Santa Ana Watershed Project Authority

Santa Ana River Regional Bacteria Monitoring Program Annual Report: 2022-2023

June 2023

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Acronyms and Abbreviations

AgSEP	Agricultural Source Evaluation Plan
Babcock	Babcock Laboratories, Inc.
Basin Plan	Water Quality Control Plan for the Santa Ana River Basin
BMP	Best Management Practice
BPA	Basin Plan Amendment
CBRP	Comprehensive Bacteria Reduction Plan
CEDEN	California Environmental Data Exchange Network
cfs	cubic feet per second
CFU	Colony Forming Units
COC	chain-of-custody
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
EVMWD	Elsinore Valley Municipal Water District
gc	gene copy
MPN	Most Probable Number
MSAR	Middle Santa Ana River
OCPHL	Orange County Health Care Agency Water Quality Laboratory
OCPW	Orange County Public Works
POTW	Publicly Owned Treatment Works
ppth	parts per thousand
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RCFC&WCD	Riverside County Flood Control & Water Conservation District
RBMP	Regional Bacteria Monitoring Program
RM	River Mile
Santa Ana Water Board	Santa Ana Regional Water Quality Control Board
SAR	Santa Ana River
SAWPA	Santa Ana Watershed Project Authority
SBCFCD	San Bernardino County Flood Control District
STV	Statistical Threshold Value
State Water Board	State Water Resources Control Board
SWQS	Stormwater Quality Standards Task Force
Task Force	MSAR TMDL / Regional Water Quality Task Force

TMDL	Total Maximum Daily Limit
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEP	Urban Source Evaluation Plan

Executive Summary

The Stormwater Quality Standards Study (SQSS) Task Force was formed in 2002 to embark upon a deliberate and measured approach to protect recreational uses in inland surface waters in the Santa Ana Basin. At the time, there were few examples of such a group including water quality regulators and watershed stakeholders spread across three counties and encompassing a mix of municipal separate storm sewer systems (MS4s), agricultural groups, state lands, and Publicly Owned Treatment Works (POTWs) coalescing together for common values. The SQSS Task Force collaborated on an amendment to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) that pulled from 17 recreational use surveys, six use attainability analyses (UAAs), economic feasibility assessments, hydrologic analysis, California Environmental Quality Act (CEQA) analysis, and many other special studies. Changes to Basin Plan were approved by Region 9 of the Environmental Protection Agency (EPA) in April 2015 and allowed for the watershed stakeholders to focus resources on areas of highest priority to protect public health. The Basin Plan Amendment (BPA) required development and implementation of a Regional Bacteria Monitoring Program (RBMP). The SQSS Task Force was sunsetted and a new Task Force was formed to oversee the RBMP -- a program of routine bacteriological data needed to meet key priorities of the BPA, as follows:

- Priority 1: Monitor bacteria levels at those locations where and when people are most likely to engage in water contact recreation.
- Priority 2: Evaluate effectiveness of implementation actions taken to comply with the Middle Santa Ana River (MSAR) bacteria total maximum daily load (TMDL).
- Priority 3: Collect data to evaluate status and trends in other bacteria impaired waters throughout the Santa Ana Basin.
- Priority 4: Ensure that waters re-designated as 'REC2 Only' meet antidegradation requirements in the absence of a numeric water quality objective (WQO).

For each of these priority categories, data are synthesized at a summary level and key interpretive findings from this 2022-23 annual report are highlighted in the following sections.

Priority 1 – Waterbody Segments with Greatest Risk of Exposure

Fecal bacteria conditions in Priority 1 waters remain generally low and support recreational use with the exceptions of Lake Elsinore at Elm Grove Beach (P1-2-ELM), Lytle Creek (P1-6), and the two Santa Ana River sites (WW-S1 and WW-S4) during both warm and cool seasons (**Figure ES-1**). The two Santa Ana River sites are being addressed through implementation of Comprehensive

Bacteria Reduction Plans (CBRP) in the MSAR TMDL. The Task Force has begun to conduct studies to investigate sources of fecal bacteria at the sites in Lake Elsinore and Lytle Creek.

