum and ferric for TOC and turbidity removal. At the time of a site visit on April 22, 2024, the WTP was operating with an alum dose of 10 mg/L. The WTP operator reported that a constant alum dose is used year-round. Ferric has been shown to achieve greater TOC removal for a comparable dose. Thus, both coagulants will be tested and will be compared on an equal molar metal ion (i.e., Fe^{3+} and Al^{3+}) basis and concentration (i.e., mg/L) basis.

Six jars will be tested using alum and six jars with ferric. The estimated coagulant doses for each jar test are shown in Table 5.

Table 5. Test matrix for comparing alum and ferric performance.

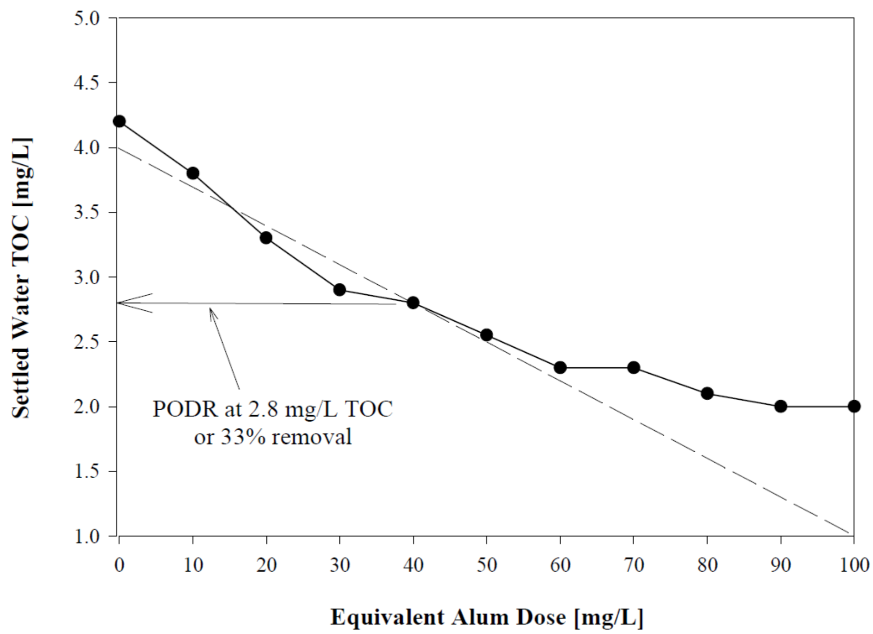
Jar Test Number	pH	Coagulant	Jar Number	Coagulant Dose: mmol/L on metal ion basis (Fe^{3+} or Al^{3+})	Coagulant Dose: mg/L as coagulant	Volume of 0.1M coagulant added to jar (mL)
1	Ambient	Alum	1	0.034	10.0	0.7
			2	0.067	20.0	1.3
			3	0.084	25.0	1.7
			4	0.101	30.0	2.0
			5	0.118	35.0	2.4
			6	0.135	40.0	2.7
2	Ambient	Ferric	1	0.034	5.5	0.7
			2	0.067	10.9	1.3
			3	0.084	13.6	1.7
			4	0.101	16.4	2.0
			5	0.118	19.1	2.4
			6	0.135	21.9	2.7

4.2 Enhanced Coagulation with Preferred Coagulant at Reduced pH

Both alum and ferric will be tested in the next set of jar tests. The preferred coagulant dose will be selected from Task 4.1 results. The preferred dose will be based on TOC/DOC removal performance. The dose of the preferred coagulant for the enhanced coagulation tests will be selected from doses that (a) meets the required TOC removal by enhanced coagulation in the D/DBP regulations, (b) meets the point of diminishing returns for TOC removal, or (c) produces a settled water DOC ≤ 2 mg/L. The Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual (EPA, 1999) provides the required TOC removal as a function of source water TOC and alkalinity, as presented in Table 6. When systems are unable to meet these removal requirements, the Guidance Manual defines the point of diminishing returns for TOC removal as the point where an additional 10 mg/L alum dose equivalent achieves less than 0.3 mg/L of additional TOC removal. The concept of this point of diminishing returns is presented in Figure 3.

Table 6. Required Removal of TOC by Enhanced Coagulation for Plants Using Conventional Treatment (EPA, 1999)

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0 to 60	>60 to 120	>120
>2.0 – 4.0	35.0%	25.0%	15.0%
>4.0 – 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%



Note: The dashed line corresponds to a slope of 0.3 mg-TOC/10 mg-alum.

Figure 3. Example Determination of the Point of Diminishing Returns (PODR) for TOC Removal.

The optimum coagulant dose will be used in this set of jar tests. TOC/DOC removal with each coagulant will be evaluated at three reduced pH's (subject to change but not below a pH of 5.5).

Based on the highest percentage DOC removal in these tests, as determined initially from UV-254 reduction and confirmed from TOC/DOC analytical results (depending on turnaround time for TOC/DOC sample analyses), the optimal coagulant dose and coagulation pH will be selected for use in developing chlorine decay, THM formation, and chloramine decay curves (Task 5 and 6). The test matrix to be applied for these jar tests is summarized in Table 7.

Table 7. Test matrix for enhanced coagulation jar tests.

Jar Test Number	pH	Coagulant	Jar Number	Coagulant Dose	
				mmol/L on metal ion basis (Fe^{3+} or Al^{3+})	mg/L
3	≈ 6.5	Alum	1		Optimal
	≈ 6.0		2		Optimal
	≈ 5.5		3		Optimal
	≈ 6.5	Ferric	4		Optimal
	≈ 6.0		5		Optimal
	≈ 5.5		6		Optimal

5 THM Formation and Free Chlorine Decay Curves

THM formation testing will be performed to assess the concentrations of THMs that would be expected to form over specified hold times, representative of the time required to meet primary disinfection requirements at the Springer WTP, prior to ammonia addition to form chloramines (i.e., combined chlorine). An example THM formation curve is shown in Figure 4. Note that in this particular source water, about 50% of the ultimate THM concentration forms in the first 24 hours.

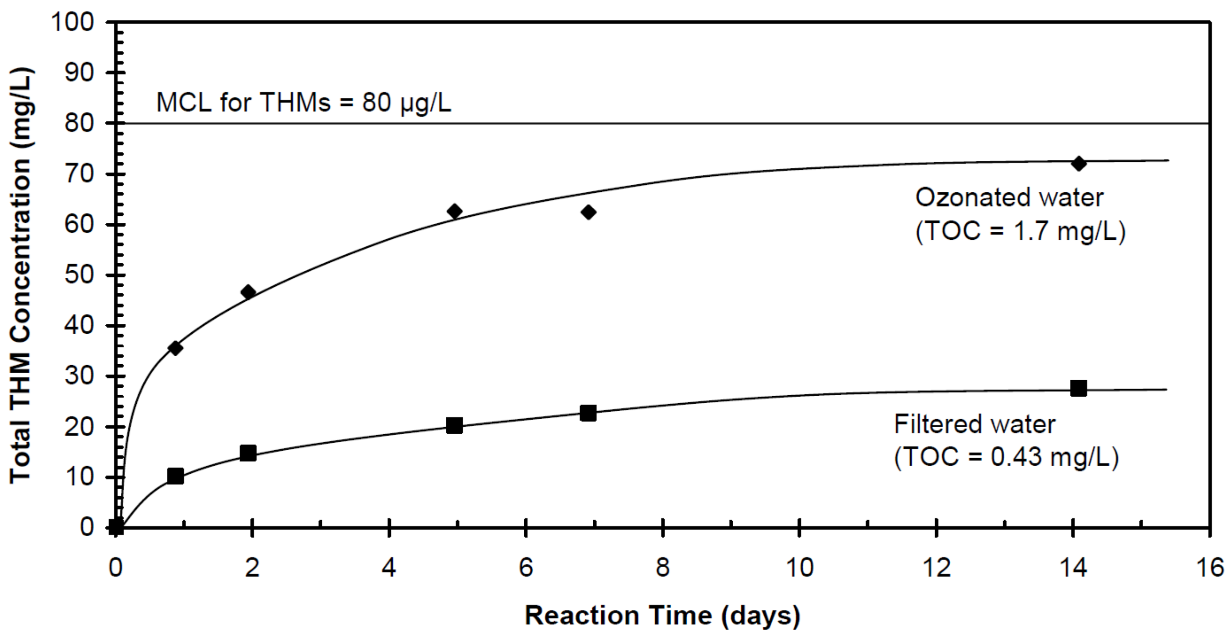


Figure 4. Example THM Formation Curve.

Water for these tests will be sourced from a set of jar tests (6 jars) using the preferred coagulant, optimal coagulant dose and pH determined from the enhanced coagulation tests in Task 3.4.2. Approximately 1.0 L of supernatant from each jar will be collected and blended to produce one sample of coagulated/settled (C/S) water. The pH will be adjusted with sodium hydroxide to the target finished water pH at the Springer WTP. The water (6 L) will be stored in a single 5-gallon cubitainer at ambient room temperature.

5.1 Initial Free Chlorine Demand

Prior to setting up the THM sample bottles, the free chlorine demand (within the first hour) will be determined. From this, the correct chlorine dose for the THM formation tests can be selected which will provide the desired free chlorine residual at the end of a 1-hour hold time (representative of the Springer WTP clearwell). Chlorine decay curves are developed by measuring chlorine residual as a function of sample holding time, as shown in the example in Figure 5. Three initial free chlorine doses (2, 3, and 4 mg/L) will be evaluated. After dosing the chlorine into bottles, the free chlorine residual will be measured at 10, 30 and 60 minutes. The tests will be performed at ambient room temperature.

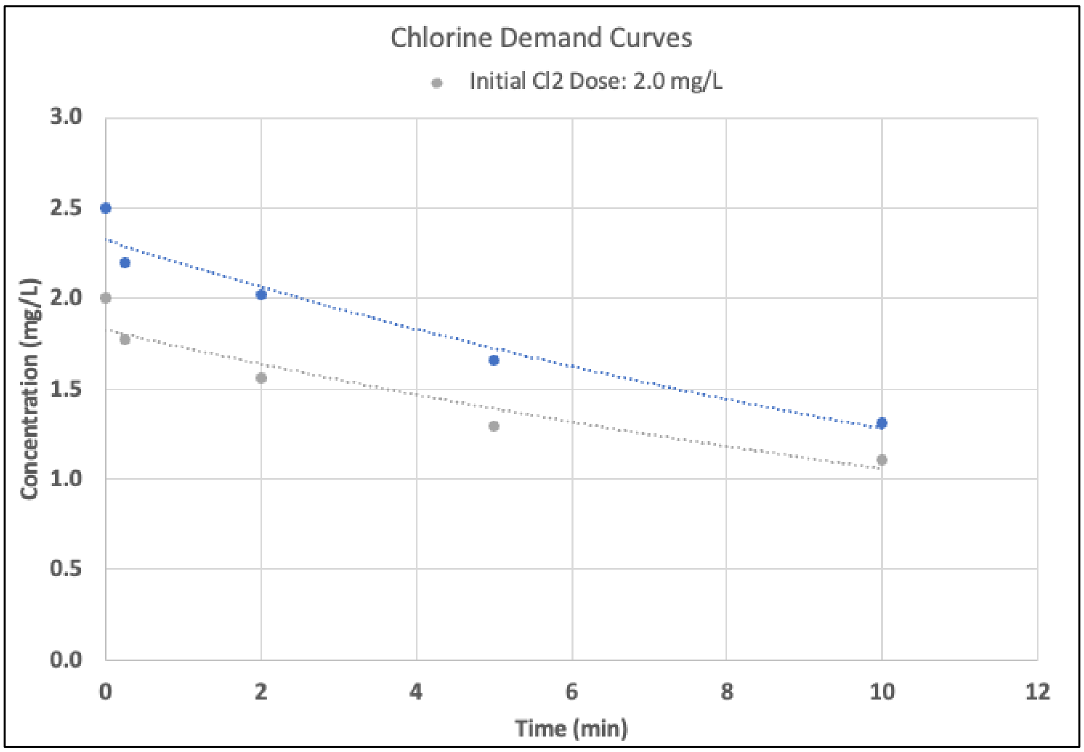


Figure 5. Example Chlorine Demand Curve.

