

Project No. 151297

VIA E-MAIL AND ENVIROSTOR UPLOAD

March 13, 2023

Mr. Steve Rounds
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
Southern California Region
9211 Oakdale Ave
Chatsworth, CA 91311-6520

RE: Recommended Groundwater Treatment System Monitoring, Raytheon Company (Former Hughes Aircraft Company) Facility, 1901 West Malvern Avenue, Fullerton, California

Dear Mr. Rounds

This letter has been prepared to evaluate the pilot Groundwater Extraction Treatment System (GETS) sampling schedule for analytes which are not compounds of concern (COCs) for the former Raytheon Company site located at 1901 West Malvern Avenue, Fullerton, California (the Site) (Figure 1). The current pilot GETS monitoring activities are performed in general accordance with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC)-approved GETS Pilot Testing, Corrective Measures Study Work Plan Addendum No. 6 (DTSC, 2013; H+A, 2013). This letter provides recommendations for future GETS monitoring, effective April 1, 2023.

BACKGROUND

The pilot GETS consists of four groundwater extraction wells, the treatment system, and the disposal system; however, the current phase of pilot testing has been operating using two extraction wells, EW-02 and MW-29 since the GETS expansion was completed in August 2014. Current total extraction rates are nominally 40 – 50 gallons per minute (gpm), with 30 – 40 gpm extraction from EW-02 and approximately 10 gpm from extraction well MW-29. The treatment system processes extracted groundwater through an advanced oxidation process (AOP), followed by a granular activated carbon polish prior to disposal to the sanitary sewer. The 2014 GETS expansion replaced the HiPOx™ AOP that used ozone and peroxide with a Trojan ultraviolet light and hydrogen peroxide (UV Ox) system.

The current pilot GETS sampling schedule includes monthly and quarterly sampling during normal operations (daily and weekly sampling was conducted after major system modifications). Samples are analyzed for Site COCs (volatile organic compounds [VOCs] and 1,4-dioxane), as well as a variety of other constituents and parameters (non-COCs) in accordance with Table 1. The non-COCs are primarily naturally occurring constituents typically found in groundwater (total dissolved solids [TDS], metals, alkalinity, bromide, total organic carbon [TOC], anions, and

chemical oxygen demand [COD]), as well as bromate, ultraviolet light absorption (UVA) and total suspended solids (TSS). GETS samples are collected from the two operating extraction wells and at the treatment system sampling points: influent (INF), post-particulate-filter (PF), post-UV-oxidation treatment (POX), carbon breakthrough (CBT), and at carbon effluent/discharge (CEFF). All sample locations except CBT are currently sampled for one or more non-COC analytes.

COMPILATION OF GETS DATA

Non-COC sample results were downloaded from the groundwater and GETS database for the entire sampling history for the extraction wells EW-02 and MW-29 and from the period from August 2014 through November 2022 for the treatment system sampling points (INF, PF, POX, and CEFF) to correspond to the current phase of operation with influent only from EW-02 and MW-29 and operation of the current Trojan UV Ox system.

Statistical information including prevalence of detections as well as range, geomean, and the 25th and 75th percentile concentrations were compiled for each analyte at each sampling point (Table 2). Additionally, box-and-whisker plots (Figures 2 – 6c) were prepared to graphically present the distribution of analyte concentrations in the data set by forming a “box” where the box bottom and top are the first and third quartile concentrations, respectively, the median is the horizontal line in the box and the mean is represented by an “X”. The height of the box is the interquartile range (IQR) and represents the concentration range for the middle 50 percent (%) of the data. The “whiskers” are the vertical lines which extend to the largest or smallest concentration within 1.5 times the IQR above or below the box, respectively. Points above or below the whiskers represent outliers. Box plots are only meaningful where most results are above the detection limit, therefore were prepared for only for analytes where prevalence of detections exceeded 50%.

EVALUATION OF GETS DATA

An evaluation was performed to determine if continuation of non-COC data collection is warranted as described below.

Total Suspended Solids: TSS is monitored monthly at PF with detection prevalence of 2% (TSS is rarely detected). Filter changeout does not rely on PF TSS results, rather the GETS technician tracks pre- and post-filtration pressure and turbidity monthly. The existing data set is sufficient.

Total Dissolved Solids: TDS is monitored quarterly at EW-02, MW-29, INF, POX and CEFF. The box plot heights (IQR), proximity of the mean and median, and infrequent outliers indicate consistent concentrations at all sampling points (Figure 2). The TDS within the detected ranges do not impact the treatment system operation or compliance with the discharge permit.

Selenium and Dissolved Metals: Selenium and dissolved metals (iron, manganese, calcium, sodium, and magnesium) are monitored quarterly at EW-02, MW-29, and INF. Box plots were prepared for calcium, magnesium, and sodium, as each had prevalence greater than 50% (Table 2,

Figures 3a - 3c). The plots for MW-29 had outlier points at non-detect or near non-detect concentrations for all three analytes during the September 2022 quarterly sampling; these anomalous results are likely sampling or laboratory error. The short box heights (IQRs) indicate consistent results for these naturally occurring metals. The existing data set is sufficient to characterize metals at the GETS and the observed concentration ranges do not impact the treatment system operation or compliance with the discharge permit.

Alkalinity: Alkalinity is monitored monthly at PF and POX and quarterly at EW-02, MW-29, and INF. The box plots show consistent concentrations at all locations with relatively few outliers given large number of samples in the data set (Figure 4, Table 2). The existing data set is sufficient to characterize alkalinity at GETS sampling points and the observed concentration range does not impact the treatment system operation or compliance with the discharge permit.

Bromate: Bromate has a maximum contaminant level (MCL) of 10 ug/l and is a legacy analyte monitored monthly at INF and POX during operation of the former HiPOxTM AOP due to this system's potential to convert bromide to bromate under certain conditions. The HiPOx AOP was replaced with the Trojan UV Ox AOP in 2014 to address this problem, and since then, bromate formation has not been an issue. Bromate data were compiled from August 2014 to date, and bromate prevalence of detection at INF was <3% (detections ranged from <0.2 – 0.3 micrograms per liter [ug/l]) and prevalence at POX was <12% (detections ranged of <0.2 – 0.7 ug/l, except for a single result of 2 ug/l during the first weekly sampling event in August 2014 during startup of the Trojan UV Ox AOP. Box plots were not prepared due to the low prevalence of detection. When detected, bromate has been primarily at or near the reporting limit and well below the MCL. The Trojan UV Ox AOP has demonstrated that conversion of bromide to bromate is not occurring.

Bromide: Bromide is a legacy analyte monitored monthly at EW-02, MW-29, and INF (Figure 5) and initially required monitoring due to the potential of the former HiPOxTM AOP to convert bromide to bromate, as discussed above. The Trojan UV Ox AOP has demonstrated that conversion of bromide to bromate at concentrations of concern (eg above MCL) is not occurring. The bromide box plot is provided in Figure 5.

Total Organic Carbon: TOC is monitored monthly at PF and POX and quarterly at EW-02, MW-29, and INF. Prevalence ranged from 0% to <12% at the three sampling points, so results are primarily below detection limits (Table 2). The existing data set is sufficient to characterize TOC at GETS and the concentration ranges do not impact the treatment system operation or compliance with the discharge permit.

Anions: Anions (chloride, nitrate, sulfate, nitrite, phosphate) are monitored quarterly at EW-02, MW-29, INF, and POX. Box plots were prepared only for chloride, nitrate, and sulfate, as these constituents had greater than 50% prevalence (Table 2, Figures 6a - 6c). The box plot heights (IQR) indicate consistent results for these naturally occurring anions and outlier detections are infrequent. The existing data set is sufficient to characterize anions at GETS and the concentration ranges do not impact the treatment system operation or compliance with the discharge permit.

Chemical Oxygen Demand: COD is monitored quarterly at EW-02, MW-29, INF, and POX. The existing data set is sufficient to characterize COD at GETS and the concentration ranges do not impact the treatment system operation or compliance with the discharge permit.

UV Absorption: Samples are collected for laboratory analysis of UVA (at 254 nanometers[nm]) monthly at PF and quarterly at EW-02, MW-29, INF, and POX. Low levels of UVA are required for effective treatment of 1,4-dioxane in the Trojan UV Ox process and an indicator for filter failure at PF (high UVA). UVA results have historically been very low, either at or below the reporting limit of 1% (0.01 per centimeter) for every sample collected since August 2014 (Table 2). Box plots were not prepared as UVA was detected at <50% prevalence. In addition, the GETS technician monitors ultraviolet light transmittance (UVT) (at 254 nm) monthly with a UVT-meter (note that $UVT = 1 - UVA$).