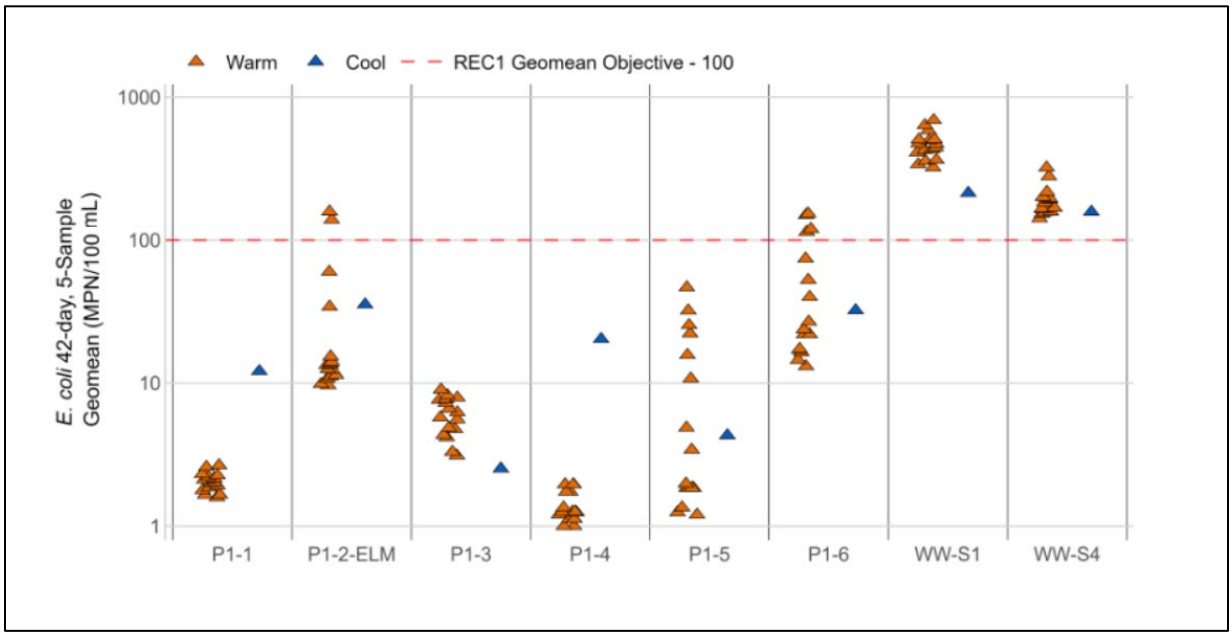

Figure ES-1. *E. coli* Geomean Concentrations in Priority 1 Waters during Dry Weather in Warm (20 consecutive weeks) and Cool (5 consecutive weeks) Seasons in 2022-2023

Lake Elsinore has naturally high salinity stemming from its status as a terminal lake. Thus, Enterococcus was included in the list of lab analytes for Lake Elsinore samples based on the guidance to use Enterococcus in waters greater than 1 part per thousand (ppth) of salinity from the Statewide Bacteria Provisions (Section 1.1.2). Sampling on Lake Elsinore for Enterococcus was conducted at Launch Pointe (P1-2) for the 2019-2020 and 2020-2021 monitoring periods. For the 2021-2022 and 2022-2023 monitoring years, the Lake Elsinore sampling site was moved to Elm Grove Beach (P1-2ELM). The Lake Elsinore sampling location was changed after coordination with the City of Lake Elsinore to achieve the Priority 1 goal of monitoring locations with the greatest risk of exposure. After two years, Enterococcus at Elm Grove Beach was found to be significantly greater than Launch Pointe (**Figure ES-2**). Enterococcus concentrations in Lake Elsinore at Elm Grove Beach pose a significant concern for swimmers based on 2022-2023 monitoring.