5.2 THM Formation and Free Chlorine Decay Curves

To assess THM formation, the C/S water will be spiked with free chlorine and held for various hold times to develop curves for THM formation and chlorine decay. Two initial chlorine doses and six hold times will be used. The initial chlorine doses will be selected from Task 5.1 to achieve a residual of 1 mg/L (close to Springer's target leaving the WTP) and 3 mg/L after 1 hour of holding time. The maximum hold times considered will be 240 hours (10 days).

The tests will be completed headspace-free in amber glass bottles. One 250-mL amber sample bottle will be used for each chlorine dose and hold time, as shown in Table 8. Spiking of chlorine will be directly into each bottle. The bottles will be inspected carefully to ensure that no air is present (i.e. headspace-free). The bottles will be stored in a dark place and at ambient room temperature during the hold times to maintain a constant temperature and minimize UV exposure.

After the designated sample hold time, amber THM sample collection vials will be filled and the residual chlorine concentration will be measured. Each of the sample collection bottles will have sufficient quenching agent for up to 4 mg/L as Cl_2.

Table 8. Chlorine doses and sample hold times for the free chlorine decay tests.

Bottle Number	Free Chlorine Residual at 1 hour (mg/L)	Approximate Sample Hold Time (hrs)
1	1	0.5
2		1
3		6
4		24
5		48
6		240
7	3	0.5
8		1
9		6
10		24
11		48
12		240

6 Chloramine Decay Curves

This last set of bench tests is intended to evaluate how rapidly the chloramine residual will decay in the Springer distribution system as well as in the distribution systems of the consecutive water systems.

The batch of C/S and pH adjusted water prepared during Task 5 will be used to develop the chloramine decay curves. Two (2) chloramine doses and five (5) sample hold times will be tested. Each sample bottle will have a free chlorine contact time to simulate pathogen disinfection through the Springer clearwell, prior to ammonia addition. For the purposes of these bench tests, a free chlorine contact time of 1-hour is assumed, which is consistent but slightly less than the estimated hydraulic residence time through the Springer clearwell (reported as 76.4 minutes in the DBS&A report for the French MDWCA (February 2021)).

The optimum chlorine to ammonia weight ratio (Cl_2/NH_3-N) for chloramine is a weight ratio between 4.0 and 5.0 in order to minimize having excess free ammonia in the sample. A Cl_2/NH_3-N of 4.0 will be applied to these chloramine decay tests. The chlorine residual concentration needed to calculate the appropriate ammonia dose will be estimated from the 1-hour free chlorine decay curves from Task 5.2. Table 9 shows the free chlorine doses to be applied along with the sample hold times following ammonia addition. The sample hold times are intended to be loosely representative of detention times through the French distribution system. The initial chloramine concentrations will not be known until the 1-hour free chlorine demand is learned from Task 5.

A single 250-mL amber sample bottle will be used for the 1 mg/L chlorine residual set. A separate 250-mL headspace-free bottle will be used for each hold time in the 3 mg/L chlorine residual set, since several of those will be analyzed for THMs, as shown in Table 9.

For the 1 mg/L dose, 200 mL of water will be placed in a 250-mL amber bottle, the appropriate chlorine dose will be added, and the appropriate ammonia dose will be added one hour later, and the bottle will be tightly capped.

For the 3 mg/L chlorine dose, the tests will be completed in individual headspace-free amber glass bottles. The 3 mg/L chlorine dose will be spiked directly into each bottle and after the 1-hour free chlorine contact time, the appropriate ammonia dose will be added. The bottles will be inspected carefully to ensure that no air is present (i.e. headspace-free).

The bottles will be stored in a dark place at ambient room temperature during the hold times to maintain a constant temperature and minimize UV exposure. Following the designated chloramine contact times, the samples will be analyzed for residual chloramine concentration. Three samples (identified with an asterisk in Table 9) also will be analyzed for THMs to confirm that DBP formation is essentially halted by ammonia addition.

Table 9. Chlorine doses and sample hold times for the chloramine decay bench tests.

Bottle Number	Free Chlorine Residual (mg/L)	Free Chlorine Contact Time (hr)	Sample Hold Times after Ammonia Addition (hrs)
1	1	1	6
1			24 (1 day)
1			48 (2 days)
1			96 (4 days)
1			240 (10 days)
2	3	1	6 *
3			24 (1 day) *
4			48 (2 days)
5			96 (4 days)
6			240 (10 days) *

* Samples will be analyzed for THMs after the designated hold times.

7 References

AWWA. (2011). Operational Control of Coagulation and Filtration Processes. Denver, CO, American Water Works Association.

APHA. (2017). Standard Methods for the Examination of Water and Wastewater, 23rd edition. American Public Health Assocation, American Water Works Assocation, and Water Environment Federation, Washington, D.C.

EPA. (1999). Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual, EPA 815-R-99-012.

Kawamura, S. (2000). Integrated Design and Operation of Water Treatment Facilities, John Wiley & Sons, Inc.

Daniel B. Stephens & Associates, Inc. (2021). Preliminary Engineering Report for Control of Disinfection Byproducts. Report for French Mutual Domestic Water Consumers Association.

Appendix B
Springer DBP Mitigation Bench Test Results

Table A.1. Comparison of Alum and Ferric at Ambient pH

Sample ID	Alum Dose (mM Al^{3+})	Alum Dose (mg/L)	TOC (mg/L)	DOC (mg/L)	UV-254 (cm^{-1})	pH	Alkalinity (mg/L as $CaCO_3$)
Raw	0	0	5.3	5.1	0.0741	8.18	147.5
T1-G1	0.034	10	5.1	5.1	0.0737	8.05	144.8
T1-G2	0.067	20	4.9	4.9	0.0648	7.82	140.7
T1-G3	0.084	25	4.7	4.7	0.0626	7.74	144.1
T1-G4	0.101	30	4.6	4.6	0.0597	7.67	143.5
T1-G5	0.118	35	4.4	4.4	0.0572	7.64	141.2
T1-G6	0.135	40	4.4	4.4	0.0585	7.69	138.0
Sample ID	**Ferric Dose (mM Fe^{3+})**	**Ferric Dose (mg/L)**	**TOC (mg/L)**	**DOC (mg/L)**	**UV-254 (cm^{-1})**	**pH**	**Alkalinity (mg/L as $CaCO_3$)**
T2-G1	0.034	5.5	5.0	4.8	0.0718	8.05	Not Analyzed
T2-G2	0.067	10.9	4.8	4.7	0.0648	7.81	
T2-G3	0.084	13.6	4.6	4.4	0.0609	7.61	
T2-G4	0.101	16.4	4.5	4.4	0.0603	7.64	
T2-G5	0.118	19.1	4.5	4.2	0.0601	7.49	
T2-G6	0.135	21.9	4.4	4.2	0.0572	7.55	

Table A.2. Enhanced Coagulation Jar Tests to Select Optimum Conditions

Sample ID	Alum Dose (mM Al^{3+})	Ferric Dose (mM Fe^{3+})	Sulfuric Acid Dose (mg/L)	pH	TOC (mg/L)	DOC (mg/L)	UV-254 (cm^{-1})
T3-G1	0.101		51.0	6.61	4.1	4.0	0.0451
T3-G2	0.101		96.0	5.96	3.9	3.7	0.0408
T3-G3	0.101		118.5	5.49	3.9	3.6	0.0406
T3-G4		0.101	51.0	6.68	4.2	3.9	0.0457
T3-G5		0.101	96.0	6.00	3.7	3.4	0.0374
T3-G6		0.101	118.5	5.53	3.3	3.1	0.0341

Table A.3. Free Chlorine Decay and THM Formation*

Sample ID	Chlorine Dose (mg/L as Cl_2)	Sample Hold Time (hrs:min)	Free Chlorine Residual (mg/L)	THM Concentrations (µg/L)
T52-2-0.5	2	0:30	1.13	26
T52-2-1		1:00	1.01	32
T52-2-6		6:00	0.67	53
T52-2-24		24:21	0.21	75
T52-2-48		49:26	0.05	86
T52-2-240		242:28	0	90

Sample ID	Chlorine Dose (mg/L as Cl_2)	Sample Hold Time (hrs:min)	Free Chlorine Residual (mg/L)	THM Concentrations (µg/L)
T52-3-0.5	4.2	0:30	3.16	32
T52-3-1		1:00	3.10	35
T52-3-6		6:00	2.58	61
T52-3-24		24:17	1.73	90
T52-3-48		49:20	1.45	110
T52-3-240		242:15	0.34	170

* To prepare C/S water for these tests, the selected optimum ferric dose was 0.101 mM Fe3+/L and the optimum coagulation pH was 6.0.

Table A.4. Chloramine Decay and THM Formation

Sample ID	Chlorine Dose (mg/L as Cl_2)	NH_3-N Dose (mg/L)	Sample Hold Time (hrs:min)	Monochloramine Residual (mg/L)	THM Concentrations (µg/L)
T6-B1	2	0.25	**0:00**	**1.01**	
			1:38	1.02	
			21:58	0.88	
			45:58	0.83	
			96:38	0.71	
			190:23	0.70	
			239:33	0.66	
--	4.2	0.75	**0:00**	3.10	
T6-B2			1:16	2.98	39
T6-B3			96:05	2.42	44
T6-B4			143:50	2.18	
T6-B5			190:20	2.22	
T6-B6			239:15	1.80	47

APPENDIX C
Springer WTP Site Visit – April 22, 2024

Attendees:
Adam Steen (Town of Springer)
Chase Stearnes (DBS&A)
Elaine Howe (HWS)
Kerry Howe (HWS)
Ryan (electrical sub)

Reservoir:

- The source water is a shallow reservoir, water was pretty clear. Incoming water into plant was 3 to 4 NTU.

Coagulation:

- The alum dose is 10 mg/L, and is never changed.
- Alum supplier is DPC Industries in Albuquerque. (See https://www.dxgroup.com/, phone (505) 877-3883).
- Used to use dry alum, now get it delivered in 55 gal drums, one drum consumed about every 2 months.
- They add polymer. Adam didn't remember the specific chemical that is used; they are going to change soon.
- There is a static mixer in a vertical section of pipe, but the feed points upstream of that had too much back pressure so the alum is being dripped in at the top of the flocculation basin. It does not appear to get good mixing. The floc is uneven in size, suggesting that the alum might clump and precipitate onto itself where it is being added.
- There is a throttle valve at the entrance to the flocculation basin that is about half closed, right near the inlet flow meter. This valve is probably what is causing the backpressure. If that valve is opened all the way and the flow is throttled with the valve below the static mixer, they would probably be able to feed the alum in the correct location. That would provide better coagulation.

Flocculation:

- The floc looks uneven (EWH also thought it looked small).
- Some big floc chunks, this is evidence the alum is not mixing well and would benefit from moving the coagulation point before the static mixer.

Settling:

- The tube settlers were heavily covered with floc. Springer should evaluate their coagulant and polymer doses because their floc might be too sticky.
- Adam drains the settling basin to below the top of the tube settlers once a week and hoses them down to clean them.

