



Procurement and Contracting Services

Request for Proposals for Water Treatment for Cooling Towers

ADDENDUM #3

Please mark all bid submission

Files with the following information

Sealed RFP # L252302

Due on April 14, 2023 no later than 2:00 PM, MST

The timeline for RFP L252302 has been amended as follows:

Section 3.3:

Original Schedule

02/22/2023 Issuance of RFP
03/08/2023 Vendor Visit University Site(s)
03/10/2023 Technical Questions/Inquiries due no later than 12:00 PM, MST
03/21/2023 RFP Due March 21, 2023, no later than 2:00 PM, MST

Revised to:

02/22/2023 Issuance of RFP
03/08/2023 Vendor Visit University Site(s)
03/10/2023 Technical Questions/Inquiries due no later than 12:00 PM, MST
04/14/2023 RFP Due April 14, 2023, no later than 2:00 PM, MST

Section 3.8: Proposal Submission and Subsequent Action

All dates within entire section 3.8 are revised to April 14, 2023 at 2:00 PM MST.

The following questions have been received by the technical question due date of March 10, 2023 by 12:00 PM, MST.

1. Need following information for below sites not visited.

- How many controllers are installed?
- Coupon Rack installed?
 - Roy Place
 - US Annex
 - AML

Assume one controller per tower. Most of the towers should have coupon racks installed.

2. Tower Legionella testing? Is it currently being conducted quarterly?

Legionella testing is not included in this RFP.

3. Just to be clear all controllers, chemistry pumps, and blue containment tanks are owned by the University of Arizona?

Correct

4. Page 1 of Attachment A references both APPENDIX A (Homeyer Consulting Services, Inc. Data Sheet from Sampling Nov. 30, 2021) and APPENDIX B (Satellite Tower Survey Information). Can these please be provided?

All available sampling data from Homeyer is attached.

5. Section 3.1.8 states weekly service for all towers, closed loops, and makeup. However, section 4.2 has “monthly” next to chilled water testing analysis. Can you please confirm onsite field service frequency?

We request weekly service for towers and make up, monthly on closed loops.

6. Section 3.3.9 requests annual cooling tower cleanings. Does this include both physical and chemical cleanings or just physical?

Physical and Chemical

7. Section 3.1.6.1 regards to chemical feed equipment and controllers. Are there minimum requirements regarding chemical feed equipment? For example, smart controller with wireless communication, conductivity, pH, ORP, traced inhibitor?

We do not require wireless communications. Please include conductivity, ORP and traced inhibitor. pH may be proposed as optional alternate or value-add, but pH related costs should be shown separate from base bid.

8. I know it was discussed that Attachment B was not originally uploaded to procurement site and I will review site for upload.

Please see attached

9. To prevent duplicate inquiries, system information on buildings did not visit during walk. Number of controllers, tonnages, pictures of chemical feed equipment, etc.

See answers to questions #1, #10.

10. The groups opted to skip site walks at several buildings in the interest of time. Can you provide the below information for these buildings (Bldg 300A- USA, Bldg. 336- Roy Place, Bldg. 490A-AML)?

- i. Location of cooling tower chemical feed area (roof, basement, ground floor, etc.)?

- ii. Location of the cooling tower (roof, ground)?
- iii. Location of associated closed loops' chemical feed and sampling areas?
- iv. Impediments to chemical feed areas (stairs/no elevator, roof hatch, must walk through occupied office area, etc)?
- v. Metallurgy/ Material of the cooling tower unit basin (Stainless, Galvanized, Fiberglass)?
- vi. A few pictures would be very helpful to see the area footprint and current set up. If you can provide these pictures for the systems, we would be grateful.
 - a. Chemical storage tanks or drum area, pumps included if sitting atop the tanks
 - b. Controller (Lakewood, walchem, etc.)
 - c. Chemical injection points (all 3 if they exist, also if there are available but unused injection points, it is useful to know)

Bldg 300 USA – Cooling tower at ground level north of facility, chemical feed and sampling areas in the Basement mechanical room, No access impediments to feed/sampling area. Basin is concrete, 1 injection point. Assume controller to be similar to all others viewed.

Bldg 490A AML – Towers and feed/sampling areas are ground level outside facility, no impediments to access. South tower is stainless steel, North tower is fiberglass.