RECOMMENDATIONS:

Based on evaluation of the non-COC data, the following updates to the sampling schedule are recommended, effective April 1, 2023, as shown in Table 3:

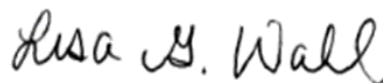
1. Discontinue monitoring TSS, TDS, dissolved metals and selenium, alkalinity, bromide, bromate, TOC, anions, and COD.
2. Discontinue laboratory monitoring of UVA, however the GETS technician will continue monitoring and recording UVT monthly. UVT meter will continue to be maintained and calibrated per manufacturer's instructions.

If you have any questions or require additional information, please contact us at 858-221-0264.

Respectfully Submitted,
Engineering Analytics, Inc.



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Cc:

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REFERENCES

- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), 2013. Email from W. Jeffers to C. Ross and S. Netto, re: Groundwater Extraction and Treatment System Pilot Testing Corrective Measures Study Workplan, Addendum #6. April 16, 2013.
- Hargis + Associates, Inc. (H+A), 2013. Groundwater Extraction and Treatment System Pilot Testing, Corrective Measures Study Workplan Addendum No. 6, Raytheon Company (former Hughes Aircraft Company), 1901 West Malvern Avenue, Fullerton, California. February 27, 2013.

TABLES

Table 1. Existing Pilot Groundwater Extraction and Treatment System Sampling Schedule

				SAMPLE FREQUENCY AND LOCATION																	
				Daily Samples ¹ : Days 1-5					Weekly Samples ¹ : Weeks 1-4					Monthly Samples: Week 5+					Quarterly Samples: Week 1+		
				System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	Extraction Wells (Well ID) ²	System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	Extraction Wells (Well ID) ²	System Influent (INF)
Compounds/Constituent	Analytical Method	Sample Container	Reporting Detection Limits (milligrams per liter)																		
Compounds/Constituents Normally Required as Part Of NPDS Or WDR Permits, Pursuant To CRWQCB Region 8 Order No. R8-2003-0085																					
Volatile Organic Compounds	EPA 8260B	3 - 40 mL VOA, HCl	QAPP ⁴	X		X	X	X	X		X	X	X	X	X		X	X			
1,4-Dioxane	EPA 8270 Modified	1 L Amber	0.002	X					X					X	X						
1,4-Dioxane	EPA 8270 SIM	1 L Amber	0.0002			X				X						X	X	X			
Total Suspended Solids	SM2540D	1 L Poly	10												X						
Total Dissolved Solids	SM2540C	1 L Poly	10																X	X	X
Selected Metals																					
Dissolved Metals (Iron, Manganese, Calcium, Sodium, Magnesium)	EPA 6010B	250 mL poly	QAPP ⁴	(a)															X	X	
Selenium	EPA 6010B	250 mL poly	QAPP ⁴																X	X	
Selected Inorganic Constituents																					
Hydroxide Alkalinity	SM2320B	1 L Poly	2.0	(a)												X	X		X	X	
Bicarbonate Alkalinity	SM2320B	1 L Poly	2.0	(a)												X	X		X	X	
Carbonate Alkalinity	SM2320B	1 L Poly	2.0	(a)												X	X		X	X	
Total Alkalinity	SM2320B	1 L Poly	2.0	(a)												X	X		X	X	
Bromate Evaluation																					
Bromate	EPA 317.0	125 mL Poly	0.0005			X					X				X		X				
Bromide	EPA 300.0	125 mL Poly	0.05	(a)					(a)					X	X						
Other Constituents/Compounds																					
Total Organic Carbon	SM5310B	2 - 40 mL VOA, H2SO4	3.0	(a)												X	X		X	X	
Anions (Chloride, Sulfate, Nitrate, Nitrite, and Phosphate)	EPA 300.0	1 L Poly	Varies	(a)															X	X	X
Chemical Oxygen Demand	EPA 410.4	125 mL Amber, H2SO4	5.0	(a)															X	X	X
UV Absorption (UVA) @254nm	EPA 415.3	125 mL Amber/ 8 oz Jar	N/A		(a)										X				X	X	X

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FOOTNOTES AND ACRONYMS:

= Non-Compound of Concern (COC) analytes evaluated in this letter

¹ Daily and weekly samples collected during the first month of operation will be repeated after major modifications to system equipment or operating parameters, as detailed in the Workplan.

² If more than one extraction well is in operation, combined influent samples will be collected in addition to extraction wellhead samples, with the same sampling schedule as the extraction wellhead.

³ Carbon breakthrough will be collected from the effluent of the first carbon unit in series; when breakthrough of the first unit is detected, the breakthrough sample will be collected from the effluent carbon unit in series.

⁴ Quality Assurance Project Plan (QAPP), Appendix B of Additional Groundwater Assessment Workplan, Hargis + Associates, Inc., April 25, 2003.

(a) Only one sample to be collected during sampling period.

CRWQCB = California Regional Water Quality Control Board, Santa Ana Region 8

NPDES = National Pollutant Discharge Elimination System

WDR = Waste Discharge Requirement

N/A = Not applicable

mL = Milliliter

VOA = Volatile organic analysis

HCl = Hydrochloric acid

H₂SO₄ = Sulfuric acid

nm = Nanometers

EPA = U.S. Environmental Protection Agency

SIM = Selected ion monitoring

SM = Standard Method

L = Liter

poly = High density polyethylene bottle

Amber = Amber glass bottle

Table 2. Statistical Summary of Pilot Groundwater Extraction and Treatment System Sampling Results¹