- The sludge pump doesn't work, Adam manually opens the sludge valve every day and lets it drain for 3 minutes.

Filtration:

- Filter runs are terminated on turbidity, target is 0.25 NTU.
- Backwash water is from the clearwell, and is chlorinated water.
- One filter has worse performance than the other, but we did not catch which one.
- The filter runs are very short.
- Garnet was observed in the waste washwater basin. This garnet is from cleaning the clearwell. This indicates that garnet was in the clearwell, which indicates damage to the underdrains that has allowed filter media to get through. Filter underdrains need to be inspected and repaired.

Disinfection and clearwell:

- Adam has just cleaned out the clearwell, it had a couple feet of mud in the bottom. Now it is clean.
- The chlorine feed pump has maximum rate of 5.5 gal/hour, currently set at 16% of speed.
- The target chlorine residual leaving the clearwell is 0.8 mg/L as Cl_2.
- The chlorine injection point is a penetration through the slab, off to the side of the clearwell. If there is no baffling in the clearwell, it is not in a good position for mixing. It's not in the path between the filter effluent and distribution pump suction, so it could be an indicator of short-circuiting that is detrimental to disinfection control.

Distribution pumping:

- The check valves on the pump discharge leak. Once the pumps are shut off, water flows from the storage tank back into the clearwell. To prevent this, Adam has to shut an isolation valve in the main distribution line when the plant is shut down for the day.
- The check valves are being replaced… new rubber flapper check valves are already on site, but need spools fabricated because they are a different length than the existing swing check valves.
- The first customer in Springer is the Crossroads Gas Station.

Waste washwater basins:

- The plant has 2 parallel washwater basins.
- The basins had garnet in them, evidence of filter underdrain damage.
- After washwater flows to the washwater basin, the supernatant flows to the creek.
- Springer has to dig out a basin once every 3 months. They swap it to the other one, let it dry out, then dig it out.

Environment Testing

1
2
3
4
5
6
7
8
9
10
11

ANALYTICAL REPORT

PREPARED FOR

Attn: Kerry Howe
Howe Water Science
6109 Pueblo Verde NE
Albuquerque, New Mexico 87111

Generated 5/14/2024 9:36:14 AM

JOB DESCRIPTION

Springer Water Plant DBP Mitigation

JOB NUMBER

885-3629-1

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque NM 87109

See page two for job notes and contact information.

Job ID: 885-3629-1 **Eurofins Albuquerque**

Job Narrative
885-3629-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers are applied to indicate exceptions. Noncompliant quality control (QC) is further explained in narrative comments.

- Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
- Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt
The samples were received on 4/30/2024 3:30 PM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 6.6°C.

Receipt Exceptions
The following samples were received at the laboratory outside the required temperature criteria: T52-2-6 (885-3629-1), T52-3-6 (885-3629-2), T52-2-24 (885-3629-3), T52-3-24 (885-3629-4), T52-2-48 (885-3629-5), T52-3-48 (885-3629-6), T6-B2 (885-3629-7), T6-B3 (885-3629-8), STOCK-1 (885-3629-9) and STOCK-2 (885-3629-10). This does not meet regulatory requirements. The client was contacted regarding this issue, and the laboratory was instructed to PROCEED WITH analysis.

The container label for the following samples did not match the information listed on the Chain-of-Custody (COC): T52-2-6 (885-3629-1), T52-3-6 (885-3629-2), T52-2-24 (885-3629-3), T52-3-24 (885-3629-4), T52-2-48 (885-3629-5), T52-3-48 (885-3629-6), T6-B2 (885-3629-7), T6-B3 (885-3629-8), STOCK-1 (885-3629-9) and STOCK-2 (885-3629-10). The container labels lists a different time than the COC for samples 3 and 4.The client was contacted, and the lab was instructed to proceed with COC time.

GC/MS VOA
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Metals
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Client Sample Results

Client Sample ID: T52-2-6
Date Collected: 04/26/24 16:30
Date Received: 04/30/24 15:30

Lab Sample ID: 885-3629-1
Matrix: Water

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	53		1.0		ug/L			05/08/24 13:55	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	2.6		0.50		ug/L			05/08/24 13:55	1
Bromodichloromethane	18		0.50		ug/L			05/08/24 13:55	1
Chloroform	17		0.50		ug/L			05/08/24 13:55	1
Dibromochloromethane	15		0.50		ug/L			05/08/24 13:55	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*86*		*70 - 130*		*05/08/24 13:55*	*1*
1,2-Dichlorobenzene-d4	*82*		*70 - 130*		*05/08/24 13:55*	*1*

Client Sample ID: T52-3-6
Lab Sample ID: 885-3629-2
Date Collected: 04/26/24 16:45
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	61		1.0	ug/L			05/08/24 14:23	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	2.2		0.50	ug/L			05/08/24 14:23	1
Bromodichloromethane	21		0.50	ug/L			05/08/24 14:23	1
Chloroform	23		0.50	ug/L			05/08/24 14:23	1
Dibromochloromethane	15		0.50	ug/L			05/08/24 14:23	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*84*		*70 - 130*		*05/08/24 14:23*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 14:23*	*1*

Client Sample Results

Client: Howe Water Science Job ID: 885-3629-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-2-24 Lab Sample ID: 885-3629-3

Date Collected: 04/27/24 10:15 **Matrix: Water**
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	75		1.0		ug/L			05/08/24 14:51	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	3.3		0.50		ug/L			05/08/24 14:51	1
Bromodichloromethane	25		0.50		ug/L			05/08/24 14:51	1
Chloroform	28		0.50		ug/L			05/08/24 14:51	1
Dibromochloromethane	19		0.50		ug/L			05/08/24 14:51	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*82*		*70 - 130*		*05/08/24 14:51*	*1*
1,2-Dichlorobenzene-d4	*85*		*70 - 130*		*05/08/24 14:51*	*1*

Client Sample ID: T52-3-24
Lab Sample ID: 885-3629-4
Date Collected: 04/27/24 10:30
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	90		1.0		ug/L			05/09/24 14:35	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	2.6		0.50		ug/L			05/08/24 15:19	1
Bromodichloromethane	29		0.50		ug/L			05/08/24 15:19	1
Chloroform	39		5.0		ug/L			05/09/24 14:35	10
Dibromochloromethane	19		0.50		ug/L			05/08/24 15:19	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*84*		*70 - 130*		*05/08/24 15:19*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 15:19*	*1*

Client Sample Results

Client Sample ID: T52-2-48
Lab Sample ID: 885-3629-5
Date Collected: 04/28/24 11:58
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	86		1.0		ug/L			05/09/24 15:03	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	3.8		0.50		ug/L			05/08/24 15:47	1
Bromodichloromethane	28		0.50		ug/L			05/08/24 15:47	1
Chloroform	33		5.0		ug/L			05/09/24 15:03	10
Dibromochloromethane	21		0.50		ug/L			05/08/24 15:47	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/08/24 15:47*	*1*
1,2-Dichlorobenzene-d4	*85*		*70 - 130*		*05/08/24 15:47*	*1*

Client Sample ID: T52-3-48

Lab Sample ID: 885-3629-6

Date Collected: 04/28/24 12:05

Matrix: Water

Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	110		1.0		ug/L			05/09/24 15:31	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	2.8		0.50		ug/L			05/08/24 16:16	1
Bromodichloromethane	32		5.0		ug/L			05/09/24 15:31	10
Chloroform	53		5.0		ug/L			05/09/24 15:31	10
Dibromochloromethane	21		0.50		ug/L			05/08/24 16:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*85*		*70 - 130*		*05/08/24 16:16*	*1*
1,2-Dichlorobenzene-d4	*85*		*70 - 130*		*05/08/24 16:16*	*1*

1 2 3 4 5 6 7 8 9 10 11

Client Sample ID: T6-B2 **Lab Sample ID: 885-3629-7**
Date Collected: 04/26/24 15:41 **Matrix: Water**
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	39		1.0	ug/L			05/08/24 16:44	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.6		0.50	ug/L			05/08/24 16:44	1
Bromodichloromethane	13		0.50	ug/L			05/08/24 16:44	1
Chloroform	13		0.50	ug/L			05/08/24 16:44	1
Dibromochloromethane	11		0.50	ug/L			05/08/24 16:44	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*88*		*70 - 130*		*05/08/24 16:44*	*1*
1,2-Dichlorobenzene-d4	*88*		*70 - 130*		*05/08/24 16:44*	*1*

Client Sample Results

Client Sample ID: T6-B3
Lab Sample ID: 885-3629-8

Date Collected: 04/30/24 14:30
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	44		1.0		ug/L			05/08/24 17:12	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.9		0.50		ug/L			05/08/24 17:12	1
Bromodichloromethane	15		0.50		ug/L			05/08/24 17:12	1
Chloroform	15		0.50		ug/L			05/08/24 17:12	1
Dibromochloromethane	12		0.50		ug/L			05/08/24 17:12	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*84*		*70 - 130*		*05/08/24 17:12*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 17:12*	*1*

Client Sample ID: STOCK-1
Lab Sample ID: 885-3629-9
Date Collected: 04/27/24 14:00
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	1.8		0.10		mg/L		05/01/24 15:07	05/03/24 13:26	5

Client Sample ID: STOCK-2
Lab Sample ID: 885-3629-10

Date Collected: 04/27/24 14:00
Matrix: Water
Date Received: 04/30/24 15:30

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Iron	2.3		0.25		mg/L		05/01/24 15:07	05/03/24 13:30	5
Manganese	0.010		0.0020		mg/L		05/01/24 15:07	05/03/24 13:28	1

Method: 524.2 - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 885-4674/3
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50	ug/L			05/08/24 12:31	1
Bromodichloromethane	ND		0.50	ug/L			05/08/24 12:31	1
Chloroform	ND		0.50	ug/L			05/08/24 12:31	1
Dibromochloromethane	ND		0.50	ug/L			05/08/24 12:31	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/08/24 12:31*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 12:31*	*1*

Lab Sample ID: LCS 885-4674/2
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.55		ug/L		102	70 - 130
Bromodichloromethane	2.50	2.55		ug/L		102	70 - 130
Chloroform	2.50	2.60		ug/L		104	70 - 130
Dibromochloromethane	2.50	2.61		ug/L		104	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*111*		*70 - 130*
1,2-Dichlorobenzene-d4	*104*		*70 - 130*

Lab Sample ID: MRL 885-4674/1
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.450	J	ug/L		90	50 - 150
Bromodichloromethane	0.500	0.420	J	ug/L		84	50 - 150
Chloroform	0.500	0.480	J	ug/L		96	50 - 150
Dibromochloromethane	0.500	0.450	J	ug/L		90	50 - 150

Surrogate	*MRL %Recovery*	*MRL Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*94*		*70 - 130*
1,2-Dichlorobenzene-d4	*102*		*70 - 130*

Lab Sample ID: MB 885-4750/3
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4750

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50	ug/L			05/09/24 13:39	1
Bromodichloromethane	ND		0.50	ug/L			05/09/24 13:39	1
Chloroform	ND		0.50	ug/L			05/09/24 13:39	1
Dibromochloromethane	ND		0.50	ug/L			05/09/24 13:39	1

Method: 524.2 - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 885-4750/3
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Method Blank
Prep Type: Total/NA

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	87		70 - 130		05/09/24 13:39	1
1,2-Dichlorobenzene-d4	87		70 - 130		05/09/24 13:39	1

Lab Sample ID: LCS 885-4750/2
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.56		ug/L		102	70 - 130
Bromodichloromethane	2.50	2.58		ug/L		103	70 - 130
Chloroform	2.50	2.66		ug/L		106	70 - 130
Dibromochloromethane	2.50	2.56		ug/L		102	70 - 130