Bldg 336 Roy Place – Towers and feed/sampling areas on roof. Roof hatch access required for access. Basin constructed unknown.

We will attempt to provide photographic information prior to RFP due date.

11. Are the current chemical storage tanks for cooling towers owned by UA and will they be staying onsite to be cleaned and used at the discretion of the new water treatment supplier? Sections 3.1.6.1 and 3.3.2 below offer some ambiguity as the first states UA owns all equipment, while the second states permanent storage containers can become the property of UA at the expiration of the contract (if purchased by UA).
- a. 3.1.6.1 **UA currently owns all of the equipment on site**; however, the equipment may be in need of replacement. The vendor should propose all new chemical feed equipment and controllers. You may propose chemical storage tanks; however, you must be aware of space limitations at the locations and be sure that any proposed storage tanks can fit in the limited-space areas.
 - b. 3.3.2 The successful bidder shall be responsible for removing all non-permanent chemical containers and their own unused chemicals (if so directed) at any time following the end of the contract period. Such requests to remove chemicals and their containers must occur within 30 days following the end of the contract period or any extensions to the contract period. Chemical containers must be heavy gauge, stainless steel or plastic, double containment, permanent storage containers, which **can become the property of UA at the expiration of the contract** or any extensions at their option (the proposal must clearly show a buyout schedule, if applicable)

The language stands as provided. Currently installed equipment is all university-owned. Section 3.3.2 refers to containers provided or installed as part of the contract resulting from this RFP.

12. Please provide the following information for the sites we did not have time to survey - Bldg. 300A (USA), Bldg. 336 (Roy Place) & Bldg. 490A (AML):
- a. Number of cooling towers, number of condenser/tower water pumps
 - b. Approximate length & width of towers (by pacing off the basin)
 - c. Number of cooling tower controllers (i.e. number of independent open water systems)
 - d. Number of functioning chemical pumps and chemical storage containers
 - e. Condenser/tower water gallons per minute and/or chiller tonnage and/or tower tonnage
 - f. Approximate operating schedule (i.e., April to November, 16 hours per day OR 24 x 7)
 - g. Photos of:
 - i. Towers
 - ii. Chemical automation/cooling tower controller
 - iii. Chemical pumps with current containment
 - iv. Corrosion coupon racks (if installed) for both chilled and tower systems

Number of towers and equipment already provided in documentation and answers elsewhere here. Assume one controller per tower. All pumps and storage containers are deemed functional, but contractor will be responsible to confirm and provide cost estimates to repair/replace if found non-functional. Tonnage and flowrates provided in Appendix B. Operating schedules are generally April to November, 24x7.

13. What shall we bid the system on? Section 6.0 states "Make-up per year (Estimated total) is 10,750,00 gallons, while 11.0 Pricing Sheets state Make-Up (Gallons) is 9,500,000 total.

Use 10,750,000. Section 11.0 was not properly updated when additional towers were added to RFP immediately prior to publishing.

14. Similar to above, what is the total tower volume we should be quoting based on 14,000 gallons or 12,500 gallons?

Use 14,000, same reason as question 13 above.

UOFAZ
 HVAC
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 Report Number: **408691**

Recorded By: **Kyle Erickson**
 (602) 571-5272
 kerickson@aquaserv.com

U of A Satellite Buildings - Bldg. 490A (AML)

Test	Make up	Bldg. 490A AML Tower 2		
Conductivity (as μmhos)	816 10 min	2033 10 min		
pH	7.9 7 min	8.73 8.3 - 9.2		
Turbidity		0.3 Record		
PTSA		200 100 - 200		
Phosphonate (ppm as PO_4)		8.4 4.2 - 8.4		
Azole (as ppm TTA)		2.99 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	150 500 max	420 700 max		
Alkalinity, M (as ppm CaCO_3)	130 500 max	300 600 max		
Silica (ppm as SiO_2)	27 0 min	73 0 min		
Temperature (F)		120 Record		
 Conductivity Cycles (Calculated)		2.5 2.5 - 4.5		
 Calcium Cycles		2.8 2.5 - 4.5		
 Alkalinity Cycles (Calculated)		2.3 2.5 - 4.5		
 LSI (Calculated)		2.3 2.2 - 2.8		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Based on current incoming city water quality the bleed set points remain unchanged.