Well or Sampling Port	Analyte	Concentration Units	Prevalence	Concentration			
				Range	Geomean	25th Percentile	75th Percentile
EW-02	Alkalinity, Bicarbonate (as CaCO ₃)	mg/l	37/38	< 5 to 260	197.53	210	230
EW-02	Alkalinity, Carbonate (as CaCO ₃)	mg/l	1/38	< 1.1 to 12	4.92	5	5
EW-02	Alkalinity, Hydroxide (as CaCO ₃)	mg/l	1/38	< 1.1 to 150	5.25	5	5
EW-02	Alkalinity, Total (as CaCO ₃)	mg/l	38/38	150 to 260	216.3	210	230
EW-02	Bromate ³	ug/l	12/55	NA	#N/A	#N/A	#N/A
EW-02	Bromide ²	mg/l	144/151	< 0.05 to 3.2	0.28	0.2	0.34
EW-02	Calcium	mg/l	51/51	74 to 180	90.53	85	94
EW-02	Chemical Oxygen Demand	mg/l	11/49	< 5 to 37	5.93	5	5
EW-02	Chloride	mg/l	48/48	71 to 190	94.67	86	100
EW-02	Iron	mg/l	3/50	< 0.11 to 1.4	0.5	0.5	0.5
EW-02	Magnesium	mg/l	51/51	23 to 58	28.01	26	29
EW-02	Manganese	mg/l	0/52	< 0.003 to < 1	0.44	0.5	0.5
EW-02	Nitrate (as N)	mg/l	41/41	2.7 to 6.4	4.29	3.9	4.8
EW-02	Nitrite (as N)	mg/l	3/40	< 0.1 to 1.7	0.18	0.1	0.2975
EW-02	Organic Carbon, Total	mg/l	4/48	< 0.49 to 6.5	2.4	3	3
EW-02	ortho-Phosphate (As P)	mg/l	3/47	< 0.032 to 1.1	0.09	0.05	0.1
EW-02	Selenium	mg/l	7/99	< 0.0054 to 0.017	0.01	0.01	0.01
EW-02	Sodium	mg/l	51/51	54 to 160	75.65	69	79
EW-02	Sulfate	mg/l	48/48	100 to 220	139.38	130	150
EW-02	Total Dissolved Solids	mg/l	80/80	560 to 1300	650.12	620	660
EW-02	Total Suspended Solids	mg/l	0/49	< 1 to < 10	6.97	3.9	10
EW-02	UV Absorption	l/cm	1/30	< 0.01 to 0.01	0.01	0.01	0.01
MW-29	Alkalinity, Bicarbonate (as CaCO ₃)	mg/l	30/31	< 5 to 270	218.63	240	260
MW-29	Alkalinity, Carbonate (as CaCO ₃)	mg/l	1/31	< 5 to 8.4	5.08	5	5
MW-29	Alkalinity, Hydroxide (as CaCO ₃)	mg/l	1/31	< 5 to 170	5.6	5	5
MW-29	Alkalinity, Total (as CaCO ₃)	mg/l	31/31	170 to 270	245.63	240	260
MW-29	Bromate	ug/l	0/0	NA	NA	NA	NA
MW-29	Bromide ²	mg/l	87/93	< 0.05 to 2.2	0.47	0.35	0.5675
MW-29	Calcium	mg/l	29/30	< 0.5 to 130	93.05	110	120
MW-29	Chemical Oxygen Demand	mg/l	7/32	< 5 to 37	6.28	5	5
MW-29	Chloride	mg/l	31/31	100 to 230	168.4	160	190
MW-29	Iron	mg/l	2/30	< 0.5 to 0.58	0.51	0.5	0.5
MW-29	Magnesium	mg/l	30/30	0.12 to 39	27.6	32	35
MW-29	Manganese	mg/l	0/30	< 0.1 to < 1	0.48	0.5	0.5
MW-29	Nitrate (as N)	mg/l	31/31	4.3 to 8.6	6.61	6.2	7.3
MW-29	Nitrite (as N)	mg/l	3/30	< 0.1 to 3	0.24	0.1	0.5
MW-29	Organic Carbon, Total	mg/l	1/31	< 0.5 to 0.41	2.26	3	3
MW-29	ortho-Phosphate (As P)	mg/l	2/30	< 0.05 to 4.5	0.13	0.05	0.25
MW-29	Selenium	mg/l	1/61	< 0.01 to 0.0057	0.01	0.01	0.01
MW-29	Sodium	mg/l	29/30	< 1 to 120	82.84	92.25	100
MW-29	Sulfate	mg/l	31/31	110 to 150	131.57	120	140
MW-29	Total Dissolved Solids	mg/l	31/31	690 to 1300	829.92	785	855
MW-29	Total Suspended Solids	mg/l	0/1	< 1 to < 1	1	1	1
MW-29	UV Absorption	l/cm	1/29	< 0.01 to 0.01	0.01	0.01	0.01
INF	Alkalinity, Bicarbonate (as CaCO ₃)	mg/l	29/30	< 5 to 250	192.87	210	220
INF	Alkalinity, Carbonate (as CaCO ₃)	mg/l	2/30	< 5 to 17	5.29	5	5
INF	Alkalinity, Hydroxide (as CaCO ₃)	mg/l	1/30	< 5 to 150	5.6	5	5
INF	Alkalinity, Total (as CaCO ₃)	mg/l	31/31	150 to 250	217.42	211	220
INF	Bromate	ug/l	2/74	< 0.2 to 0.3	0.9	0.5	0.5
INF	Bromide ²	mg/l	90/97	< 0.05 to 1.5	0.31	0.23	0.37
INF	Calcium	mg/l	32/32	78 to 110	92.76	90.75	96
INF	Chemical Oxygen Demand	mg/l	6/32	< 5 to 23	5.79	5	5
INF	Chloride	mg/l	31/31	81 to 180	107.63	100	115
INF	Iron	mg/l	0/32	< 0.5 to < 1	0.51	0.5	0.5
INF	Magnesium	mg/l	32/32	24 to 32	28.33	27.75	29.25

Well or Sampling Port	Analyte	Concentration Units	Prevalence	Concentration			
				Range	Geomean	25th Percentile	75th Percentile
INF	Manganese	mg/l	1/32	< 0.5 to 0.54	0.51	0.5	0.5
INF	Nitrate (as N)	mg/l	30/31	< 0.1 to 5.4	4.04	4.25	4.95
INF	Nitrite (as N)	mg/l	3/31	< 0.1 to 2	0.21	0.1	0.5
INF	Organic Carbon, Total	mg/l	0/32	< 0.3 to < 3	2.26	3	3
INF	ortho-Phosphate (As P)	mg/l	3/31	< 0.05 to 0.83	0.1	0.05	0.25
INF	Selenium	mg/l	1/62	< 0.01 to 0.014	0.01	0.01	0.01
INF	Sodium	mg/l	32/32	57 to 91	76.34	73.5	80.5
INF	Sulfate	mg/l	31/31	120 to 160	138.91	130	150
INF	Total Dissolved Solids	mg/l	30/30	460 to 800	675.02	650	700
INF	Total Suspended Solids	mg/l	0/0	NA	NA	NA	NA
INF	UV Absorption	l/cm	1/30	< 0.01 to 0.01	0.01	0.01	0.01
PF	Alkalinity, Bicarbonate (as CaCO3)	mg/l	95/95	14 to 270	211.04	210	220
PF	Alkalinity, Carbonate (as CaCO3)	mg/l	6/95	< 5 to 210	5.46	5	5
PF	Alkalinity, Hydroxide (as CaCO3)	mg/l	0/95	< 5 to < 10	5.04	5	5
PF	Alkalinity, Total (as CaCO3)	mg/l	97/97	150 to 270	217.87	210	220
PF	Bromate	ug/l	0/0	NA	NA	NA	NA
PF	Bromide	mg/l	1/1	0.14 to 0.14	0.14	0.14	0.14
PF	Calcium	mg/l	0/0	NA	NA	NA	NA
PF	Chemical Oxygen Demand	mg/l	0/0	NA	NA	NA	NA
PF	Chloride	mg/l	0/0	NA	NA	NA	NA
PF	Iron	mg/l	0/0	NA	NA	NA	NA
PF	Magnesium	mg/l	0/0	NA	NA	NA	NA
PF	Manganese	mg/l	0/0	NA	NA	NA	NA
PF	Nitrate (as N)	mg/l	0/0	NA	NA	NA	NA
PF	Nitrite (as N)	mg/l	0/0	NA	NA	NA	NA
PF	Organic Carbon, Total	mg/l	11/96	< 0.5 to 4.3	2.32	3	3
PF	ortho-Phosphate (As P)	mg/l	0/0	NA	NA	NA	NA
PF	Selenium	mg/l	0/0	NA	NA	NA	NA
PF	Sodium	mg/l	0/0	NA	NA	NA	NA
PF	Sulfate	mg/l	0/0	NA	NA	NA	NA
PF	Total Dissolved Solids	mg/l	0/0	NA	NA	NA	NA
PF	Total Suspended Solids	mg/l	2/96	< 0.84 to 690	1.63	1	2
PF	UV Absorption	l/cm	3/91	< 0.01 to 0.01	0.01	0.01	0.01
POX	Alkalinity, Bicarbonate (as CaCO3)	mg/l	94/94	150 to 270	217.4	210	220
POX	Alkalinity, Carbonate (as CaCO3)	mg/l	2/94	< 5 to 12	5.11	5	5
POX	Alkalinity, Hydroxide (as CaCO3)	mg/l	0/94	< 5 to < 10	5.04	5	5
POX	Alkalinity, Total (as CaCO3)	mg/l	96/96	150 to 270	217.69	210	220
POX	Bromate	ug/l	10/87	< 0.3 to 2	0.78	0.5	0.5
POX	Bromide	mg/l	1/1	0.27 to 0.27	0.27	0.27	0.27
POX	Calcium	mg/l	0/0	NA	NA	NA	NA
POX	Chemical Oxygen Demand	mg/l	6/30	< 5 to 27	5.82	5	5
POX	Chloride	mg/l	29/29	81 to 120	106.19	100	110
POX	Iron	mg/l	0/0	NA	NA	NA	NA
POX	Magnesium	mg/l	0/0	NA	NA	NA	NA
POX	Manganese	mg/l	0/0	NA	NA	NA	NA
POX	Nitrate (as N)	mg/l	29/29	3.5 to 5.6	4.55	4.3	4.9
POX	Nitrite (as N)	mg/l	3/29	< 0.1 to 2.2	0.21	0.1	0.5
POX	Organic Carbon, Total	mg/l	9/95	< 0.3 to 42	2.4	3	3
POX	ortho-Phosphate (As P)	mg/l	2/29	< 0.05 to 0.26	0.1	0.05	0.25
POX	Selenium	mg/l	0/0	NA	NA	NA	NA
POX	Sodium	mg/l	0/0	NA	NA	NA	NA
POX	Sulfate	mg/l	29/29	110 to 160	138.53	130	150
POX	Total Dissolved Solids	mg/l	30/30	590 to 800	677.96	652.5	700
POX	Total Suspended Solids	mg/l	0/0	NA	NA	NA	NA
POX	UV Absorption	l/cm	1/30	< 0.01 to 0.01	0.01	0.01	0.01
CEFF	Alkalinity, Bicarbonate (as CaCO3)	mg/l	0/0	NA	NA	NA	NA
CEFF	Alkalinity, Carbonate (as CaCO3)	mg/l	0/0	NA	NA	NA	NA
CEFF	Alkalinity, Hydroxide (as CaCO3)	mg/l	0/0	NA	NA	NA	NA