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	111		70 - 130
1,2-Dichlorobenzene-d4	110		70 - 130

Lab Sample ID: MRL 885-4750/1
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.370	J	ug/L		74	50 - 150
Bromodichloromethane	0.500	0.450	J	ug/L		90	50 - 150
Chloroform	0.500	0.480	J	ug/L		96	50 - 150
Dibromochloromethane	0.500	0.450	J	ug/L		90	50 - 150

Surrogate	MRL %Recovery	MRL Qualifier	Limits
4-Bromofluorobenzene (Surr)	96		70 - 130
1,2-Dichlorobenzene-d4	102		70 - 130

Method: 200.7 Rev 4.4 - Metals (ICP)

Lab Sample ID: MRL 885-4378/13
Matrix: Water
Analysis Batch: 4378

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Aluminum	0.0100	ND		mg/L		77	50 - 150
Iron	0.0200	0.0183	J	mg/L		92	50 - 150
Manganese	0.00200	0.00192	J	mg/L		96	50 - 150

Lab Sample ID: MB 885-4210/1-A
Matrix: Water
Analysis Batch: 4378

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 4210

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		0.020	mg/L		05/01/24 15:07	05/03/24 10:42	1

Method: 200.7 Rev 4.4 - Metals (ICP) (Continued)

Lab Sample ID: MB 885-4210/1-A — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total Recoverable**
Analysis Batch: 4378 — **Prep Batch: 4210**

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		0.050		mg/L		05/01/24 15:07	05/03/24 10:42	1
Manganese	ND		0.0020		mg/L		05/01/24 15:07	05/03/24 10:42	1

Lab Sample ID: LCS 885-4210/3-A — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total Recoverable**
Analysis Batch: 4378 — **Prep Batch: 4210**

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Aluminum			0.500	0.552		mg/L		110	85 - 115		
Iron			0.500	0.480		mg/L		96	85 - 115		
Manganese			0.500	0.471		mg/L		94	85 - 115		

Lab Sample ID: LLCS 885-4210/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total Recoverable**
Analysis Batch: 4378 — **Prep Batch: 4210**

Analyte			Spike Added	LLCS Result	LLCS Qualifier	Unit	D	%Rec	%Rec Limits		
Aluminum			0.0100	ND		mg/L		105	50 - 150		
Iron			0.0200	0.0182	J	mg/L		91	50 - 150		
Manganese			0.00200	0.00221		mg/L		110	50 - 150		

GC/MS VOA

Analysis Batch: 4674

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3629-1	T52-2-6	Total/NA	Water	524.2	
885-3629-2	T52-3-6	Total/NA	Water	524.2	
885-3629-3	T52-2-24	Total/NA	Water	524.2	
885-3629-4	T52-3-24	Total/NA	Water	524.2	
885-3629-5	T52-2-48	Total/NA	Water	524.2	
885-3629-6	T52-3-48	Total/NA	Water	524.2	
885-3629-7	T6-B2	Total/NA	Water	524.2	
885-3629-8	T6-B3	Total/NA	Water	524.2	
MB 885-4674/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4674/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4674/1	Lab Control Sample	Total/NA	Water	524.2	

Analysis Batch: 4750

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3629-4	T52-3-24	Total/NA	Water	524.2	
885-3629-5	T52-2-48	Total/NA	Water	524.2	
885-3629-6	T52-3-48	Total/NA	Water	524.2	
MB 885-4750/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4750/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4750/1	Lab Control Sample	Total/NA	Water	524.2	

Analysis Batch: 4877

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3629-1	T52-2-6	Total/NA	Water	524.2	
885-3629-2	T52-3-6	Total/NA	Water	524.2	
885-3629-3	T52-2-24	Total/NA	Water	524.2	
885-3629-4	T52-3-24	Total/NA	Water	524.2	
885-3629-5	T52-2-48	Total/NA	Water	524.2	
885-3629-6	T52-3-48	Total/NA	Water	524.2	
885-3629-7	T6-B2	Total/NA	Water	524.2	
885-3629-8	T6-B3	Total/NA	Water	524.2	

Metals

Prep Batch: 4210

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3629-9	STOCK-1	Total Recoverable	Water	200.2	
885-3629-10	STOCK-2	Total Recoverable	Water	200.2	
MB 885-4210/1-A	Method Blank	Total Recoverable	Water	200.2	
LCS 885-4210/3-A	Lab Control Sample	Total Recoverable	Water	200.2	
LLCS 885-4210/2-A	Lab Control Sample	Total Recoverable	Water	200.2	

Analysis Batch: 4378

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3629-9	STOCK-1	Total Recoverable	Water	200.7 Rev 4.4	4210
885-3629-10	STOCK-2	Total Recoverable	Water	200.7 Rev 4.4	4210
885-3629-10	STOCK-2	Total Recoverable	Water	200.7 Rev 4.4	4210
MB 885-4210/1-A	Method Blank	Total Recoverable	Water	200.7 Rev 4.4	4210
LCS 885-4210/3-A	Lab Control Sample	Total Recoverable	Water	200.7 Rev 4.4	4210
LLCS 885-4210/2-A	Lab Control Sample	Total Recoverable	Water	200.7 Rev 4.4	4210
MRL 885-4378/13	Lab Control Sample	Total/NA	Water	200.7 Rev 4.4	

1 2 3 4 5 6 7 8 9 10 11

Client Sample ID: T52-2-6
Lab Sample ID: 885-3629-1
Date Collected: 04/26/24 16:30
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 13:55
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/08/24 13:55

Client Sample ID: T52-3-6
Lab Sample ID: 885-3629-2
Date Collected: 04/26/24 16:45
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 14:23
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/08/24 14:23

Client Sample ID: T52-2-24
Lab Sample ID: 885-3629-3
Date Collected: 04/27/24 10:15
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 14:51
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/08/24 14:51

Client Sample ID: T52-3-24
Lab Sample ID: 885-3629-4
Date Collected: 04/27/24 10:30
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 15:19
Total/NA	Analysis	524.2		10	4750	RA	EET ALB	05/09/24 14:35
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/09/24 14:35

Client Sample ID: T52-2-48
Lab Sample ID: 885-3629-5
Date Collected: 04/28/24 11:58
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 15:47
Total/NA	Analysis	524.2		10	4750	RA	EET ALB	05/09/24 15:03
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/09/24 15:03

Client Sample ID: T52-3-48
Lab Sample ID: 885-3629-6
Date Collected: 04/28/24 12:05
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 16:16
Total/NA	Analysis	524.2		10	4750	RA	EET ALB	05/09/24 15:31
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/09/24 15:31

Lab Chronicle

Client: Howe Water Science
Job ID: 885-3629-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T6-B2
Lab Sample ID: 885-3629-7
Date Collected: 04/26/24 15:41
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 16:44
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/08/24 16:44

Client Sample ID: T6-B3
Lab Sample ID: 885-3629-8
Date Collected: 04/30/24 14:30
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 17:12
Total/NA	Analysis	524.2		1	4877	CM	EET ALB	05/08/24 17:12

Client Sample ID: STOCK-1
Lab Sample ID: 885-3629-9
Date Collected: 04/27/24 14:00
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.2			4210	JN	EET ALB	05/01/24 15:07
Total Recoverable	Analysis	200.7 Rev 4.4		5	4378	JR	EET ALB	05/03/24 13:26

Client Sample ID: STOCK-2
Lab Sample ID: 885-3629-10
Date Collected: 04/27/24 14:00
Matrix: Water
Date Received: 04/30/24 15:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.2			4210	JN	EET ALB	05/01/24 15:07
Total Recoverable	Analysis	200.7 Rev 4.4		1	4378	JR	EET ALB	05/03/24 13:28
Total Recoverable	Prep	200.2			4210	JN	EET ALB	05/01/24 15:07
Total Recoverable	Analysis	200.7 Rev 4.4		5	4378	JR	EET ALB	05/03/24 13:30

Laboratory References:

EET ALB = Eurofins Albuquerque, 4901 Hawkins NE, Albuquerque, NM 87109, TEL (505)345-3975

1 2 3 4 5 6 7 8 9 10 11

Laboratory: Eurofins Albuquerque

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
New Mexico	State	NM9425, NM0901	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
200.7 Rev 4.4	200.2	Water	Aluminum
200.7 Rev 4.4	200.2	Water	Iron
200.7 Rev 4.4	200.2	Water	Manganese
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total

Authority	Program	Identification Number	Expiration Date
Oregon	NELAP	NM100001	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
200.7 Rev 4.4	200.2	Water	Aluminum
200.7 Rev 4.4	200.2	Water	Iron
200.7 Rev 4.4	200.2	Water	Manganese
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque, NM 87109
Phone: 505-345-3975 Fax: 505-345-4107

Chain of Custody Record

eurofins | Envir

885-3629 COC

Client Information			
Client Contact: Kerry Howe	Sampler: K. Howe	Lab PM: Freeman, Andy	Carrier Tracking No(s):
Company: Howe Water Science	Phone: 505-241-9135	E-Mail: andy.freeman@et.eurofinsus.com	State of Origin:
Address: 6109 Pueblo Verde NE	PWSID:	COC No: 885-888-223.4	Page: Page 4 of 4
City: Albuquerque	Due Date Requested:	Job #:	
State, Zip: NM, 87111	TAT Requested (days):		
Phone:	Compliance Project: Δ Yes Δ No		
Email: kerry@howewater.com	PO #: Purchase Order not required		
Project Name: Springer Water Plant DBP Mitigation	WO #:		
Site:	Project #: 88501710		
	SSOW#:		

Preservation Codes:
A - HCL
R - NaThioSO4
D - HNO3
Other:

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SM5310B - Total Organic Carbon	SM5310_DOC_B - Dissolved Organic Carbon	524.2_TTHM_Sum - Total Trihalomethanes	200.7 - Fe Mn	Aluminum	Total Number of containers	Special Instructions/Note:
				Preservation Code:			A	A	R	D			
T52-2-6	4.26	4:30p	G	Water					X				
T52-3-6	4.26	4:45p	G	Water					X				
T52-2-24	4-27	10:16a	G	Water					X				
T52-3-24	4.27	10:30a	G	Water					X				
T52-2-48	4-28	11:58a	G	"					X				
T52-3-48	4.28	12:05p	G	"					X				
T6-B2	4.26	15:41	G	"					X				
T6-B3	4.30	14:30	G	"					X				
STOCK-1	4.27	14:00	G	"							X		
STOCK-2	4.27	14:00	G	"						X			

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: Kerry J Howe	Date/Time: 4/30 3:50pm	Company	Received by: [signature] CDO	Date/Time: 4/30/24 1530	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No

Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: 6.6 ± 0 = 6.6 MoAty OK to run

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: Howe Water Science

Job Number: 885-3629-1

Login Number: 3629
List Number: 1
Creator: McQuiston, Steven

List Source: Eurofins Albuquerque

Question	Answer	Comment
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	False	Cooler temperature outside required temperature criteria.
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
TCEQ Mtd 1005 soil sample was frozen/delivered for prep within 48H of sampling.	N/A	

Environment Testing

1 2 3 4 5 6 7 8 9 10 11

ANALYTICAL REPORT

PREPARED FOR

Attn: Kerry Howe
Howe Water Science
6109 Pueblo Verde NE
Albuquerque, New Mexico 87111

Generated 5/15/2024 9:38:30 AM

JOB DESCRIPTION

Springer Water Plant DBP Mitigation

JOB NUMBER

885-3974-1

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque NM 87109

See page two for job notes and contact information.

