Comal System - Spring Run 3 – Summer 2023

2023 EAHCP Expanded Water Quality Annual Report

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1 | Introduction

The Edwards Aquifer Habitat Conservation Plan (EAHCP) Expanded Water Quality Monitoring Program was developed to monitor surface water and groundwater quality of the San Marcos and Comal spring systems and act as an early detection mechanism for water impairments that may negatively affect EAHCP Covered Species. From 2013 – 2016, the Expanded Water Quality Program deployed a broad range of sampling activities including surface water (base flow) sampling, groundwater sampling, sediment sampling, real-time water quality monitoring, and stormwater sampling. A Work Group was assembled in 2016 and charged to review the expanded water quality monitoring program and evaluate the recommendations from the National Academies of Sciences review of the EAHCP. The Work Group prepared a final report that included adjustments to the program including the incorporation of fish tissue analysis, reduced sampling frequency of sediment and stormwater sampling, removal of surface water and groundwater sampling, and the addition of one real-time water quality monitoring station per system. More information can be found in the *Report of the 2016 Expanded Water Quality Monitoring Program Work Group*. During the transition from Phase I to Phase II of the EAHCP, a second review of the program was conducted in 2020 that analyzed the results of contaminant detections among stormwater, sediment, and passive diffusion sampling activities and evaluated the parameters monitored in the real-time water quality network. Overall, the number of contaminant detections was low among sampling events 2013-2020. This is in part due to the focus on industrial and commercial contaminants that may not pose substantial risks to the Edwards Aquifer spring communities. Therefore, suggestions from the EAHCP Science Committee were implemented in 2021 that shifted sampling to focus on nutrients and pharmaceutical and personal care products (PPCPs). Additionally, sampling for sucralose, an artificial sweetener, was initiated in 2021 as measure of human and wastewater influence on the San Marcos and Comal spring systems. The current sampling type and activities can be viewed in Table 1-1. Sampling location and activity are displayed in Figure 1-1 for the San Marcos system and Figure 1-2 for the Comal system.

Table 1-1. EAHCP Expanded Water Quality Monitoring Program Sampling Activities

Sample Type	Activities and Sampling Locations
Real-Time Network	Continuous 15-minute interval, telemetered measurements Analytes include temperature, dissolved oxygen, and conductivity Locations include 3 San Marcos and 3 Comal stations
Surface water	Twice annual sampling in conjunction with Biological Monitoring activities Laboratory analyses are focused on nutrients including total phosphorus, orthophosphate, orthophosphate as P, TOC, DOC, DIC, kjeldahl nitrogen, nitrate at N, and ammonia Locations include upper and lower stations at each spring system
Groundwater	Twice annual sampling in conjunction with EAA springs sampling activities Laboratory analyses are focused on geochemical analytes and industrial, commercial, and emerging contaminants. The analytes include cations, anions, nutrients, metals, VOCs, SVOCs, herbicides, pesticides, bacteria, TOC, PCBs, and PPCPs Locations include Spring 1, Spring 3, and Spring 7 (Comal), Hotel, and Deep (San Marcos)
Sediment	Every other year sampling in even numbered years Laboratory analyses are focused on PAHs Locations include 6 San Marcos and 5 Comal stations
Fish Tissue	Every other year sampling in odd numbered years Laboratory analyses are focused on metals and PPCPs in two fish species Locations include upper and lower stations at each spring system

1.1 Real-Time Network

Real-time water quality (RTWQ) instruments have been deployed within the San Marcos and Comal systems for the entirety of the water quality monitoring program. From 2013-2020, real-time instruments consisted of Eureka Manta+ 30s containing five water quality sensors including, dissolved oxygen (mg/l), specific conductivity (µs/cm), turbidity (NTU), water temperature (°C), and pH (SU). Turbidity sensors were discontinued in 2020, excluding Sessom Creek, due to the high rate of malfunction and cost of replacement. In 2021, pH sensors were also discontinued due to the sensor variability being greater than environmental variability. In 2021, Eureka Manta+30s were replaced with InSitu AT 600 real-time instruments. Measurements are recorded every 15 minutes (excluding the Sessom Creek site that is measured every five minutes) and subjected to quality control measures prior to storage in EAHCP and EAA databases. Table 1-2 describes the stations within each river system including station ID, location from headwaters (i.e., Spring Lake Hotel at San Marcos and Headwaters of Landa Lake at Comal River), and period of data record.

Presently, three RTWQ sites are located in the San Marcos system, including Aquarena Springs Drive (ASD), Texas Parks and Wildlife Department (TPWD) hatchery, and Sessom Creek (Figure 1-1). ASD was deployed and brought online by late May 2013, the TPWD hatchery site was installed in January 2016, and the Sessom Creek station began collecting data in January 2018.

Three RTWQ sites are located in the Comal system, including two locations in Landa Lake (i.e., Spring run 3 (SR 3), and Spring run 7 (SR 7)), and one site in the Old Channel (OC, Figure 1-2). Spring run 3 and SR 7 were installed in 2013 whereas the OC station was installed in April 2018.

Table 1-2. EAA real-time water quality station ID, location, and period of record for the San Marcos and Comal spring systems.

River system	Station ID	Location (river km from headwaters)	Period of record
San Marcos	Sessom Creek	0.5 rkm from SMR confluence	1/1/2018 - present
	Aquarena Springs	0.8	5/30/2013 - present
	Rio Vista	1.9	5/30/2013 – 12/31/2020
	TPWD hatchery	4	1/8/2016 - present
Comal	Upper Spring Run	0.1	4/1/2019 – 12/31/2020
	Spring Run 7	1.0	9/10/2013 - present
	Spring Run 3	1.2	4/11/2013 - present
	Landa Lake	1.2	6/10/2013 – 3/31/2018
	Old Channel	1.5	4/20/2018 - present
	New Channel	2.7	5/30/2013 – 12/31/2020

Real-time water quality stations assist in discerning when and what river conditions result in water quality exceeding critical biological standards. One of EAHCP's long-term management objectives is to maintain water quality conditions that do not deviate > 10% from historical water quality conditions recorded during the EAA Variable Flow Study. Additionally, specific EAHCP water quality thresholds include, maintaining water temperature < 25°C as to not inhibit fountain darter reproduction and recruitment rates (McDonald et al. 2007) and maintaining dissolved oxygen concentrations > 4.0 mg/L throughout fountain darter habitat. EAHCP's RTWQ stations are designed to track water quality conditions within the San Marcos and Comal systems to monitor whether river conditions remain within historic conditions and under specific thresholds.

Figure 1-1. Expanded Water Quality Sampling Locations in the San Marcos system.

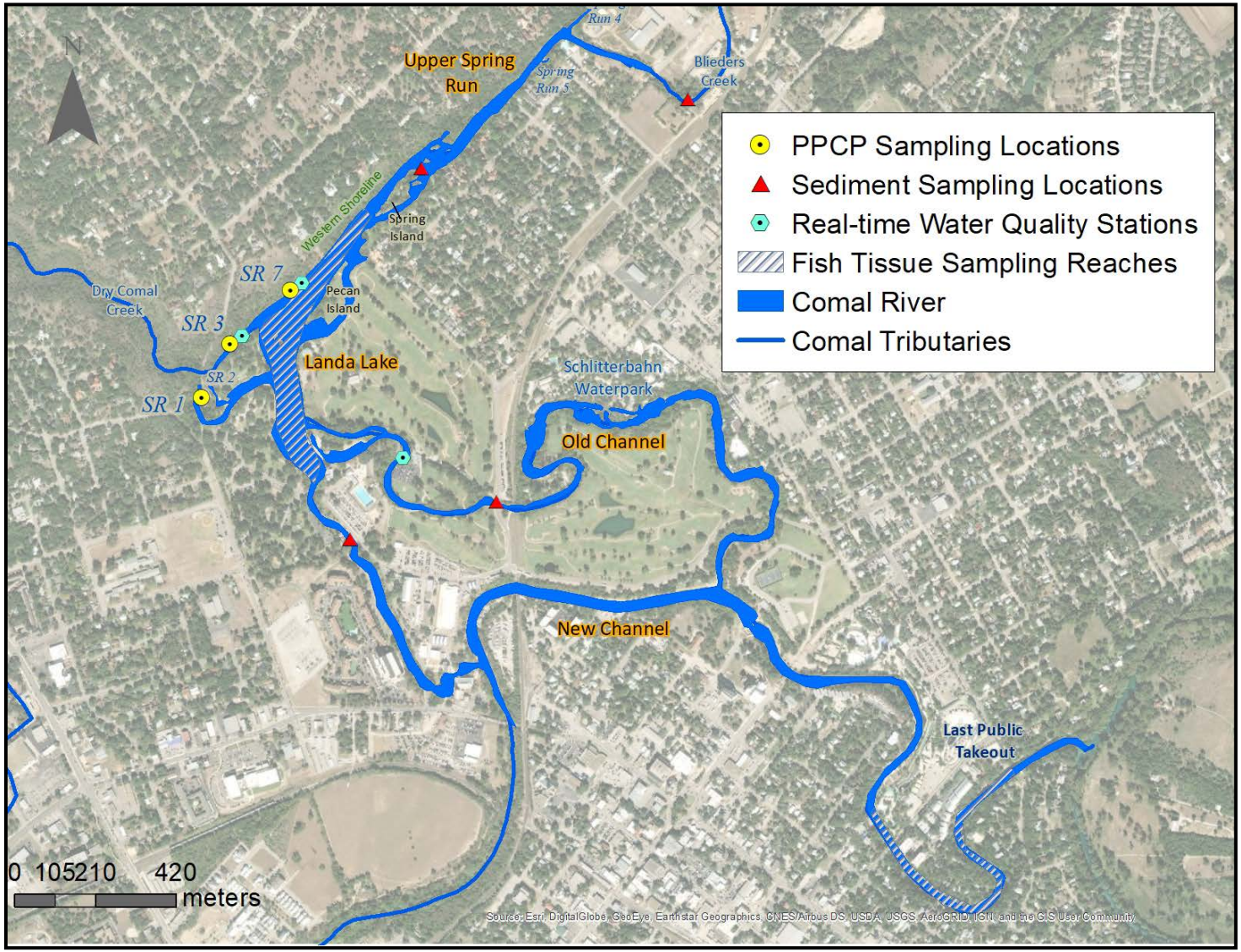

Figure 1-2. Expanded Water Quality Sampling Locations in the Comal system.

1.2 Surface water sampling

Monthly sucralose sampling occurs at one location in each spring system (i.e., Hotel Spring in San Marcos and Spring Run 3 in Comal). Sucralose, an artificial sweetener found in many diet beverages and candies, is not efficiently processed by the body, and subsequently ends up in septic and city wastewater effluent (Whitall et al. 2021). Sucralose has shown minimal degradation when processed through wastewater facilities, is relatively stable in the environment, and has demonstrated reliable detection rates (Oppenheimer et al. 2011). Therefore, monitoring the occurrence and levels of sucralose systems has proven to be a suitable indicator of wastewater input among rivers and groundwater systems.

Additional surface water samples are collected on a biannual basis under normal flow conditions in conjunction with the Biological Monitoring program (Spring and Fall). Sampling locations consist of upper and lower river stations in both systems. For the Comal system, Landa Lake near Spring Island serves as the upper location, and the lower station is located at the last public river take out just upstream of the confluence with the Guadalupe River. In San Marcos, Hotel Spring in Spring Lake serves as the upper location, and the downstream location is located at the most downstream real-time water quality monitoring station (i.e., TPWD hatchery). Samples are submitted to a laboratory for analysis of nutrients (Table 1-3). During the collection event, field parameters are collected that include dissolved oxygen, pH, conductivity, and temperature.

Table 1-3. List of Nutrients Analyzed during Surface Water Sampling

Analyte
Ortho-phosphate
Ortho-phosphate as P
Phosphorus (total)
Dissolved Inorganic Carbon (DIC)
Dissolved Organic Carbon (DOC)
Kjeldahl Nitrogen
Nitrate as N
Ammonia

1.3 Groundwater sampling

Groundwater sampling is conducted by the EAA Aquifer Science Division and is part of their routine water quality monitoring of streams, wells, and springs in the Edwards Aquifer Region (Edwards

Aquifer Water Quality Summary 2020 Report). Two spring orifices in the San Marcos system (i.e., Hotel Spring and Deep Hole) and three springs within the Comal system (ie., Spring Run 1, Spring Run 3, and Spring Run 7) are sampled on a biannual basis in conjunction with the EAHCP Biological Monitoring program (i.e, Spring and Fall). Beginning in 2022, PPCP samples were also collected every other month at Hotel Spring and Spring Run 3 locations. Groundwater samples are submitted to a laboratory for analysis of cations, anions, nutrients, metals, VOCs, SVOCs, herbicides and pesticides, bacteria, TOC, PCBs, and PPCPs. The analyte list for laboratory analyses along with the methods are shown in Table 1-4. During the collection event, field parameters will be collected that include dissolved oxygen, pH, conductivity, temperature, and alkalinity.

Table 1-4. List of Items Analyzed during Groundwater Sampling

Analyte
Volatile Organic Compounds (VOCs)
Semi-volatile Organic Compounds (SVOCs)
Organochlorine Pesticides
Polychlorinated Biphenyls (PCBs)
Organophosphorous Pesticides
Herbicides
Metals (Al, Sb, As, Ba, Be, B, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn)
General Chemistry (GWQP) Total Alkalinity (as CaCO3), Bicarbonate Alkalinity (as CaCO3), Carbonate Alkalinity (as CaCO3); (Cl, Br, NO_3, SO_4, Fl, pH, TDS, TSS, Ca, Mg, Na, K, Si, Sr, CO_3,)), and Total Suspended Solids (TSS).
Phosphorus (total)
Total Organic Carbon (TOC),
Dissolved Organic Carbon (DOC)
Kjeldahl Nitrogen
Bacteria Testing (*E coli*)
PPCPs

Method	**Method Description**	**Protocol**
8260B	Volatile Organic Compounds	(GC/MS) SW846
8270C	Semivolatile Organic Compounds	(GC/MS) SW846
8081B	Organochlorine Pesticides	(GC) SW846
8082A	Polychlorinated Biphenyls (PCBs)	by Gas Chromatography SW846
8141A	Organophosphorous Pesticides	(GC) SW846
8151A	Herbicides	(GC) SW846
6010B	Metals	(ICP) SW846
6020	Metals	(ICP/MS) SW846
7470A	Mercury	(CVAA) SW846
300.0	Anions,	Ion Chromatography
340.2	Fluoride	MCAWW
365.4	Phosphorus,	Total EPA
9040C	pH	SW846
9060	Organic Carbon,	Total (TOC) SW846
SM 2320B	Alkalinity	SM
SM 2540C	Solids,	Total Dissolved (TDS) SM
SM 2540D	Solids, Total Suspended (TSS)	SM
351.2	Nitrogen, Total Kjeldahl	MCAWW
1694	PPCPs	LC-MS/MS

Protocol References:
EPA = US Environmental Protection Agency
MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
SM = "Standard Methods For The Examination Of Water And Wastewater",
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

1.4 Sediment and Fish Tissue sampling

Sediment and fish tissue sampling occurs on an every other year basis with sediment sampling completed in even years and fish tissue sampling in odd years. Sampling collections for sediment and fish tissue occur in the Spring during the EAHCP Biological Monitoring surveys.

Collection of sediment samples within in each spring system was included in the program to help determine potential effects on EAHCP covered species via direct or indirect exposure to sediment contaminants. Sediment samples are collected once from four locations within the Comal system and six locations in San Marcos system (Figures 1-1 and 1-2). Samples are collected at each sample site and composited into one sample for analysis. Sediment samples are analyzed for polycyclic aromatic hydrocarbons (PAHs) and other contaminants listed in Table 1-5.

Table 1-5. List of Contaminants Analyzed during Sediment Sampling.

Analyte
Benzo[a]anthracene
Chrysene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Fluoranthene
Dibenz(a,h)anthracene
Indeno[1,2,3-cd]pyrene
Pyrene
Phenanthrene
Fluorene
Benzo[g,h,i]perylene
Anthracene
Acenaphthene
Acenaphthylene
Benzo[g,h,i]perylene
Carbazole
2-Methylnaphthalene
Naphthalene
Total Organic Carbon (TOC)

Fish tissue sampling within in each spring system was included to the program in 2017 to serve as a direct link between water quality impairments and their potential effects on EAHCP covered species. Prior to 2017, the linkage between contaminants and metals found in the spring systems and their accumulation in EAHCP covered species was unknown. Surrogate species were selected to represent EAHCP covered species and the two species selected for analysis are *Gambusia* (mosquito

fish) and *Micropterus salmoides* (largemouth bass). The mosquito fish serves as a short-lived species, similar to the EAHCP covered fountain darter, whereas the largemouth bass represents the longer-lived species. Mosquito fish and largemouth bass are collected from upper and lower sections in both spring systems. In the San Marcos, fish are collected in Spring Lake (i.e., upper section) and in the San Marcos River near IH35 (i.e., lower section). For the Comal, both species are collected from Landa Lake (i.e., upper section) and in the Comal River near the last public take out (i.e., lower section). For each section, whole body organisms are combined to create a mosquito fish composite sample. Composites for largemouth bass are created from individual fillet aliquots from each fish. Tissue samples are submitted to a laboratory and analyzed for metals and PPCP contaminants listed in Table 1-6.

Table 1-6. List of Metals and Contaminants Analyzed among Fish Tissue Samples.

Analyte
Metals (Al, Sb, As, Ba, Be, B, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn)
PPCPs

Method	**Method Description**	**Protocol**
6010B	Metals	(ICP) SW846
6020	Metals	(ICP/MS) SW846
7470A	Mercury	(CVAA) SW846
1694	PPCPs	LC-MS/MS

Protocol References:
EPA = US Environmental Protection Agency
MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
SM = "Standard Methods For The Examination Of Water And Wastewater",
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates

2 | Methods

2.1 Real-Time Network

The near continuous (15-minute interval) raw data collected at San Marcos River and Comal system RTWQ sites underwent a quality assurance review process before being utilized for this assessment. Water quality sonde data was overlayed with river streamflow and precipitation data to verify significant increases and decreases in measured values. The data from each site within the basins were also compared to ensure validity. The multiparameter water quality instruments were switched out at 5 to 6-week intervals, with the unit returned to the EAA office for data download, calibration checks, and cleaning. Data obtained from independent field visit measurements and post-deployment sensor calibration checks were used to determine any necessary adjustments to the near continuous raw data sets. Additional quality control was completed to the data in the Power BI Pro License software.

Turbidity data recorded at Sessom Creek were edited for any values in the continuous raw data interpreted as not being representative of actual ambient water quality conditions. Sporadic spikes in turbidity values without any corresponding change in other parameters (i.e. Specific Conductance, Temperature, or Dissolved Oxygen) were deleted from the finalized continuous data sets before their use in this assessment.

Mean daily, maximum daily, and minimum daily values for water quality parameters at each of the San Marcos River and Comal system RTWQ sites were exported from AQUARIUS database. Hydrographs since the start of the EAHCP (2013) for the two systems were constructed using surface water discharge data (recorded in 15 minute intervals) obtained for the San Marcos River at San Marcos (USGS Station 08170500) and the Comal River at New Braunfels (USGS Station 0816900). Mean daily springflow (cfs) for the San Marcos springs (USGS Station 08178710) and the Comal springs (USGS Station 0816900) were used to construct springflow hydrographs for 2013-2021. Differences in maximum daily temperatures and minimum daily dissolved oxygen among sites and seasons were assessed using boxplots. Seasons were defined as: Winter (January, February, December), Spring (March – May), Summer (June – August), and Fall (September – November). For sites exceeding water temperatures > 25°C, 15-minute interval data (5 minute interval data for Sessom Creek) were used to assess the number of days and percent of day a site exceeded 25°C. Similar analysis was completed for sites that dropped below the 4.0 mg/L dissolved oxygen threshold.

2.2 Surface water sampling

Water samples for sucralose were collected from Hotel Spring in the San Marcos system and Spring run 3 in the Comal system monthly January – December 2023. Prior to water sample collection, an Insitu AquaTroll 600 water quality sonde was placed directly in each location to measure water quality parameters (i.e., pH, specific conductivity, dissolved oxygen, and temperature) for a ten-minute period. Sample bottles were submerged directly into the springs to be filled. Field duplicates and field blanks (i.e., bottles filled with DI water) were also filled following sampling protocols. All sample bottles were kept chilled during transport in an ice chest and placed in a freezer until later shipment to the laboratory that occurred on a quarterly basis.

Surface water samples for nutrient analysis were collected in May and October 2023 at upper and lower sites in the San Marcos and Comal systems. During sampling collections, water quality parameters were measured following same protocols as monthly sucralose sampling. Filtration for methods 6010B (metals), 6020 (metals), and 7470A (mercury) were performed at the sample locations by using a 0.45 micron high capacity cartridge filter inserted into syringe. Preservatives were placed in the bottles (as appropriate) by the contracted laboratory. Field duplicates and field blanks were also filled following sampling protocols. All sample bottles were kept chilled during transport in an ice chest frozen and immediately shipped to the contract laboratory for analysis.

All water quality data were exported to excel and medians values were calculated for water quality parameters collected during sucralose and bi-annual surface water sampling collections.

2.3 Groundwater sampling

Groundwater samples for PPCPs and other analyses were collected from Hotel and Deep Hole springs in the San Marcos system and from Spring Run 1, 3, and 7 within the Comal Spring system in April and October 2023. Additional PPCP samples were also collected for four additional months (i.e., January, June, July, and December) at Hotel and Spring Run 3 locations. Prior to groundwater collections, an Insitu AquaTroll 600 water quality sonde was placed directly into the spring orifice to measure water quality parameters (i.e., pH, specific conductivity, dissolved oxygen, and temperature). Sample bottles were then submerged directly into the spring to obtain samples, except for Deep Hole Spring where EAA staff utilized a peristaltic pump with 30 feet of sample tubing inserted into the spring orifice to collect field parameters and fill sample bottles. Samples were collected in accordance with the criteria set forth in the *EAA Groundwater Monitoring Plan*.

Filtration for methods 6010B (metals), 6020 (metals), 7470A (mercury) and field alkalinity were performed at the sample locations by utilizing a 0.45 micron high capacity cartridge filter inserted into a weighted single sample disposable bailer or sample tubing (if peristaltic pump was used). Preservatives were placed in the bottles (as appropriate) by the contracted laboratory. Ice was

placed into the cooler immediately after sampling and later shipped to the contract laboratory. When not in use or after collection, sampling equipment and/or coolers containing samples were secured inside the EAA vehicles to maintain appropriate sample custody and security.