Bldg. 490A AML Tower 1

 Online 

Tower is offline and not circulating.

Bldg. 490A AML Tower 2

 Online 

Tower online during visit.

Chemistry operating below programmed bleed set point. No overflow or visible uncontrolled water loss to repot at this time.

Chemical inventory is satisfactory. No additions required at this time.



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Report Number: **408691**

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U of A Satellite Buildings - Bldg. 490A (AML)

 PTSA

Inhibitor residuals optimal for scale and corrosion protection. No feed rate adjustments required at this time.

Closing Comment

Thank you for your business!

UOFAZ
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Report Number: 408682

Recorded By: Kyle Erickson
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 kerickson@aqua-serv.com

U of A Satellite Buildings - Bldg. 151 (Babcock)

Test	Make up	Bldg. 151 Babcock Tower		
Conductivity (as μmhos)	865 10 min	1948 10 min		
pH	7.9 7 min	8.7 8.3 - 9.2		
Turbidity		0 Record		
PTSA		125 50 - 125		
Phosphonate (ppm as PO_4)		5.6 4.2 - 8.4		
Azole (as ppm TTA)		2.88 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	190 500 max	520 Record		
Alkalinity, M (as ppm CaCO_3)	140 500 max	290 600 max		
Silica (ppm as SiO_2)	31 0 min	78 0 min		
Chlorine, Total (as ppm Cl_2)		0.6 1 - 4		
Temperature (F)		120 Record		
 Conductivity Cycles (Calculated)		2.3 2.5 - 4.5		
 Hardness Cycles (Calculated)		2.7 2.5 - 4.5		
 Alkalinity Cycles (Calculated)		2.1 2.5 - 4.5		
 LSI (Calculated)		2.3 2.5 max		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

City water consistent with previous visit.
 No bleed set point adjustments required at this time.

Bldg. 151 Babcock Tower

 Online 

Tower circulating during visit. Chiller was offline. No load at this time.
 Chemistry levels operating below programmed bleed set point of 2,500 due to tower still cycling up. It appears there has been little to no load on the system since last week.
 Chemical inventory is satisfactory. No additions required at this time.

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Report Number: **408682**

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U of A Satellite Buildings - Bldg. 151 (Babcock)

PTSA

Inhibitor residuals optimal for scale and corrosion protection. No feed rate adjustments required at this time.

Chlorine, Total (as ppm Cl₂)

Bromine levels low due to small pinhole in feed line. I turned the pump off as of now so that chemical is not being sprayed all over equipment. It's likely the hole developed in the last day or two because there isn't much residual on the equipment and ground. New line will be installed next visit. Hand fed Towerchlor to basin as a temporary biocide.

Closing Comment

Thank you for your business!

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 Report Number: **408634**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 506 Vet Science

Test	Make up Water	Bldg. 506 Vet Science Tower		
Conductivity (as μmhos)	563 10 min	738 10 min		
pH	7.9 7 min	8.48 8.3 - 9.2		
Turbidity		0 Record		
PTSA		125 50 - 125		
Phosphonate (ppm as PO_4)		6.3 4.2 - 8.4		
Azole (as ppm TTA)		2.8 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	70 500 max	140 Record		
Alkalinity, M (as ppm CaCO_3)	60 500 max	180 200 - 600		
Silica (ppm as SiO_2)	28 0 min	51 0 min		
Temperature (F)		120 Record		
 Conductivity Cycles (Calculated)		1.3 2.5 - 7		
 Hardness Cycles (Calculated)		2.0 2.5 - 7		
 Alkalinity Cycles (Calculated)		3.0 2.5 - 7		
 LSI (Calculated)		1.4 2.5 max		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Very large change in city water quality.
 Bleed set point increased to 1,800.

Bldg. 506 Vet Science Tower

 Online 

Tower is offline due to cold weather.
 Chemistry levels are low due to very large change in city water quality. Bleed set point increased in order to cycle up tower.
 Chemical inventory is satisfactory. No additions required at this time.