Job ID: 885-3974-1 Eurofins Albuquerque

Job Narrative
885-3974-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers are applied to indicate exceptions. Noncompliant quality control (QC) is further explained in narrative comments.

- Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
- Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt
The samples were received on 5/6/2024 4:50 PM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 12.9°C.

Receipt Exceptions
The following samples were received at the laboratory outside the required temperature criteria: T52-2-240 (885-3974-1), T52-3-240 (885-3974-2) and T6-B6 (885-3974-3). There was no cooling media present in the cooler. The client was contacted regarding this issue, and the laboratory was instructed to proceed with analysis

GC/MS VOA
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Client: Howe Water Science | Job ID: 885-3974-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-2-240 | **Lab Sample ID: 885-3974-1**
Date Collected: 05/06/24 13:00 | **Matrix: Water**
Date Received: 05/06/24 16:50

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	90		1.0	ug/L			05/10/24 14:23	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	3.8		0.50	ug/L			05/09/24 21:08	1
Bromodichloromethane	29		0.50	ug/L			05/09/24 21:08	1
Chloroform	36		5.0	ug/L			05/10/24 14:23	10
Dibromochloromethane	21		0.50	ug/L			05/09/24 21:08	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*82*		*70 - 130*		*05/09/24 21:08*	*1*
4-Bromofluorobenzene (Surr)	*82*		*70 - 130*		*05/10/24 14:23*	*10*
1,2-Dichlorobenzene-d4	*85*		*70 - 130*		*05/09/24 21:08*	*1*
1,2-Dichlorobenzene-d4	*83*		*70 - 130*		*05/10/24 14:23*	*10*

Client Sample Results

Client: Howe Water Science Job ID: 885-3974-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-3-240 Lab Sample ID: 885-3974-2

Date Collected: 05/06/24 13:10 **Matrix: Water**
Date Received: 05/06/24 16:50

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	170		1.0		ug/L			05/10/24 14:51	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	3.2		0.50		ug/L			05/09/24 21:36	1
Bromodichloromethane	45		5.0		ug/L			05/10/24 14:51	10
Chloroform	100		5.0		ug/L			05/10/24 14:51	10
Dibromochloromethane	24		0.50		ug/L			05/09/24 21:36	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/09/24 21:36*	*1*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/10/24 14:51*	*10*
1,2-Dichlorobenzene-d4	*85*		*70 - 130*		*05/09/24 21:36*	*1*
1,2-Dichlorobenzene-d4	*83*		*70 - 130*		*05/10/24 14:51*	*10*

Client Sample ID: T6-B6

Lab Sample ID: 885-3974-3

Date Collected: 05/06/24 13:30

Matrix: Water

Date Received: 05/06/24 16:50

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	47		1.0		ug/L			05/09/24 22:04	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	2.0		0.50		ug/L			05/09/24 22:04	1
Bromodichloromethane	16		0.50		ug/L			05/09/24 22:04	1
Chloroform	17		0.50		ug/L			05/09/24 22:04	1
Dibromochloromethane	12		0.50		ug/L			05/09/24 22:04	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*82*		*70 - 130*		*05/09/24 22:04*	*1*
1,2-Dichlorobenzene-d4	*80*		*70 - 130*		*05/09/24 22:04*	*1*

Client: Howe Water Science
Project/Site: Springer Water Plant DBP Mitigation

Job ID: 885-3974-1

Method: 524.2 - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 885-4750/3
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50		ug/L			05/09/24 13:39	1
Bromodichloromethane	ND		0.50		ug/L			05/09/24 13:39	1
Chloroform	ND		0.50		ug/L			05/09/24 13:39	1
Dibromochloromethane	ND		0.50		ug/L			05/09/24 13:39	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*87*		*70 - 130*		*05/09/24 13:39*	*1*
1,2-Dichlorobenzene-d4	*87*		*70 - 130*		*05/09/24 13:39*	*1*

Lab Sample ID: LCS 885-4750/2
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.56		ug/L		102	70 - 130
Bromodichloromethane	2.50	2.58		ug/L		103	70 - 130
Chloroform	2.50	2.66		ug/L		106	70 - 130
Dibromochloromethane	2.50	2.56		ug/L		102	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*111*		*70 - 130*
1,2-Dichlorobenzene-d4	*110*		*70 - 130*

Lab Sample ID: MRL 885-4750/1
Matrix: Water
Analysis Batch: 4750

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.370	J	ug/L		74	50 - 150
Bromodichloromethane	0.500	0.450	J	ug/L		90	50 - 150
Chloroform	0.500	0.480	J	ug/L		96	50 - 150
Dibromochloromethane	0.500	0.450	J	ug/L		90	50 - 150

Surrogate	*MRL %Recovery*	*MRL Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*96*		*70 - 130*
1,2-Dichlorobenzene-d4	*102*		*70 - 130*

Lab Sample ID: MB 885-4846/3
Matrix: Water
Analysis Batch: 4846

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50		ug/L			05/10/24 13:55	1
Bromodichloromethane	ND		0.50		ug/L			05/10/24 13:55	1
Chloroform	ND		0.50		ug/L			05/10/24 13:55	1
Dibromochloromethane	ND		0.50		ug/L			05/10/24 13:55	1

Method: 524.2 - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 885-4846/3
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4846

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*85*		*70 - 130*		*05/10/24 13:55*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/10/24 13:55*	*1*

Lab Sample ID: LCS 885-4846/2
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4846

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.64		ug/L		106	70 - 130
Bromodichloromethane	2.50	2.64		ug/L		106	70 - 130
Chloroform	2.50	2.56		ug/L		102	70 - 130
Dibromochloromethane	2.50	2.57		ug/L		103	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*114*		*70 - 130*
1,2-Dichlorobenzene-d4	*111*		*70 - 130*

Lab Sample ID: MRL 885-4846/1
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4846

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.450	J	ug/L		90	50 - 150
Bromodichloromethane	0.500	0.480	J	ug/L		96	50 - 150
Chloroform	0.500	0.520		ug/L		104	50 - 150
Dibromochloromethane	0.500	0.480	J	ug/L		96	50 - 150

Surrogate	*MRL %Recovery*	*MRL Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*97*		*70 - 130*
1,2-Dichlorobenzene-d4	*103*		*70 - 130*

QC Association Summary

Client: Howe Water Science
Project/Site: Springer Water Plant DBP Mitigation

Job ID: 885-3974-1

GC/MS VOA

Analysis Batch: 4750

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3974-1	T52-2-240	Total/NA	Water	524.2	
885-3974-2	T52-3-240	Total/NA	Water	524.2	
885-3974-3	T6-B6	Total/NA	Water	524.2	
MB 885-4750/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4750/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4750/1	Lab Control Sample	Total/NA	Water	524.2	

Analysis Batch: 4846

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3974-1	T52-2-240	Total/NA	Water	524.2	
885-3974-2	T52-3-240	Total/NA	Water	524.2	
MB 885-4846/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4846/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4846/1	Lab Control Sample	Total/NA	Water	524.2	

Analysis Batch: 4883

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3974-1	T52-2-240	Total/NA	Water	524.2	
885-3974-2	T52-3-240	Total/NA	Water	524.2	
885-3974-3	T6-B6	Total/NA	Water	524.2	

Lab Chronicle

Client: Howe Water Science — Job ID: 885-3974-1

Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-2-240 — **Lab Sample ID: 885-3974-1**

Date Collected: 05/06/24 13:00 — **Matrix: Water**

Date Received: 05/06/24 16:50

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4750	RA	EET ALB	05/09/24 21:08
Total/NA	Analysis	524.2		10	4846	RA	EET ALB	05/10/24 14:23
Total/NA	Analysis	524.2		1	4883	CM	EET ALB	05/10/24 14:23

Client Sample ID: T52-3-240 — **Lab Sample ID: 885-3974-2**

Date Collected: 05/06/24 13:10 — **Matrix: Water**

Date Received: 05/06/24 16:50

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4750	RA	EET ALB	05/09/24 21:36
Total/NA	Analysis	524.2		10	4846	RA	EET ALB	05/10/24 14:51
Total/NA	Analysis	524.2		1	4883	CM	EET ALB	05/10/24 14:51

Client Sample ID: T6-B6 — **Lab Sample ID: 885-3974-3**

Date Collected: 05/06/24 13:30 — **Matrix: Water**

Date Received: 05/06/24 16:50

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4750	RA	EET ALB	05/09/24 22:04
Total/NA	Analysis	524.2		1	4883	CM	EET ALB	05/09/24 22:04

Laboratory References:

EET ALB = Eurofins Albuquerque, 4901 Hawkins NE, Albuquerque, NM 87109, TEL (505)345-3975

Accreditation/Certification Summary

Client: Howe Water Science	Job ID: 885-3974-1
Project/Site: Springer Water Plant DBP Mitigation

Laboratory: Eurofins Albuquerque

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
New Mexico	State	NM9425, NM0901	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total

Authority	Program	Identification Number	Expiration Date
Oregon	NELAP	NM100001	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total

Chain-of-Custody Record

Client: Kerry Howe
Howe Water Science LLC
Mailing Address: 6109 Pueblo Verde NE
Albuquerque NM 87111
Phone #: 505-241-9135
email or Fax#: Kerry@HoweWater.com
QA/QC Package: ☒ Standard ☐ Level 4 (Full Validation)
Accreditation: ☐ Az Compliance ☐ NELAC ☐ Other
☐ EDD (Type)

Turn-Around Time: ☒ Standard ☐ Rush
Project Name: Springer Water Plant DBP Mitigation
Project #: 88501710
Project Manager: Andy Freeman
Sampler: Kerry Howe
On Ice: ☐ Yes ☒ No
# of Coolers: 1
Cooler Temp (including CF): 12.8 +0.1 = 12.9 (°C) Yogi

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107
885-3974 COC

Analysis Request

Date	Time	Matrix	Sample Name	Container Type and #	Preservative Type	HEAL No.	BTEX / MTBE / TMB's (8021)	TPH:8015D(GRO / DRO / MRO)	8081 Pesticides/8082 PCB's	EDB (Method 504.1)	PAHs by 8310 or 8270SIMS	RCRA 8 Metals	Cl, F, Br, NO_3, NO_2, PO_4, SO_4	8260 (VOA)	8270 (Semi-VOA)	Total Coliform (Present/Absent)	TTHMs					
5/6	1pm	water	T52-2-240														X					
5/6	1:10 p	"	T52-3-240														X					
5/6	1:30 pm	"	T6-B6														X					

Date	Time	Relinquished by	Received by	Via	Date	Time
5/6	4:50	Kerry G. Howe	S. Berelli	COO	5/6/24	16:50 ~~4:50~~ SB 5/6/24

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Login Sample Receipt Checklist

Client: Howe Water Science

Job Number: 885-3974-1

Login Number: 3974
List Number: 1
Creator: McQuiston, Steven

List Source: Eurofins Albuquerque

Question	Answer	Comment
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	Refer to Job Narrative for details.
Cooler Temperature is acceptable.	False	Received same day of collection; chilling process has begun.
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
TCEQ Mtd 1005 soil sample was frozen/delivered for prep within 48H of sampling.	N/A	

eurofins

Environment Testing

1 2 3 4 5 6 7 8 9 10 11

ANALYTICAL REPORT

PREPARED FOR

Attn: Kerry Howe
Howe Water Science
6109 Pueblo Verde NE
Albuquerque, New Mexico 87111

Generated 5/20/2024 5:01:22 PM

JOB DESCRIPTION

Springer Water Plant DBP Mitigation

JOB NUMBER

885-3540-1

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque NM 87109

See page two for job notes and contact information.

myEOL

Job ID: 885-3540-1 Eurofins Albuquerque

Job Narrative
885-3540-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers are applied to indicate exceptions. Noncompliant quality control (QC) is further explained in narrative comments.

- Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
- Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt
The samples were received on 4/26/2024 12:20 PM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 4.0°C.

Receipt Exceptions
The Chain-of-Custody (COC) was incomplete as received and/or improperly completed. Extra sample was received but not listed on COC. Client was contacted and advised us to add sample to COC using information on containers.

The method requirement for no headspace was not met. The following samples were analyzed with headspace in the sample container(s): T1-G1 (885-3540-1), T1-G2 (885-3540-2), T1-G3 (885-3540-3), T1-G4 (885-3540-4), T1-G5 (885-3540-5), T1-G6 (885-3540-6), T2-G1 (885-3540-7), T2-G2 (885-3540-8), T2-G3 (885-3540-9), T2-G4 (885-3540-10), T2-G5 (885-3540-11), T2-G6 (885-3540-12), T3-G1 (885-3540-13), T3-G2 (885-3540-14), T3-G3 (885-3540-15), T3-G4 (885-3540-16), T3-G5 (885-3540-17), T3-G6 (885-3540-18), T4-Optim (885-3540-19), T52-2-0.5 (885-3540-20), T52-3-05 (885-3540-21), T52-2-1 (885-3540-22), T52-3-1 (885-3540-23) and RAW (885-3540-24). All TOC and DOC containers.

GC/MS VOA
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry
Method SM5310B: The following TOC samples had results manually averaged by the analyst: (885-3540-B-24 MSD). The TOC instrument automatically averages 4 readings of a sample; however, 1 of the 4 readings of each sample was 0, and should be excluded. The method allows for at least 3 readings to be averaged. The mean area, mean concentration, and %RSD was of the last 3 readings were manually calculated by the analyst. Results were manually entered onto a new batch (4270) but linked to the QC from the original batch (4159).

(885-3540-B-24 MSD)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Client Sample ID: T1-G1

Lab Sample ID: 885-3540-1

Date Collected: 04/23/24 11:00

Matrix: Water

Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	5.1		1.0	mg/L			04/30/24 02:30	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	5.2		1.0	mg/L			05/06/24 22:23	1

Client Sample ID: T1-G2

Lab Sample ID: 885-3540-2

Date Collected: 04/23/24 11:00

Matrix: Water

Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.9		1.0	mg/L			04/30/24 03:20	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.7		1.0	mg/L			05/06/24 22:42	1

Client Sample Results

Client: Howe Water Science
Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T1-G3
Lab Sample ID: 885-3540-3

Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.7		1.0		mg/L			04/30/24 03:37	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.5		1.0		mg/L			05/06/24 23:28	1

Client Sample Results

Client: Howe Water Science — Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T1-G4 — **Lab Sample ID: 885-3540-4**
Date Collected: 04/23/24 11:00 — **Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.6		1.0		mg/L			04/30/24 03:55	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.4		1.0		mg/L			05/06/24 23:45	1

Client Sample Results

Client: Howe Water Science | Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T1-G5 | **Lab Sample ID: 885-3540-5**
Date Collected: 04/23/24 11:00 | **Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.4		1.0		mg/L			04/30/24 04:12	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.4		1.0		mg/L			05/07/24 00:00	1

Client: Howe Water Science
Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T1-G6
Lab Sample ID: 885-3540-6
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.4		1.0		mg/L			04/30/24 04:29	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.4		1.0		mg/L			05/07/24 00:15	1

Client Sample Results

Client: Howe Water Science — Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T2-G1

Lab Sample ID: 885-3540-7
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	5.0		1.0		mg/L			04/30/24 04:43	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.8		1.0		mg/L			05/07/24 00:30	1

Client Sample ID: T2-G2

Lab Sample ID: 885-3540-8

Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.8		1.0		mg/L			04/30/24 05:00	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.7		1.0		mg/L			05/07/24 01:19	1

Client Sample ID: T2-G3 | **Lab Sample ID: 885-3540-9**
Date Collected: 04/23/24 14:00 | **Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.6		1.0		mg/L			04/30/24 05:18	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.4		1.0		mg/L			05/07/24 01:36	1

Client Sample Results

Client: Howe Water Science | Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T2-G4 | **Lab Sample ID: 885-3540-10**
Date Collected: 04/23/24 14:00 | **Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.5		1.0		mg/L			04/30/24 06:52	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.4		1.0		mg/L			05/07/24 01:51	1

Client Sample Results

Client: Howe Water Science
Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T2-G5
Lab Sample ID: 885-3540-11
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.5		1.0		mg/L			04/30/24 07:42	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.2		1.0		mg/L			05/07/24 02:43	1

Client Sample ID: T2-G6 | **Lab Sample ID: 885-3540-12**

Date Collected: 04/23/24 14:00 | **Matrix: Water**

Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.4		1.0		mg/L			04/30/24 07:56	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.2		1.0		mg/L			05/07/24 03:00	1

1 2 3 4 5 6 7 8 9 10 11

Client Sample ID: T3-G1

Lab Sample ID: 885-3540-13

Date Collected: 04/24/24 11:00

Matrix: Water

Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.1		1.0		mg/L			04/30/24 08:14	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	4.0		1.0		mg/L			05/07/24 03:17	1

Client Sample ID: T3-G2 — **Lab Sample ID: 885-3540-14**

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	3.9		1.0		mg/L			04/30/24 08:31	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.7		1.0		mg/L			05/07/24 03:34	1

Client Sample Results

Client Sample ID: T3-G3
Lab Sample ID: 885-3540-15
Date Collected: 04/24/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	3.9		1.0		mg/L			04/30/24 08:45	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.6		1.0		mg/L			05/07/24 03:50	1

Client Sample ID: T3-G4
Lab Sample ID: 885-3540-16
Date Collected: 04/24/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	4.2		1.0		mg/L			04/30/24 09:03	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.9		1.0		mg/L			05/07/24 04:07	1

Client Sample ID: T3-G5　　Lab Sample ID: 885-3540-17

Date Collected: 04/24/24 11:00　　**Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	3.7		1.0		mg/L			04/30/24 09:51	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.4		1.0		mg/L			05/07/24 05:12	1

Client Sample ID: T3-G6	**Lab Sample ID: 885-3540-18**
Date Collected: 04/24/24 11:00	**Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	3.3		1.0		mg/L			04/30/24 10:08	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.1		1.0		mg/L			05/07/24 06:31	1

Client Sample ID: T4-Optim | Lab Sample ID: 885-3540-19

Date Collected: 04/25/24 11:00 | **Matrix: Water**
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	3.9		1.0		mg/L			04/30/24 10:25	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	3.5		1.0		mg/L			05/07/24 06:48	1

Client: Howe Water Science — Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-2-0.5 — **Lab Sample ID: 885-3540-20**
Date Collected: 04/26/24 11:02 — **Matrix: Water**
Date Received: 04/26/24 12:20

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	26		1.0		ug/L			05/06/24 22:47	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.3		0.50		ug/L			05/06/24 22:47	1
Bromodichloromethane	8.5		0.50		ug/L			05/06/24 22:47	1
Chloroform	9.1		0.50		ug/L			05/06/24 22:47	1
Dibromochloromethane	7.2		0.50		ug/L			05/06/24 22:47	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*81*		*70 - 130*		*05/06/24 22:47*	*1*
1,2-Dichlorobenzene-d4	*81*		*70 - 130*		*05/06/24 22:47*	*1*

Client Sample ID: T52-3-05
Lab Sample ID: 885-3540-21

Date Collected: 04/26/24 11:15
Matrix: Water
Date Received: 04/26/24 12:20

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	32		1.0		ug/L			05/06/24 23:15	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.2		0.50		ug/L			05/06/24 23:15	1
Bromodichloromethane	10		0.50		ug/L			05/06/24 23:15	1
Chloroform	12		0.50		ug/L			05/06/24 23:15	1
Dibromochloromethane	8.4		0.50		ug/L			05/06/24 23:15	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/06/24 23:15*	*1*
1,2-Dichlorobenzene-d4	*82*		*70 - 130*		*05/06/24 23:15*	*1*

Client Sample Results

Client: Howe Water Science | Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-2-1
Lab Sample ID: 885-3540-22
Date Collected: 04/26/24 11:32
Matrix: Water
Date Received: 04/26/24 12:20

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	32		1.0		ug/L			05/08/24 13:27	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.8		0.50		ug/L			05/08/24 13:27	1
Bromodichloromethane	11		0.50		ug/L			05/08/24 13:27	1
Chloroform	10		0.50		ug/L			05/08/24 13:27	1
Dibromochloromethane	9.4		0.50		ug/L			05/08/24 13:27	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/08/24 13:27*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 13:27*	*1*

Client Sample Results

Client: Howe Water Science Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T52-3-1
Lab Sample ID: 885-3540-23
Date Collected: 04/26/24 11:45
Matrix: Water
Date Received: 04/26/24 12:20

Method: EPA-DW 524.2 - Total Trihalomethanes

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Trihalomethanes, Total	35		1.0	ug/L			05/08/24 12:59	1

Method: EPA-DW 524.2 - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	1.4		0.50	ug/L			05/08/24 12:59	1
Bromodichloromethane	12		0.50	ug/L			05/08/24 12:59	1
Chloroform	12		0.50	ug/L			05/08/24 12:59	1
Dibromochloromethane	9.2		0.50	ug/L			05/08/24 12:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/08/24 12:59*	*1*
1,2-Dichlorobenzene-d4	*81*		*70 - 130*		*05/08/24 12:59*	*1*

Client Sample Results

Client: Howe Water Science
Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: RAW
Lab Sample ID: 885-3540-24
Date Collected: 04/22/24 13:00
Matrix: Water
Date Received: 04/26/24 12:20

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon (SM 5310B)	5.3		1.0		mg/L			04/30/24 10:42	1

General Chemistry - Dissolved

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon (SM 5310B)	5.1		1.0		mg/L			05/07/24 07:06	1

Method: 524.2 - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 885-4569/3 **Client Sample ID: Method Blank**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 4569

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50	ug/L			05/06/24 13:26	1
Bromodichloromethane	ND		0.50	ug/L			05/06/24 13:26	1
Chloroform	ND		0.50	ug/L			05/06/24 13:26	1
Dibromochloromethane	ND		0.50	ug/L			05/06/24 13:26	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
4-Bromofluorobenzene (Surr)	*82*		*70 - 130*		*05/06/24 13:26*	*1*
1,2-Dichlorobenzene-d4	*80*		*70 - 130*		*05/06/24 13:26*	*1*

Lab Sample ID: LCS 885-4569/2 **Client Sample ID: Lab Control Sample**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 4569

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.58		ug/L		103	70 - 130
Bromodichloromethane	2.50	2.58		ug/L		103	70 - 130
Chloroform	2.50	2.60		ug/L		104	70 - 130
Dibromochloromethane	2.50	2.59		ug/L		104	70 - 130

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*112*		*70 - 130*
1,2-Dichlorobenzene-d4	*108*		*70 - 130*

Lab Sample ID: MRL 885-4569/1 **Client Sample ID: Lab Control Sample**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 4569

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.450	J	ug/L		90	50 - 150
Bromodichloromethane	0.500	0.460	J	ug/L		92	50 - 150
Chloroform	0.500	0.470	J	ug/L		94	50 - 150
Dibromochloromethane	0.500	0.470	J	ug/L		94	50 - 150

Surrogate	*MRL %Recovery*	*MRL Qualifier*	*Limits*
4-Bromofluorobenzene (Surr)	*95*		*70 - 130*
1,2-Dichlorobenzene-d4	*100*		*70 - 130*

Lab Sample ID: MB 885-4674/3 **Client Sample ID: Method Blank**
Matrix: Water **Prep Type: Total/NA**
Analysis Batch: 4674