Analyses for field alkalinity were conducted at EAA's Camden Building using Hach Titralab® AT1000. The method used for field alkalinity is discussed in detail in the *EAA Groundwater Monitoring Plan.*

A full report of groundwater sampling results at Hotel and Deep Hole springs will be available under the Science and Aquifer Protection section on the EAA website and entitled Water Quality Summary Report 2023. Sampling results for PPCPs are reported in Section 3.3.

2.4 Fish Tissue sampling

Fish tissue samples were collected in May-June 2023. No mosquitofish were sent for analysis due to shipping restrictions on whole specimens. Largemouth bass were collected from the upper and lower sites in the San Marcos system (i.e., Spring Lake and the lower San Marcos River near IH35) and the Comal system (i.e., Landa Lake and Comal River near the last public take out). Largemouth bass were collected via hook and line and humanely euthanized by being placed in a cooler with ice. Collected specimens were frozen until further processing. Largemouth bass composite samples were made by grinding frozen fillets with stainless steel implements and processing implements were cleaned and rinsed with DI prior to use. Composite samples were then shipped off to the contract laboratory.

3 | Results and Discussion

3.1 Real-Time Network

3.1.1 San Marcos

Hydrology

Average springflow for the San Marcos Springs calculated from the period of record (i.e., 1956 – present) was 175 cfs. Since 2013, San Marcos springflow ranged from below average in 2013-2014 to above average from mid-2015-2017 (Figure 3-1). During 2013, the San Marcos springflow dropped down to as low as 99 cfs on May 21st. A flow pulse on October 30th, 2013, estimated at 5,400 cfs, resulted in a temporary spike in above average springflow. No substantial rain events occurred in 2014 and consequently, springflow dropped below average. Increased springflow in 2015 occurred following two large precipitation events in late May and October with above average springflow continued into 2016 - 2017. In 2018, springflows dropped below average, reaching 117 cfs in late August. However, several small rain events in the early fall resulted in springflows increasing and becoming above average (~250 cfs). Springflows were largely above average in 2019, but with a lack of large flow pulses (> 500 cfs), springflows lessened throughout the year and dropped just below average beginning in October. With no large flow pulses in 2020, springflows continued to decrease and dropped below 120 cfs by December. Springflow in early 2021 continued to decline and dropped briefly below 100 cfs in April before rain events in late spring resulted in springflow rising to average flows. Springflows dropped slightly during early fall but increased again after significant rain events (i.e., 1,070 cfs pulse in October) to end 2021 at average springflow. No significant rainfall events occurred in 2022 with springflows at critical period monitoring levels during most of the year, declining down to ~85 cfs from September-December. Springflows remained below 100 cfs during all of 2023 (median 88 cfs), dropping in August to the lowest observed springflow (66cfs) since 1956.

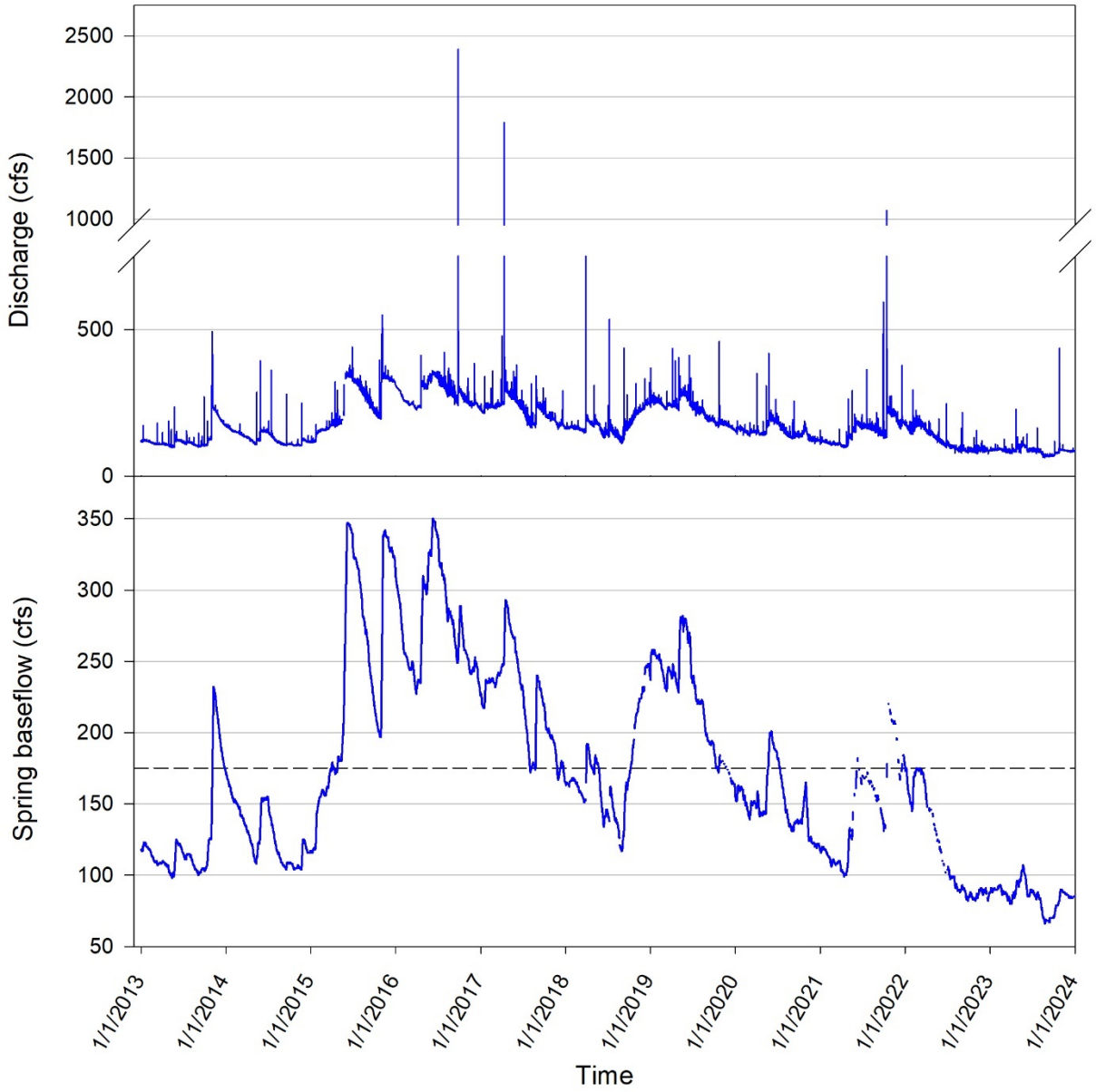

Figure 3.1-1. Hydrographs for the San Marcos River at San Marcos (USGS station 08170500) and mean daily springflow for the San Marcos springs (USGS Station 08170000) 2013 – 2023. Dashed line denotes the long-term average springflow (175 cfs) in the San Marcos River.

Temperature

Table 3.1-1 displays monthly summary statistics (i.e., monthly mean and 15 minute minimum and maximum values reported that month) for water temperatures recorded in 2023 at the San Marcos River RTWQ sites. Slightly more variation in mean water temperatures (~3-4 °C) was observed this year and is attributed to the continued lower than average springflows in the system during 2023. The TPWD hatchery site displayed greater variability in water temperature with minimum daily water temperatures reaching lower temperatures in winter months and warmer maximum daily

water temperatures during summer months. Maximum daily water temperatures recorded in 2023 reached the 25°C threshold with the highest temperature (26.60°C) recorded at the TPWD hatchery in August. The lowest temperature (10.49°C) in 2023 was observed at the TPWD hatchery site in March.

Table 3.1-1. Monthly mean, minimum, and maximum water temperatures among San Marcos River RTWQ (2023).

	Water temperature (°C) at San Marcos Water Quality Sites					
Month (2023)	**Aquarena Springs**			**TPWD hatchery**		
	Mean	Min	Max	Mean	Min	Max
Jan	20.80	18.67	22.69	20.26	16.77	22.87
Feb	20.87	16.81	23.00	20.32	13.03	23.75
Mar	21.71	19.50	23.78	21.66	10.49	24.62
Apr	22.00	19.42	24.03	21.95	16.69	24.98
May	22.81	21.42	24.36	23.13	21.15	25.52
Jun	23.32	22.03	24.83	24.09	22.03	26.37
Jul	23.57	22.53	25.06	24.48	22.84	26.53
Aug	23.65	22.28	25.08	24.63	22.59	26.60
Sept	23.34	22.23	24.95	24.18	22.42	26.32
Oct	22.21	18.82	24.35	22.36	18.35	25.15
Nov	21.23	19.71	23.53	20.87	18.78	23.58
Dec	20.79	19.22	22.55	20.18	17.80	22.41

Box plots for maximum daily temperatures (i.e., highest 15 minute interval recorded daily) observed at San Marcos RTWQ sites from time of equipment deployment (i.e., 2013 for Aquarena Springs Drive (ASD) and 2016 for TPWD hatchery) through 2023 compared to maximum daily temperature observed in 2023 are shown in Figure 3.1-2. The median of maximum daily temperatures for 2023 were slightly higher and exhibited more variability than the median of maximum daily temperatures from time of equipment deployment at both San Marcos sites but this was not unexpected with the lower springflows experienced throughout 2023.

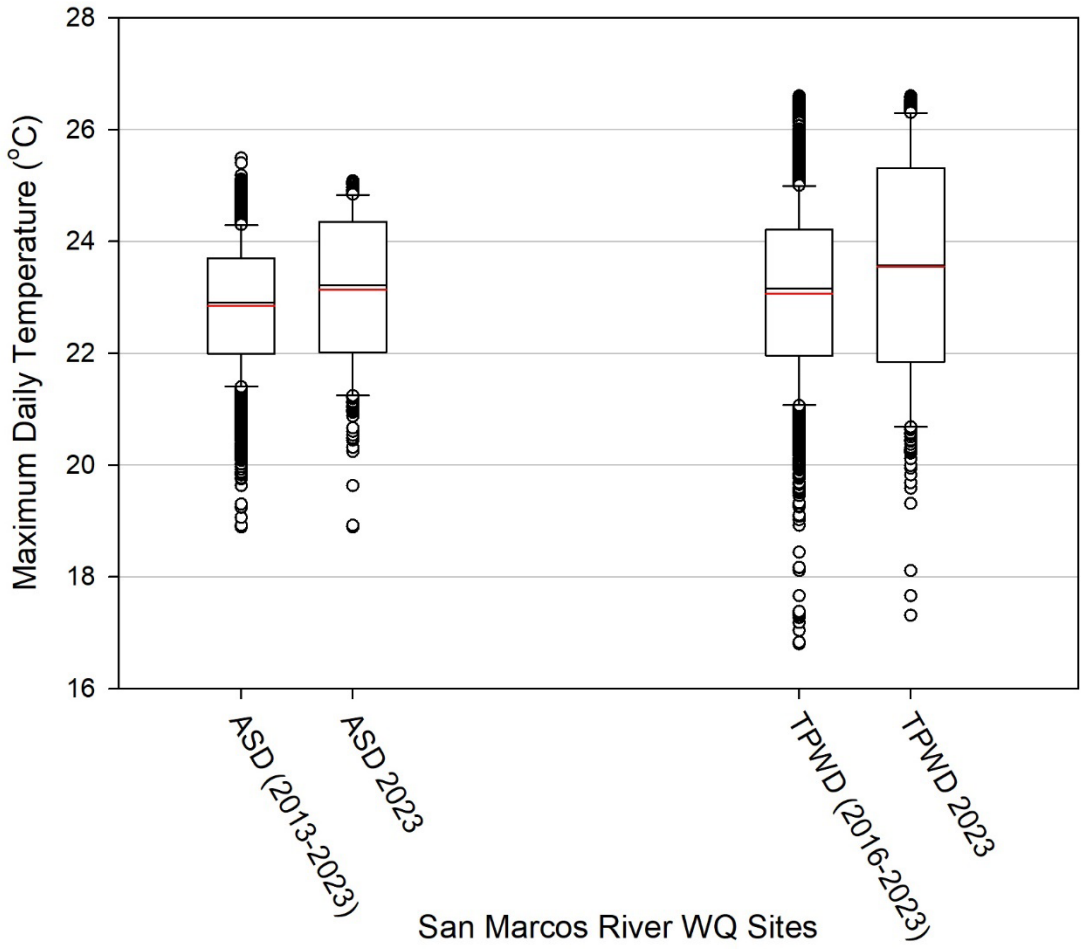

Figure 3.1-2. Box plots of maximum water daily temperatures (°C) among San Marcos River RTWQ sites from time of equipment deployment through 2023 compared to 2023 values. Black lines represent median values and red lines denote mean values. Whiskers represent maximum and minimum temperature values, excluding outliers (open circles).

Maximum daily water temperatures were plotted for San Marcos River RTWQ sites for 2023 (Figure 3.1-3). Throughout 2023, maximum daily temperatures were more variable at the TPWD hatchery site compared to the upstream ASD site. Maximum daily temperatures reached or exceeded 25°C at the TPWD hatchery site for 112 days during the months of May - October in 2023. Among those 112 days, time spent at or above 25°C ranged from 1.5 hrs – 11.0 hrs (mean = 7.82 hrs and median = 8.75 hrs). At the Aquarena Springs Drive site, maximum daily water temperature reached 25°C 16 days in 2023 (7/30/2023 - 8/27/2023) for a period of 0.25-1.75 hours per day.

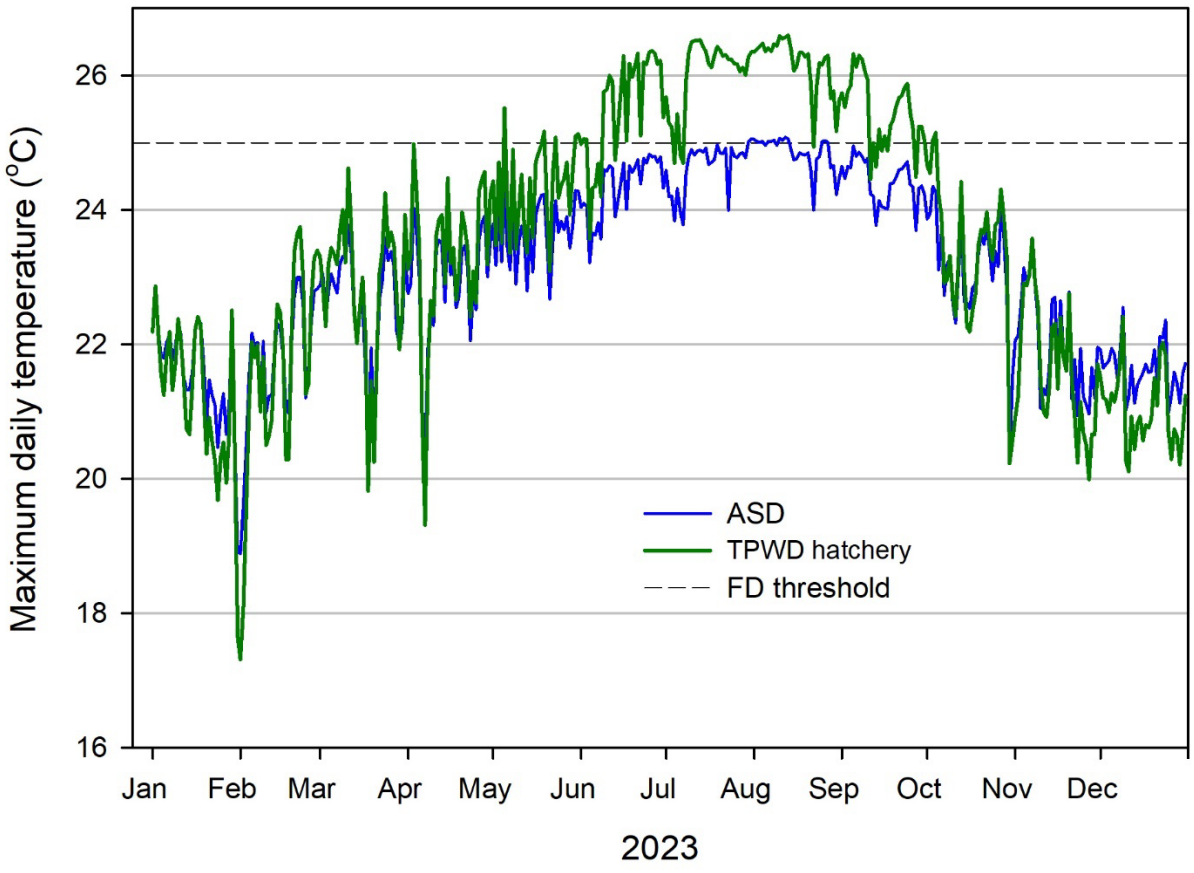

Figure 3.1-3. Maximum daily water temperatures (°C) among San Marcos River RTWQ sites (2023). Dashed line represents temperature threshold for reduced reproduction for the fountain darter (25°C).

Box plots for seasonal maximum daily water temperatures at San Marcos RTWQ sites for 2023 are shown in Figure 3.1-4. Across seasons, median maximum daily temperatures varied by ~3-4°C among San Marcos River WQ sites with some more outlier temperatures observed in winter. Greater variability in maximum daily temperatures across seasons corresponds with the continued lower springflows experienced throughout all of 2023. Fall continues to show the greatest range in maximum daily temperatures for San Marcos WQ sites.

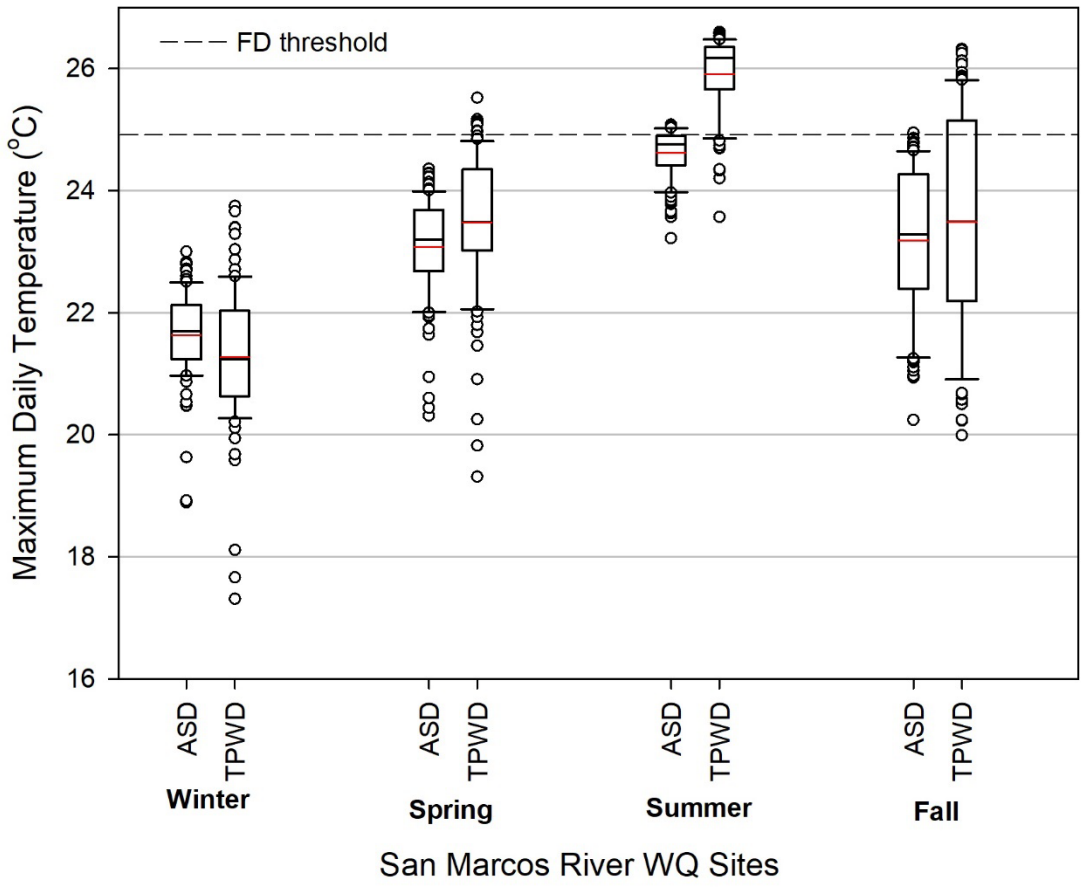

Figure 3.1-4. Box plots of maximum daily water temperatures (°C) among seasons at San Marcos River RTWQ sites in 2023. Black lines represent median values and red lines denote mean values. Whiskers represent maximum and minimum temperature values, excluding outliers (open circles).

Dissolved Oxygen

Table 3.1-2 displays monthly summary statistics for dissolved oxygen (DO) recorded in 2023 at the San Marcos River RTWQ sites. Mean monthly DO remained relatively consistent with variations averaging 1 mg/l within a site and did not vary greatly between the two sites. The TWPD hatchery site demonstrated greater variability in DO in 2023 with minimum DO at ~6 mg/l and maximum DOs slightly higher than 11 mg/l. The highest DO recorded in 2023 was 11.08 mg/l at TPWD hatchery in March, and the lowest DO (6.00mg/l) also occurred in July.

Table 3.1-2. Monthly mean, minimum, and maximum DO (mg/l) among San Marcos River RTWQ sites (2023).

	Dissolved oxygen (mg/l) at San Marcos Water Quality Sites					
Month (2023)	**Aquarena Springs**			**TPWD hatchery**		
	Mean	Min	Max	Mean	Min	Max
Jan	8.23	7.04	9.95	8.73	7.47	10.84
Feb	8.41	7.02	10.32	8.91	7.27	11.03
Mar	8.01	6.71	10.33	8.42	6.90	11.08
Apr	7.85	6.70	9.63	8.19	6.84	10.08
May	7.69	6.75	9.08	8.05	6.95	9.79
Jun	7.57	6.68	8.77	7.77	6.55	9.49
Jul	7.63	6.85	8.81	7.62	6.00	9.02
Aug	7.62	6.84	8.78	7.72	6.88	9.28
Sept	7.66	6.84	8.84	7.82	6.57	9.38
Oct	7.83	6.86	9.51	8.03	6.77	9.61
Nov	8.03	6.96	9.80	8.28	7.21	9.62
Dec	8.09	7.10	9.78	8.49	7.40	10.00

Box plots for minimum daily DO (i.e., lowest DO reported for one 15-minute interval in a 24-hour period) observed at San Marcos RTWQ sites from time of equipment deployment (i.e., 2013 for ASD and 2016 for TPWD hatchery) through 2023 compared to minimum daily DO observed in 2023 are shown in Figure 3.1-5. The medians of minimum daily DO for 2032 were lower than the medians of minimum daily DO from time of equipment deployment for San Marcos River RTWQ sites, dropping below the 25th percentile for to the comprehensive minimum daily DO dataset.