 **PTSA**

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Report Number: **408634**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 506 Vet Science

Inhibitor residuals optimal for scale and corrosion protection. No feed rate adjustments required at this time.

Alkalinity, M (as ppm CaCO_3)

Alkalinity levels low due to large change in city water quality which drastically reduced cycles. Levels will increase when the tower comes back online and cycles up to its new set point of 1,800.

Closing Comment

Thank you for your business!

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 Report Number: **408641**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 336 (Roy Place)

Test	Make up	Bldg. 336 Roy Place Tower		
Conductivity (as μmhos)	811 10 min	2408 10 min		
pH	7.9 7 min	8.85 8.3 - 9.2		
Turbidity		2.2 Record		
PTSA		101 50 - 125		
Phosphonate (ppm as PO_4)		5.6 4.2 - 8.4		
Azole (as ppm TTA)		2.51 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	140 500 max	460 Record		
Alkalinity, M (as ppm CaCO_3)	140 500 max	350 600 max		
Silica (ppm as SiO_2)	29 0 min	91 0 min		
Chlorine, Total (as ppm Cl_2)		1.66 1 - 4		
Temperature (F)		120 Record		
 Conductivity Cycles (Calculated)		3.0 2.5 - 4.5		
 Calcium Cycles		3.3 2.5 - 4.5		
 Alkalinity Cycles (Calculated)		2.5 2.5 - 4.5		
 LSI (Calculated)		2.5 2 - 2.5		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Based on current city water quality the programmed bleed set point remains unchanged.

Bldg. 336 Roy Place Tower

 Online 

Tower circulating during visit.
 Chemistry is within control parameters.
 Chemical inventory is satisfactory. No additions required at this time.

PTSA

Inhibitor residuals optimal for scale and corrosion protection. No feed rate adjustments required at this time.



AQUA-SERV
ENGINEERS, INC.

Service Report

SRT_UOFAZ_KTE_Roy Place

Thursday, April 6, 2023 6:39 AM PST

UOFAZ
HVAC
1580 E Hanley Blvd.
Lock Code: 5060
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Report Number: **408641**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 336 (Roy Place)

Closing Comment

Thank you for your business!

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 Report Number: **408655**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 158B (Marshall)

Test	Make up	Bldg. 158B Marshall Tower 1	Bldg. 158B Maeshall Tower 2	
Conductivity (as μmhos)	858 10 min	2513 10 min	2408 10 min	
pH	7.9 7 min	8.72 8.3 - 9.2	8.7 8.3 - 9.2	
Turbidity		1.3 Record	0 Record	
PTSA		116 50 - 125	90 50 - 125	
Phosphonate (ppm as PO_4)		5.6 4.2 - 8.4	4.9 4.2 - 8.4	
Azole (as ppm TTA)		2.41 2 - 5	1.89 2 - 5	
Hardness, Calcium (as ppm CaCO_3)	190 500 max	600 Record	570 Record	
Alkalinity, M (as ppm CaCO_3)	120 500 max	300 600 max	300 600 max	
Silica (ppm as SiO_2)	30 0 min	93 0 min	89 0 min	
Chlorine, Total (as ppm Cl_2)		1.66 1 - 4	0.76 1 - 4	
Temperature (F)		100 Record	100 Record	
 Conductivity Cycles (Calculated)		2.9 2.5 - 4.5	2.8 2.5 - 4.5	
 Hardness Cycles (Calculated)		3.2 2.5 - 4.5	3.0 2.5 - 4.5	
 Alkalinity Cycles (Calculated)		2.5 2.5 - 4.5	2.5 2.5 - 4.5	
 LSI (Calculated)		2.2 2.5 max	2.2 2.5 max	

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Based on current incoming city water quality the programmed bleed set point remains unchanged.

Bldg. 158B Marshall Tower 1

 Online 

Tower online during service visit.
 Chemistry is within control parameters.
 Chemical inventory is satisfactory. No additions required at this time.

Towerchlor added to tower basin for additional bio protection.

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Report Number: **408655**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 158B (Marshall)

PTSA

Inhibitor residuals optimal for scale and corrosion protection. No feed rate adjustments required at this time.

Bldg. 158B Maeshall Tower 2

Online 

Tower online during service visit.
Chemistry is within control parameters.
Chemical inventory is satisfactory. No additions required at this time.