Well or Sampling Port	Analyte	Concentration Units	Prevalence	Concentration			
				Range	Geomean	25th Percentile	75th Percentile
CEFF	Alkalinity, Total (as CaCO ₃)	mg/l	0/0	NA	NA	NA	NA
CEFF	Bromate	ug/l	0/0	NA	NA	NA	NA
CEFF	Bromide	mg/l	0/0	NA	NA	NA	NA
CEFF	Calcium	mg/l	0/0	NA	NA	NA	NA
CEFF	Chemical Oxygen Demand	mg/l	0/0	NA	NA	NA	NA
CEFF	Chloride	mg/l	0/0	NA	NA	NA	NA
CEFF	Iron	mg/l	0/0	NA	NA	NA	NA
CEFF	Magnesium	mg/l	0/0	NA	NA	NA	NA
CEFF	Manganese	mg/l	0/0	NA	NA	NA	NA
CEFF	Nitrate (as N)	mg/l	0/0	NA	NA	NA	NA
CEFF	Nitrite (as N)	mg/l	0/0	NA	NA	NA	NA
CEFF	Organic Carbon, Total	mg/l	0/0	NA	NA	NA	NA
CEFF	ortho-Phosphate (As P)	mg/l	0/0	NA	NA	NA	NA
CEFF	Selenium	mg/l	0/0	NA	NA	NA	NA
CEFF	Sodium	mg/l	0/0	NA	NA	NA	NA
CEFF	Sulfate	mg/l	0/0	NA	NA	NA	NA
CEFF	Total Dissolved Solids	mg/l	30/30	610 to 830	680.16	650	700
CEFF	Total Suspended Solids	mg/l	0/0	NA	NA	NA	NA
CEFF	UV Absorption	l/cm	0/0	NA	NA	NA	NA

Notes:

- ¹ = Pilot groundwater extraction and treatment system (GETS) sample results were evaluated over the period August 2014 through November 2022 to correspond to the current phase of operation with influent only from EW-02 and MW-29 and operation of the Trojan UV oxidation system. Results from samples collected at EW-02 and MW-29 were evaluated over their entire sampling history.
- ² = Bromide samples from 10/06/2017 and 12/02/2021 were excluded from the data due to likely mis-entry of results.
- ³ = Bromate samples were collected at EW-02 during period from 3/2010 through 3/2014, corresponding to incorporation of EW-02 in extraction network and operation of the HiPOx AOP
- ## = Number of detected samples / number of samples. 0/0 indicates analyte not sampled at sampling point.

Abbreviations:

CEFF = Effluent from
INF = Influent to Groundwater Extraction and Treatment System
NA = Not Applicable
PF = Post-filter
POX = Post-UV/Ox treatment
l/cm = per cm
mg/l = milligrams per liter
ug/l = micrograms per liter

Table 3. Recommended Pilot Groundwater Extraction and Treatment System Sampling Schedule

				SAMPLE FREQUENCY AND LOCATION																			
				Daily Samples ¹ : Days 1-5					Weekly Samples ¹ : Weeks 1-4					Monthly Samples: Week 5+					Quarterly Samples: Week 1+				
				System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	Extraction Wells (Well ID) ²	System Influent (INF)	Post-Filter (PF)	Post-Oxidation (POX)	Carbon Breakthrough (CBT) ³	Post-Carbon (CEFF)	Extraction Wells (Well ID) ²	System Influent (INF)	Post-Oxidation (POX)	Post-Carbon (CEFF)
Compounds/Constituent	Analytical Method	Sample Container	Reporting Detection Limits (milligrams per liter)																				
Compounds/Constituents Normally Required as Part Of NPDS Or WDR Permits, Pursuant To CRWQCB Region 8 Order No. R8-2003-0085																							
Volatile Organic Compounds	EPA 8260B	3 - 40 mL VOA, HCl	QAPP ⁴	X		X	X	X	X		X	X	X	X	X	X							
1,4-Dioxane	EPA 8270 Modified	1 L Amber	0.002	X					X					X	X								
1,4-Dioxane	EPA 8270 SIM	1 L Amber	0.0002			X					X					X	X	X					
UV Transmittance (UVT) @254nm	Field UVT Meter	N/A	N/A		(a)										X				X				
Field Parameters																							
Dissolve Oxygen (DO)	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Electrical Conductance (EC)	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Redox Potential	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Temperature	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
pH	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Turbidity	N/A	N/A	N/A	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Flow-Meter	N/A	N/A	N/A	X				X	X				X	X	X								
Residual Hydrogen Peroxide	N/A	N/A	N/A			(a)	(a)	(a)			X	X	X				X	X	X				

FOOTNOTES AND ACRONYMS:

¹ Daily and weekly samples collected during the first month of operation will be repeated after major modifications to system equipment or operating parameters, as detailed in the Workplan.

² If more than one extraction well is in operation, combined influent samples will be collected in addition to extraction wellhead samples, with the same sampling schedule as the extraction wellheads.

³ Carbon breakthrough will be collected from the effluent of the first carbon unit in series; when breakthrough of the first unit is detected, the breakthrough sample will be collected from the effluent of the second carbon unit in series.

⁴ Quality Assurance Project Plan (QAPP), Appendix B of Additional Groundwater Assessment Workplan, Hargis + Associates, Inc., April 25, 2003.

(a) Only one sample to be collected during sampling period.

CRWQCB = California Regional Water Quality Control Board, Santa Ana Region 8

NPDES = National Pollutant Discharge Elimination System

WDR = Waste Discharge Requirement

N/A = Not applicable

mL = Milliliter

VOA = Volatile organic analysis

HCl = Hydrochloric acid

nm = Nanometers

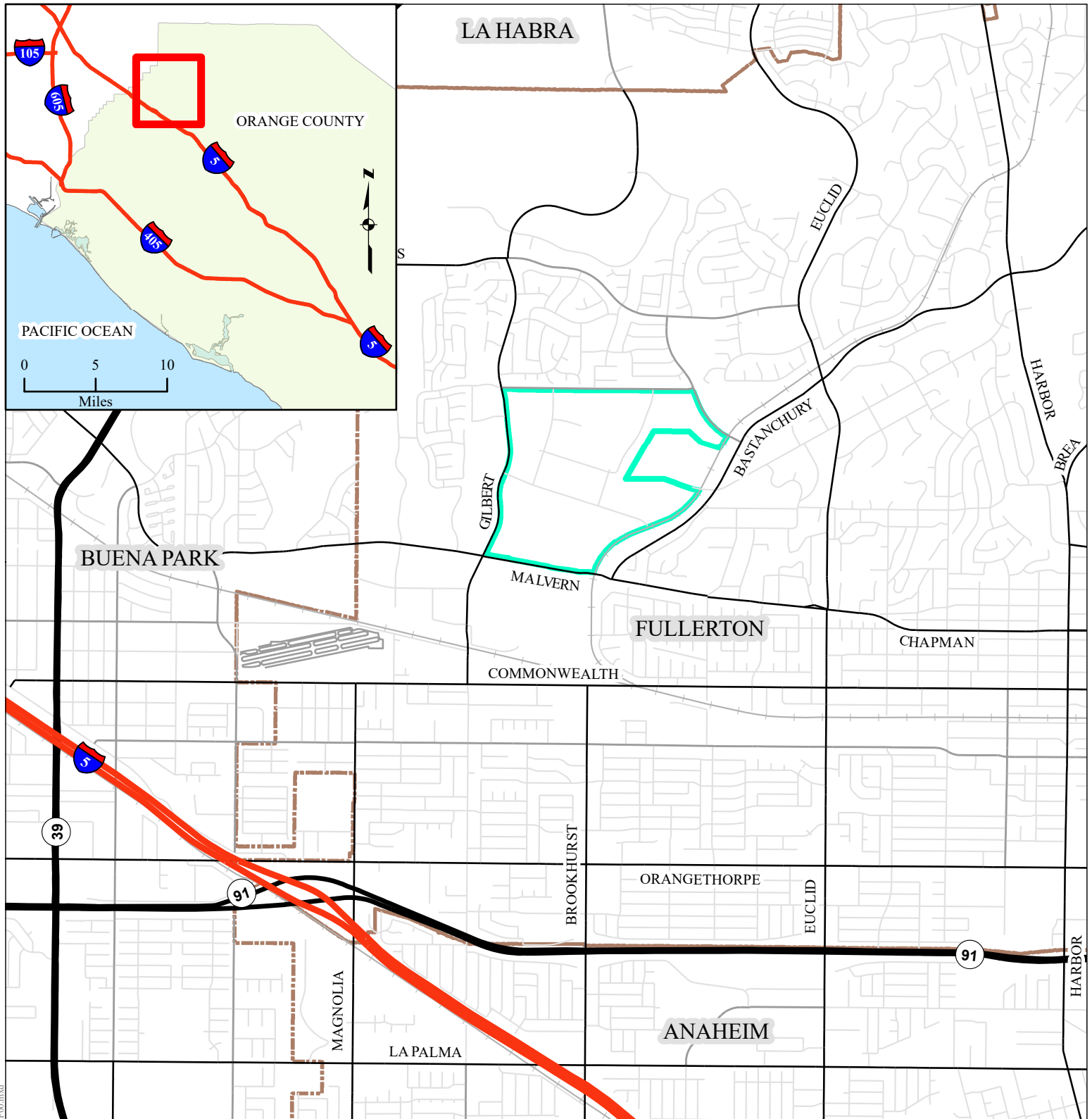
EPA = U.S. Environmental Protection Agency