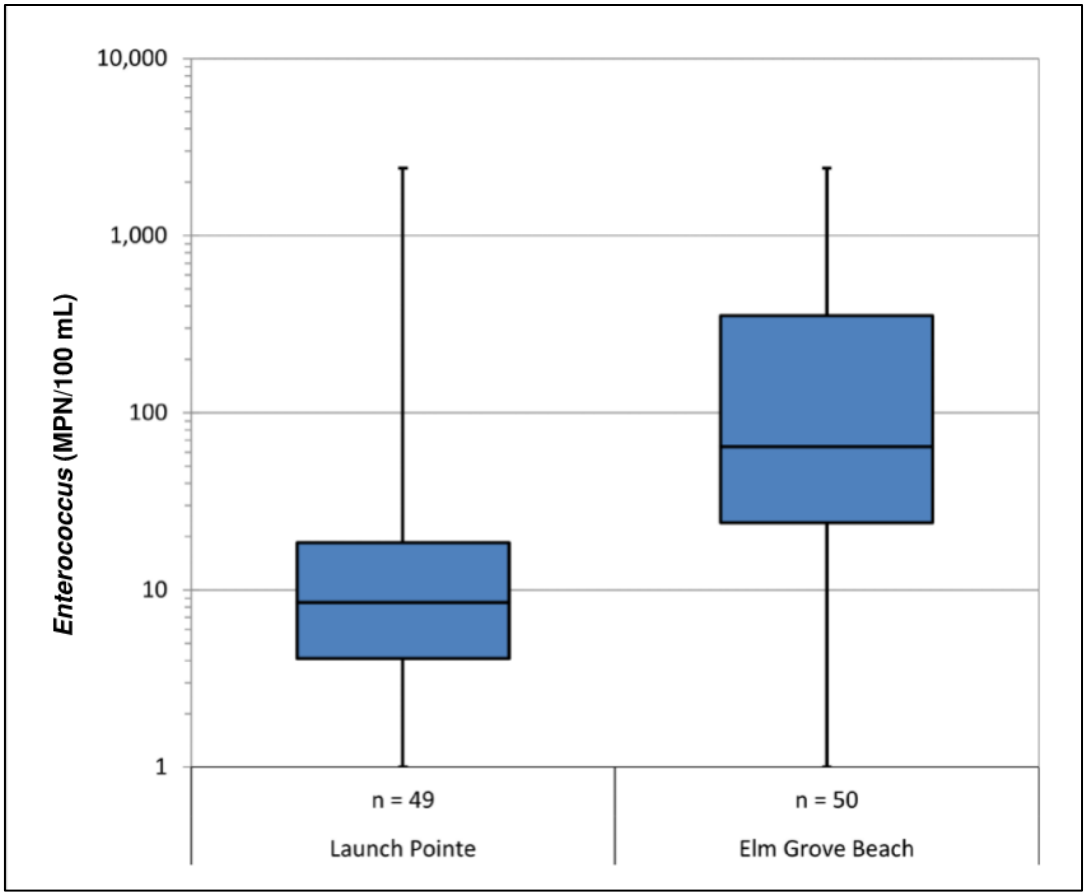

Figure ES-2. Enterococcus Concentrations at Lake Elsinore at Launch Pointe (2019-2020) and Elm Grove Beach (2021-2022)