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoform	ND		0.50	ug/L			05/08/24 12:31	1
Bromodichloromethane	ND		0.50	ug/L			05/08/24 12:31	1
Chloroform	ND		0.50	ug/L			05/08/24 12:31	1
Dibromochloromethane	ND		0.50	ug/L			05/08/24 12:31	1

Method: 524.2 - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 885-4674/3
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	*83*		*70 - 130*		*05/08/24 12:31*	*1*
1,2-Dichlorobenzene-d4	*84*		*70 - 130*		*05/08/24 12:31*	*1*

Lab Sample ID: LCS 885-4674/2
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	2.50	2.55		ug/L		102	70 - 130
Bromodichloromethane	2.50	2.55		ug/L		102	70 - 130
Chloroform	2.50	2.60		ug/L		104	70 - 130
Dibromochloromethane	2.50	2.61		ug/L		104	70 - 130

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	*111*		*70 - 130*
1,2-Dichlorobenzene-d4	*104*		*70 - 130*

Lab Sample ID: MRL 885-4674/1
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4674

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromoform	0.500	0.450	J	ug/L		90	50 - 150
Bromodichloromethane	0.500	0.420	J	ug/L		84	50 - 150
Chloroform	0.500	0.480	J	ug/L		96	50 - 150
Dibromochloromethane	0.500	0.450	J	ug/L		90	50 - 150

Surrogate	MRL %Recovery	MRL Qualifier	Limits
4-Bromofluorobenzene (Surr)	*94*		*70 - 130*
1,2-Dichlorobenzene-d4	*102*		*70 - 130*

Method: SM 5310B - Organic Carbon, Total (TOC)

Lab Sample ID: MB 885-4159/38
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4159

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	ND		1.0	mg/L			04/30/24 05:51	1

Lab Sample ID: MB 885-4159/5
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 4159

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Organic Carbon	ND		1.0	mg/L			04/29/24 20:58	1

Method: SM 5310B - Organic Carbon, Total (TOC) (Continued)

Lab Sample ID: LCS 885-4159/41
Matrix: Water
Analysis Batch: 4159

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	4.85	4.68		mg/L		96	90 - 110

Lab Sample ID: LCS 885-4159/6
Matrix: Water
Analysis Batch: 4159

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	4.85	4.84		mg/L		100	90 - 110

Lab Sample ID: LCSD 885-4159/7
Matrix: Water
Analysis Batch: 4159

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Total Organic Carbon	4.85	4.83		mg/L		99	90 - 110	0	10

Lab Sample ID: MRL 885-4159/2
Matrix: Water
Analysis Batch: 4159

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	1.00	0.947	J	mg/L		95	50 - 150

Lab Sample ID: MRL 885-4159/37
Matrix: Water
Analysis Batch: 4159

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	1.00	0.928	J	mg/L		93	50 - 150

Lab Sample ID: 885-3540-10 MS
Matrix: Water
Analysis Batch: 4159

Client Sample ID: T2-G4
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	4.5		4.65	9.08		mg/L		99	85 - 115

Lab Sample ID: 885-3540-10 MSD
Matrix: Water
Analysis Batch: 4159

Client Sample ID: T2-G4
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Total Organic Carbon	4.5		4.65	9.11		mg/L		99	85 - 115	0	15

Lab Sample ID: 885-3540-24 MS
Matrix: Water
Analysis Batch: 4159

Client Sample ID: RAW
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Total Organic Carbon	5.3		4.98	10.5		mg/L		105	85 - 115

Method: SM 5310B - Organic Carbon, Total (TOC)

Lab Sample ID: 885-3540-24 MSD
Matrix: Water
Analysis Batch: 4270

Client Sample ID: RAW
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Total Organic Carbon	5.3		4.98	9.96		mg/L					

Method: SM 5310B - Organic Carbon, Dissolved (DOC)

Lab Sample ID: MB 885-4560/36
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Method Blank
Prep Type: Dissolved

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon	ND		1.0		mg/L			05/07/24 04:41	1

Lab Sample ID: MB 885-4560/5
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Method Blank
Prep Type: Dissolved

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Dissolved Organic Carbon	ND		1.0		mg/L			05/06/24 20:18	1

Lab Sample ID: LCS 885-4560/37
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Lab Control Sample
Prep Type: Dissolved

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	4.85	4.69		mg/L		97	90 - 110

Lab Sample ID: LCS 885-4560/6
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Lab Control Sample
Prep Type: Dissolved

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	4.85	4.77		mg/L		98	90 - 110

Lab Sample ID: MRL 885-4560/2
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Lab Control Sample
Prep Type: Dissolved

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	1.00	1.03		mg/L		103	50 - 150

Lab Sample ID: MRL 885-4560/35
Matrix: Water
Analysis Batch: 4560

Client Sample ID: Lab Control Sample
Prep Type: Dissolved

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	1.00	1.02		mg/L		102	50 - 150

Method: SM 5310B - Organic Carbon, Dissolved (DOC) (Continued)

Lab Sample ID: 885-3540-7 MS
Client Sample ID: T2-G1
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 4560

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	4.8		4.98	9.99		mg/L		104	85 - 115

Lab Sample ID: 885-3540-17 MS
Client Sample ID: T3-G5
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 4560

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Dissolved Organic Carbon	3.4		4.98	8.60		mg/L		105	85 - 115

Lab Sample ID: 885-3540-17 MSD
Client Sample ID: T3-G5
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 4560

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Dissolved Organic Carbon	3.4		4.98	8.66		mg/L		106	85 - 115	1	15

Lab Sample ID: 885-3540-7 MSD
Client Sample ID: T2-G1
Matrix: Water
Prep Type: Dissolved
Analysis Batch: 5021

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Dissolved Organic Carbon	4.8		4.98	9.70		mg/L		98	85 - 115	3	15

GC/MS VOA

Analysis Batch: 4569

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-20	T52-2-0.5	Total/NA	Water	524.2	
885-3540-21	T52-3-05	Total/NA	Water	524.2	
MB 885-4569/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4569/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4569/1	Lab Control Sample	Total/NA	Water	524.2	

Analysis Batch: 4593

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-20	T52-2-0.5	Total/NA	Water	524.2	
885-3540-21	T52-3-05	Total/NA	Water	524.2	
885-3540-22	T52-2-1	Total/NA	Water	524.2	
885-3540-23	T52-3-1	Total/NA	Water	524.2	

Analysis Batch: 4674

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-22	T52-2-1	Total/NA	Water	524.2	
885-3540-23	T52-3-1	Total/NA	Water	524.2	
MB 885-4674/3	Method Blank	Total/NA	Water	524.2	
LCS 885-4674/2	Lab Control Sample	Total/NA	Water	524.2	
MRL 885-4674/1	Lab Control Sample	Total/NA	Water	524.2	

General Chemistry

Analysis Batch: 4159

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-1	T1-G1	Total/NA	Water	SM 5310B	
885-3540-2	T1-G2	Total/NA	Water	SM 5310B	
885-3540-3	T1-G3	Total/NA	Water	SM 5310B	
885-3540-4	T1-G4	Total/NA	Water	SM 5310B	
885-3540-5	T1-G5	Total/NA	Water	SM 5310B	
885-3540-6	T1-G6	Total/NA	Water	SM 5310B	
885-3540-7	T2-G1	Total/NA	Water	SM 5310B	
885-3540-8	T2-G2	Total/NA	Water	SM 5310B	
885-3540-9	T2-G3	Total/NA	Water	SM 5310B	
885-3540-10	T2-G4	Total/NA	Water	SM 5310B	
885-3540-11	T2-G5	Total/NA	Water	SM 5310B	
885-3540-12	T2-G6	Total/NA	Water	SM 5310B	
885-3540-13	T3-G1	Total/NA	Water	SM 5310B	
885-3540-14	T3-G2	Total/NA	Water	SM 5310B	
885-3540-15	T3-G3	Total/NA	Water	SM 5310B	
885-3540-16	T3-G4	Total/NA	Water	SM 5310B	
885-3540-17	T3-G5	Total/NA	Water	SM 5310B	
885-3540-18	T3-G6	Total/NA	Water	SM 5310B	
885-3540-19	T4-Optim	Total/NA	Water	SM 5310B	
885-3540-24	RAW	Total/NA	Water	SM 5310B	
MB 885-4159/38	Method Blank	Total/NA	Water	SM 5310B	
MB 885-4159/5	Method Blank	Total/NA	Water	SM 5310B	
LCS 885-4159/41	Lab Control Sample	Total/NA	Water	SM 5310B	
LCS 885-4159/6	Lab Control Sample	Total/NA	Water	SM 5310B	
LCSD 885-4159/7	Lab Control Sample Dup	Total/NA	Water	SM 5310B	
MRL 885-4159/2	Lab Control Sample	Total/NA	Water	SM 5310B	

General Chemistry (Continued)

Analysis Batch: 4159 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MRL 885-4159/37	Lab Control Sample	Total/NA	Water	SM 5310B	
885-3540-10 MS	T2-G4	Total/NA	Water	SM 5310B	
885-3540-10 MSD	T2-G4	Total/NA	Water	SM 5310B	
885-3540-24 MS	RAW	Total/NA	Water	SM 5310B	

Analysis Batch: 4270

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-24 MSD	RAW	Total/NA	Water	SM 5310B	

Analysis Batch: 4560

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-1	T1-G1	Dissolved	Water	SM 5310B	
885-3540-2	T1-G2	Dissolved	Water	SM 5310B	
885-3540-3	T1-G3	Dissolved	Water	SM 5310B	
885-3540-4	T1-G4	Dissolved	Water	SM 5310B	
885-3540-5	T1-G5	Dissolved	Water	SM 5310B	
885-3540-6	T1-G6	Dissolved	Water	SM 5310B	
885-3540-7	T2-G1	Dissolved	Water	SM 5310B	
885-3540-8	T2-G2	Dissolved	Water	SM 5310B	
885-3540-9	T2-G3	Dissolved	Water	SM 5310B	
885-3540-10	T2-G4	Dissolved	Water	SM 5310B	
885-3540-11	T2-G5	Dissolved	Water	SM 5310B	
885-3540-12	T2-G6	Dissolved	Water	SM 5310B	
885-3540-13	T3-G1	Dissolved	Water	SM 5310B	
885-3540-14	T3-G2	Dissolved	Water	SM 5310B	
885-3540-15	T3-G3	Dissolved	Water	SM 5310B	
885-3540-16	T3-G4	Dissolved	Water	SM 5310B	
885-3540-17	T3-G5	Dissolved	Water	SM 5310B	
885-3540-18	T3-G6	Dissolved	Water	SM 5310B	
885-3540-19	T4-Optim	Dissolved	Water	SM 5310B	
885-3540-24	RAW	Dissolved	Water	SM 5310B	
MB 885-4560/36	Method Blank	Dissolved	Water	SM 5310B	
MB 885-4560/5	Method Blank	Dissolved	Water	SM 5310B	
LCS 885-4560/37	Lab Control Sample	Dissolved	Water	SM 5310B	
LCS 885-4560/6	Lab Control Sample	Dissolved	Water	SM 5310B	
MRL 885-4560/2	Lab Control Sample	Dissolved	Water	SM 5310B	
MRL 885-4560/35	Lab Control Sample	Dissolved	Water	SM 5310B	
885-3540-7 MS	T2-G1	Dissolved	Water	SM 5310B	
885-3540-17 MS	T3-G5	Dissolved	Water	SM 5310B	
885-3540-17 MSD	T3-G5	Dissolved	Water	SM 5310B	