SIM = Selected ion monitoring

L = Liter

Amber = Amber glass bottle

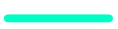
FIGURES



EXPLANATION



City Boundaries



Former Hughes Aircraft Facility

GETS = Groundwater Extraction and Treatment System

GWM = Groundwater Monitoring

Q4 = Quarter 4

0 2,500 5,000

FEET

FIGURE 1: SITE LOCATION

RECOMMENDED TREATMENT SYSTEM
MONITORING

FORMER HUGHES AIRCRAFT COMPANY
1901 WEST MALVERN AVE, FULLERTON, CA



Figure 2. Total Dissolved Solids

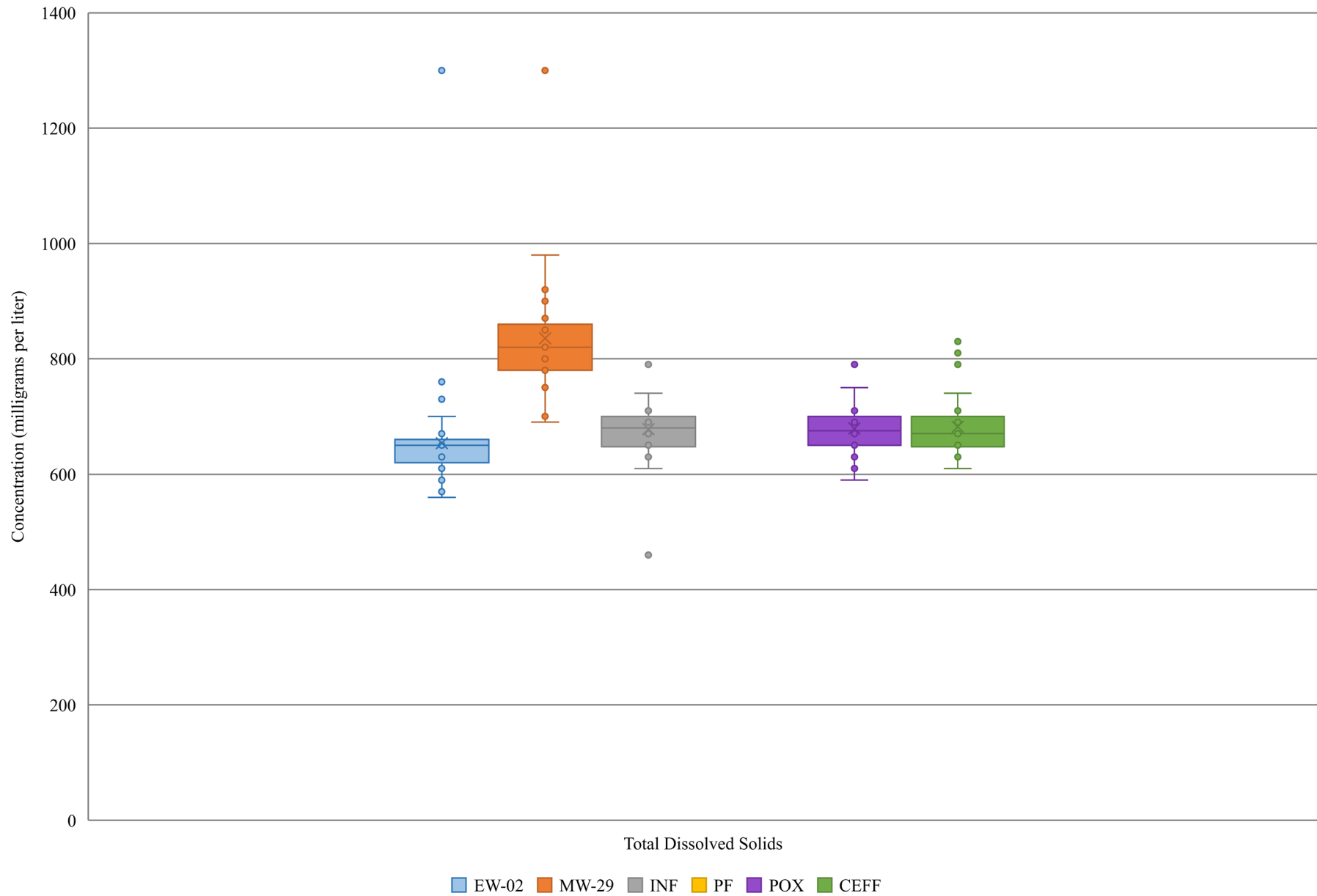


Figure 3a. Dissolved Metals: Calcium