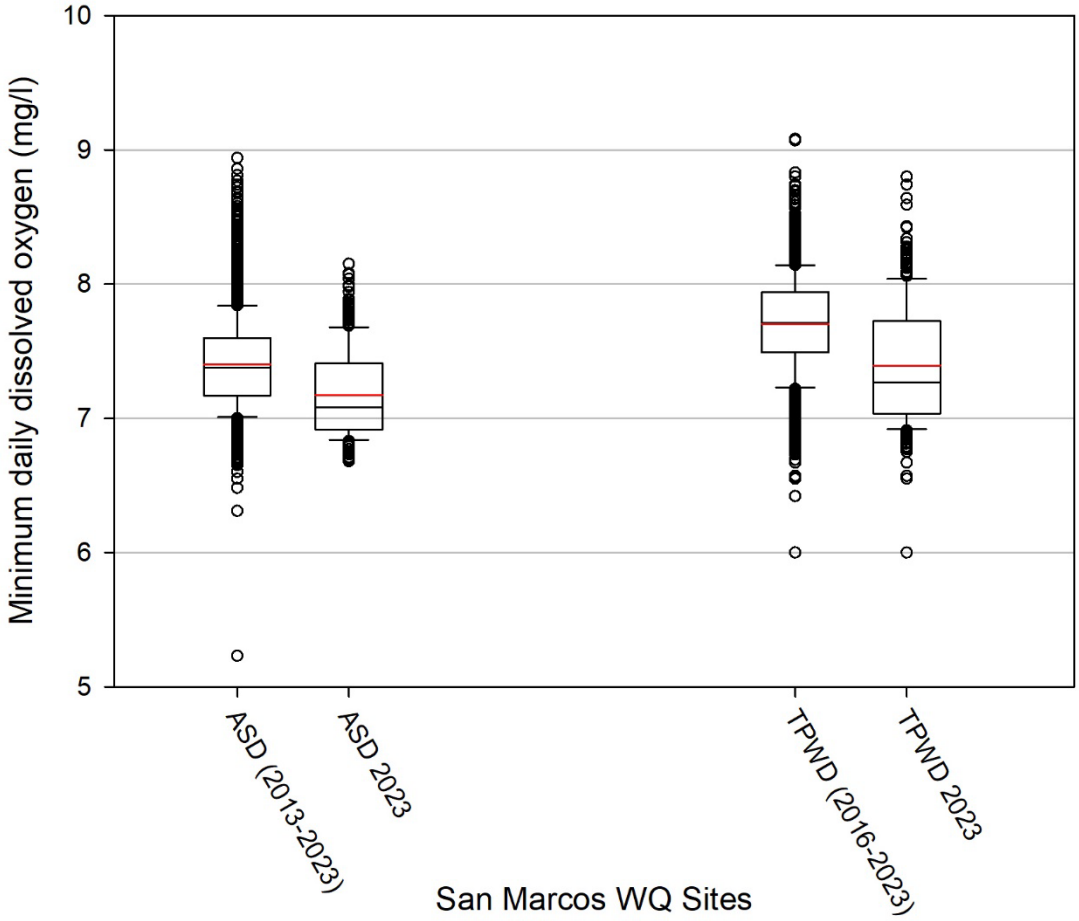

Figure 3.1-5. Box plots of minimum daily DO (mg/l) among RTWQ sites in the San Marcos River from time of equipment deployment through 2023 compared to 2023 only. Black lines represent median values and red lines denote mean values. Whiskers represent maximum and minimum DO values, excluding outliers (open circles).

Minimum daily DO recorded in 2023 were plotted for San Marcos River RTWQ sites (Figure 3.1-6). Similar to previous years, the TPWD hatchery site maintained higher minimum daily DO levels compared to the ASD site, but the seasonal trends in minimum daily DO levels were analogous among the two sites. The minimum DO threshold (4 mg/l) was not reached at either San Marcos River RTWQ site in 2023.

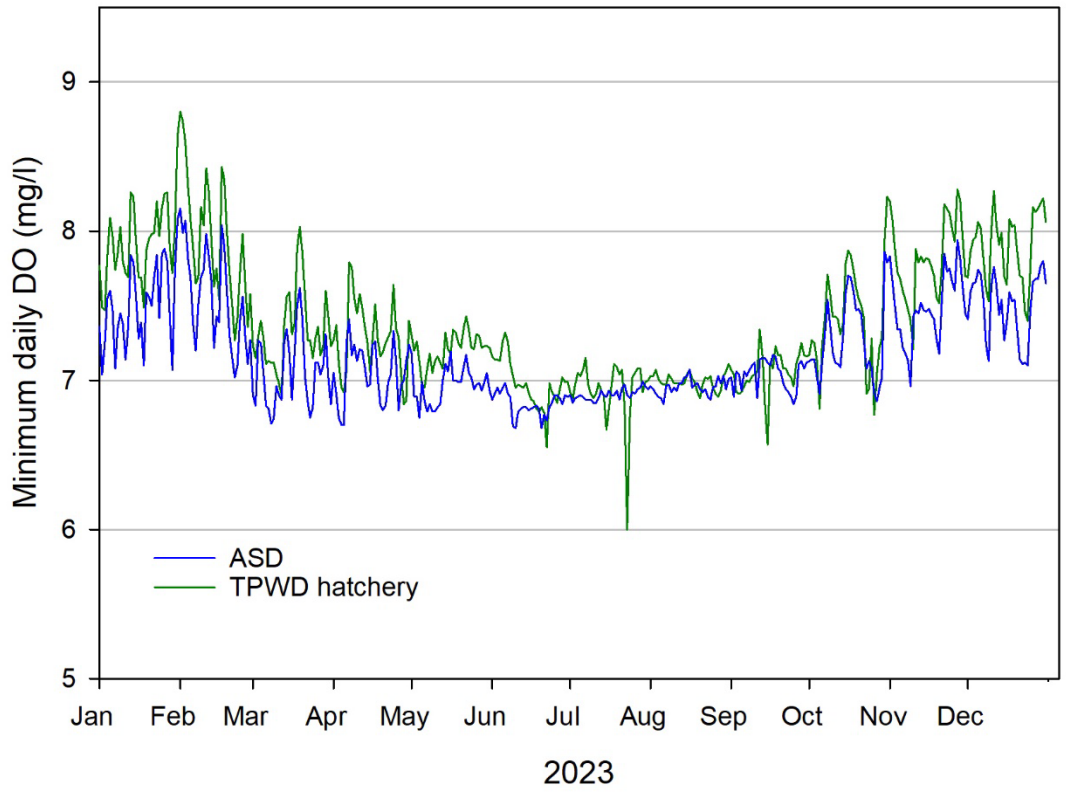

Figure 3.1-6. Minimum daily DO (mg/l) among San Marcos River water quality stations (2023).

Conductivity

Table 3.1-3 displays monthly summary statistics for conductivity (µs/cm) recorded in 2023 at the San Marcos River RTWQ sites. Mean monthly conductivity remained consistent among sites and throughout the year. The highest conductivity in 2023 was recorded at the ASD site in October (658 µs/cm) and the lowest conductivity (99 µs/cm) was also recorded in October at the TPWD hatchery.

San Marcos River discharge and mean daily conductivity were plotted for San Marcos River RTWQ sites for 2023 (Figure 3.1-7). Mean daily conductivity was influenced by rain events in the San Marcos River with decreases in conductivity corresponding with influxes of run-off entering the river. Outside of rain events, mean conductivity generally ranged between 620-635 µs/cm at the two San Marcos RTWQ sites.

Table 3.1-3. Monthly mean, minimum, and maximum conductivity (µs/cm) among San Marcos River RTWQ sites (2023).

	Conductivity (µs/cm) at San Marcos Water Quality Sites					
Month (2023)	**Aquarena Springs**			**TPWD hatchery**		
	Mean	Min	Max	Mean	Min	Max
Jan	631	541	635	630	465	639
Feb	631	563	639	631	484	641
Mar	633	540	641	631	320	642
Apr	632	486	638	617	182	639
May	632	540	639	630	440	644
Jun	633	513	643	637	477	644
Jul	635	623	644	634	372	642
Aug	637	613	647	635	617	642
Sept	641	468	652	630	498	640
Oct	628	161	658	609	99	634
Nov	632	409	641	621	424	630
Dec	633	474	645	619	474	629

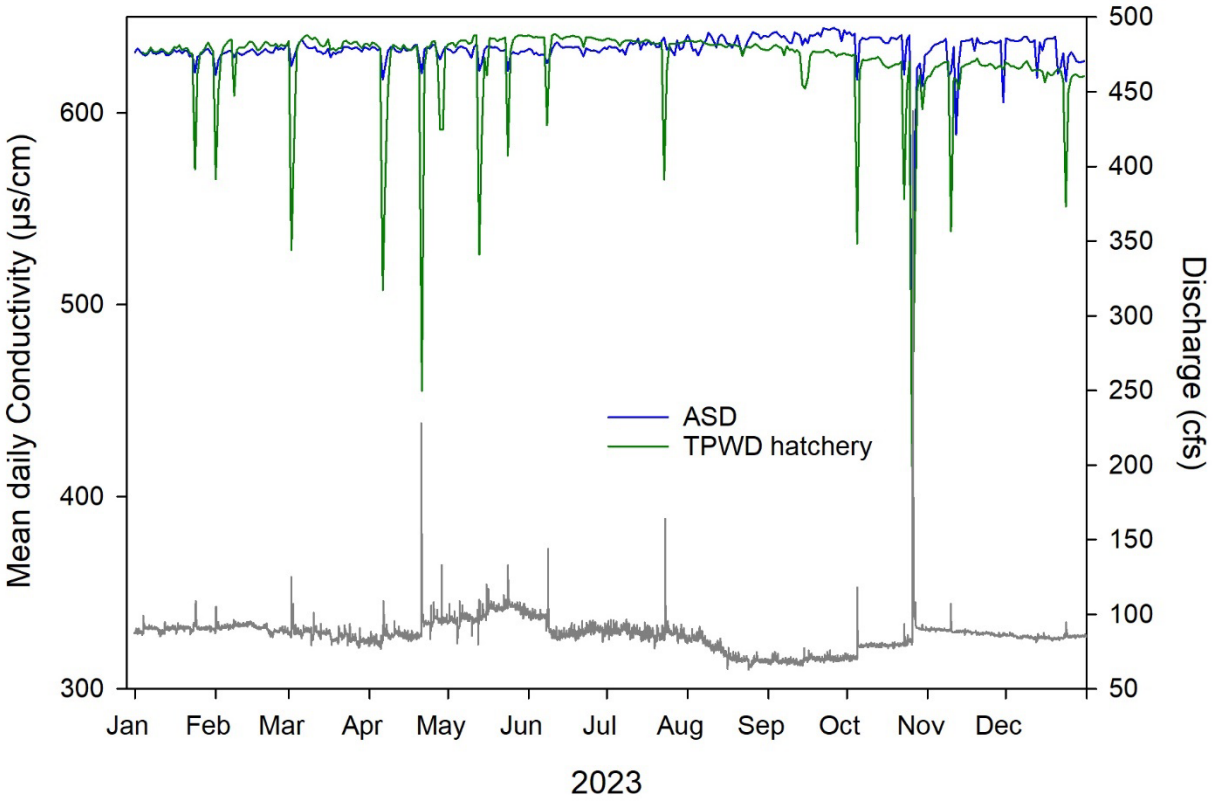

Figure 3.1-7. Mean daily conductivity (µs/cm) among San Marcos River RTWQ sites and San Marcos River discharge (USGS Gage#08170500) in 2023.

Sessom Creek Water Quality Characterization

Table 3.1-4 displays monthly summary statistics for water quality parameters measured in Sessom Creek for 2023. Figures 3.1-8 to 3.1-10 illustrate the daily values for water quality parameters in Sessom Creek (maximum daily temperature, minimum daily DO, mean daily turbidity and conductivity, respectively). Sessom Creek displayed more variability in water quality conditions than the San Marcos River RTWQ sites. The highest maximum daily water temperature reported in Sessom Creek for 2023 was 31.64°C in August. Maximum daily water temperatures exceeded 25°C for 119 days (June – October) in 2023, ranging from 0.1 hours – 24.0 hours (mean = 8.13 hours, median = 7.75 hours) at or above 25°C during those 119 days. DO dropped below 4.0 mg/l in Sessom Creek for 169 days in January – December ranging from 0.1 hours – 24.0 hours (median = 8.0 hours, mean = 8.75 hours). The lower minimum daily DOs observed in Sessom Creek in part corresponded with rainfall events during months when instream springflow was minimal and run-off dominated creek water volume. Spikes in mean daily turbidity were observed with corresponding drops in conductivity, indicating an influx of run-off from a rain event (Figure 3.1-10).

Table 3.1-4. Monthly mean, minimum, and maximum for water quality parameters in Sessom Creek (2023).

Month (2023)	**Temperature (°C)**			**DO (mg/l)**			**Conductivity (µs/cm)**			**Turbidity (NTU)**		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Jan	17.58	10.56	22.48	4.77	2.67	10.72	621	44	663	12	0	850
Feb	16.69	2.95	23.08	6.74	2.76	13.50	583	60	658	26	0	465
Mar	20.08	15.23	23.91	5.38	2.47	11.38	616	52	667	19	0	1200
Apr	20.40	12.30	24.89	5.46	3.09	10.22	587	41	665	29	0	1929
May	22.66	20.43	25.00	5.46	3.10	8.45	609	48	673	11	0	564
Jun	24.03	22.00	29.02	5.81	3.45	11.83	643	50	786	12	0	892
Jul	24.93	23.42	30.69	5.75	2.29	11.71	654	54	702	14	0	799
Aug	25.33	22.81	31.64	5.99	1.31	12.02	668	218	1098	9	0	852
Sept	24.64	22.70	28.54	4.76	1.90	10.30	655	88	686	13	0	655
Oct	21.80	11.88	27.19	6.01	3.41	10.81	597	40	704	23	0	1568
Nov	18.96	15.44	22.93	5.22	2.93	9.93	632	52	686	6	0	226
Dec	17.82	13.63	21.75	4.09	1.06	8.95	625	91	685	6	0	249

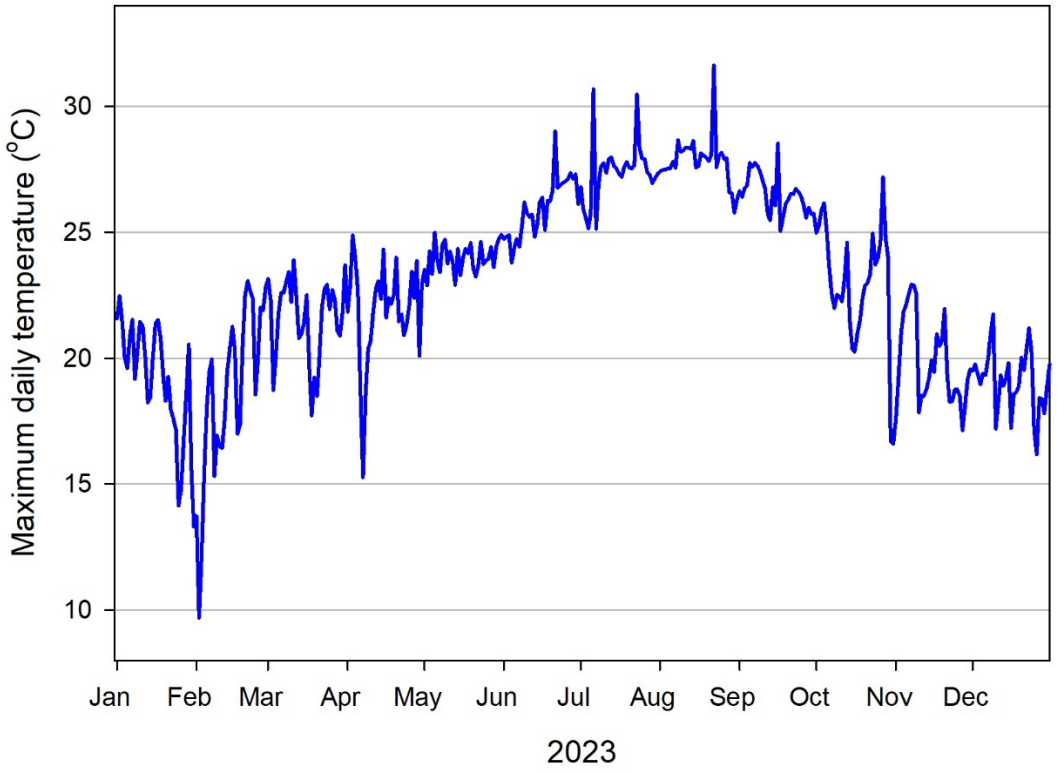

Figure 3.1-8. Maximum daily water temperatures (°C) in Sessom Creek (2023).

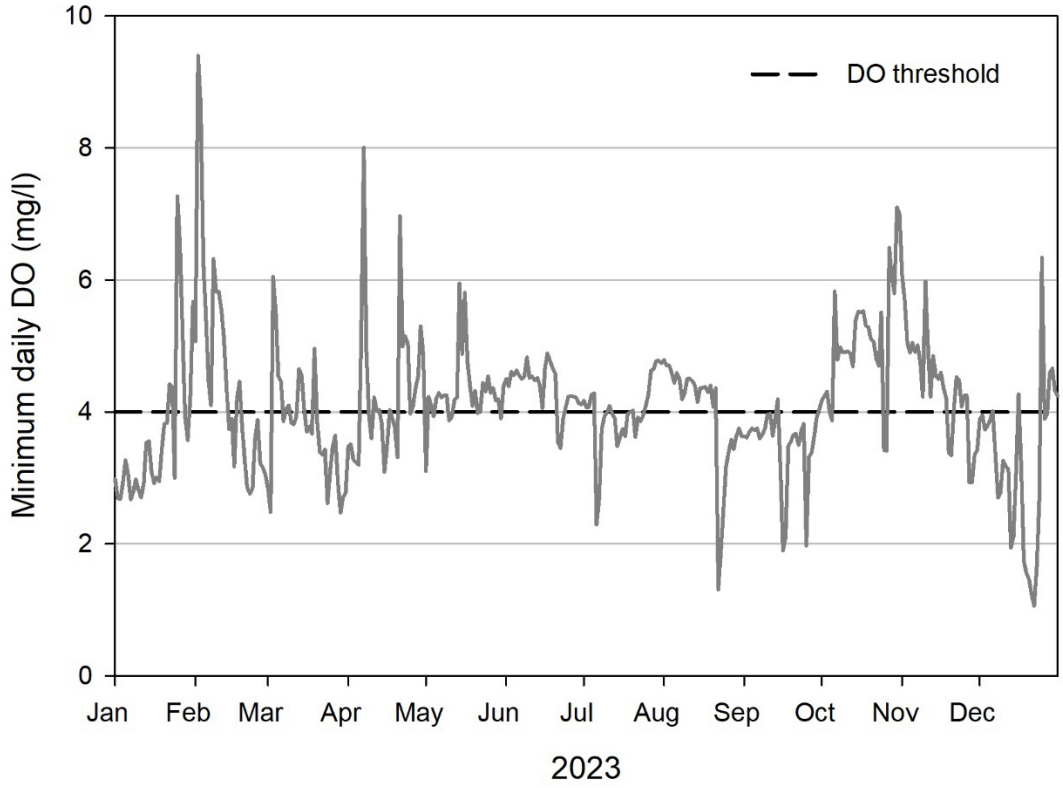

Figure 3.1-9. Minimum daily DO (mg/l) in Sessom Creek (2023).

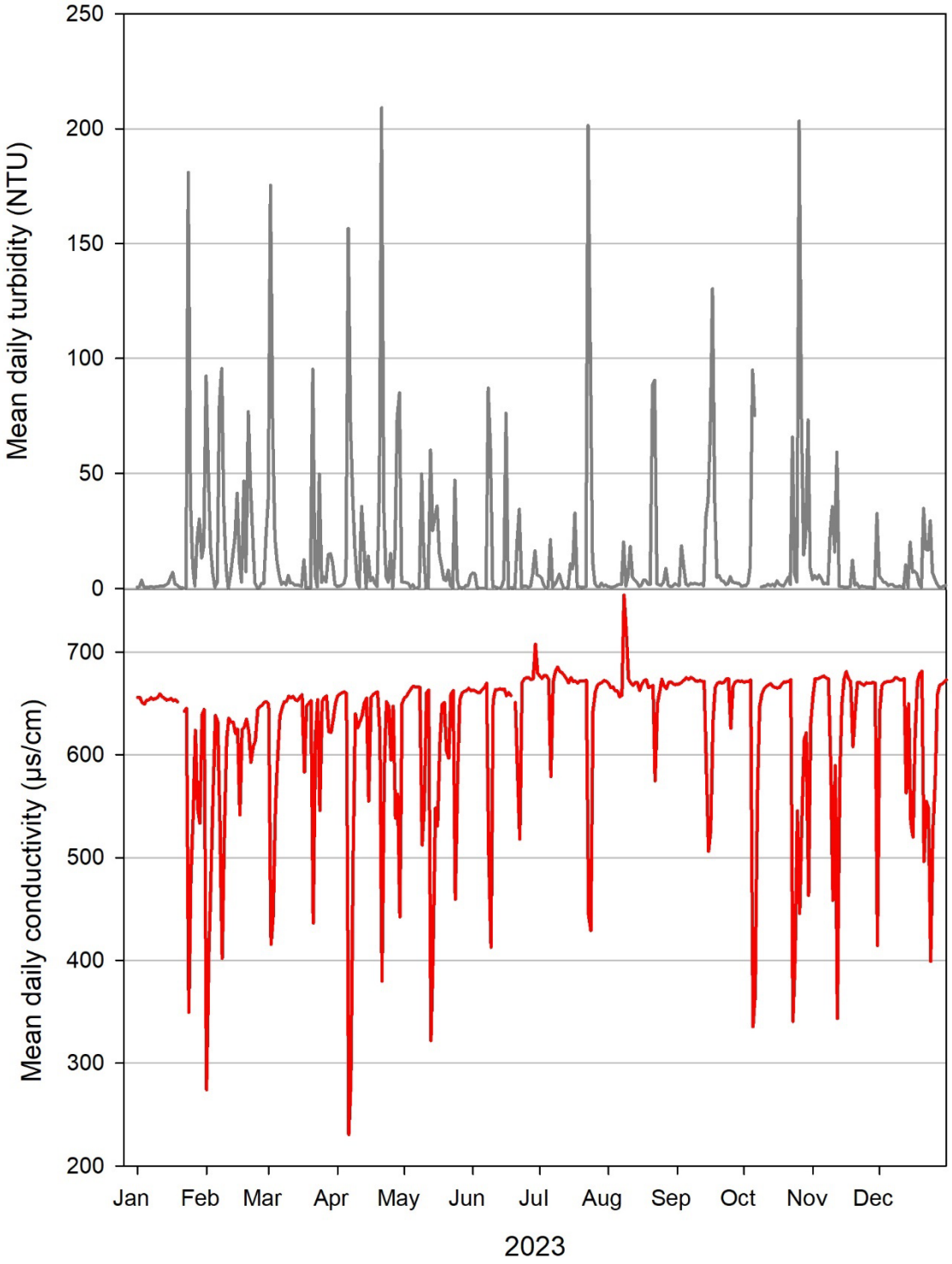

Figure 3.1-10. Mean daily turbidity (NTU) and mean daily conductivity (µs/cm) in Sessom Creek (2023).