Towerchlor added to tower basin for additional bio protection.

PTSA

Inhibitor feed rate increased from 8% to 9%.

Azole (as ppm TTA)

Inhibitor feed rate increased.

Chlorine, Total (as ppm Cl₂)

Bromine levels low due to injector clogging. New injector ordered and will be installed next visit. Towerchlor added to tower basin as an additional biocide.

Closing Comment

Thank you for your business!

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 Report Number: **408646**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 300A (USA)

Test	Make up	Bldg. 300A USA Tower		
Conductivity (as μmhos)	809 10 min	2519 10 min		
pH	7.9 7 min	8.74 8.3 - 9.2		
Turbidity		4.3 Record		
PTSA		88 50 - 125		
Phosphonate (ppm as PO_4)		4.9 4.2 - 8.4		
Azole (as ppm TTA)		2.53 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	160 500 max	540 Record		
Alkalinity, M (as ppm CaCO_3)	110 500 max	300 600 max		
Silica (ppm as SiO_2)	30 0 min	99 0 min		
Chlorine, Total (as ppm Cl_2)		2.56 1 - 4		
Temperature (F)		120 Record		
 Conductivity Cycles (Calculated)		3.1 2.5 - 4.5		
 Alkalinity Cycles (Calculated)		2.7 2.5 - 4.5		
 Hardness Cycles (Calculated)		3.4 2.5 - 4.5		
 LSI (Calculated)		2.4 2.5 max		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Based on current city water quality the programmed bleed at point remains unchanged.

Bldg. 300A USA Tower

 Online 

Tower circulating during visit.

Chemistry is within control parameters. Inhibitor feed rate increased slightly.

Chemical inventory is satisfactory. No additions required at this time.

 **PTSA**

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Report Number: **408646**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 300A (USA)

Inhibitor feed rate increased from 8% to 8.5%.

Closing Comment

Thank you for your business!

UOFAZ
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 Tucson AZ 85721-0300
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 Report Number: **408653**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 158A (USB)

Test	Make up	Bldg. 158A USB Tower		
Conductivity (as μmhos)	858 10 min	2367 10 min		
pH	7.9 7 min	8.78 8.3 - 9.2		
Turbidity		0.8 Record		
PTSA		146 50 - 125		
Phosphonate (ppm as PO_4)		6.3 4.2 - 8.4		
Azole (as ppm TTA)		2.88 2 - 5		
Hardness, Calcium (as ppm CaCO_3)	190 500 max	590 Record		
Alkalinity, M (as ppm CaCO_3)	120 500 max	310 600 max		
Silica (ppm as SiO_2)	30 0 min	93 0 min		
Chlorine, Total (as ppm Cl_2)		1.9 1 - 4		
Temperature (F)		100 Record		
 Conductivity Cycles (Calculated)		2.8 2.5 - 4.5		
 Alkalinity Cycles (Calculated)		2.6 2.5 - 4.5		
 Hardness Cycles (Calculated)		3.1 2.5 - 4.5		
 LSI (Calculated)		2.3 2.5 max		

Opening Comment

Today's visit is to perform routine service.

Make up Water

 Online 

Based on current city water quality the programmed bleed set point remains unchanged.

Bldg. 158A USB Tower

 Online 

Towers online during service visit.
 Chemistry is within control parameters. Inhibitor feed rate decreased.
 5 gallons of inhibitor added to inventory.

 **PTSA**

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Report Number: **408653**

Recorded By: **Kyle Erickson**
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U of A Satellite Buildings - Bldg. 158A (USB)

Inhibitor feed rate decreased from 5% to 4.5%.

Closing Comment

Thank you for your business!