The City of Lake Elsinore sought to understand whether Elsinore Valley Municipal Water District's (EVMWD) discharge of reclaimed water near Elm Grove Beach could be responsible for the high levels of Enterococcus observed at the RBMP sampling site. A special study was conducted in February 2022 to collect indicator bacteria and human Bacteroides markers at multiple sites in the flood control channel, at the reclaimed water discharge and in the lake near the discharge. The study found that Enterococcus at the reclaimed water outfall and in the lake near the outfall was low showing that the source is not directly associated with EVMWD's plant. High levels of Enterococcus and human HF-183 marker were observed near the mouth of the flood control channel that historically conveyed reclaimed water to the lake. In 2021, EVMWD reconfigured the discharge into an existing pipeline that was extended to the lakeshore. Concentrations within the lake, south of the old effluent channel, were lower but also had detected values for Enterococcus and the HF-183 marker, suggesting that another source that originates within the old effluent channel may be important. The City of Lake Elsinore staff have indicated that unhoused people use this area. The RBMP Task Force will continue to monitor the site at Elm Grove Beach and coordinate with the City of Lake Elsinore on supplemental source tracking in the 2023 dry season with the goal to identify and eliminate this source.

During the 2022 dry season, Lytle Creek exceeded the statewide bacteria provision for *E. coli* of 100 Most Probably Number (MPN)/100 mL in four out of 16 calculated five-sample geomeans

(**Figure ES-3**). Prior to 2022, this site had not exceeded WQOs over the period of record for the RBMP. The four exceedances occurred in the final four weeks of monitoring program implementation (August 30 – September 20, 2022). The cumulative impact of recreational use within the riparian zones of inland streams over the course of the dry season could be a source of *E. coli* bacteria through direct fecal contamination or indirectly, such as from increased trash accumulation attracting other animals. Additionally, flow rates were lower in the 2022 dry season than in past monitoring years, which could have contributed to the higher concentration of *E. coli*. Further study of this seasonal pattern may be considered by the Task Force.