3.1.2 Comal

Hydrology

Average springflow at Comal Springs for the period of record (i.e., 1927 – present) was 288 cfs. Since 2013, Comal springflow ranged from below average in 2013-2014 to above average from mid-2015-2017 (Figure 3.1-11). Extended low flow conditions occurred in 2014 and Comal springflow dropped down to as low as 65 cfs on August 29, 2014. In 2015, rainfall throughout the course of the year, particularly two large precipitation events in late May and October, resulted in above average springflow. The large flood pulse on October 30, 2015 had a peak discharge reaching 14,100 cfs. Springflows remained above average in 2016 through 2017 due to several moderate rain events. In 2018, springflow dropped below average, reaching 161 cfs in late August. However, multiple rain events in the early fall resulted in increased springflow and subsequent above average springflow rates. Springflow in 2019 was generally above 350 cfs until July when springflow decreased to average by mid-August but rose above 300 cfs before the end of the year. No substantial flow events occurred in 2019. The absence of large flow event continued into 2020 and springflows continued to decrease, dropping below the long-term average from May to December. Sprinflows continued to decline in early 2021 to just below 200 cfs in April, but rain events in late spring resulted in sprinflows increasing to above average. Additional rain events in fall (i.e., 5,030 cfs pulse in October) helped maintain near average springflows through December 2021. Springflows decreased and remained below average during 2022, dropping below 100 cfs in July and hitting 90 cfs in mid-August. Similar to the San Marcos system, no major run-off events occurred in 2022. In 2023, no large rain events led to springflows declining to levels not observed since 2014 with the lowest flow of 55 cfs recorded in August.

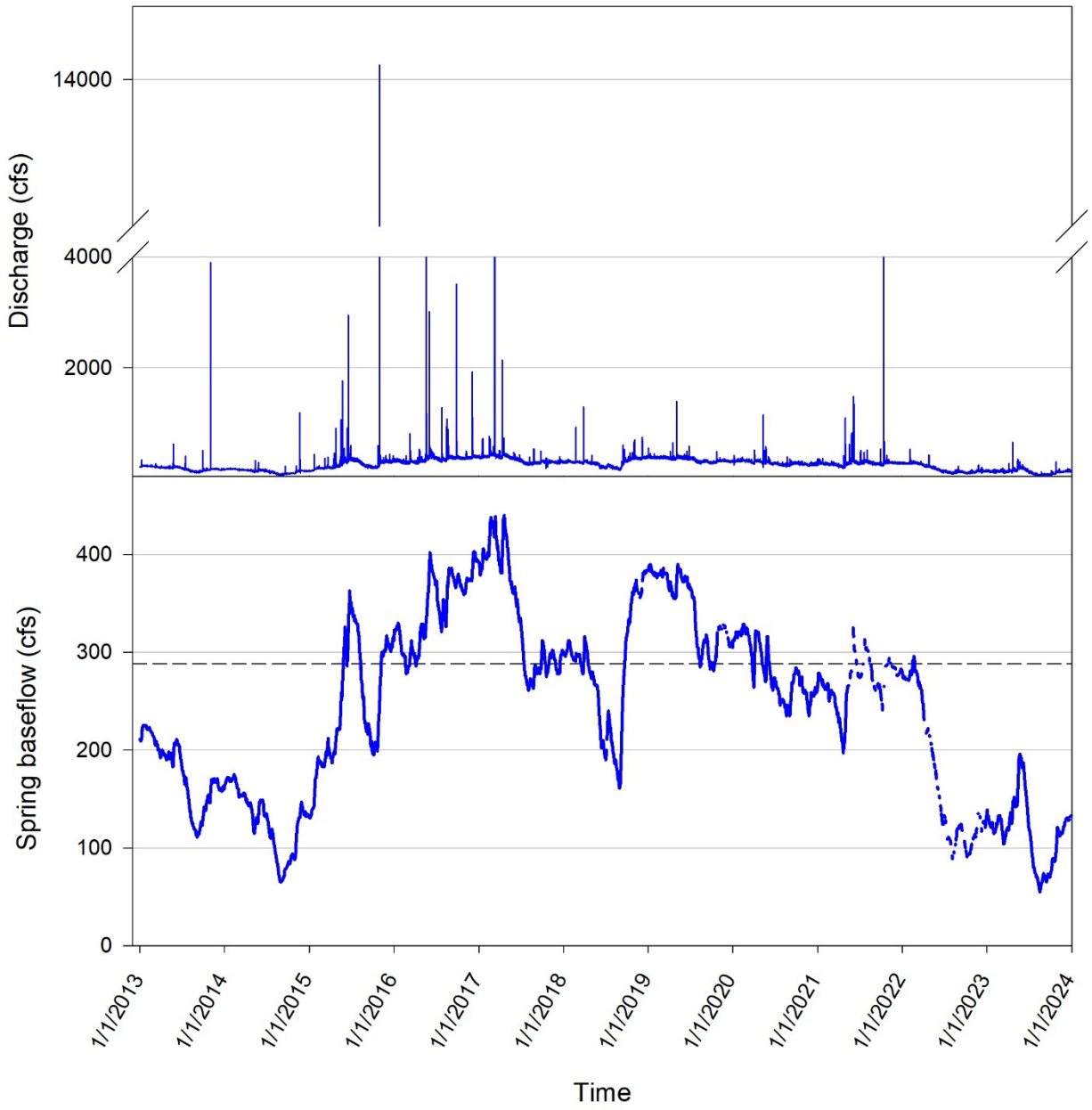

Figure 3.1-11. Hydrographs for th Comal River at New Braunfels (USGS station 08169000) and mean daily springflow for Comal springs (USGS Station 08168710) 2013 – 2023. Dashed line denotes long term average springflow (288 cfs) in the Comal River.

Temperature

Table 3.1-5 displays monthly summary statistics for water temperature at Comal RTWQ sites for 2023. In general, mean monthly water temperatures remained fairly stable within a site with deviations averaging ~1-2 °C and did not vary greatly among sites. Between Spring Run sites, water temperature at SR 7 continued to be slightly warmer than SR 3. With the lower springflows observed in 2023, higher maximum water temperatures were observed in the spring runs during

the summer months. Outside the direct influx of spring runs, the Old Channel (OC) exhibited more variability in minimum and maximum monthly water temperatures. The highest water temperature recorded in 2023 was 27.03°C in the OC during August whereas the lowest temperature (20.69°C) occurred in the OC during February.

Table 3.1-5. Monthly mean, minimum, and maximum water temperatures (°C) among Comal RTWQ (2023).

Month (2023)	Spring Run 3			Spring Run 7			Old Channel		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Jan	23.46	23.36	23.56	23.81	23.79	23.83	22.64	20.86	24.56
Feb	23.44	23.28	23.56	23.83	23.80	23.85	22.73	20.69	25.07
Mar	23.46	23.33	23.58	23.82	23.77	23.84	23.36	21.46	25.59
Apr	23.48	23.23	23.60	23.78	23.74	23.85	23.56	21.57	25.89
May	23.53	23.44	23.62	23.82	23.74	23.87	24.08	22.77	26.20
Jun	23.57	23.53	23.65	23.85	23.83	23.87	24.54	23.16	26.69
Jul	23.71	23.54	24.14	23.95	23.83	24.01	24.76	23.50	26.77
Aug	23.99	23.60	25.68	23.93	23.87	23.96	24.90	23.39	27.03
Sept	23.82	23.61	24.96	23.93	23.87	23.99	24.60	23.36	26.60
Oct	23.68	23.51	23.93	23.83	23.74	23.98	23.70	21.25	26.07
Nov	23.67	23.59	23.78	23.90	23.86	24.09	23.00	21.71	24.90
Dec	23.58	23.39	23.76	23.87	23.85	23.89	22.69	21.45	24.55

Box plots for maximum daily water temperatures observed at Comal RTWQ sites from time of sensor deployment (i.e., 2013 for SR 3, SR 7 and 2018 for OC) through 2023 compared to maximum daily water temperatures observed in 2023 are shown in Figure 3.1-12. The medians of maximum daily temperatures for 2023 were slightly higher than the medians of maximum daily temperatures from time of equipment deployment at Comal RTWQ sites.

Maximum daily temperatures were plotted for Comal system RTWQ sites for 2023 (Figure 3.1-13). Throughout 2023, maximum daily water temperatures were more variable at the OC river site. However, more variability in maximum daily water temperatures was observed this year in SR 3 during the summer months and is associated with the drop in springflows. Similar to previous years, maximum daily water temperatures in 2023 consistently reached and exceeded 25°C at the OC site. Maximum daily temperatures reached or exceeded 25°C at the OC site for 175 days during the months of February - October in 2023. Among those 175 days, time spent at or above 25°C ranged from 0.25 hrs – 11.25 hrs (mean = 7.05 hrs and median = 7.75 hrs). Spring Run 3 reached 25°C for six days in August ranging 0.5 hrs to 3.75 hrs in time of exceedance per day.

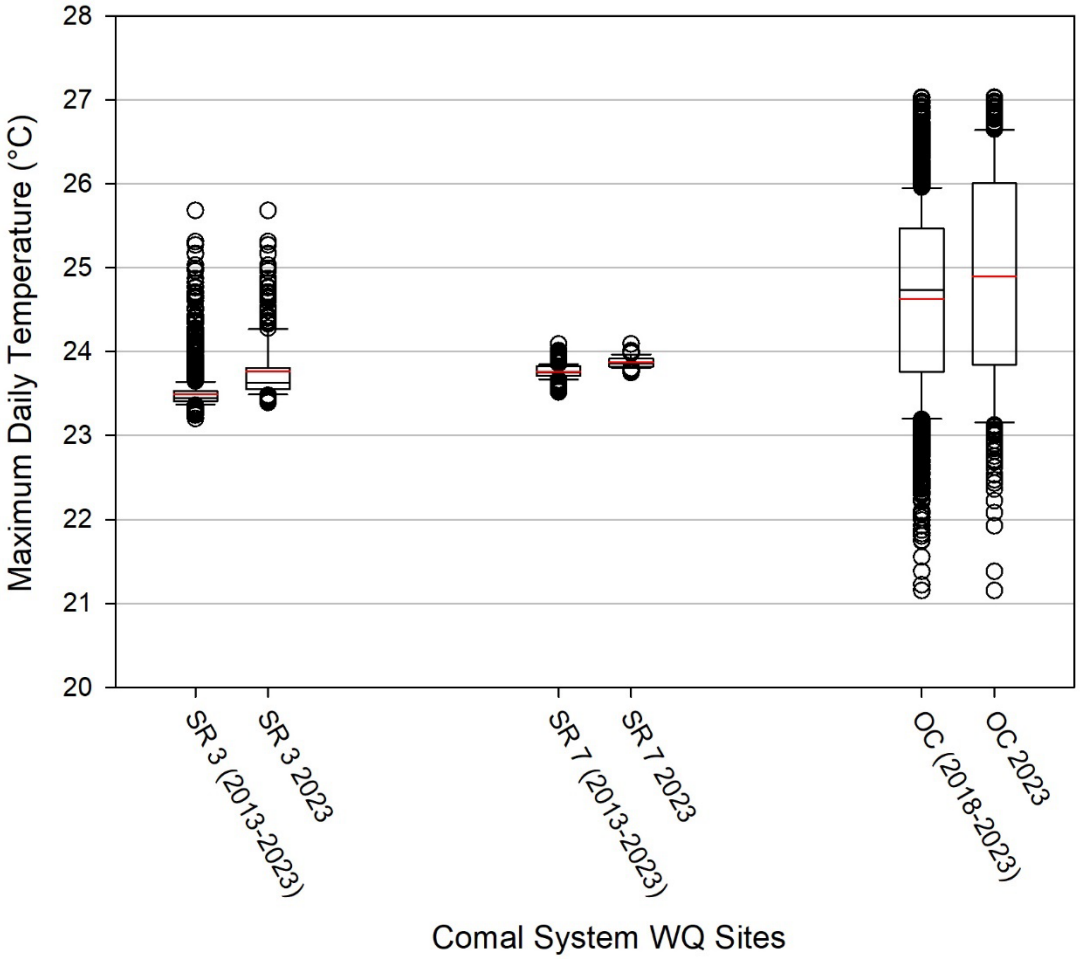

Figure 3.1-12. Box plots of maximum water daily temperatures (°C) among Comal system RTWQ sites from time of deployment through 2023 compared to 2023. Black lines represent median values and red lines denote mean values. Whiskers represent maximum and minimum temperature values, excluding outliers (open circles).

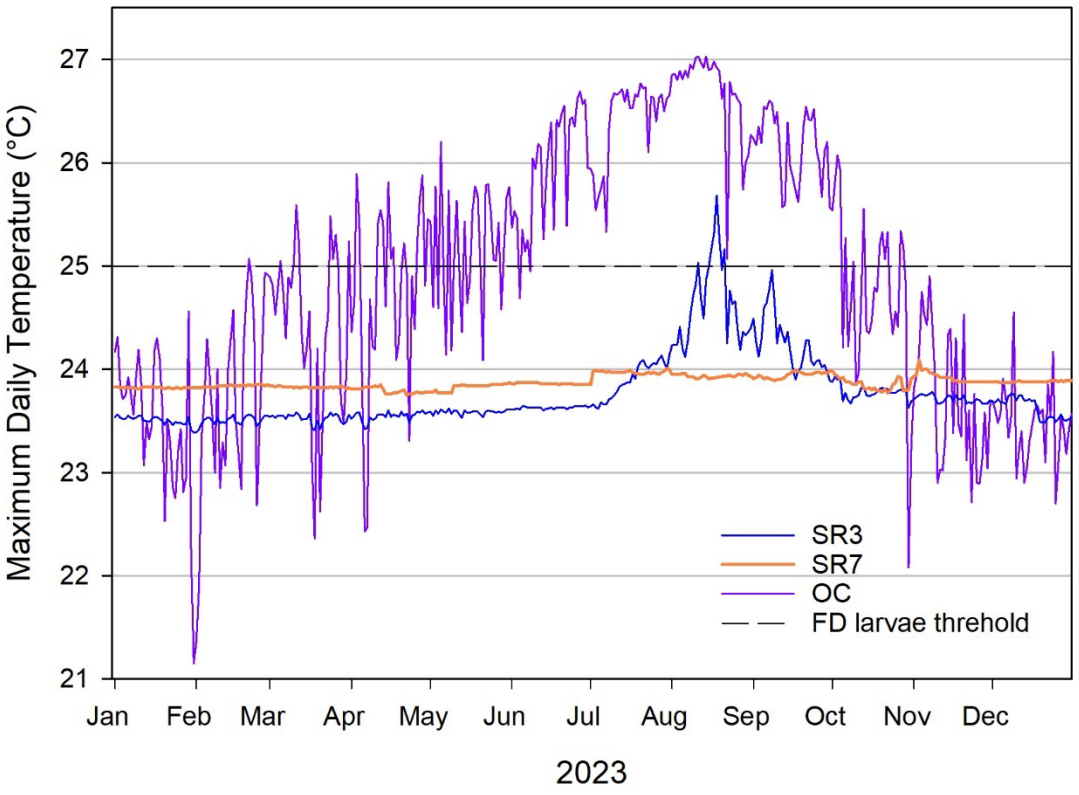

Figure 3.1-13. Maximum daily water temperature (°C) among Comal RTWQ sites (2023).

Box plots for seasonal maximum daily temperatures at the Comal system RTWQ sites for 2023 are shown in Figure 3.1-14. Little seasonal variation in maximum daily temperature (i.e., <0.05°C) was observed at SR 7 but more variability during summer and fall was observed at SR 3 than previous years. The OC river site exhibited a wider range in seasonal variation with median values differing ~3 °C. Spring and fall also showed variability in maximum daily temperature at the OC site while summer months showed less variability but recorded the highest maximum daily temperatures.

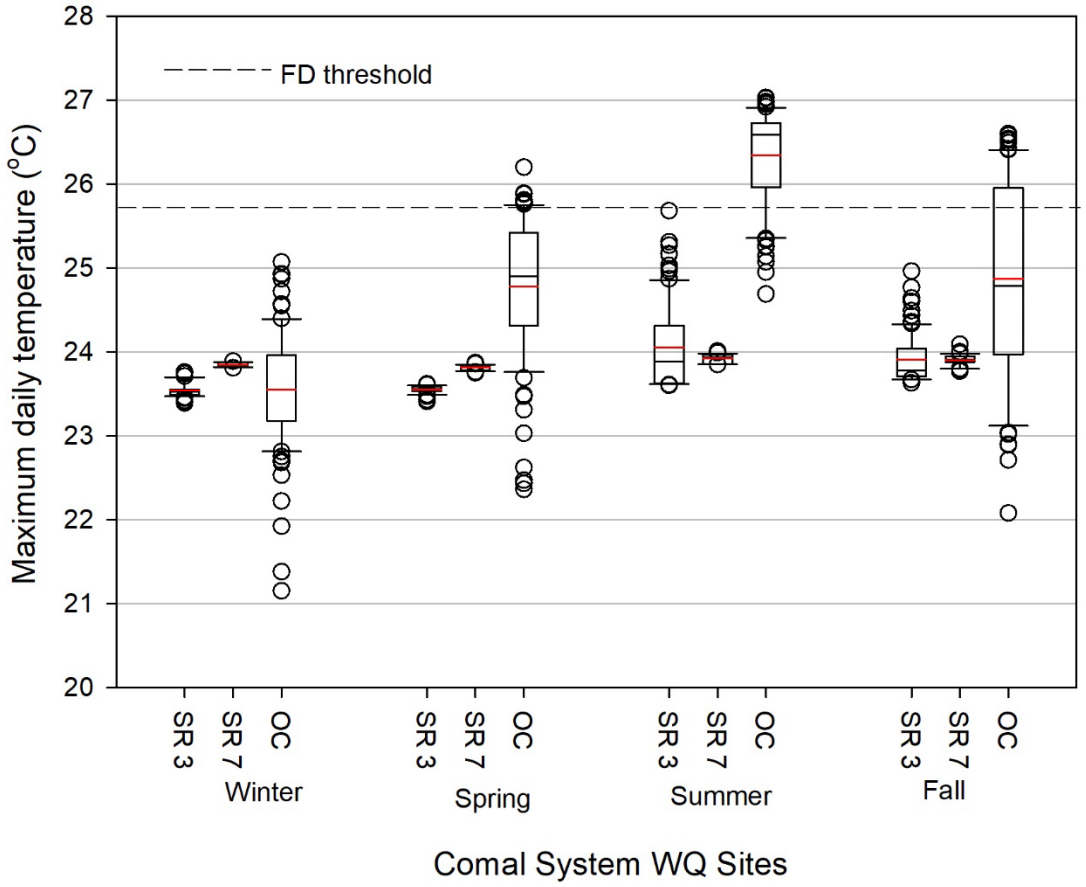

Figure 3.1-14. Box plots of maximum daily water temperatures (°C) among seasons at Comal system RTWQ sites in 2023. Black lines represent median values and red lines denotes mean values. Whiskers represent maximum and minimum temperature values, excluding outliers (open circles).

Dissolved Oxygen

Table 3.1-6 displays monthly summary statistics for dissolved oxygen (DO) recorded for Comal RTWQ sites in 2023. Mean monthly dissolved oxygen remained consistent within a site with variations averaging ~ 1 mg/l. Similar to previous years, mean monthly DO was lower in the spring run sites than the OC river site. The highest DO recorded in 2023 was 11.20 mg/l in the OC during May and the lowest DO (4.64 mg/l) occurred at SR 3 in August.

Table 3.1-6. Monthly mean, minimum, and maximum DO (mg/l) among Comal system RTWQ sites (2023).

Month (2023)	Spring Run 3			Spring Run 7			Old Channel		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Jan	5.16	5.03	5.41	5.08	5.06	5.09	7.50	5.89	10.08
Feb	5.15	5.02	5.39	5.06	5.05	5.08	7.76	5.86	10.76
Mar	5.13	4.98	5.44	5.06	5.01	5.07	7.46	5.65	10.88
Apr	5.09	4.98	5.34	5.03	4.95	5.07	7.52	5.70	11.12
May	5.11	5.01	5.32	5.04	4.90	5.12	7.12	5.56	11.20
Jun	5.21	5.09	5.54	5.08	5.06	5.09	7.06	5.51	9.51
Jul	5.41	5.22	6.25	5.09	4.95	5.35	6.98	5.29	9.30
Aug	5.63	4.64	7.21	5.07	4.95	5.29	7.00	5.17	9.53
Sept	5.63	5.07	7.06	5.08	5.04	5.11	6.81	5.21	9.28
Oct	5.33	5.13	6.02	5.04	4.96	5.09	6.89	5.53	8.94
Nov	5.23	5.00	5.47	5.05	4.98	5.07	7.12	6.06	9.05
Dec	5.30	5.10	5.51	5.05	5.04	5.07	7.21	6.09	9.18

Box plots for minimum daily DO observed at Comal system RTWQ sites from time of equipment deployment (i.e., 2013 for SR3, SR7 and 2018 for OC) through 2023 compared to minimum daily DO observed in 2023 are shown in Figure 3.1-15. The medians of minimum daily DO for 2023 were generally consistent with medians of minimum daily DO since time of sensor deployment at Comal system RTWQ sites. However, the median minimum daily DO in Spring Run 3 for 2023 was slightly lower than minimum daily DO observed since 2013, and the median minimum daily DO in Spring Run 7 was slightly higher.