The University of Arizona
The University of Arizona
Tucson, AZ 85721

Test Results

Sampled: Wednesday, 8/10/2022
Site ID: 5525

4 Samples

	SAMPLE ID	USA Make-Up	USA Cooling Tower	USB Make-Up	USB Cooling Tower		
1	pH	7.9540	8.7320	8.0160	8.7870		
2	Conductivity (MMHS)	755.50	2,220.9	362.00	2,071.1		
3	Free Halogen (PPM)		0.4900		0.1600		
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)	109.88	337.81	108.41	342.61		
6	OH-Alkalinity (PPM)						
7	Calcium (PPM)	208.60	628.07	99.852	634.26		
8	Magnesium (PPM)	38.673	135.21	11.467	137.62		
9	Molybdenum (PPM)		0.0080		0.0090		
10	Zinc (PPM)	0.0020	0.0100	0.0090	0.0050		
11	Total Iron (PPM)	0.0180	0.0270	0.0390	0.0180		
12	Manganese (PPM)	0.0000	0.0010	0.0010	0.0010		
13	Copper (PPM)	0.0070	0.0100	0.0090	0.0170		
14	Aluminum (PPM)	0.0020	0.0150	0.0050	0.0070		
15	Silica (PPM)	29.411	103.02	34.072	102.77		
16	Nickel (PPM)	0.0010	0.0000	0.0050	0.0000		
17	Vanadium (PPM)	0.0340	0.1180	0.0120	0.1160		
18	Sodium (PPM)	97.313	359.92	48.689	295.74		
19	Potassium (PPM)	3.4400	14.073	1.5290	10.818		
20	Chloride (PPM)	69.595	219.43	16.506	200.78		
21	Bromide (PPM)	0.0000	0.9480	0.0000	0.3350		
22	Nitrite (PPM)						
23	Nitrate (PPM)	3.7810	15.704	3.8470	20.364		
24	Ammonia (PPM)						
25	Phosphonate (PPM)		2.1160 U		1.0930 U		
26	Ortho Phosphate (PPM)	0.0100	0.2000	0.0100	0.0400		
27	Total Phosphate (PPM)	0.0170	2.8390	0.0210	1.7870		
28	Fluorescent Tracer (PPB)		110.70		71.270		
29	Sulfite (PPM)						
30	Sulfate (PPM)	154.86	472.53	45.956	484.87		
31	Total Azole (PPM)		1.2640 T		0.8340 T		
32	Glycol (PPM)						
33	Glycol E/P (%)						
34	Turbidity (NTU)	0.00	0.02	0.00	0.00		
35	Aerobic Bacteria (Cells/mL)		500		100,000		
36	Primary Organism		Bacillus Specie		Pseudomonas Specie		
37	Secondary Organism		Pseudomonas Specie		Bacillus Specie		
38	DEAE (PPM)						
39	Morpholine (PPM)						
40	Cyclohexylamine (PPM)						
41	Boiler Polymer (PPM)						
42	Cycles (Magnesium/USA Make-Up)		3.5				
43	Cycles (Magnesium/USB Make-Up)				12.0		

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

The University of Arizona
The University of Arizona
Tucson, AZ 85721

Test Results

Sampled: Tuesday, 12/13/2022
Site ID: 5525

3 Samples

	SAMPLE ID	Marshall Make-Up	Marshall Cooling Tower 1	Marshall Cooling Tower 2			
1	pH	8.0770	8.6820	8.6880			
2	Conductivity (MMHS)	432.03	2,538.2	2,528.3			
3	Free Halogen (PPM)		0.0000	0.0000			
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)	106.01	375.51	376.80			
6	OH-Alkalinity (PPM)						
7	Calcium (PPM)	100.30	724.02	712.78			
8	Magnesium (PPM)	14.853	196.65	193.83			
9	Molybdenum (PPM)		0.0000	0.0000			
10	Zinc (PPM)	0.0060	0.4420	0.3170			
11	Total Iron (PPM)	0.0160	0.0140	0.0040			
12	Manganese (PPM)	0.0000	0.0010	0.0000			
13	Copper (PPM)	0.0300	0.0730	0.0470			
14	Aluminum (PPM)	0.0050	0.0090	0.0050			
15	Silica (PPM)	34.383	101.87	103.59			
16	Nickel (PPM)	0.0020	0.0030	0.0030			
17	Vanadium (PPM)	0.0180	0.1790	0.1760			
18	Sodium (PPM)	44.658	240.49	240.89			
19	Potassium (PPM)	2.4850	10.832	10.669			
20	Chloride (PPM)	22.546	267.81	267.70			
21	Bromide (PPM)	0.0000	0.0910	0.4050			
22	Nitrite (PPM)						
23	Nitrate (PPM)	4.2910	33.653	32.459			
24	Ammonia (PPM)						
25	Phosphonate (PPM)		1.4010 U	1.3130 U			
26	Ortho Phosphate (PPM)	0.0330	0.0760	0.0470			
27	Total Phosphate (PPM)		2.2050	2.2650			
28	Fluorescent Tracer (PPB)		84.120	88.860			
29	Sulfite (PPM)						
30	Sulfate (PPM)	65.846	658.66	654.58			
31	Total Azole (PPM)		1.1680 T	1.2650 T			
32	Glycol (PPM)						
33	Glycol E/P (%)						
34	Turbidity (NTU)	0.00	0.00	0.00			
35	Aerobic Bacteria (Cells/mL)		10,000	10,000			
36	Primary Organism		Bacillus Specie	Bacillus Specie			
37	Secondary Organism		Pseudomonas Specie	Pseudomonas Specie			
38	DEAE (PPM)						
39	Morpholine (PPM)						
40	Cyclohexylamine (PPM)						
41	Boiler Polymer (PPM)						
42	Cycles (Magnesium/Marshall Make-Up)		13.2	13.0			