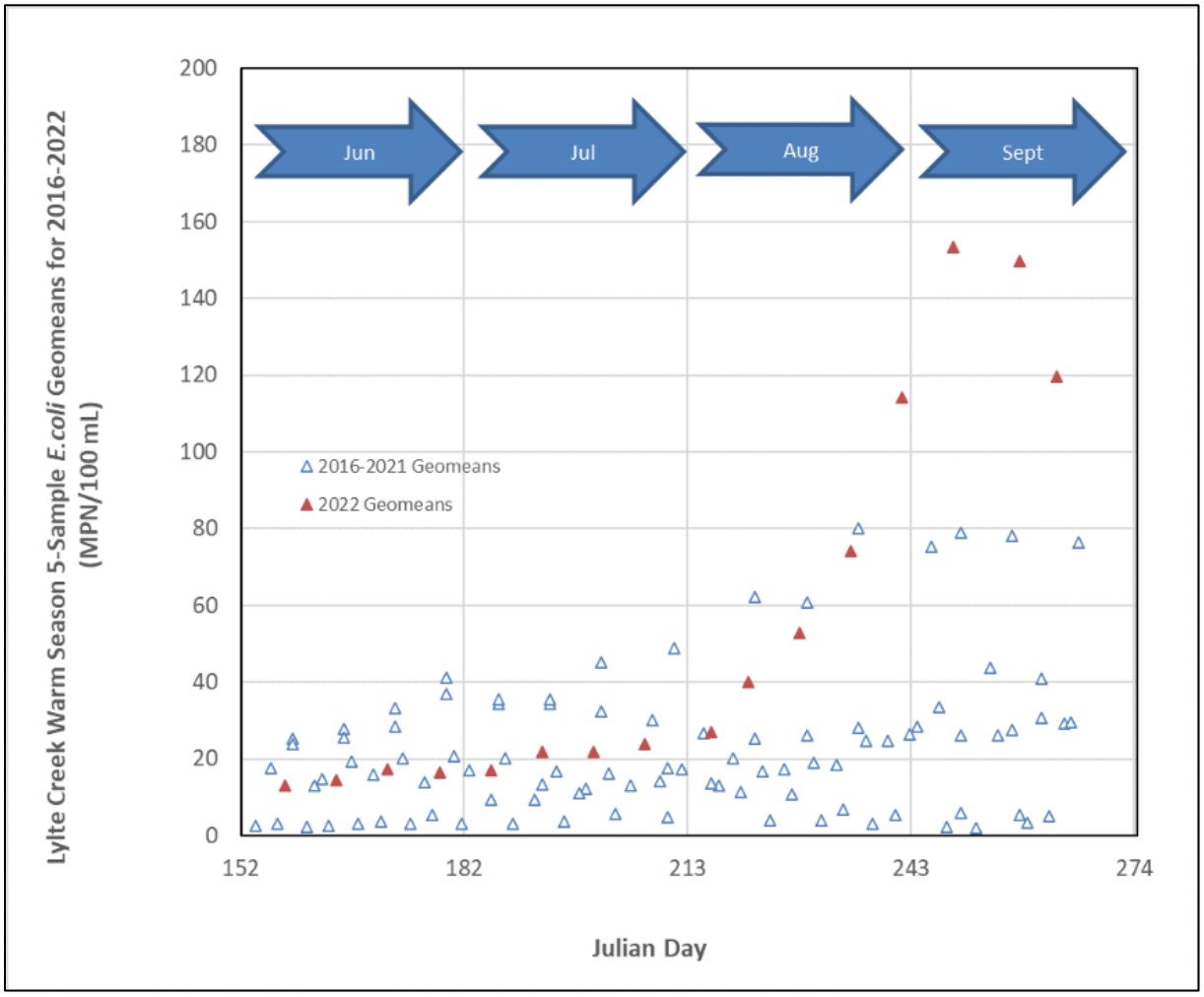

Figure ES-3. Five-Sample Geomeans for *E. coli* during Dry Seasons from 2016-2022 at Lytle Creek

Priority 2 – Waters Subject to an Existing TMDL

This RBMP annual report characterizes fecal bacteria conditions within the MSAR TMDL waters: Santa Ana River Reach 3, Mill-Cucamonga Creek, and Chino Creek. **Figure ES-4** shows the calculated geomean concentrations for both the warm and cool 2022 dry season. In 2022, no site attained the TMDL waste load allocations (WLAs) for the entirety of the dry season, with rolling geomeans compliance percentages of 79, 50, 37, 0 and 0, at Prado Park Lake, Santa Ana River at Pedley Avenue, Chino Creek, Mill-Cucamonga Creek, and Santa Ana River at MWD Crossing,

respectively. For dry weather samples during the cool season, Chino Creek has met the geometric mean WLA in the past two years.

Several notable findings from monitoring and other source tracking in the MSAR watershed from 2022-23 period are presented below. For more in-depth analysis, the 2023 MSAR TMDL Triennial Report synthesizes most bacteria source tracking and other special studies implemented over the past three years as well as historical implementation activities.