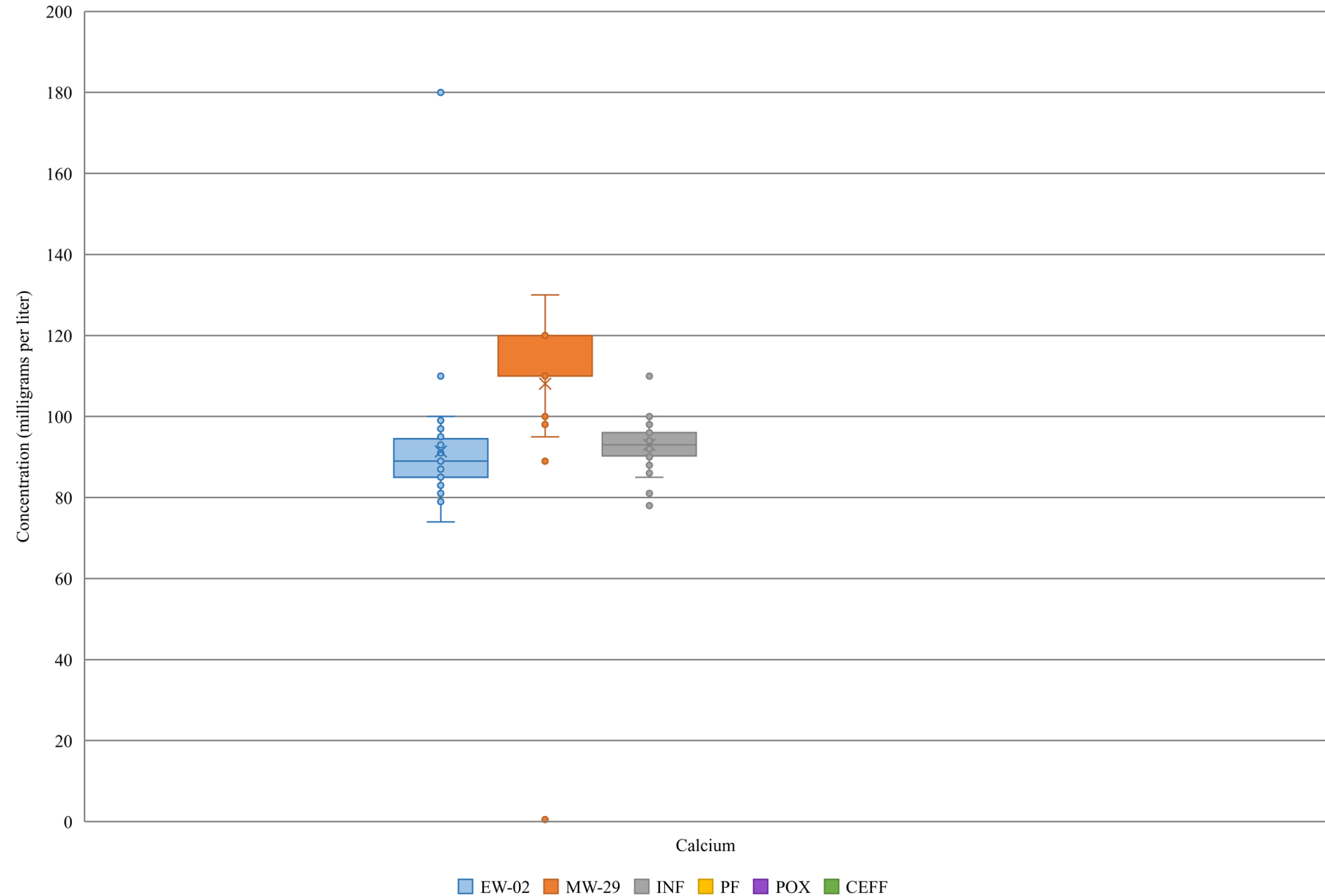


Figure 3b. Dissolved Metals: Magnesium

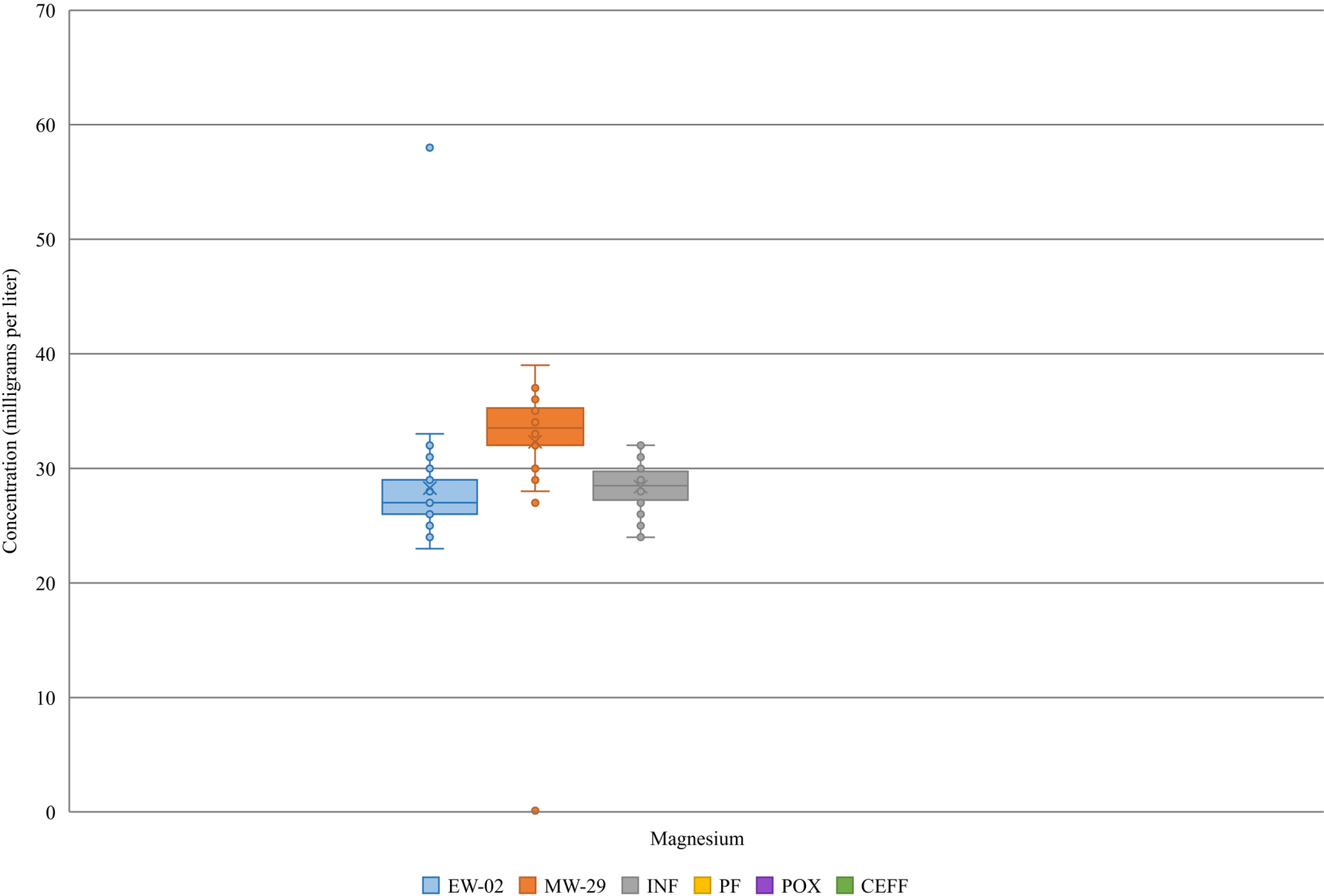


Figure 3c. Dissolved Metals: Sodium

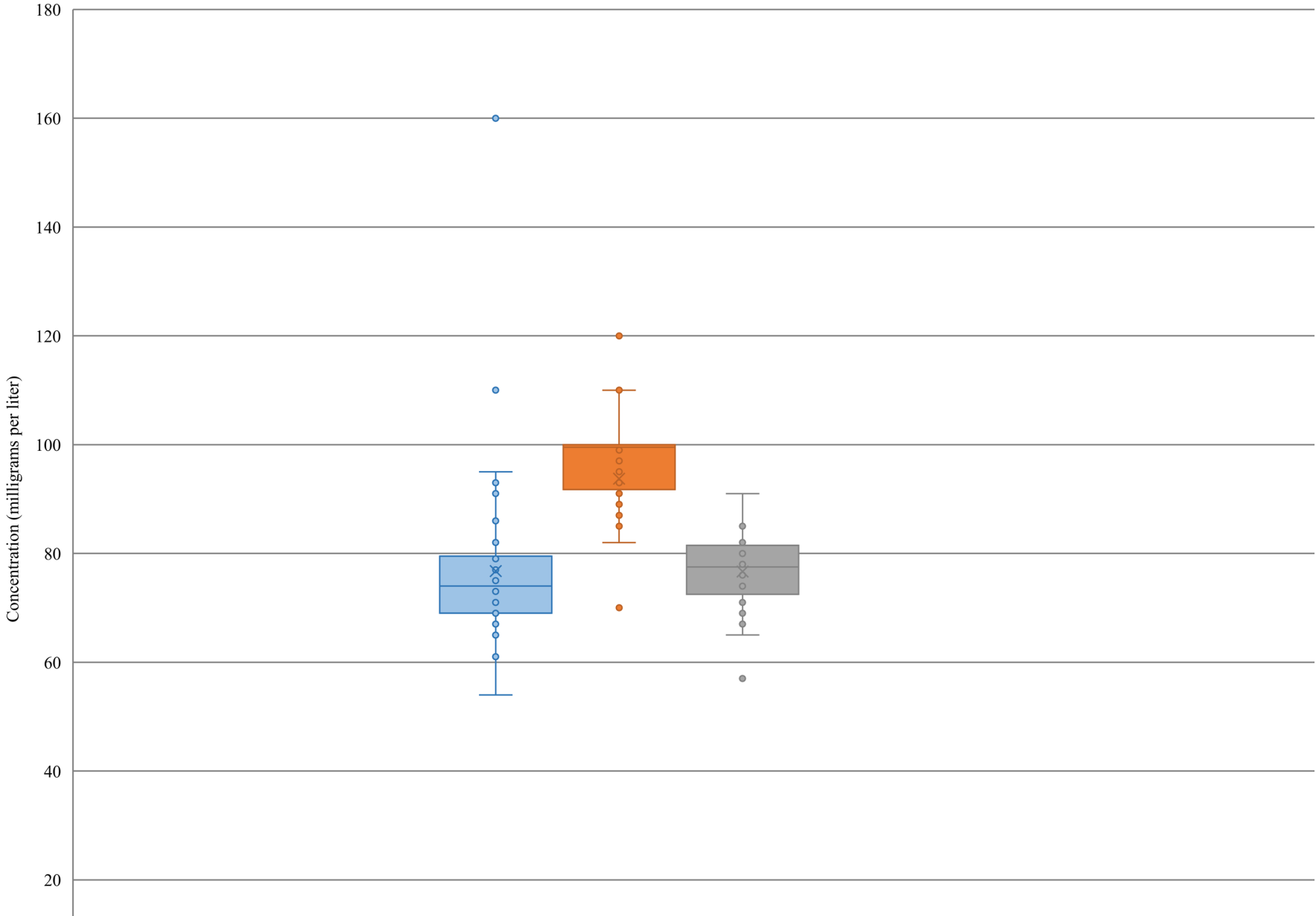


Figure 4. Total Alkalinity