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The University of Arizona
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Tucson, AZ 85721

Test Results

Sampled: Tuesday, 12/13/2022
Site ID: 5525

4 Samples

	SAMPLE ID	USA Make-Up	USA Cooling Tower	USB Make-Up	USB Cooling Tower		
1	pH	8.0310	8.6400	8.0970	8.7000		
2	Conductivity (MMHS)	826.41	2,508.4	526.65	2,438.7		
3	Free Halogen (PPM)		0.0100		0.0000		
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)	113.60	363.13	109.65	382.48		
6	OH-Alkalinity (PPM)						
7	Calcium (PPM)	205.96	671.66	128.83	699.14		
8	Magnesium (PPM)	51.482	175.78	24.310	181.96		
9	Molybdenum (PPM)		0.0000		0.0000		
10	Zinc (PPM)	0.0030	0.0220	0.0240	0.0190		
11	Total Iron (PPM)	0.0060	0.0100	0.0160	0.0190		
12	Manganese (PPM)	0.0000	0.0010	0.0010	0.0020		
13	Copper (PPM)	0.0180	0.0220	0.0430	0.0720		
14	Aluminum (PPM)	0.0040	0.0050	0.0060	0.0060		
15	Silica (PPM)	30.535	108.83	33.615	108.88		
16	Nickel (PPM)	0.0030	0.0030	0.0030	0.0030		
17	Vanadium (PPM)	0.0470	0.1650	0.0250	0.1650		
18	Sodium (PPM)	69.482	255.24	47.609	229.65		
19	Potassium (PPM)	3.3350	11.776	2.0390	10.063		
20	Chloride (PPM)	77.213	280.72	34.579	254.09		
21	Bromide (PPM)	0.0000	1.5210	0.0000	0.2630		
22	Nitrite (PPM)						
23	Nitrate (PPM)	4.9720	20.911	4.8430	32.290		
24	Ammonia (PPM)						
25	Phosphonate (PPM)		1.6360 U		2.2040 U		
26	Ortho Phosphate (PPM)	0.2150	0.1620	0.0420	0.1450		
27	Total Phosphate (PPM)		2.4500		2.9690		
28	Fluorescent Tracer (PPB)		89.640		70.410		
29	Sulfite (PPM)						
30	Sulfate (PPM)	174.61	613.58	92.044	622.08		
31	Total Azole (PPM)		1.4040 T		1.1640 T		
32	Glycol (PPM)						
33	Glycol E/P (%)						
34	Turbidity (NTU)	0.00	0.00	0.00	0.00		
35	Aerobic Bacteria (Cells/mL)		10		2,000		
36	Primary Organism		Bacillus Specie		Bacillus Specie		
37	Secondary Organism				Pseudomonas Specie		
38	DEAE (PPM)						
39	Morpholine (PPM)						
40	Cyclohexylamine (PPM)						
41	Boiler Polymer (PPM)						
42	Cycles (Magnesium/USA Make-Up)		3.4				
43	Cycles (Magnesium/USB Make-Up)				7.5		

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End of addendum, all else remains the same.