Minimum daily DO was plotted for Comal RTWQ sites in 2023. (Figure 3.1-16). Spring run 3, and SR 7 demonstrated relatively constant DO whereas the OC river site was more variable in DO with seasonally drops in minimum daily DO during the summer months. Although greater in variability, the OC maintained higher minimum daily DO compared to the spring run sites and no sites recorded a minimum daily DO below 4.0 mg/l in 2023.

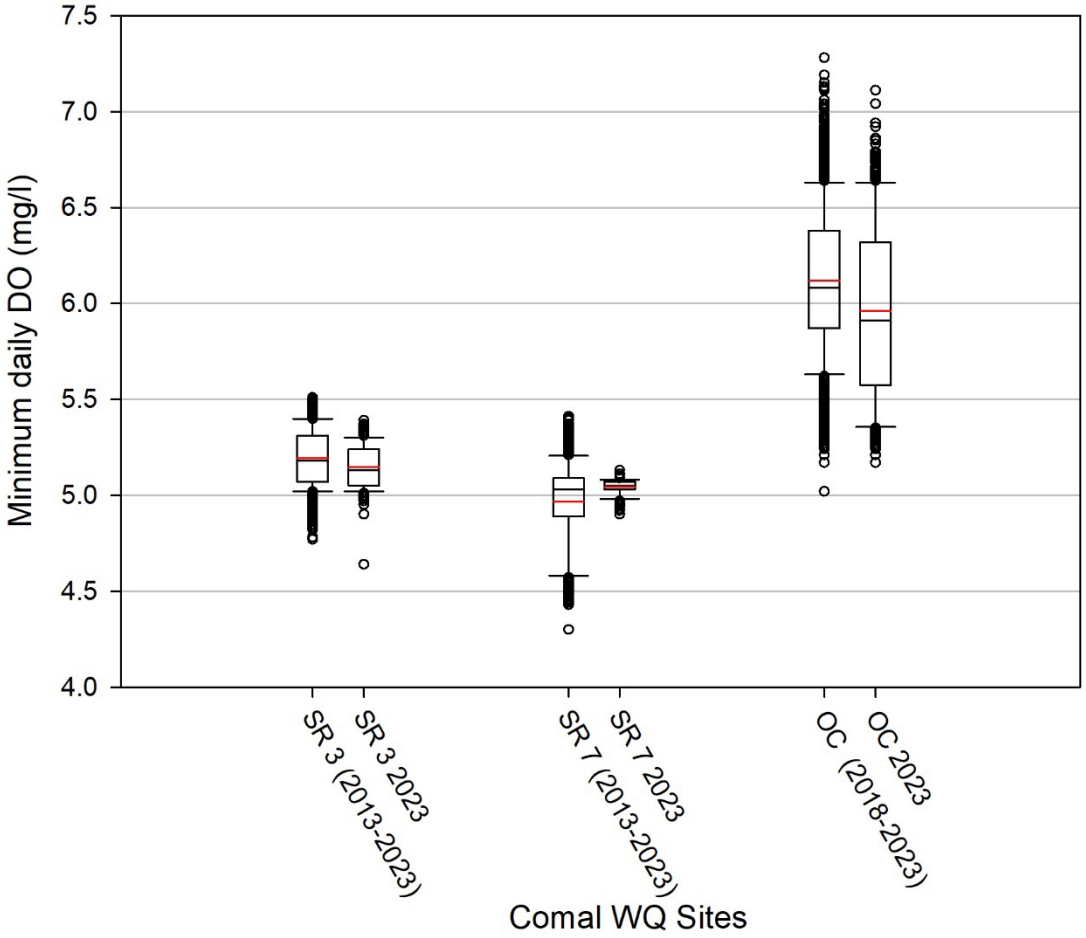

Figure 3.1-15. Box plots of minimum daily DO (mg/l) among Comal system RTWQ sites from time of equipment deployment through 2023 compared to 2023. Black lines represent median values and red lines denotes mean values. Whiskers represent maximum and minimum DO values, excluding outliers (open circles).

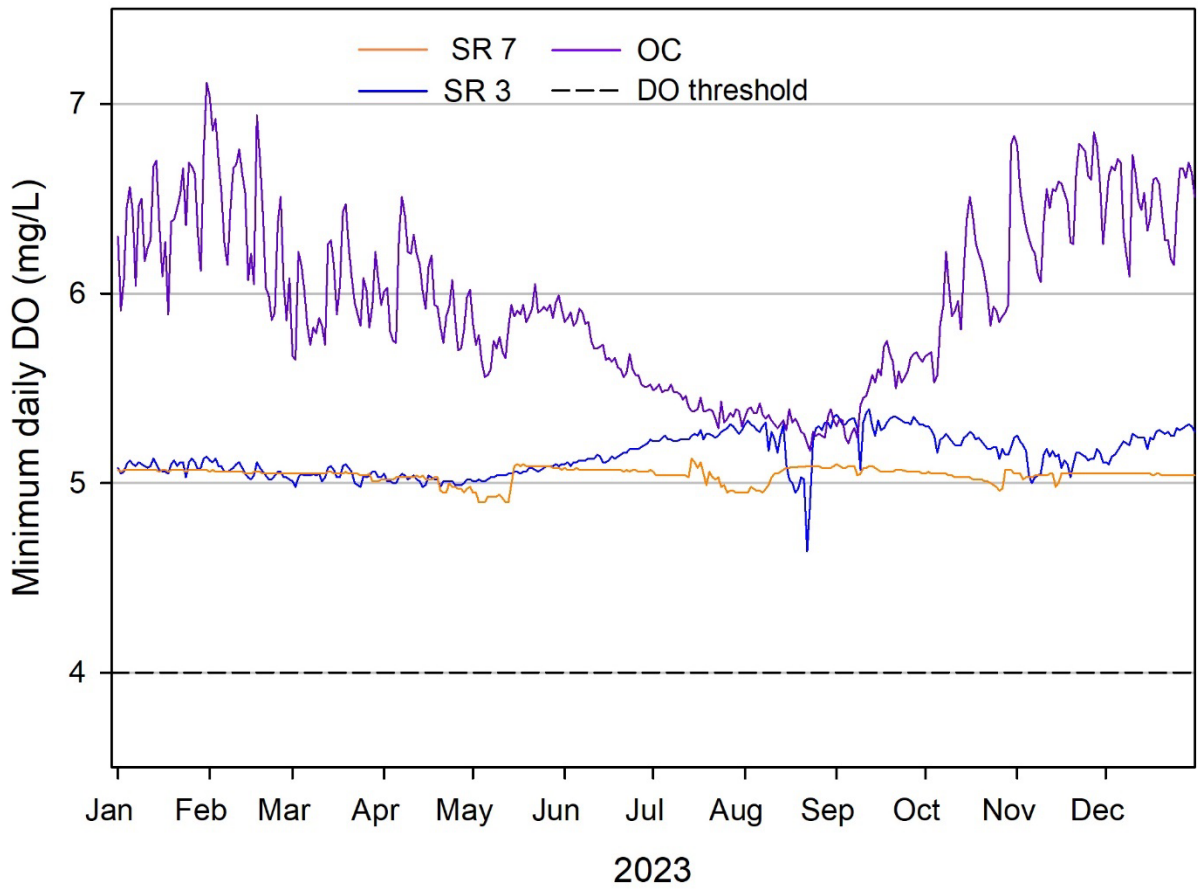

Figure 3.1-16. Minimum daily DO (mg/l) among Comal RTWQ sites (2023).

Conductivity

Table 3.1-7 displays monthly summary statistics for conductivity (µs/cm) recorded at Comal system RTWQ sites during 2023. Mean monthly conductivity remained consistent at the three WQ sites throughout the year with little variability between sites. In general, mean conductivity ranged between 565-590 µs/cm among all Comal system RTWQ sites. The lowest conductivity in 2023 was recorded in the OC in March (291 µs/cm) during a run-off event (Figure 3.1-17).

Comal River discharge (cfs) and mean daily conductivity were plotted for Comal system RTWQ sites for 2023 (Figure 3.1-17). Little variation in mean daily conductivity for spring run sites occurred in 2023. However, mean daily conductivity in the OC was influenced by rain events with drops in conductivity values corresponding with influxes of run-off. Since the Comal discharge gage location is located downstream from the confluence of the Old and New Channel of the Comal, some rain events in the system do not result in conductivity drops in the Old Channel. Additionally, the Comal River has slightly lower conductivity than the San Marcos River.

Table 3.1-7. Monthly mean, minimum, and maximum conductivity (µs/cm) among Comal system RTWQ sites (2023).

Month (2023)	Spring Run 3			Spring Run 7			Old Channel		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Jan	596	590	599	569	567	571	567	555	573
Feb	595	590	597	571	569	572	562	520	592
Mar	593	587	596	571	550	573	552	291	581
Apr	590	526	592	566	551	572	565	474	625
May	588	570	590	568	560	572	558	456	602
Jun	585	575	590	569	562	571	576	505	603
Jul	585	571	590	568	565	575	576	527	584
Aug	584	570	590	572	560	578	575	516	583
Sept	584	570	590	576	564	580	579	568	585
Oct	584	570	590	575	565	578	579	552	589
Nov	583	570	590	577	561	580	577	568	581
Dec	584	570	590	575	563	580	574	561	579

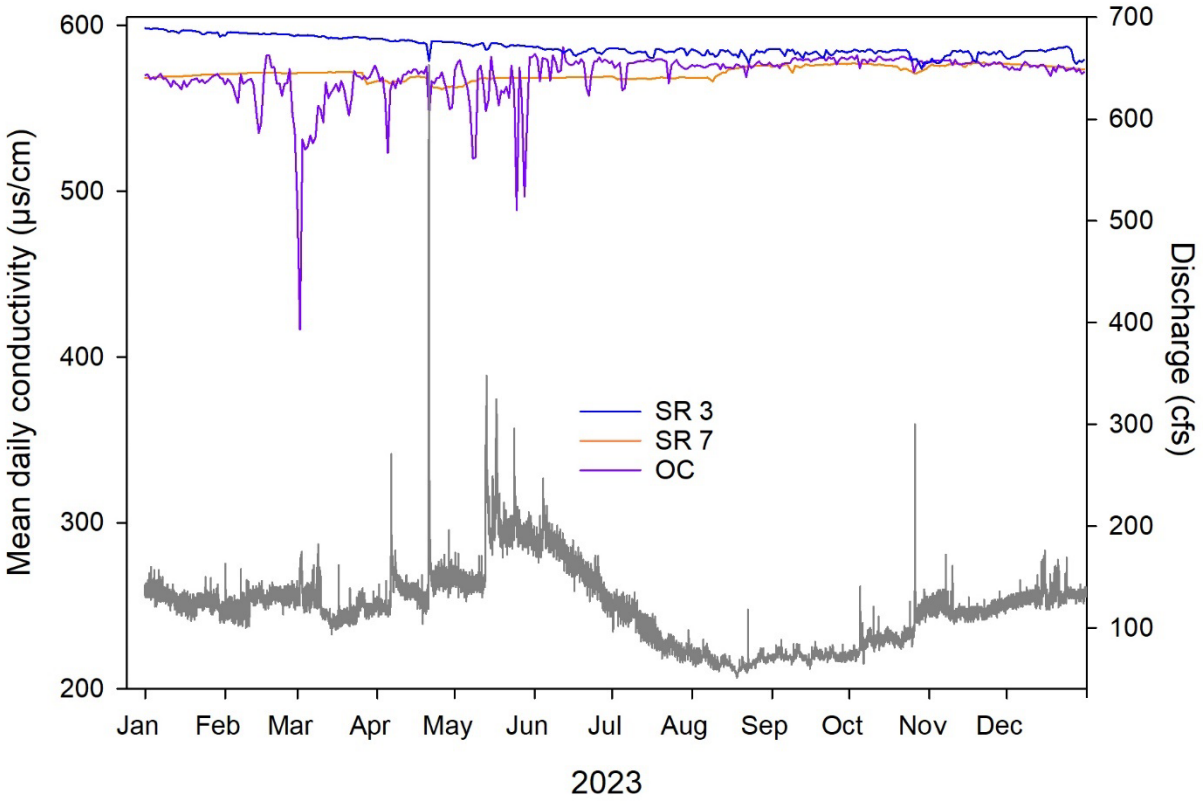

Figure 3.1-17. Mean daily conductivity (µs/cm) among Comal system RTWQ sites and Comal River discharge (Gage#08169000) in 2023.

3.2 Surface water sampling

3.2.1 San Marcos

Table 3.2-1 denotes the water quality parameters collected at Hotel Spring during monthly sucralose collections. Water quality parameters measured during monthly sampling events were consistent with measurements collected by the RTWQ network station at Aquarena Springs.

Table 3.2-1. Monthly (2023) water quality parameters measured at Hotel Spring (Spring Lake, San Marcos).

Month	Conductivity (µs/cm)	DO (mg/l)	pH (SU)	Temperature (°C)
Jan	610	4.58	7.04	22.09
Feb	NA	4.50	7.04	22.01
Mar	623	4.53	6.93	22.16
Apr	630	4.58	7.03	22.02
May	620	4.53	6.99	21.95
Jun	662	4.56	7.03	21.88
Jul	636	4.33	7.33	21.96
Aug	648	4.67	7.15	22.01
Sep	652	4.71	7.10	22.07
Oct	651	4.78	7.11	22.06
Nov	631	4.47	7.05	22.06
Dec	633	4.51	7.03	22.10

A total of 12 sucralose samples were collected during monthly collections at Hotel Spring in 2023, including one field duplicate and two DI (i.e., deionized water) blanks. Sucralose was detected in all months sampled (still waiting on results from Nov and Dec);. at Hotel Spring in 2023 (Table 3.2-2). Detected sucralose concentrations ranged from 12.8-21.7 ng/L. Quality control spike recoveries for all sampling events were between 62.8 – 105 %. A full table including duplicate samples, field and laboratory blanks can be found in Table A-1 in appendix A.

Table 3.2-2. Sucralose concentrations (ng/L) measured at Hotel Springs in Spring Lake (2023). Samples with detectable concentrations denoted in bold.

Month	Sample (ng/L)
January	**21.7**[B]
February	**19.7**
March	**19.3**[A]
April	**18.6**
May	**19.6**
June	**16.8**
July	**13.6**
August	**14.8**
September	**12.8**[A]
October	**13.2**
November	NA
December	NA

[U] Non-detect at reporting limit

[A] Not detected in DI blank

[B] Detected in duplicate sampling

During Spring and Fall sampling events, nutrient samples and one duplicate sample per site per season (i.e., upper in Spring and lower in Fall) were taken. Nutrient concentrations measured at the upper and lower sites (i.e., Hotel Springs and near the TPWD hatchery) in the San Marcos system during Spring and Fall are denoted in Table 3.2-3. Dissolved organic carbon, dissolved inorganic carbon and nitrate as N were reported among each site and sampling event in 2023. Other nutrients detected were total organic carbon at both sites in Spring. Kjeldahl nitrogen was detected during the Fall but was also detected in the equipment or DI blank. Ammonia was detected at the lower site during the Fall. Additional results for duplicate samples, percent difference between sample and duplicate samples, and field and laboratory blank values can be found in Table A-3 and A-4 in appendix A.

Table 3.2-3. Nutrient concentrations (mg/L) measured at the upper and lower sites in the San Marcos system during Spring and Fall (2023). Samples with detectable concentrations denoted in bold.

	Spring		Fall	
Nutrients	**Upper**	**Lower**	**Upper**	**Lower**
Total Phosphorus	0.01[UA]	0.01[U]	**0.93[C]**	**0.04[BCD]**
Orthophosphate as P	**0.01[JHBD]**	0.004[UH]	0.006[U]	0.03[UA]
Total Organic Carbon	**1.0[BD]**	**0.89[J]**	0.5[U]	0.5[UA]
Dissolved Inorganic Carbon	**64.6[BC]**	**62.7[C]**	**64.9[F1C]**	**64.2[BC]**
Dissolved Organic Carbon	**1.1[BCD]**	**1.01[C]**	**1.59[C]**	**1.55[BC]**
Kjeldahl Nitrogen	0.09[UAC]	0.09[UC]	**0.86[C]**	**0.44[BCD]**
Nitrate as N	**1.26[HBC]**	**1.35[HC]**	**1.48[C]**	**1.53[BC]**
Ammonia	0.035[UAC]	0.035[UC]	0.05[U]	**0.08[JF1BD]**

[U] Non-detect

[H] Sample was prepped and analyzed past holding time

[F1] MS and/or MSD recovery exceeds control limits

[J] Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

[A] Not detected in duplicate sample

[B] Detected in duplicate sample

[C] Detected in laboratory or field blank

[D] Greater than 20% Relative Percent Difference between sample and duplicate

3.2.2 Comal

Table 3.2-4 denotes the water quality parameters collected at Spring Run 3 in Landa Lake during monthly sucralose collections in 2023. Water quality parameters measured during monthly sampling events were consistent with measurements collected by the RTWQ network station in Spring Run 3.

Table 3.2-4. Monthly (2023) water quality parameters measured at Spring Run 3 (Landa Lake).

Month	Conductivity (µs/cm)	DO (mg/l)	pH (SU)	Temperature (°C)
Jan	579	5.24	7.07	23.42
Feb	NA	5.17	7.05	23.36
Mar	584	5.22	6.95	23.35
Apr	586	5.15	7.07	23.31
May	578	NA	7.10	23.33
Jun	612	5.17	7.05	23.35
Jul	586	4.90	7.24	23.31
Aug	592	5.76	7.30	23.70
Sep	595	5.72	7.22	23.69
Oct	596	5.28	7.20	23.59
Nov	577	4.97	7.10	23.63
Dec	577	4.97	6.98	23.64

A total of 12 sucralose samples were collected during monthly collections at Spring Run 3 in 2023, including one field duplicate samples and one DI blanks. Among monthly collections, sucralose was detected during one sampling events at Spring Run 3 with a concentration of 9.65 ng/L recorded in April (Table 3.2-5). Quality control spike recoveries for all sampling events were between 66.0 – 107.0 %. A full table including duplicate samples, field and laboratory blanks can be found in Table A-2 appendix A.

Table 3.2-5. Sucralose concentrations (ng/L) measured at Spring Run 3 in Landa Lake (2023). Samples with detectable concentrations denoted in bold.

Month	Sample (ng/L)
January	8.19[U]
February	9.11[U]
March	7.84[U]
April	**9.65**
May	7.93[U]
June	8.92[UA]
July	8.74[UB]
August	8.64[U]
September	9.06[U]
October	8.31[U]
November	NA
December	NA

[U] Non-detect at reporting limit

[A] Non detected in DI blank

[B] Detected in duplicate sample

[C] Non-detect in duplicate sample

During Spring and Fall sampling events, nutrient samples and one duplicate sample for each season (i.e., upper in Spring and lower in Fall) were taken. Nutrient concentrations measured at the upper and lower sites (i.e., Spring Run 3 and at the last public exit) in the Comal system during Spring and Fall are denoted in Table 3.2-6. No detections for total phosphorous and orthophosphate as P were reported in 2023. Among nutrients detected, dissolved inorganic carbon, dissolved organic carbon and nitrate as N were reported at both sites for the two sampling events in 2023. Total organic carbon was detected at both sites during the Spring and nitrogen was detected at the upper site in the Spring an both sites during the Fall. Ammonia was detected at both sites in the Fall. Dissolved inorganic carbon, dissolved organic carbon, nitrogen, and nitrate as N were detected in the laboratory or field blank that suggests a false positive. Results for duplicate samples, percent difference between sample and duplicate samples, and field and laboratory blank values can be found in Table A-5 and A-6 in appendix A.

Table 3.2-6. Nutrient concentrations (mg/L) measured at the upper and lower sites in the Comal system during Spring and Fall (2023). Samples with detectable concentrations denoted in bold.

	Spring		**Fall**	
Nutrients	**Upper**	**Lower**	**Upper**	**Lower**
Total Phosphorus	0.01^{UA}	0.01^{U}	0.009^{UF1C}	0.009^{UAC}
Orthophosphate as P	0.004^{UHA}	0.004^{UH}	0.03^{U}	0.006^{UA}
Total Organic Carbon	**0.85^{JB}**	**0.82^{J}**	0.5^{U}	0.5^{UF1BD}
Dissolved Inorganic Carbon	**58.0^{BC}**	**57.6^{C}**	**58.8^{C}**	**58.2^{BC}**
Dissolved Organic Carbon	**0.91^{JBC}**	**0.79^{JC}**	**1.63^{C}**	**1.46^{BCD}**
Kjeldahl Nitrogen	0.09^{UBCD}	**0.19^{JC}**	**0.54^{C}**	**0.57^{BCD}**
Nitrate as N	**1.83^{HBC}**	**1.83^{HC}**	**1.88^{C}**	**1.72^{BC}**
Ammonia	0.035^{UAC}	0.035^{UF1C}	**0.053^{J}**	**0.06^{JB}**

[U] Non-detect

[H] Sample was prepped and analyzed past holding time

[F1] MS and/or MSD recovery exceeds control limits

[J] Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

[A] Not detected in duplicate sample

[B] Detected in duplicate sample

[C] Detected in laboratory or field blank

[D] Greater than 20% Relative Percent Difference between sample and duplicate

3.3 Groundwater sampling

3.3.1 San Marcos

A total of eight PPCP samples (i.e., one sample at each sampling site and event) were collected during 2023, including two blanks (i.e., one equipment blank in Spring at Hotel and one DI blank at Deep Hole in Fall) and one field duplicate taken at Hotel in Fall. Samples were taken at Hotel in the months of January, April, June, July, October, and December. Deep Hole was only sampled in April and October. Results for PPCP sampling during the regular Spring (April) and Fall sampling (October) events are denoted in Table 3.3-1 and 3.3-2. Results for PPCP sampling at Hotel for January, June, July, and December are denoted in Table 3.3-3 and Table 3.3-4. Overall, few PPCP detections at the reporting limit occurred in 2023 sampling events. DEET was detected at each sampling event for Hotel and Deep Hole; however, it is likely a false positive because they were flagged as "b" indicating that a concentration was also detected in the lab blank in all sampling events. Penicillin G was detected at both sites in Spring, at Hotel in July, and at Deep Hole in Fall, but like DEET, it was detected in the lab blank. Penicillin V was detected at Deep Hole in Fall but was also detected in the blank. Cocaine was detected at Hotel in Spring and July and detected at Deep Hole in the Fall. Other PPCP detections at Hotel included Caffeine in January and July, and Theophylline in January. Results for samples and the equipment, DI, and laboratory blank values can be found in Table A-7 through A-10 in appendix A.