Analysis Batch: 5021

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
885-3540-7 MSD	T2-G1	Dissolved	Water	SM 5310B	

Client: Howe Water Science
Job ID: 885-3540-1
Project/Site: Springer Water Plant DBP Mitigation

Client Sample ID: T1-G1
Lab Sample ID: 885-3540-1
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/06/24 22:23
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 02:30

Client Sample ID: T1-G2
Lab Sample ID: 885-3540-2
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/06/24 22:42
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 03:20

Client Sample ID: T1-G3
Lab Sample ID: 885-3540-3
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/06/24 23:28
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 03:37

Client Sample ID: T1-G4
Lab Sample ID: 885-3540-4
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/06/24 23:45
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 03:55

Client Sample ID: T1-G5
Lab Sample ID: 885-3540-5
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 00:00
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 04:12

Client Sample ID: T1-G6
Lab Sample ID: 885-3540-6
Date Collected: 04/23/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 00:15
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 04:29

Client Sample ID: T2-G1
Lab Sample ID: 885-3540-7
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 00:30
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 04:43

Client Sample ID: T2-G2
Lab Sample ID: 885-3540-8
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 01:19
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 05:00

Client Sample ID: T2-G3
Lab Sample ID: 885-3540-9
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 01:36
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 05:18

Client Sample ID: T2-G4
Lab Sample ID: 885-3540-10
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 01:51
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 06:52

Client Sample ID: T2-G5
Lab Sample ID: 885-3540-11
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 02:43
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 07:42

Client Sample ID: T2-G6
Lab Sample ID: 885-3540-12
Date Collected: 04/23/24 14:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 03:00
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 07:56

1 2 3 4 5 6 7 8 9 10 11

Client Sample ID: T3-G1 — Lab Sample ID: 885-3540-13

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 03:17
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 08:14

Client Sample ID: T3-G2 — Lab Sample ID: 885-3540-14

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 03:34
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 08:31

Client Sample ID: T3-G3 — Lab Sample ID: 885-3540-15

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 03:50
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 08:45

Client Sample ID: T3-G4 — Lab Sample ID: 885-3540-16

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 04:07
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 09:03

Client Sample ID: T3-G5 — Lab Sample ID: 885-3540-17

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 05:12
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 09:51

Client Sample ID: T3-G6 — Lab Sample ID: 885-3540-18

Date Collected: 04/24/24 11:00 — **Matrix: Water**

Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 06:31
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 10:08

Client Sample ID: T4-Optim
Lab Sample ID: 885-3540-19
Date Collected: 04/25/24 11:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 06:48
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 10:25

Client Sample ID: T52-2-0.5
Lab Sample ID: 885-3540-20
Date Collected: 04/26/24 11:02
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4569	RA	EET ALB	05/06/24 22:47
Total/NA	Analysis	524.2		1	4593	JR	EET ALB	05/06/24 22:47

Client Sample ID: T52-3-05
Lab Sample ID: 885-3540-21
Date Collected: 04/26/24 11:15
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4569	RA	EET ALB	05/06/24 23:15
Total/NA	Analysis	524.2		1	4593	JR	EET ALB	05/06/24 23:15

Client Sample ID: T52-2-1
Lab Sample ID: 885-3540-22
Date Collected: 04/26/24 11:32
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4593	JR	EET ALB	05/08/24 13:27
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 13:27

Client Sample ID: T52-3-1
Lab Sample ID: 885-3540-23
Date Collected: 04/26/24 11:45
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	524.2		1	4593	JR	EET ALB	05/08/24 12:59
Total/NA	Analysis	524.2		1	4674	RA	EET ALB	05/08/24 12:59

Client Sample ID: RAW
Lab Sample ID: 885-3540-24
Date Collected: 04/22/24 13:00
Matrix: Water
Date Received: 04/26/24 12:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Dissolved	Analysis	SM 5310B		1	4560	SS	EET ALB	05/07/24 07:06
Total/NA	Analysis	SM 5310B		1	4159	SS	EET ALB	04/30/24 10:42

Laboratory References:

EET ALB = Eurofins Albuquerque, 4901 Hawkins NE, Albuquerque, NM 87109, TEL (505)345-3975

Accreditation/Certification Summary

Client: Howe Water Science
Project/Site: Springer Water Plant DBP Mitigation

Job ID: 885-3540-1

Laboratory: Eurofins Albuquerque

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
New Mexico	State	NM9425, NM0901	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total
SM 5310B		Water	Dissolved Organic Carbon
SM 5310B		Water	Total Organic Carbon

Authority	Program	Identification Number	Expiration Date
Oregon	NELAP	NM100001	02-26-25

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
524.2		Water	Bromodichloromethane
524.2		Water	Bromoform
524.2		Water	Chloroform
524.2		Water	Dibromochloromethane
524.2		Water	Trihalomethanes, Total
SM 5310B		Water	Dissolved Organic Carbon

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque, NM 87109
Phone: 505-345-3975 Fax 505-345-4107

Chain of Custody Record

eurofins

Client Information	Sampler: E. Howe	Lab PM: Freeman, Andy	Carrier Tracking No(s):	COC No: 885-888-223 1
Client Contact: Kerry Howe	Phone: 505-220-1195	E-Mail: andy freeman@et.eurofinsus com	State of Origin: NM	Page: Page 1 of 4
Company: Howe Water Science	PWSID:			Job #:

885-3540 COC

Address: 6109 Pueblo Verde NE	Due Date Requested:
City: Albuquerque	TAT Requested (days):
State Zip: NM, 87111	Compliance Project: Δ Yes Δ No
Phone: 505-241-9135	PO #: Purchase Order not required
Email: kerry@howewater com	WO #:
Project Name: Springer Water Plant DBP Mitigation	Project #: 88501710
Site:	SSOW#:

Analysis Requested

Preservation Codes
A - HCL
R - NaThioSO4
D - HNO3
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water S=solid O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SM5310B - Total Organic Carbon	SM5310_DOC_B - Dissolved Organic Carbon	524.2_TTHM_Sum - Total Trihalomethanes	200.7 -	Total Number of containers	Special Instructions/Note:
				Preservation Code:			A	A	R	D		
T1-G1	4-23-24	11:00	G	Water			✓	✓				-1
T1-G2	↓	↓	↓	Water			✓	✓				-2
T1-G3	↓	↓	↓	Water			✓	✓				-3
T1-G4	↓	↓	↓	Water			✓	✓				-4
T1-G5	↓	↓	↓	Water			✓	✓				-5
T1-G6	↓	↓	↓	Water			✓	✓				-6
T2-G1	4/23/24	14:00	G	Water			✓	✓				-7
T2-G2	↓	↓	↓	Water			✓	✓				-8
T2-G3	↓	↓	↓	Water			✓	✓				-9
T2-G4	↓	↓	↓	Water			✓	✓				-10
T2-G5	↓	↓	↓	Water			✓	✓				-11

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☒ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Deliverable Requested I, II, III, IV Other (specify)

Special Instructions/QC Requirements

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: Kerry Howe	Date/Time: 4/26 12:20 pm	Company: HWS	Received by: SCM CDO	Date/Time: 4/26/24 1220	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No	Custody Seal No	Cooler Temperature(s) °C and Other Remarks: 4.0 I0=4.0°C YOGI

Ver: 06/08/2021

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque, NM 87109
Phone: 505-345-3975 Fax: 505-345-4107

Chain of Custody Record

eurofins | Environment Testing

Client Information	Sampler: E. Howe	Lab PM: Freeman, Andy	Carrier Tracking No(s):	COC No: 885-888-223.2
Client Contact: Kerry Howe	Phone: 505-220-1195	E-Mail: andy.freeman@et.eurofinsus.com	State of Origin: NM	Page: Page 2 of 4
Company: Howe Water Science	PWSID:			Job #: 3540
Address: 6109 Pueblo Verde NE	Due Date Requested:			
City: Albuquerque	TAT Requested (days):			
State, Zip: NM, 87111	Compliance Project: Δ Yes Δ No			
Phone: 505-241-9135	PO #: Purchase Order not required			
Email: kerry@howewater.com	WO #:			
Project Name: Springer Water Plant DBP Mitigation	Project #: 88501710			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL
R - NaThioSO4
D - HNO3

Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SM5310B - Total Organic Carbon	SM5310_DOC_B - Dissolved Organic Carbon	524.2_TTHM_Sum - Total Trihalomethanes	200.7 -	Total Number of containers	Special Instructions/Note:
				Preservation Code:			A	A	R	D		
T2-G6	4/23/24	14:00	G	Water			✓	✓				-12
T3-G1	4/24	11:00	G	Water			✓	✓				-13
T3-G2	↓	↓	↓	Water			✓	✓				-14
T3-G3	↓	↓	↓	Water			✓	✓				-15
T3-G4	↓	↓	↓	Water			✓	✓				-16
T3-G5	↓	↓	↓	Water			✓	✓				-17
T3-G6	↓	↓	↓	Water			✓	✓				-18
T4-Optim	4/25	14:00	G	Water			✓	✓				-19
T52-2-0.5	4/26	11:02	G	Water					✓			-20
T52-3-05	4/26	11:15	G	Water					✓			-21
				Water								

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☒ *Disposal By Lab* ☐ *Archive For* ________ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Kerry G Howe	4/26 12:20 pm	HWS	SCM CDO	4/26/24 1220	

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks: 4.0 ±.0 = 4.0°C YOU

Ver: 06/08/2021

Eurofins Albuquerque
4901 Hawkins NE
Albuquerque, NM 87109
Phone: 505-345-3975 Fax: 505-345-4107

Chain of Custody Record

eurofins | Environment Testing

Client Information	Sampler: E. Howe	Lab PM: Freeman, Andy	Carrier Tracking No(s):	COC No: 885-888-223.3
Client Contact: Kerry Howe	Phone: 505-220-1195	E-Mail: andy.freeman@et.eurofinsus.com	State of Origin: NM	Page: Page 3 of 4
Company: Howe Water Science	PWSID:	**Analysis Requested**		Job #: 3540
Address: 6109 Pueblo Verde NE	**Due Date Requested:**			**Preservation Codes:** A - HCL; R - NaThioSO4; D - HNO3
City: Albuquerque	**TAT Requested (days):**			
State, Zip: NM, 87111	**Compliance Project:** Δ Yes Δ No			
Phone: 505-~~242~~ 241-9135	PO #: Purchase Order not required			
Email: kerry@howewater.com	WO #:			
Project Name: Springer Water Plant DBP Mitigation	Project #: 88501710			
Site:	SSOW#:			Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SM5310B - Total Organic Carbon	SM5310_DOC_B - Dissolved Organic Carbon	524.2_TTHM_Sum - Total Trihalomethanes	200.7 -	Total Number of containers	Special Instructions/Note:
				Preservation Code:			A	A	R	D		
T52-2-1	4/26	11:32	G	Water					✓			-22
T52-3-1	4/26	11:45	G	Water					✓			-23
				Water								
RAW	4/22	1300		Water					✓			-24 → 4/29/24 per client
				Water								
				Water								
				Water								
				Water								
				Water								
				Water								
				Water								

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:	
Relinquished by: Kerry J Howe	Date/Time: 4/26 12:20 pm	Company: HWS	Received by: Scu CDO	Date/Time: 4/26/24 1220	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks: 4.0±0=4.0°C YOG1

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: Howe Water Science

Job Number: 885-3540-1

Login Number: 3540
List Number: 1
Creator: Proctor, Nancy

List Source: Eurofins Albuquerque

Question	Answer	Comment
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	False	Received extra sample not listed on COC.
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	False	Headspace larger tha 1/4"
TCEQ Mtd 1005 soil sample was frozen/delivered for prep within 48H of sampling.	N/A	