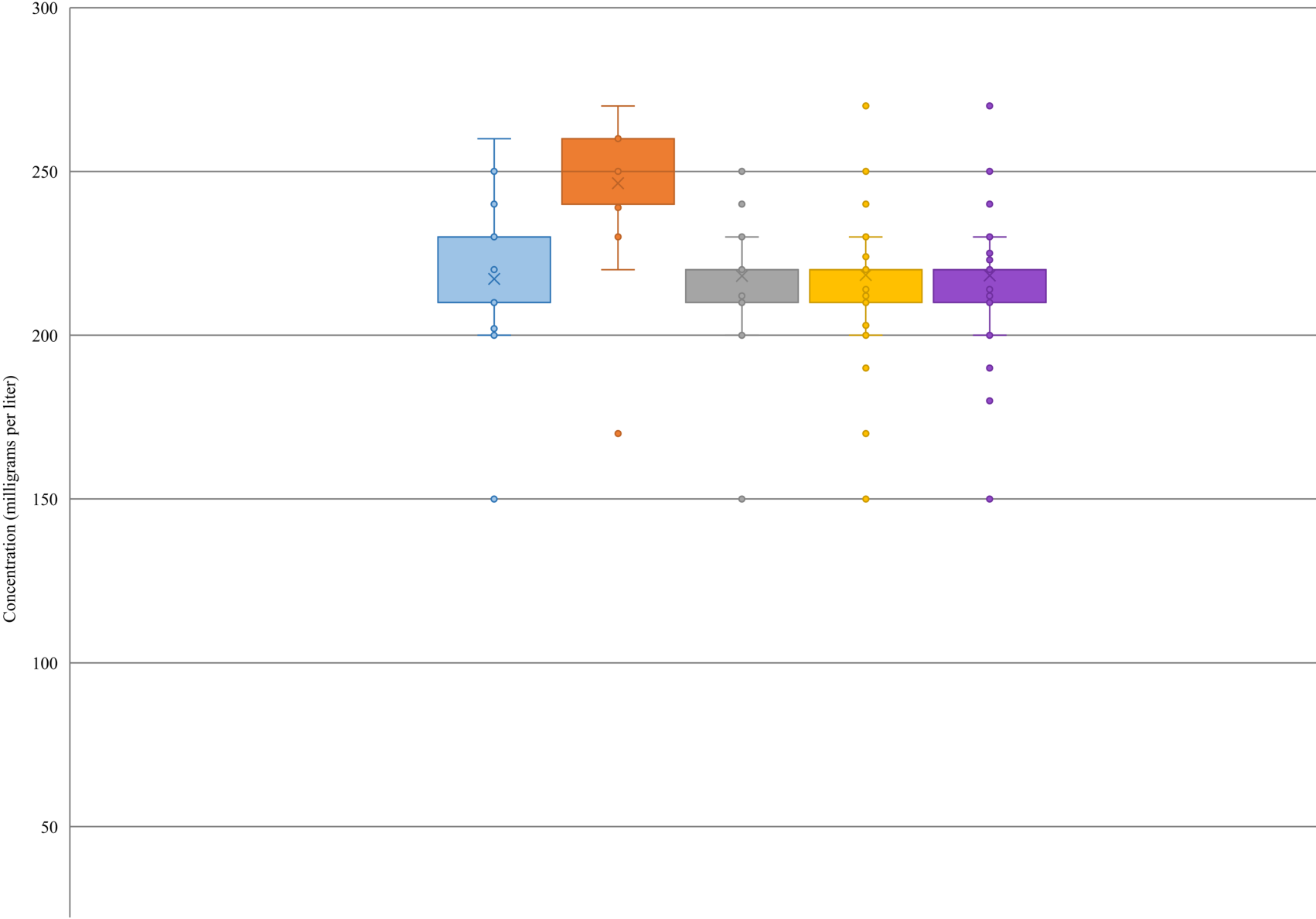


Figure 5. Bromide

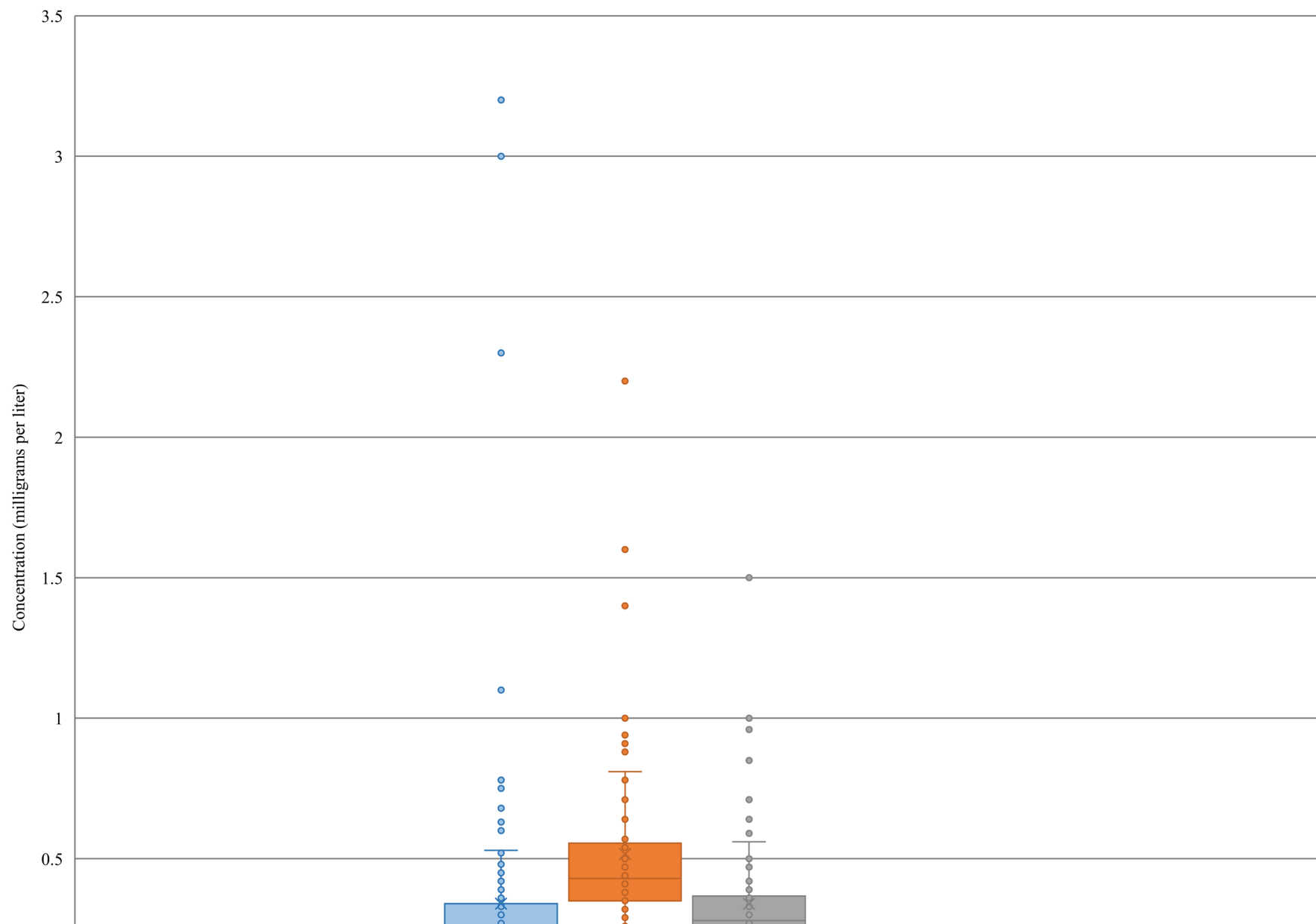


Figure 6a. Anions: Chloride

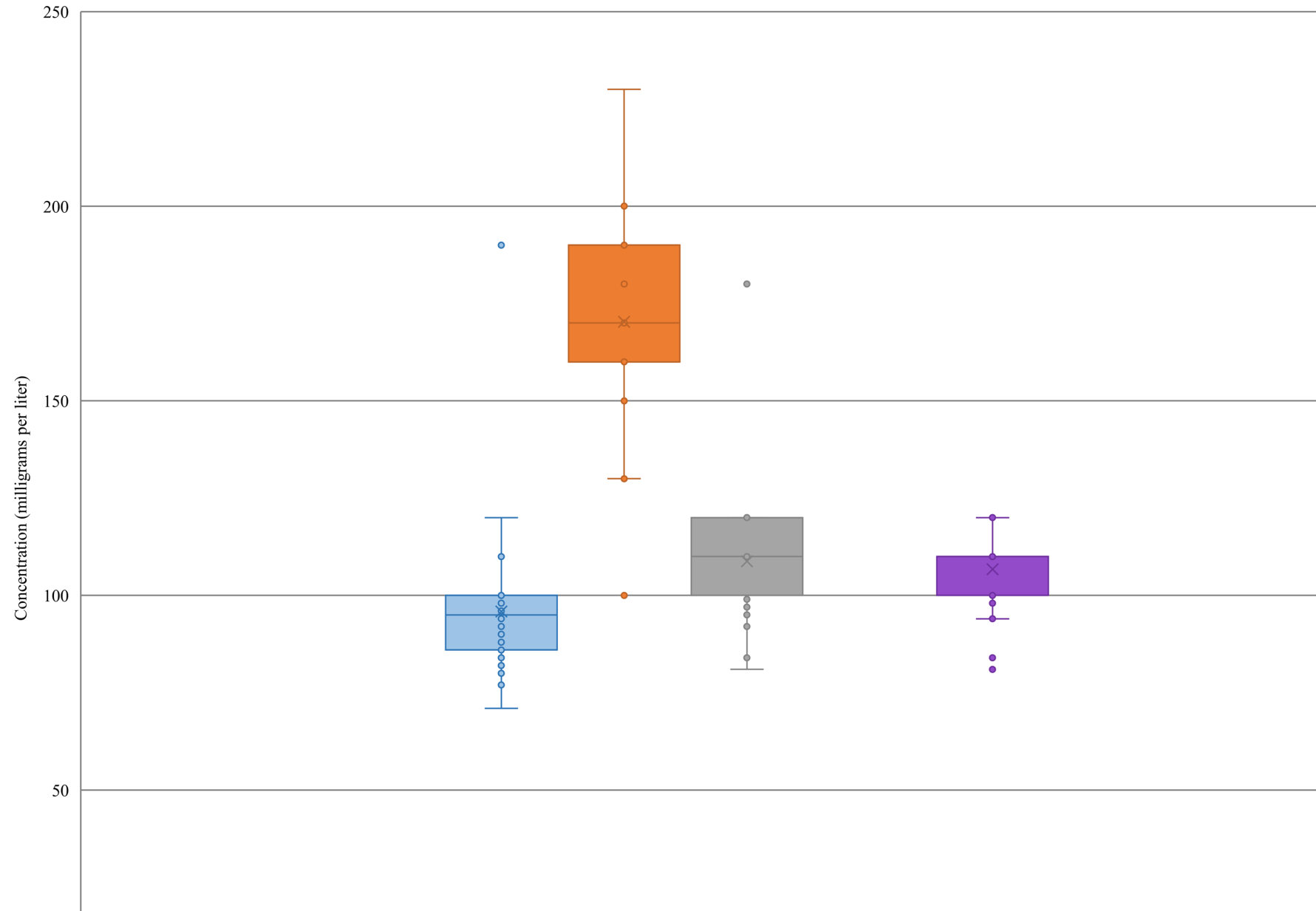


Figure 6b. Anions: Nitrate (as Nitrogen)

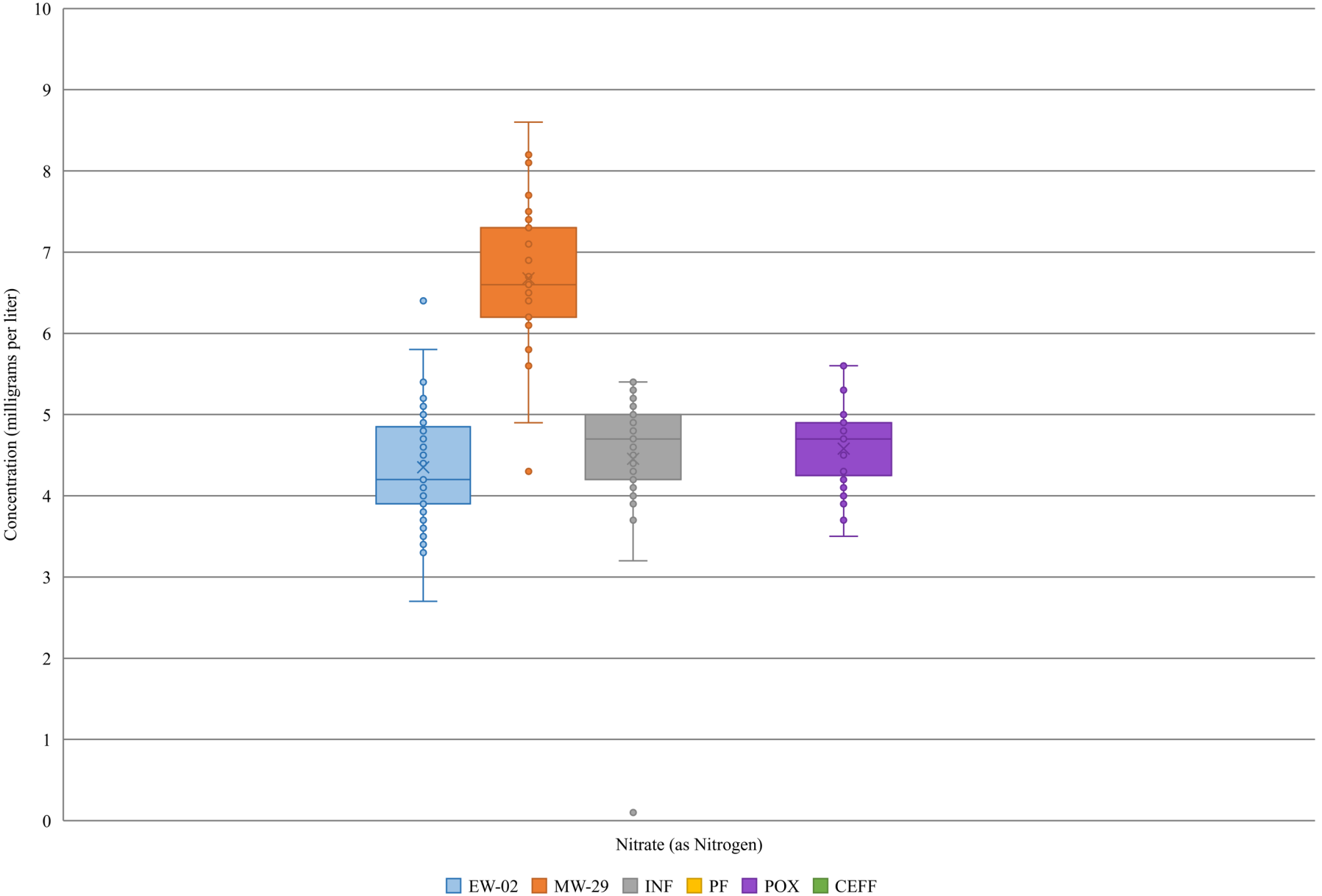


Figure 6c. Anions: Sulfate