Table 3.3-1. PPCP concentrations (ng/L) measured at Hotel and Deep Hole Spring (Spring Lake, San Marcos) during Spring and Fall sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List	Spring				Fall			
	Hotel spring		Deep Hole		Hotel spring		Deep Hole	
Acetaminophen	3.08	U	3.15	U	3.02	U	3.06	U
Azithromycin	1.54	U	1.58	U	1.51	U	1.53	U
Caffeine	6.17	U	6.3	U	6.04	UB	6.11	UB
Carbadox	0.617	U	0.63	U	0.604	U	0.611	U
Carbamazepine	0.308	U	0.315	U	0.302	U	0.306	U
Cefotaxime	6.1	U	6.24	U	5.98	U	6.05	U
Ciprofloxacin	1.54	U	1.58	U	1.51	U	1.53	U
Clarithromycin	0.308	U	0.315	U	0.302	U	0.306	U
Clinafloxacin	2.05	U	2.1	U	2.01	U	2.04	U
Cloxacillin	3.08	U H	3.15	U H	3.02	UBH	3.06	UBH
Dehydronifedipine	0.308	U	0.315	U	0.302	U	0.306	U
Digoxigenin	1.54	U	1.58	U	1.51	U	1.53	U
Digoxin	6.17	U	6.3	U	6.04	U	6.11	U
Diltiazem	0.154	U	0.158	U	0.151	U	0.153	U
Diphenhydramine	0.617	U	0.63	U	0.604	U	0.611	U
Enrofloxacin	0.617	U	0.63	U	0.604	U	0.611	U
Erythromycin-H2O	1.54	U H	1.58	U H	1.51	U H	1.53	U H
Flumequine	0.308	U	0.315	U	0.302	U	0.306	U
Fluoxetine	0.154	U	0.158	U	0.151	U	0.153	U
Lincomycin	0.617	U	0.63	U	0.604	U	0.611	U
Lomefloxacin	0.617	U	0.63	U	0.604	U	0.611	U
Miconazole	0.308	U	0.315	U	0.302	U	0.306	U
Norfloxacin	2.05	U	2.1	U	2.01	U	2.04	U
Norgestimate	1.54	U	1.58	U	1.51	U	1.53	U
Ofloxacin	0.617	U	0.63	U	0.604	U	0.611	U
Ormetoprim	0.154	U	0.158	U	0.151	U	0.153	U
Oxacillin	1.54	U H	1.58	U H	1.51	U H	1.53	U H
Oxolinic Acid	0.617	U	0.63	U	0.604	U	0.611	U
Penicillin G	**3.86**	RBH	**11.9**	RBH	3.02	UBCH	**20.4**	RBH
Penicillin V	1.54	U	1.58	U	1.51	UB	**17.3**	RB
Roxithromycin	0.154	U	0.158	U	0.151	U	0.153	U
Sarafloxacin	3.08	U	3.15	U	3.02	U	3.06	U
Sulfachloropyridazine	0.617	U	0.63	U	0.604	U	0.611	U
Sulfadiazine	0.617	U	0.63	U	0.604	U	0.611	U
Sulfadimethoxine	0.308	U	0.315	U	0.302	U	0.306	U
Sulfamerazine	0.617	U	0.63	U	0.604	U	0.611	U
Sulfamethazine	0.617	U	0.63	U	0.604	U	0.611	U
Sulfamethizole	0.617	U	0.63	U	0.604	U	0.611	U
Sulfamethoxazole	0.617	U	0.63	U	0.604	U	0.611	U
Sulfanilamide	6.17	U	6.3	U	6.04	U	6.11	U
Sulfathiazole	1.54	U	1.58	U	1.51	U	1.53	U
Thiabendazole	0.308	U	0.315	U	0.302	U	0.306	U
Trimethoprim	0.308	U	0.315	U	0.302	U	0.306	U
Tylosin	0.617	U	0.63	U	0.604	U	0.611	U
Virginiamycin M1	0.617	U	0.663	U	0.604	U	0.798	U
1,7-Dimethylxanthine	6.17	U	6.3	U	6.04	U	6.11	U

[U] Non-detect at reporting limit
[H] Concentration is estimated
[R] Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration
[B] Analyte found in associated blank
[C] Detected in duplicate sample

Table 3.3-2. PPCP concentrations (ng/L) measured at Hotel and Deep Hole Spring (Spring Lake, San Marcos) during Spring and Fall sampling events (2023). Samples with detectable concentrations denoted in bold.

	Spring				Fall			
PPCP List	Hotel spring		Deep Hole		Hotel spring		Deep Hole	
Alprazolam	0.308	U	0.315	U	0.302	U	0.306	U
Amitriptyline	0.308	U	0.315	U	0.302	U	0.306	U
Amlodipine	1.03	U	1.06	U	1.01	U	1.03	U
Benzoylecgonine	0.154	U	0.158	U	0.151	U	0.153	U
Benztropine	0.719	U	0.735	U	0.705	U	0.713	U
Betamethasone	1.54	U	1.58	U	1.51	U	1.53	U
Cocaine	**0.164**		0.158	U	0.151	UC	**0.569**	
DEET	**5.19**	B	**9.44**	B	**9.00**	BC	**7.36**	B
Desmethyldiltiazem	0.154	U	0.158	U	0.151	U	0.153	U
Diazepam	0.516	U	0.527	U	0.506	U	0.512	U
Fluocinonide	2.07	U	2.11	U	2.02	U	2.05	U
Fluticasone propionate	2.07	U	2.11	U	2.02	U	2.05	U
Hydrocortisone	6.17	U	6.3	U	6.04	U	6.11	U
10-hydroxy-amitriptyline	0.154	U	0.158	U	0.151	U	0.153	U
Meprobamate	1.54	U	1.58	U	1.51	U	1.53	U
Methylprednisolone	4.11	U	4.2	U	4.03	U	4.08	U
Metoprolol	0.516	U	0.527	U	0.506	U	0.512	U
Norfluoxetine	0.516	U	0.527	U	0.506	U	0.512	U
Norverapamil	0.154	U	0.158	U	0.151	U	0.153	U
Paroxetine	1.03	U	1.06	U	1.01	U	1.03	U
Prednisolone	4.11	U	4.2	U	4.03	U	4.08	U
Prednisone	6.17	U	6.3	U	6.04	U	6.11	U
Promethazine	0.308	U	0.315	U	0.302	U	0.306	U
Propoxyphene	0.308	U	0.315	U	0.302	U	0.306	U
Propranolol	0.308	U	0.315	U	0.302	U	0.306	U
Sertraline	0.308	U	0.315	U	0.302	U	0.306	U
Simvastatin	2.07	U	2.11	U	2.02	U	2.05	U
Theophylline	6.17	U	6.3	U	6.04	U	6.11	U
Trenbolone	2.07	U	2.11	U	2.02	U	2.05	U
Trenbolone acetate	0.308	U	0.315	U	0.302	U	0.306	U
Valsartan	4.11	U	4.2	U	4.03	U	4.08	U
Verapamil	0.154	U	0.158	U	0.151	U	0.153	U

[U] Non-detect at reporting limit
[H] Concentration is estimated
[B] Analyte found in associated blank
[C] Detected in duplicate sample

Table 3.3-3. PPCP concentrations (ng/L) measured at Hotel (Spring Lake, San Marcos) during January, June, and July sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List	January	June	July
Acetaminophen	3.13 U	3.41 U	3.38 U
Azithromycin	1.56 U	1.71 U	1.69 U
Caffeine	**29**	6.82 U	**7.54**
Carbadox	0.625 U	0.682 U	0.677 U
Carbamazepine	0.313 U	0.341 U	0.338 U
Cefotaxime	6.19 U	6.75 U	6.7 U
Ciprofloxacin	1.56 U	1.71 U	1.69 U
Clarithromycin	0.313 U	0.341 U	0.338 U
Clinafloxacin	2.08 U	2.27 U	2.25 U
Cloxacillin	3.13 U H	3.41 U H	3.38 U H
Dehydronifedipine	0.313 U	0.341 U	0.338 U
Digoxigenin	1.56 U	1.71 U	1.69 U
Digoxin	6.25 U	6.82 U	6.77 U
Diltiazem	0.156 U	0.171 U	0.169 U
Diphenhydramine	0.625 U	0.682 U	0.677 U
Enrofloxacin	0.625 U	0.682 U	0.677 U
Erythromycin-H2O	1.56 U H	1.71 U H	1.69 U H
Flumequine	0.313 U	0.341 U	0.338 U
Fluoxetine	0.156 U	0.171 U	0.169 U
Lincomycin	0.625 U	0.682 U	0.677 U
Lomefloxacin	0.625 U	0.682 U	0.677 U
Miconazole	0.313 U	0.341 U	0.338 U
Norfloxacin	2.08 U	2.27 U	2.25 U
Norgestimate	1.56 U	1.71 U	1.69 U
Ofloxacin	0.625 U	0.682 U	0.677 U
Ormetoprim	0.156 U	0.171 U	0.169 U
Oxacillin	1.56 U H	1.71 U H	1.69 U H
Oxolinic Acid	0.625 U	0.682 U	0.677 U
Penicillin G	**4.22** RBH	**3.84** RBH	3.38 U H
Penicillin V	1.56 U	1.71 U	1.69 U
Roxithromycin	0.156 U	0.171 U	0.169 U
Sarafloxacin	3.13 U	3.41 U	3.38 U
Sulfachloropyridazine	0.625 U	0.682 U	0.677 U
Sulfadiazine	0.625 U	0.682 U	0.677 U
Sulfadimethoxine	0.313 U	0.341 U	0.338 U
Sulfamerazine	0.625 U	0.682 U	0.677 U
Sulfamethazine	0.625 U	0.682 U	0.677 U
Sulfamethizole	0.625 U	0.682 U	0.677 U
Sulfamethoxazole	0.625 U	0.682 U	0.677 U
Sulfanilamide	6.25 U	6.82 U	6.77 U
Sulfathiazole	1.56 U	1.71 U	1.69 U
Thiabendazole	0.313 U	0.341 U	0.338 U
Trimethoprim	0.313 U	0.341 U	0.338 U
Tylosin	0.625 U	0.682 U	0.677 U
Virginiamycin M1	0.625 U	0.682 U	0.677 U
1,7-Dimethylxanthine	11.4	6.82 U	6.77 U

U Non-detect at reporting limit

R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration

H Concentration is estimated

B Analyte found in associated blank

Table 3.3-4. PPCP concentrations (ng/L) measured at Hotel (Spring Lake, San Marcos) during January, May, July, and November sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List Continued	January	June	July
Alprazolam	0.313 U	0.341 U	0.338 U
Amitriptyline	0.313 U	0.341 U	0.338 U
Amlodipine	1.05 U	1.14 U	1.14 U
Benzoylecgonine	0.156 U	0.171 U	0.169 U
Benztropine	0.729 U	0.796 U	0.79 U
Betamethasone	1.56 U	1.71 U	1.69 U
Cocaine	0.156 U	0.171 U	**0.413**
DEET	**3.12** B	**3.5** B	**2.95** B
Desmethyldiltiazem	0.156 U	0.171 U	0.169 U
Diazepam	0.523 U	0.571 U	0.566 U
Fluocinonide	2.09 U	2.29 U	2.27 U
Fluticasone propionate	2.09 U	2.29 U	2.27 U
Hydrocortisone	6.25 U	6.82 U	6.77 U
10-hydroxy-amitriptyline	0.156 U	0.171 U	0.169 U
Meprobamate	1.56 U	1.71 U	1.69 U
Methylprednisolone	4.17 U	4.55 U	4.51 U
Metoprolol	0.523 U	0.571 U	0.566 U
Norfluoxetine	0.523 U	0.571 U	0.566 U
Norverapamil	0.156 U	0.171 U	0.169 U
Paroxetine	1.05 U	1.14 U	1.14 U
Prednisolone	4.17 U	4.55 U	4.51 U
Prednisone	6.25 U	6.82 U	6.77 U
Promethazine	0.313 U	0.341 U	0.338 U
Propoxyphene	0.313 U	0.341 U	0.338 U
Propranolol	0.313 U	0.341 U	0.338 U
Sertraline	0.313 U	0.341 U	0.338 U
Simvastatin	2.09 U	2.29 U	2.27 U
Theophylline	**23.09**	6.82 U	6.77 U
Trenbolone	2.09 U	2.29 U	2.27 U
Trenbolone acetate	0.313 U	0.341 U	0.338 U
Valsartan	4.17 U	4.55 U	4.51 U
Verapamil	0.156 U	0.171 U	0.169 U

U Non-detect at reporting limit

R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration

H Concentration is estimated

B Analyte found in associated blank

3.3.2 Comal

A total of ten PPCP samples were collected during Spring and Fall collections in 2023, including one field duplicate sample during the Spring at Spring Run 3. Samples were collected at Spring Run 3 during the months of January, April, June, July, and December. Samples were taken at Spring Run 1 and Spring Run 7 during the standard Spring (April) and Fall (October) sampling events. Results for the Spring and Fall PPCP sampling at Spring Runs 1, 3, and 7 are denoted in Table 3.3-5 and 3.3-6 and PPCP results for Spring Run 3 for January, June, July, and December are noted in Tables 3.3-7 and 3.3-8. Overall, minimal PPCP detections at the reporting limit occurred in 2023 sampling events. DEET was detected at all three sampling sites in Spring and Fall sampling events; however, it is likely a false positive because it was also found in the blank in all sampling events. Penicillin G was detected at all three sites in Spring and at Spring Run 3 in January, June, and July but was also detected in the lab blanks. Cocaine was detected at all three Spring Runs in the Fall. Benzoylecgonine and Hydrocortisone were detected at Spring Runs 1 and 7 during the Fall. Sulfamethoxazole and Sulfamethizole were only detected at Spring Run 7 during the Fall. 1,7-Dimethylxanthine, Caffeine, Acetaminophen, and Theophylline and were detected at Spring Run 1 during the Fall. At Spring Run 3, Caffeine was detected in January and July, and Theophylline and 1,7-Dimethylxanthine were detected in January. Results for samples, duplicate samples, equipment blank, DI blank, and laboratory blank values can be found in Table A-11 through A-14 in appendix A.

Table 3.3-5. PPCP concentrations (ng/L) measured at Spring Run 1, Spring Run 3, and Spring Run 7 (Landa Lake) during Spring and Fall sampling events (2023). Samples with detectable concentrations denoted in bold.

	Spring			Fall		
PPCP List	Spring Run 1	Spring Run 3	Spring Run 7	Spring Run 1	Spring Run 3	Spring Run 7
Acetaminophen	3.32 U	3.4 U	3.18 U	**7.56**	3.19 U	3.13 U
Azithromycin	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Caffeine	6.63 U	6.8 U	6.35 U	**21.1**	6.38 U	6.26 U
Carbadox	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Carbamazepine	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Cefotaxime	6.56 U	6.73 U	6.29 U	6.74 U	6.31 U	6.2 U
Ciprofloxacin	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Clarithromycin	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Clinafloxacin	2.21 U	2.27 U	2.12 U	2.27 U	2.12 U	2.09 U
Cloxacillin	3.32 UH	3.4 UH	3.18 UH	3.4 UH	3.19 UH	3.13 UH
Dehydronifedipine	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Digoxigenin	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Digoxin	6.63 U	6.8 U	6.35 U	6.81 U	6.38 U	6.26 U
Diltiazem	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Diphenhydramine	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Enrofloxacin	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Erythromycin-H2O	1.66 UH	1.7 UH	1.59 UH	1.7 UH	1.59 UH	1.57 UH
Flumequine	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Fluoxetine	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Lincomycin	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Lomefloxacin	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Miconazole	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Norfloxacin	2.21 U	2.27 U	2.12 U	2.27 U	2.12 U	2.09 U
Norgestimate	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Ofloxacin	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Ormetoprim	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Oxacillin	1.66 UH	1.7 UH	1.59 UH	1.7 UH	1.59 UH	1.57 UH
Oxolinic Acid	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Penicillin G	**4.65** RBH	**3.84** RBCH	**4.09** RBH	3.4 UH	3.19 UH	3.13 UH
Penicillin V	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Roxithromycin	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Sarafloxacin	3.32 U	3.4 U	3.18 U	3.4 U	3.19 U	3.13 U
Sulfachloropyridazine	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Sulfadiazine	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Sulfadimethoxine	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Sulfamerazine	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Sulfamethazine	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Sulfamethizole	0.663 U	0.68 U	0.635 U	0.745 U	0.638 U	**0.818**
Sulfamethoxazole	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	**0.667**
Sulfanilamide	6.63 U	6.8 U	6.35 U	6.81 U	6.38 U	6.26 U
Sulfathiazole	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Thiabendazole	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Trimethoprim	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Tylosin	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
Virginiamycin M1	0.663 U	0.68 U	0.635 U	0.681 U	0.638 U	0.626 U
1,7-Dimethylxanthine	6.63 U	6.8 U	6.35 U	**7.98**	6.38 U	6.26 U

U Non-detect at reporting limit
H Concentration is estimated
B Analyte found in associated blank
C Detected in duplicate sample

Table 3.3-6. PPCP concentrations (ng/L) measured at Spring Run 1, Spring Run 3, and Spring Run 7 (Landa Lake) during Spring and Fall sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List Continued	Spring			Fall		
	Spring Run 1	Spring Run 3	Spring Run 7	Spring Run 1	Spring Run 3	Spring Run 7
Alprazolam	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Amitriptyline	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Amlodipine	1.11 U	1.14 U	1.07 U	1.14 U	1.07 U	1.05 U
Benzoylecgonine	0.166 U	0.17 U	0.159 U	**0.46**	0.159 U	**0.384**
Benztropine	0.774 U	0.794 U	0.741 U	0.794 U	0.744 U	0.731 U
Betamethasone	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Cocaine	0.166 U	0.17 U	0.159 U	**1.33**	**0.25**	**3.16**
DEET	**3.98** B	**3.77** BC	**5.06** B	**3.04** B	**2.7** B	**9.18** B
Desmethyldiltiazem	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Diazepam	0.555 U	0.569 U	0.531 U	0.57 U	0.534 U	0.524 U
Fluocinonide	2.22 U	2.28 U	2.13 U	2.28 U	2.14 U	2.1 U
Fluticasone propionate	2.22 U	2.28 U	2.13 U	2.28 U	2.14 U	2.1 U
Hydrocortisone	6.63 U	6.8 U	6.35 U	**40.8**	6.38 U	**6.48**
10-hydroxy-amitriptyline	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Meprobamate	1.66 U	1.7 U	1.59 U	1.7 U	1.59 U	1.57 U
Methylprednisolone	4.42 U	4.53 U	4.23 U	4.54 U	4.25 U	4.17 U
Metoprolol	0.555 U	0.569 U	0.531 U	0.57 U	0.534 U	0.524 U
Norfluoxetine	0.555 U	0.569 U	0.531 U	0.57 U	0.534 U	0.524 U
Norverapamil	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U
Paroxetine	1.11 U	1.14 U	1.07 U	1.14 U	1.07 U	1.05 U
Prednisolone	4.42 U	4.53 U	4.23 U	4.54 U	4.25 U	4.17 U
Prednisone	6.63 U	6.8 U	6.35 U	6.81 U	6.38 U	6.26 U
Promethazine	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Propoxyphene	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Propranolol	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Sertraline	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Simvastatin	2.22 U	2.28 U	2.13 U	2.28 U	2.14 U	2.1 U
Theophylline	6.63 U	6.8 U	6.35 U	**14.9** R	6.38 U	6.26 U
Trenbolone	2.22 U	2.28 U	2.13 U	2.28 U	2.14 U	2.1 U
Trenbolone acetate	0.332 U	0.34 U	0.318 U	0.34 U	0.319 U	0.313 U
Valsartan	4.42 U	4.53 U	4.23 U	4.54 U	4.25 U	4.17 U
Verapamil	0.166 U	0.17 U	0.159 U	0.17 U	0.159 U	0.157 U

U Non-detect at reporting limit
H Concentration is estimated

Table 3.3-7. PPCP concentrations (ng/L) measured at Spring Run3 (Landa Lake, New Braunfels) during January, June, and July sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List	January	June	July
Acetaminophen	3.24 U	3.64 U	3.27 U
Azithromycin	1.62 U	1.82 U	1.63 U
Caffeine	**18.7**	7.27 U	**7.44**
Carbadox	0.647 U	0.727 U	0.653 U
Carbamazepine	0.324 U	0.364 U	0.327 U
Cefotaxime	6.41 U	7.2 U	6.47 U
Ciprofloxacin	1.62 U	1.82 U	1.63 U
Clarithromycin	0.324 U	0.364 U	0.327 U
Clinafloxacin	2.16 U	2.42 U	2.18 U
Cloxacillin	3.24 UH	3.64 UH	3.27 UH
Dehydronifedipine	0.324 U	0.364 U	0.327 U
Digoxigenin	1.62 U	1.82 U	1.63 U
Digoxin	6.47 U	7.27 U	6.53 U
Diltiazem	0.162 U	0.182 U	0.163 U
Diphenhydramine	0.647 U	0.727 U	0.653 U
Enrofloxacin	0.647 U	0.727 U	0.653 U
Erythromycin-H2O	1.62 UH	1.82 UH	1.63 UH
Flumequine	0.324 U	0.364 U	0.327 U
Fluoxetine	0.162 U	0.182 U	0.163 U
Lincomycin	0.647 U	0.727 U	0.653 U
Lomefloxacin	0.647 U	0.727 U	0.653 U
Miconazole	0.324 U	0.364 U	0.327 U
Norfloxacin	2.16 U	2.42 U	2.18 U
Norgestimate	1.62 U	1.82 U	1.63 U
Ofloxacin	0.647 U	0.727 U	0.653 U
Ormetoprim	0.162 U	0.182 U	0.163 U
Oxacillin	1.62 UH	1.82 UH	1.63 UH
Oxolinic Acid	0.647 U	0.727 U	0.653 U
Penicillin G	**4.12** RBH	**3.64** RBH	**4.28** RH
Penicillin V	1.62 U	1.82 U	1.63 U
Roxithromycin	0.162 U	0.182 U	0.163 U
Sarafloxacin	3.24 U	3.64 U	3.27 U
Sulfachloropyridazine	0.647 U	0.727 U	0.653 U
Sulfadiazine	0.647 U	0.727 U	0.653 U
Sulfadimethoxine	0.324 U	0.364 U	0.327 U
Sulfamerazine	0.647 U	0.727 U	0.653 U
Sulfamethazine	0.647 U	0.727 U	0.653 U
Sulfamethizole	0.647 U	0.727 U	0.752 U
Sulfamethoxazole	0.647 U	0.727 U	0.653 U
Sulfanilamide	6.47 U	7.27 U	6.53 U
Sulfathiazole	1.62 U	1.82 U	1.63 U
Thiabendazole	0.324 U	0.364 U	0.327 U
Trimethoprim	0.324 U	0.364 U	0.327 U
Tylosin	0.647 U	0.727 U	0.653 U
Virginiamycin M1	0.647 U	0.727 U	0.653 U
1,7-Dimethylxanthine	**6.74**	7.27 U	6.53 U

U Non-detect at reporting limit
R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration
H Concentration is estimated

Table 3.3-8. PPCP concentrations (ng/L) measured at Spring Run3 (Landa Lake, New Braunfels) during January, June, and July sampling events (2023). Samples with detectable concentrations denoted in bold.

PPCP List Continued	January		June		July	
Alprazolam	0.324	U	0.364	U	0.327	U
Amitriptyline	0.324	U	0.364	U	0.327	U
Amlodipine	1.09	U	1.22	U	1.1	U
Benzoylecgonine	0.162	U	0.182	U	0.163	U
Benztropine	0.755	U	0.848	U	0.762	U
Betamethasone	1.62	U	1.82	U	1.63	U
Cocaine	0.162	U	0.182	U	0.163	U
DEET	**3.33**	B	**4.17**	B	**3.03**	B
Desmethyldiltiazem	0.162	U	0.182	U	0.163	U
Diazepam	0.542	U	0.608	U	0.547	U
Fluocinonide	2.17	U	2.44	U	2.19	U
Fluticasone propionate	2.17	U	2.44	U	2.19	U
Hydrocortisone	6.47	U	7.27	U	6.53	U
10-hydroxy-amitriptyline	0.162	U	0.182	U	0.163	U
Meprobamate	1.62	U	1.82	U	1.63	U
Methylprednisolone	4.32	U	4.85	U	4.36	U
Metoprolol	0.542	U	0.608	U	0.547	U
Norfluoxetine	0.542	U	0.608	U	0.547	U
Norverapamil	0.162	U	0.182	U	0.163	U
Paroxetine	1.09	U	1.22	U	1.1	U
Prednisolone	4.32	U	4.85	U	4.36	U
Prednisone	6.47	U	7.27	U	6.53	U
Promethazine	0.324	U	0.364	U	0.327	U
Propoxyphene	0.324	U	0.364	U	0.327	U
Propranolol	0.324	U	0.364	U	0.327	U
Sertraline	0.324	U	0.364	U	0.327	U
Simvastatin	2.17	U	2.44	U	2.19	U
Theophylline	**14.1**		7.27	U	6.53	U
Trenbolone	2.17	U	2.44	U	2.19	U
Trenbolone acetate	0.324	U	0.364	U	0.327	U
Valsartan	4.32	U	4.85	U	4.36	U
Verapamil	0.162	U	0.182	U	0.163	U

[U] Non-detect at reporting limit

[R] Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration

[H] Concentration is estimated

3.4 Fish Tissue sampling

3.4.1 San Marcos

Table 3.4-1 denotes the PPCP results for fish tissue samples collected in 2023 in the San Marcos system sites. Only one PPCP was detected among fish tissue samples, Ciprofloxacin (i.e., antibiotic) was found in fish collected from the Upper San Marcos system.

Table 3.4-1 PPCP concentrations (ng/g) detected in fish tissue samples collected from the San Marcos system in May-June 2023. PPCPs detected are denoted in bold.

PPCP List	Upper		Lower	
Acetaminophen	1.15	U	1.19	U
Azithromycin	0.577	U	0.595	U
Caffeine	2.31	U	2.38	U
Carbadox	0.231	U	0.238	U
Carbamazepine	0.115	U	0.119	U
Cefotaxime	2.28	U	2.36	U
Ciprofloxacin	**0.663**		0.595	U
Clarithromycin	0.115	U	0.119	U
Clinafloxacin	0.768	U	0.793	U
Cloxacillin	1.15	U H	1.19	U H
Dehydronifedipine	0.115	U	0.119	U
Digoxigenin	0.577	U	0.595	U
Digoxin	2.31	U	2.38	U
Diltiazem	0.0577	U	0.0595	U
Diphenhydramine	0.231	U	0.238	U
Enrofloxacin	0.231	U	0.238	U
Erythromycin-H2O	0.577	U H	0.595	U H
Flumequine	0.115	U	0.119	U
Fluoxetine	0.0577	U	0.0595	U
Lincomycin	0.231	U	0.238	U
Lomefloxacin	0.231	U	0.238	U
Miconazole	0.115	U	0.119	U
Norfloxacin	0.768	U	0.793	U
Norgestimate	0.577	U	0.595	U
Ofloxacin	0.231	U	0.238	U
Ormetoprim	0.0577	U	0.0595	U
Oxacillin	0.577	U H	0.595	U H
Oxolinic Acid	0.231	U	0.238	U
Penicillin G	1.15	U H	1.19	U H
Penicillin V	0.577	U	0.595	U
Roxithromycin	0.0577	U	0.0595	U
Sarafloxacin	1.15	U	1.19	U
Sulfachloropyridazine	0.231	U	0.238	U
Sulfadiazine	0.231	U	0.238	U
Sulfadimethoxine	0.115	U	0.119	U
Sulfamerazine	0.231	U	0.238	U
Sulfamethazine	0.231	U	0.238	U
Sulfamethizole	0.363	U	0.306	U
Sulfamethoxazole	0.231	U	0.238	U
Sulfanilamide	2.31	U	2.38	U
Sulfathiazole	0.577	U	0.595	U
Thiabendazole	0.115	U	0.119	U
Trimethoprim	0.115	U	0.119	U
Tylosin	0.231	U	0.238	U
Virginiamycin M1	0.231	U	0.238	U
1,7-Dimethylxanthine	2.31	U	2.38	U

U Non-detect at reporting limit
H Concentration is estimated

3.4.2 **Comal**

Table 3.4-2 denotes the PPCP results for fish tissue samples collected in 2023 in the Comal system sites. Like the San Marcos, only one PPCP were detected among fish tissue samples, Penicillin G was found in fish collected in the Upper Comal system.

Table 3.4-2 PPCP concentrations (ng/g) detected in fish tissue samples collected from the Comal system in June 2023. PPCPs detected are denoted in bold.

PPCP List	Upper		Lower	
Acetaminophen	1.17	U	1.15	U
Azithromycin	0.586	U	0.577	U
Caffeine	2.34	U	2.31	U
Carbadox	0.234	U	0.231	U
Carbamazepine	0.117	U	0.115	U
Cefotaxime	2.32	U	3.37	U
Ciprofloxacin	0.586	U	0.577	U
Clarithromycin	0.117	U	0.115	U
Clinafloxacin	0.78	U	0.768	U
Cloxacillin	1.17	U H	1.15	U H
Dehydronifedipine	0.117	U	0.115	U
Digoxigenin	0.586	U	0.577	U
Digoxin	2.34	U	2.31	U
Diltiazem	0.0586	U	0.0577	U
Diphenhydramine	0.234	U	0.231	U
Enrofloxacin	0.234	U	0.231	U
Erythromycin-H2O	0.586	U H	0.577	U H
Flumequine	0.117	U	0.115	U
Fluoxetine	0.0586	U	0.0577	U
Lincomycin	0.234	U	0.231	U
Lomefloxacin	0.234	U	0.231	U
Miconazole	0.117	U	0.115	U
Norfloxacin	0.78	U	0.768	U
Norgestimate	0.586	U	0.577	U
Ofloxacin	0.234	U	0.231	U
Ormetoprim	0.0586	U	0.0577	U
Oxacillin	0.586	U H	0.577	U H
Oxolinic Acid	0.234	U	0.231	U
Penicillin G	**1.21**	H	1.15	U H
Penicillin V	0.586	U	0.577	U
Roxithromycin	0.0586	U	0.0577	U
Sarafloxacin	1.17	U	1.15	U
Sulfachloropyridazine	0.234	U	0.231	U
Sulfadiazine	0.234	U	0.231	U
Sulfadimethoxine	0.117	U	0.115	U
Sulfamerazine	0.234	U	0.231	U
Sulfamethazine	0.234	U	0.231	U
Sulfamethizole	0.239	U	0.231	U
Sulfamethoxazole	0.234	U	0.231	U
Sulfanilamide	2.34	U	2.31	U
Sulfathiazole	0.586	U	0.58	U
Thiabendazole	0.117	U	0.12	U
Trimethoprim	0.117	U	0.12	U
Tylosin	0.234	U	0.23	U
Virginiamycin M1	0.234	U	0.23	U
1,7-Dimethylxanthine	2.34	U	2.31	U

U Non-detect at reporting limit
H Concentration is estimated

4 | References

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Appendix A – Laboratory Quality Control Results

Table A-1. Sucralose concentrations (ng/L) for samples, DI blanks, lab blanks, and spiked matrices measured at Hotel Springs in Spring Lake (2023). Quality control spike recoveries (%) are reported to the right of each sample and samples with detectable concentrations are denoted in bold.

Month	Sample (ng/L)	QC Spike Recovery (%)	Duplicate (ng/L)	QC Spike Recovery (%)	DI Blank (ng/L)	QC Spike Recovery (%)	Lab Blank (ng/L)	QC Spike Recovery (%)	Spiked Matrix (ng/L)	Spiked Recovery (%)
January	**21.7**	62.8	**14.1**	64.5	NA	NA	10.1[U]	65.4	1.01	101
February	**19.7**	105.0	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
March	**19.3**	67.8	NA	NA	8.69[U]	81.0	10.1[U]	65.4	1.01	101
April	**18.6**	68.9	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
May	**19.6**	71.5	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
June	**16.8**	80.6	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
July	**13.6**	74.5	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
August	**14.8**	70.3	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
September	**12.8**	73.9	NA	NA	8.16[U]	70.6	10.1[U]	92.0	1.01	94.6
October	**13.20**	70.4	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
November	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
December	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[U] Non-detect at reporting limit

Table A-2. Sucralose concentrations (ng/L) for samples, duplicate samples, DI blanks, lab blanks, and spiked matrices measured for Spring Run 3 in Landa Lake (2023). Quality control spike recoveries (%) are reported to the right of each sample and samples with detectable concentrations are denoted in bold.

Month	Sample (ng/L)	QC Spike Recovery (%)	Duplicate (ng/L)	QC Spike Recovery (%)	DI Blank (ng/L)	QC Spike Recovery (%)	Lab Blank (ng/L)	QC Spike Recovery (%)	Spiked Matrix (ng/L)	QC Spiked Recovery (%)
January	8.19[U]	66.0	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
February	9.11[U]	82.1	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
March	7.84[U]	91.9	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
April	**9.65**	69.2	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
May	7.93[U]	107.0	NA	NA	NA	NA	10.1[U]	65.4	1.01	101
June	8.92[U]	71.8	NA	NA	8.46[U]	66.6	10.1[U]	65.4	1.01	101
July	8.74[U]	105.0	**34.4**	67.3	NA	NA	10.1[U]	92.0	1.01	94.6
August	8.64[U]	78.7	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
September	9.06[U]	80.1	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
October	8.31[U]	83.9	NA	NA	NA	NA	10.1[U]	92.0	1.01	94.6
November	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
December	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[U] Non-detect at reporting limit

Table A-3. Nutrient concentrations (mg/L) reported for samples, duplicate samples, lab blanks, and field blanks, and the relative percent difference between sample and duplicate sample concentrations (%) at the San Marcos River upper and lower sites for Spring 2023. Samples with detectable concentrations denoted in bold.

Nutrients	Upper	Upper Duplicates	Relative Percent Difference	Laboratory Blank	Field Blank
Total Phosphorus	0.01[U]	0.01[U]	0.00%	0.01[U]	0.01[U]
Orthophosphate as P	**0.01[JH]**	**0.006[JH]**	50.00%	0.004[UH]	0.004[UH]
Total Organic Carbon	**1**	**0.8[J]**	22.20%	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**64.6**	**64.5**	0.15%	**0.51[J]**	**0.69[J]**
Dissolved Organic Carbon	**1.1**	**0.615[J]**	56.56%	**0.76[J]**	**0.49[J]**
Kjeldahl Nitrogen	0.09[U]	0.09[U]	0.00%	**0.33**	0.09[U]
Nitrate as N	**1.26[H]**	**1.23[H]**	2.41%	**0.06[JH]**	**0.06[JH]**
Ammonia	0.035[U]	0.035[U]	0.00%	**0.72**	0.035[U]
Nutrients	**Lower**	**Lower Duplicates**	**Relative Percent Difference**	**Laboratory Blank**	**Field Blank**
Total Phosphorus	0.01[U]	NA	NA	0.01[U]	0.01[U]
Orthophosphate as P	0.004[UH]	NA	NA	0.004[UH]	0.004[UH]
Total Organic Carbon	**0.89[J]**	NA	NA	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**62.7**	NA	NA	**0.51[J]**	**0.69[J]**
Dissolved Organic Carbon	**1.01**	NA	NA	**0.76[J]**	**0.49[J]**
Kjeldahl Nitrogen	0.09[U]	NA	NA	**0.33**	0.09[U]
Nitrate as N	**1.35[H]**	NA	NA	**0.06[JH]**	**0.06[JH]**
Ammonia	0.035[U]	NA	NA	**0.72**	0.035[U]

[U] Non-detect

[H] Sample was prepped and analyzed past holding time

[J] Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table A-4. Nutrient concentrations (mg/L) reported for samples, duplicate samples, lab blanks, and field blanks, and the relative percent difference between sample and duplicate sample concentrations (%) at the San Marcos upper and lower sites for Fall 2023. Samples with detectable concentrations denoted in bold.

Nutrients	Upper	Upper Duplicates	Relative Percent Difference	Laboratory Blank	Field Blank
Total Phosphorus	**0.93**	NA	NA	0.009[U]	**0.03**
Orthophosphate as P	0.006[U]	NA	NA	0.006[U]	0.006[U]
Total Organic Carbon	0.5[U]	NA	NA	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**64.9[F1]**	NA	NA	**2.21**	**2.26**
Dissolved Organic Carbon	**1.59**	NA	NA	**1.37**	**1.39**
Kjeldahl Nitrogen	**0.86**	NA	NA	**0.49**	**0.40**
Nitrate as N	**1.48**	NA	NA	**0.13**	**0.12**
Ammonia	0.05[U]	NA	NA	0.051[U]	0.051[U]
Nutrients	**Lower**	**Lower Duplicates**	**Relative Percent Difference**	**Laboratory Blank**	**Field Blank**
Total Phosphorus	**0.04**	**0.03**	28.57%	0.009[U]	**0.03**
Orthophosphate as P	0.03[U]	0.03[U]	0.00%	0.006[U]	0.006[U]
Total Organic Carbon	0.5[U]	0.5[U]	0.00%	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**64.2**	**63.4**	1.25%	**2.21**	**2.26**
Dissolved Organic Carbon	**1.55**	**1.7**	9.23%	**1.37**	**1.39**
Kjeldahl Nitrogen	**0.44**	**0.84**	62.50%	**0.49**	**0.40**
Nitrate as N	**1.53**	**1.54**	0.65%	**0.13**	**0.12**
Ammonia	**0.08[JF1]**	**0.13[F1]**	47.62%	0.051[U]	0.051[U]

[U] Non-detect

[H] Sample was prepped and analyzed past holding time

[F1] MS and/or MSD recovery exceeds control limits

[J] Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table A-5. Nutrient concentrations (mg/L) reported for samples, duplicate samples, lab blanks, and field blanks, and the relative percent difference between sample and duplicate sample concentrations (%) at the Comal upper and lower sites for Spring 2023. Samples with detectable concentrations denoted in bold.

Nutrients	Upper	Upper Duplicates	Relative Percent Difference	Laboratory Blank	Field Blank
Total Phosphorus	0.01[U]	0.01[U]	0.00%	0.01[U]	0.01[U]
Orthophosphate as P	0.004[UH]	0.004[UH]	0.00%	0.004[UH]	0.004[UH]
Total Organic Carbon	**0.85[J]**	**0.82[J]**	3.50%	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**58**	**57.6**	0.60%	**0.51[J]**	**0.69[J]**
Dissolved Organic Carbon	**0.91[J]**	**0.79[J]**	14.11%	**0.76[J]**	**0.49[J]**
Kjeldahl Nitrogen	0.09[U]	**0.19[J]**	71.43%	**0.33**	0.09[U]
Nitrate as N	**1.83[H]**	**1.83[H]**	0.00%	**0.06[JH]**	**0.06[JH]**
Ammonia	0.035[U]	0.035[UF1]	0.00%	**0.72**	0.035[U]
Nutrients	**Lower**	**Lower Duplicates**	**Relative Percent Difference**	**Laboratory Blank**	**Field Blank**
Total Phosphorus	0.01[U]	NA	NA	0.01[U]	0.01[U]
Orthophosphate as P	0.004[UH]	NA	NA	0.004[UH]	0.004[UH]
Total Organic Carbon	**0.82[J]**	NA	NA	0.5[U]	0.5[U]
Dissolved Inorganic Carbon	**57.6**	NA	NA	**0.51[J]**	**0.69[J]**
Dissolved Organic Carbon	**0.79[J]**	NA	NA	**0.76[J]**	**0.49[J]**
Kjeldahl Nitrogen	**0.19[J]**	NA	NA	**0.33**	0.09[U]
Nitrate as N	**1.83[H]**	NA	NA	**0.06[JH]**	**0.06[JH]**
Ammonia	0.035[UF1]	NA	NA	**0.72**	0.035[U]

[U] Non-detect

[H] Sample was prepped and analyzed past holding time

[F1] MS and/or MSD recovery exceeds control limits

[J] Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table A-6. Nutrient concentrations (mg/L) reported for samples, duplicate samples, lab blanks, and field blanks, and the relative percent difference between sample and duplicate sample concentrations (%) at the Comal upper and lower sites for Fall 2023. Samples with detectable concentrations denoted in bold.

Nutrients	Upper	Upper Duplicates	Relative Percent Difference	Laboratory Blank	Field Blank
Total Phosphorus	0.009^{UF1}	NA	NA	0.009^{U}	**0.03**
Orthophosphate as P	0.03^{U}	NA	NA	0.006^{U}	0.006^{U}
Total Organic Carbon	0.5^{U}	NA	NA	0.5^{U}	0.5^{U}
Dissolved Inorganic Carbon	**58.8**	NA	NA	**2.21**	**2.26**
Dissolved Organic Carbon	**1.63**	NA	NA	**1.37**	**1.39**
Kjeldahl Nitrogen	**0.54**	NA	NA	**0.49**	**0.40**
Nitrate as N	**1.88**	NA	NA	**0.13**	**0.12**
Ammonia	**0.053^{J}**	NA	NA	0.051^{U}	0.051^{U}
Nutrients	**Lower**	**Lower Duplicates**	**Relative Percent Difference**	**Laboratory Blank**	**Field Blank**
Total Phosphorus	0.009^{U}	0.009^{U}	0.00%	0.009^{U}	**0.03**
Orthophosphate as P	0.006^{U}	0.006^{U}	0.00%	0.006^{U}	0.006^{U}
Total Organic Carbon	0.5^{UF1}	**0.67^{J}**	29.06%	0.5^{U}	0.5^{U}
Dissolved Inorganic Carbon	**58.2**	**59.1**	1.53%	**2.21**	**2.26**
Dissolved Organic Carbon	**1.46**	**2.18**	39.56%	**1.37**	**1.39**
Kjeldahl Nitrogen	**0.57**	**0.37**	42.55%	**0.49**	**0.40**
Nitrate as N	**1.72**	**1.72**	0.00%	**0.13**	**0.12**
Ammonia	**0.06^{J}**	**0.06^{J}**	0.00%	0.051^{U}	0.051^{U}

^{U} Non-detect

^{F1} MS and/or MSD recovery exceeds control limits

^{J} Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table A-7. PPCP concentrations reported for samples, equipment blank, DI blank, and lab blank at the San Marcos groundwater sites (i.e., Hotel and Deep Hole springs) in Spring. Samples with detectable concentrations denoted in bold.

PPCP List	Hotel spring	Deep Hole	DI Blank	Lab Blank
Acetaminophen	3.08 U	3.15 U	3.29 U	3.00 U
Azithromycin	1.54 U	1.58 U	1.65 U	1.50 U
Caffeine	6.17 U	6.3 U	6.59 U	6.00 U
Carbadox	0.617 U	0.63 U	0.659 U	0.60 U
Carbamazepine	0.308 U	0.315 U	0.329 U	0.30 U
Cefotaxime	6.1 U	6.24 U	6.52 U	5.94 U
Ciprofloxacin	1.54 U	1.58 U	1.65 U	1.50 U
Clarithromycin	0.308 U	0.315 U	0.329 U	0.30 U
Clinafloxacin	2.05 U	2.1 U	2.19 U	2.00 U
Cloxacillin	3.08 U H	3.15 U H	3.29 U H	3.00 U H
Dehydronifedipine	0.308 U	0.315 U	0.329 U	0.30 U
Digoxigenin	1.54 U	1.58 U	1.65 U	1.50 U
Digoxin	6.17 U	6.3 U	6.59 U	6.00 U
Diltiazem	0.154 U	0.158 U	0.165 U	0.15 U
Diphenhydramine	0.617 U	0.63 U	0.659 U	0.60 U
Enrofloxacin	0.617 U	0.63 U	0.659 U	0.60 U
Erythromycin-H2O	1.54 U H	1.58 U H	1.65 U H	1.50 U H
Flumequine	0.308 U	0.315 U	0.329 U	0.30 U
Fluoxetine	0.154 U	0.158 U	0.165 U	0.15 U
Lincomycin	0.617 U	0.63 U	0.659 U	0.60 U
Lomefloxacin	0.617 U	0.63 U	0.659 U	0.60 U
Miconazole	0.308 U	0.315 U	0.329 U	0.30 U
Norfloxacin	2.05 U	2.1 U	2.19 U	2.00 U
Norgestimate	1.54 U	1.58 U	1.65 U	1.50 U
Ofloxacin	0.617 U	0.63 U	0.659 U	0.60 U
Ormetoprim	0.154 U	0.158 U	0.165 U	0.15 U
Oxacillin	1.54 U H	1.58 U H	1.65 U H	1.50 U H
Oxolinic Acid	0.617 U	0.63 U	0.659 U	0.60 U
Penicillin G	**3.86** RH	**11.9** RH	**4.47** RH	**4.16** RH
Penicillin V	1.54 U	1.58 U	1.65 U	1.50 U
Roxithromycin	0.154 U	0.158 U	0.165 U	0.15 U
Sarafloxacin	3.08 U	3.15 U	3.29 U	3.00 U
Sulfachloropyridazine	0.617 U	0.63 U	0.659 U	0.60 U
Sulfadiazine	0.617 U	0.63 U	0.659 U	0.60 U
Sulfadimethoxine	0.308 U	0.315 U	0.329 U	0.30 U
Sulfamerazine	0.617 U	0.63 U	0.659 U	0.60 U
Sulfamethazine	0.617 U	0.63 U	0.659 U	0.60 U
Sulfamethizole	0.617 U	0.63 U	0.659 U	0.60 U
Sulfamethoxazole	0.617 U	0.63 U	0.659 U	0.60 U
Sulfanilamide	6.17 U	6.3 U	6.59 U	6.00 U
Sulfathiazole	1.54 U	1.58 U	1.65 U	1.50 U
Thiabendazole	0.308 U	0.315 U	0.329 U	0.30 U
Trimethoprim	0.308 U	0.315 U	0.329 U	0.30 U
Tylosin	0.617 U	0.63 U	0.659 U	0.60 U
Virginiamycin M1	0.617 U	0.663 U	0.659 U	0.60 U
1,7-Dimethylxanthine	6.17 U	6.3 U	6.59 U	6.00 U

U Non-detect at reporting limit

R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration

H Concentration is estimated

Table A-8. PPCP concentrations reported for samples, equipment blank, DI blank, and Lab blank at the San Marcos groundwater sites (i.e., Hotel and Deep Hole springs) in Spring. Samples with detectable concentrations denoted in bold.

PPCP List Continued	Hotel spring	Deep Hole	DI Blank	Lab Blank
Alprazolam	0.308 U	0.315 U	0.329 U	0.30 U
Amitriptyline	0.308 U	0.315 U	0.329 U	0.30 U
Amlodipine	1.03 U	1.06 U	1.1 U	1.01 U
Benzoylecgonine	0.154 U	0.158 U	0.165 U	0.15 U
Benztropine	0.719 U	0.735 U	0.769 U	0.70 U
Betamethasone	1.54 U	1.58 U	1.65 U	1.50 U
Cocaine	**0.164**	0.158 U	0.165 U	0.15 U
DEET	**5.19**	**9.44**	**3.29**	**3.30**
Desmethyldiltiazem	0.154 U	0.158 U	0.165 U	0.15 U
Diazepam	0.516 U	0.527 U	0.551 U	0.50 U
Fluocinonide	2.07 U	2.11 U	2.21 U	2.01 U
Fluticasone propionate	2.07 U	2.11 U	2.21 U	2.01 U
Hydrocortisone	6.17 U	6.3 U	6.59 U	6.00 U
10-hydroxy-amitriptyline	0.154 U	0.158 U	0.165 U	0.15 U
Meprobamate	1.54 U	1.58 U	1.65 U	1.50 U
Methylprednisolone	4.11 U	4.2 U	4.39 U	4.00 U
Metoprolol	0.516 U	0.527 U	0.551 U	0.50 U
Norfluoxetine	0.516 U	0.527 U	0.551 U	0.50 U
Norverapamil	0.154 U	0.158 U	0.165 U	0.15 U
Paroxetine	1.03 U	1.06 U	1.1 U	1.01 U
Prednisolone	4.11 U	4.2 U	4.39 U	4.00 U
Prednisone	6.17 U	6.3 U	6.59 U	6.00 U
Promethazine	0.308 U	0.315 U	0.329 U	0.30 U
Propoxyphene	0.308 U	0.315 U	0.329 U	0.30 U
Propranolol	0.308 U	0.315 U	0.329 U	0.30 U
Sertraline	0.308 U	0.315 U	0.329 U	0.30 U
Simvastatin	2.07 U	2.11 U	2.21 U	2.01 U
Theophylline	6.17 U	6.3 U	6.59 U	6.00 U
Trenbolone	2.07 U	2.11 U	2.21 U	2.01 U
Trenbolone acetate	0.308 U	0.315 U	0.329 U	0.30 U
Valsartan	4.11 U	4.2 U	4.39 U	4.00 U
Verapamil	0.154 U	0.158 U	0.165 U	0.15 U

U Non-detect at reporting limit

H Concentration is estimated

Table A-9. PPCP concentrations reported for samples, DI blank, and lab blank at the San Marcos groundwater sites (i.e., Hotel and Deep Hole springs) in Fall. Samples with detectable concentrations denoted in bold.

PPCP List	Hotel spring	Hotel spring Duplicate	Deep Hole	Equipment DI Blank	Lab Blank
Acetaminophen	3.02 U	3.35 U	3.06 U	3.29 U	3.00 U
Azithromycin	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Caffeine	6.04 U	6.71 U	6.11 U	**7.33**	6.00 U
Carbadox	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Carbamazepine	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Cefotaxime	5.98 U	6.64 U	6.05 U	6.52 U	5.94 U
Ciprofloxacin	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Clarithromycin	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Clinafloxacin	2.01 U	2.23 U	2.04 U	2.19 U	2.00 U
Cloxacillin	3.02 UH	3.35 UH	3.06 UH	**36.3** H	3.00 UH
Dehydronifedipine	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Digoxigenin	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Digoxin	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U
Diltiazem	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Diphenhydramine	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Enrofloxacin	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Erythromycin-H2O	1.51 UH	1.68 UH	1.53 UH	1.65 UH	1.50 UH
Flumequine	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Fluoxetine	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Lincomycin	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Lomefloxacin	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Miconazole	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Norfloxacin	2.01 U	2.23 U	2.04 U	2.19 U	2.00 U
Norgestimate	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Ofloxacin	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Ormetoprim	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Oxacillin	1.51 UH	1.68 UH	1.53 UH	1.65 UH	1.50 UH
Oxolinic Acid	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Penicillin G	3.02 UH	**4.04** RH	**20.4** RH	**384** RH	3.00 UH
Penicillin V	1.51 U	1.68 U	**17.3** R	**201** R	1.50 U
Roxithromycin	0.151 U	0.168 U	0.153 U	0.219 U	0.15 U
Sarafloxacin	3.02 U	3.35 U	3.06 U	3.29 U	3.00 U
Sulfachloropyridazine	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfadiazine	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfadimethoxine	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Sulfamerazine	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfamethazine	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfamethizole	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfamethoxazole	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Sulfanilamide	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U
Sulfathiazole	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Thiabendazole	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Trimethoprim	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Tylosin	0.604 U	0.671 U	0.611 U	0.659 U	0.60 U
Virginiamycin M1	0.604 U	0.671 U	0.798 U	0.95 U	0.60 U
1,7-Dimethylxanthine	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U

U Non-detect at reporting limit
R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration
H Concentration is estimated

Table A-10. PPCP concentrations reported for samples, DI blank, and lab blank at the San Marcos groundwater sites (i.e., Hotel and Deep Hole springs) in Fall. Samples with detectable concentrations denoted in bold.

PPCP List Continued	Hotel spring	Hotel spring Duplicate	Deep Hole	Equipment DI Blank	Lab Blank
Alprazolam	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Amitriptyline	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Amlodipine	1.01 U	1.12 U	1.03 U	1.1 U	1.01 U
Benzoylecgonine	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Benztropine	0.705 U	0.783 U	0.713 U	0.769 U	0.70 U
Betamethasone	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Cocaine	0.151 U	**0.479**	**0.569**	**0.618**	0.15 U
DEET	**9.00**	**3.56**	**7.36**	**50.1**	**3.53**
Desmethyldiltiazem	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Diazepam	0.506 U	0.561 U	0.512 U	0.551 U	0.50 U
Fluocinonide	2.02 U	2.25 U	2.05 U	2.21 U	2.01 U
Fluticasone propionate	2.02 U	2.25 U	2.05 U	2.21 U	2.01 U
Hydrocortisone	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U
10-hydroxy-amitriptyline	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Meprobamate	1.51 U	1.68 U	1.53 U	1.65 U	1.50 U
Methylprednisolone	4.03 U	4.47 U	4.08 U	4.39 U	4.00 U
Metoprolol	0.506 U	0.561 U	0.512 U	0.551 U	0.50 U
Norfluoxetine	0.506 U	0.561 U	0.512 U	0.551 U	0.50 U
Norverapamil	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U
Paroxetine	1.01 U	1.12 U	1.03 U	1.1 U	1.01 U
Prednisolone	4.03 U	4.47 U	4.08 U	4.39 U	4.00 U
Prednisone	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U
Promethazine	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Propoxyphene	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Propranolol	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Sertraline	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Simvastatin	2.02 U	2.25 U	2.05 U	2.21 U	2.01 U
Theophylline	6.04 U	6.71 U	6.11 U	6.59 U	6.00 U
Trenbolone	2.02 U	2.25 U	2.05 U	2.21 U	2.01 U
Trenbolone acetate	0.302 U	0.335 U	0.306 U	0.329 U	0.30 U
Valsartan	4.03 U	4.47 U	4.08 U	4.39 U	4.00 U
Verapamil	0.151 U	0.168 U	0.153 U	0.165 U	0.15 U

U Non-detect at reporting limit
H Concentration is estimated

Table A-11. PPCP concentrations reported for samples, equipment blank, DI blank, and lab blank at the Comal groundwater sites (i.e., Spring run 1, 3 and 7) in Spring. Samples with detectable concentrations denoted in bold.

PPCP List	Spring Run 1	Spring Run 3	Spring Run 3 Duplicate	Spring Run 7	DI Blank	Lab Blank
Acetaminophen	3.32 U	3.4 U	3.47 U	3.18 U	3.29 U	3.00 U
Azithromycin	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Caffeine	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
Carbadox	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Carbamazepine	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Cefotaxime	6.56 U	6.73 U	6.87 U	6.29 U	6.52 U	5.94 U
Ciprofloxacin	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Clarithromycin	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Clinafloxacin	2.21 U	2.27 U	2.31 U	2.12 U	2.19 U	2.00 U
Cloxacillin	3.32 UH	3.4 UH	3.47 UH	3.18 UH	3.29 UH	3.00 UH
Dehydronifedipine	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Digoxigenin	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Digoxin	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
Diltiazem	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Diphenhydramine	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Enrofloxacin	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Erythromycin-H2O	1.66 UH	1.7 UH	1.74 UH	1.59 UH	1.65 UH	1.50 UH
Flumequine	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Fluoxetine	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Lincomycin	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Lomefloxacin	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Miconazole	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Norfloxacin	2.21 U	2.27 U	2.31 U	2.12 U	2.19 U	2.00 U
Norgestimate	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Ofloxacin	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Ormetoprim	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Oxacillin	1.66 UH	1.7 UH	1.74 UH	1.59 UH	1.65 UH	1.50 UH
Oxolinic Acid	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Penicillin G	**4.65** RH	**3.84** RH	**3.58** RH	**4.09** RH	**4.47** RH	**4.16** RH
Penicillin V	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Roxithromycin	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Sarafloxacin	3.32 U	3.4 U	3.47 U	3.18 U	3.29 U	3.00 U
Sulfachloropyridazine	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfadiazine	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfadimethoxine	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Sulfamerazine	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfamethazine	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfamethizole	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfamethoxazole	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Sulfanilamide	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
Sulfathiazole	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Thiabendazole	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Trimethoprim	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Tylosin	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
Virginiamycin M1	0.663 U	0.68 U	0.694 U	0.635 U	0.659 U	0.60 U
1,7-Dimethylxanthine	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U

U Non-detect at reporting limit
R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration
H Concentration is estimated

Table A-12. PPCP concentrations reported for samples, equipment blank, DI blank, and lab blank at the Comal groundwater sites (i.e., Spring run 1, 3 and 7) in Spring. Samples with detectable concentrations denoted in bold.

PPCP List Continued	Spring Run 1	Spring Run 3	Spring Run 3 Duplicate	Spring Run 7	DI Blank	Lab Blank
Alprazolam	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Amitriptyline	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Amlodipine	1.11 U	1.14 U	1.16 U	1.07 U	1.1 U	1.01 U
Benzoylecgonine	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Benztropine	0.774 U	0.794 U	0.81 U	0.741 U	0.769 U	0.70 U
Betamethasone	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Cocaine	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
DEET	**3.98**	**3.77**	**4.65**	**5.06**	**3.29**	**3.30**
Desmethyldiltiazem	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Diazepam	0.555 U	0.569 U	0.581 U	0.531 U	0.551 U	0.50 U
Fluocinonide	2.22 U	2.28 U	2.33 U	2.13 U	2.21 U	2.01 U
Fluticasone propionate	2.22 U	2.28 U	2.33 U	2.13 U	2.21 U	2.01 U
Hydrocortisone	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
10-hydroxy-amitriptyline	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Meprobamate	1.66 U	1.7 U	1.74 U	1.59 U	1.65 U	1.50 U
Methylprednisolone	4.42 U	4.53 U	4.63 U	4.23 U	4.39 U	4.00 U
Metoprolol	0.555 U	0.569 U	0.581 U	0.531 U	0.551 U	0.50 U
Norfluoxetine	0.555 U	0.569 U	0.581 U	0.531 U	0.551 U	0.50 U
Norverapamil	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U
Paroxetine	1.11 U	1.14 U	1.16 U	1.07 U	1.1 U	1.01 U
Prednisolone	4.42 U	4.53 U	4.63 U	4.23 U	4.39 U	4.00 U
Prednisone	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
Promethazine	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Propoxyphene	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Propranolol	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Sertraline	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Simvastatin	2.22 U	2.28 U	2.33 U	2.13 U	2.21 U	2.01 U
Theophylline	6.63 U	6.8 U	6.94 U	6.35 U	6.59 U	6.00 U
Trenbolone	2.22 U	2.28 U	2.33 U	2.13 U	2.21 U	2.01 U
Trenbolone acetate	0.332 U	0.34 U	0.347 U	0.318 U	0.329 U	0.30 U
Valsartan	4.42 U	4.53 U	4.63 U	4.23 U	4.39 U	4.00 U
Verapamil	0.166 U	0.17 U	0.174 U	0.159 U	0.165 U	0.15 U

U Non-detect at reporting limit
H Concentration is estimated

Table A-13. PPCP concentrations reported for samples, DI blank, and lab blank at the Comal groundwater sites (i.e., Spring run 1, 3 and 7) in Fall. Samples with detectable concentrations denoted in bold.

PPCP List	Spring Run 1	Spring Run 3	Spring Run 7	Lab Blank
Acetaminophen	**7.56**	3.19 U	3.13 U	3.00 U
Azithromycin	1.7 U	1.59 U	1.57 U	1.50 U
Caffeine	**21.1**	6.38 U	6.26 U	6.00 U
Carbadox	0.681 U	0.638 U	0.626 U	0.60 U
Carbamazepine	0.34 U	0.319 U	0.313 U	0.30 U
Cefotaxime	6.74 U	6.31 U	6.2 U	5.94 U
Ciprofloxacin	1.7 U	1.59 U	1.57 U	1.50 U
Clarithromycin	0.34 U	0.319 U	0.313 U	0.30 U
Clinafloxacin	2.27 U	2.12 U	2.09 U	2.00 U
Cloxacillin	3.4 UH	3.19 UH	3.13 UH	3.00 UH
Dehydronifedipine	0.34 U	0.319 U	0.313 U	0.30 U
Digoxigenin	1.7 U	1.59 U	1.57 U	1.50 U
Digoxin	6.81 U	6.38 U	6.26 U	6.00 U
Diltiazem	0.17 U	0.159 U	0.157 U	0.15 U
Diphenhydramine	0.681 U	0.638 U	0.626 U	0.60 U
Enrofloxacin	0.681 U	0.638 U	0.626 U	0.60 U
Erythromycin-H2O	1.7 UH	1.59 UH	1.57 UH	1.50 UH
Flumequine	0.34 U	0.319 U	0.313 U	0.30 U
Fluoxetine	0.17 U	0.159 U	0.157 U	0.15 U
Lincomycin	0.681 U	0.638 U	0.626 U	0.60 U
Lomefloxacin	0.681 U	0.638 U	0.626 U	0.60 U
Miconazole	0.34 U	0.319 U	0.313 U	0.30 U
Norfloxacin	2.27 U	2.12 U	2.09 U	2.00 U
Norgestimate	1.7 U	1.59 U	1.57 U	1.50 U
Ofloxacin	0.681 U	0.638 U	0.626 U	0.60 U
Ormetoprim	0.17 U	0.159 U	0.157 U	0.15 U
Oxacillin	1.7 UH	1.59 UH	1.57 UH	1.50 UH
Oxolinic Acid	0.681 U	0.638 U	0.626 U	0.60 U
Penicillin G	3.4 UH	3.19 UH	3.13 UH	3.00 UH
Penicillin V	1.7 U	1.59 U	1.57 U	1.50 U
Roxithromycin	0.17 U	0.159 U	0.157 U	0.15 U
Sarafloxacin	3.4 U	3.19 U	3.13 U	3.00 U
Sulfachloropyridazine	0.681 U	0.638 U	0.626 U	0.60 U
Sulfadiazine	0.681 U	0.638 U	0.626 U	0.60 U
Sulfadimethoxine	0.34 U	0.319 U	0.313 U	0.30 U
Sulfamerazine	0.681 U	0.638 U	0.626 U	0.60 U
Sulfamethazine	0.681 U	0.638 U	0.626 U	0.60 U
Sulfamethizole	0.745 U	0.638 U	**0.818**	0.60 U
Sulfamethoxazole	0.681 U	0.638 U	**0.667**	0.60 U
Sulfanilamide	6.81 U	6.38 U	6.26 U	6.00 U
Sulfathiazole	1.7 U	1.59 U	1.57 U	1.50 U
Thiabendazole	0.34 U	0.319 U	0.313 U	0.30 U
Trimethoprim	0.34 U	0.319 U	0.313 U	0.30 U
Tylosin	0.681 U	0.638 U	0.626 U	0.60 U
Virginiamycin M1	0.681 U	0.638 U	0.626 U	0.60 U
1,7-Dimethylxanthine	**7.98**	6.38 U	6.26 U	6.00 U

U Non-detect at reporting limit
H Concentration is estimated

Table A-14. PPCP concentrations reported for samples, DI blank, and lab blank at the Comal groundwater sites (i.e., Spring run 1, 3 and 7) in Fall. Samples with detectable concentrations denoted in bold.

PPCP List	Spring Run 1	Spring Run 3	Spring Run 7	Lab Blank
Alprazolam	**0.34** U	0.319 U	0.313 U	0.30 U
Amitriptyline	0.34 U	0.319 U	0.313 U	0.30 U
Amlodipine	**1.14** U	1.07 U	1.05 U	1.01 U
Benzoylecgonine	**0.46**	0.159 U	**0.384**	0.15 U
Benztropine	0.794 U	0.744 U	0.731 U	0.70 U
Betamethasone	1.7 U	1.59 U	1.57 U	1.50 U
Cocaine	**1.33**	**0.25**	**3.16**	0.15 U
DEET	**3.04**	**2.7**	**9.18**	**3.53**
Desmethyldiltiazem	0.17 U	0.159 U	0.157 U	0.15 U
Diazepam	0.57 U	0.534 U	0.524 U	0.50 U
Fluocinonide	2.28 U	2.14 U	2.1 U	2.01 U
Fluticasone propionate	2.28 U	2.14 U	2.1 U	2.01 U
Hydrocortisone	**40.8**	6.38 U	**6.48**	6.00 U
10-hydroxy-amitriptyline	0.17 U	0.159 U	0.157 U	0.15 U
Meprobamate	1.7 U	1.59 U	1.57 U	1.50 U
Methylprednisolone	4.54 U	4.25 U	4.17 U	4.00 U
Metoprolol	0.57 U	0.534 U	0.524 U	0.50 U
Norfluoxetine	0.57 U	0.534 U	0.524 U	0.50 U
Norverapamil	0.17 U	0.159 U	0.157 U	0.15 U
Paroxetine	1.14 U	1.07 U	1.05 U	1.01 U
Prednisolone	4.54 U	4.25 U	4.17 U	4.00 U
Prednisone	6.81 U	6.38 U	6.26 U	6.00 U
Promethazine	0.34 U	0.319 U	0.313 U	0.30 U
Propoxyphene	0.34 U	0.319 U	0.313 U	0.30 U
Propranolol	0.34 U	0.319 U	0.313 U	0.30 U
Sertraline	0.34 U	0.319 U	0.313 U	0.30 U
Simvastatin	2.28 U	2.14 U	2.1 U	2.01 U
Theophylline	**14.9** R	6.38 U	6.26 U	6.00 U
Trenbolone	2.28 U	2.14 U	2.1 U	2.01 U
Trenbolone acetate	0.34 U	0.319 U	0.313 U	0.30 U
Valsartan	4.54 U	4.25 U	4.17 U	4.00 U
Verapamil	0.17 U	0.159 U	0.157 U	0.15 U

U Non-detect at reporting limit

R Peak detected but did not meet quantification criteria, result reported is estimated maximum possible concentration

H Concentration is estimated