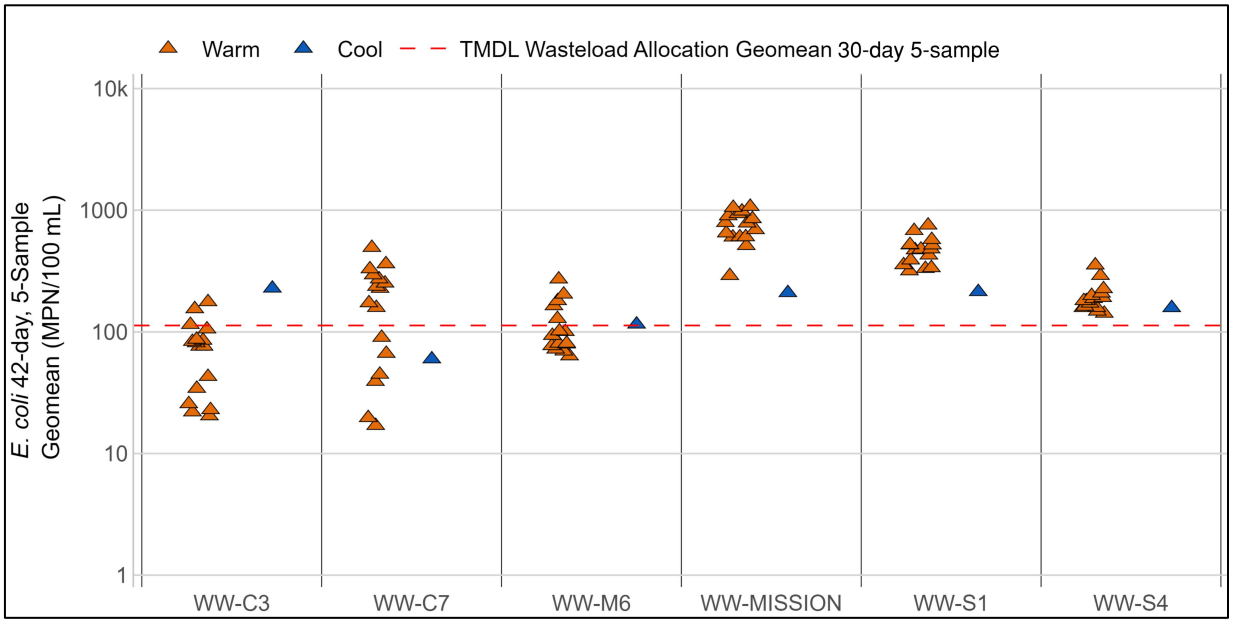

Figure ES-4. *E. coli* (MPN/100 mL) and Geomeans for Priority 2 Waters in 2022-2023

The Task Force implemented a special study to collect supplemental data within the MSAR waters to advance understanding of the presence and magnitude of fecal bacteria associated with defecation by feral pigs within the riparian ecosystem. The focus on feral pigs stemmed from exploratory sampling within the 2021 Homeless Encampment Study, which found elevated levels of the Pig2Bac marker during the final two sampling events at three sites downstream of the Mission Avenue Bridge. It is well known by local stakeholders that a population of feral pigs resides within the Santa Ana River riparian corridor; accordingly, they may be an important source of fecal bacteria in the impaired waters.[1] Recently, California Department of Fish and Wildlife staff indicated that a significant number of pigs are in the riparian corridor in an area that generally spans from the Riverside Drive Bridge crossing to Prado Basin. These non-native pigs are considered to have a negative impact on the native riparian habitat (Rick Whetsel, personal communication with California Department of Fish and Wildlife staff, September 13, 2022).

The Task Force sought to assess the importance of this uncontrollable wildlife source within sampling during the 2022 dry season. Samples were collected every other week over the 2022

[1] Orange County Register (January 14, 2022; updated January 19, 2022) noted that in the 1990s it was estimated that the population of feral pigs likely ranged from 300-400 animals and even at that time pigs have been observed for decades in parts of Riverside County. https://www.ocregister.com/2022/01/14/wild-hungry-pigs-still-rampaging-around-santa-ana-river/.

dry season from the following Priority 2 sites: WW-MISSION, WW-S1 and WW-S4; and the Mill-Cucamonga Creek site: WW-M6 (see **Figure 2-1**). Samples were sent to Weston Labs for qPCR analysis of the Pig2Bac marker. **Table ES-1** summarizes the results from the Pig2Bac analysis of water samples. The study found that the concentration of *Bacteroides* from feral pigs varies significantly from site to site. Specifically,

- No detections of the Pig2Bac marker were observed at the Mill-Cucamonga Creek (WW-M6) TMDL compliance site.
- Consistent detections [ranging from 295 – 5,322 gene copy (gc)/100 mL] were observed at the Santa Ana River MWD Crossing (WW-S1) and Pedley Avenue (WW-S4) sites, indicating that feral pigs may be a potentially important source of *E. coli* at these sites.
- At the WW-MISSION site, shown to generate the majority of dry weather *E. coli* load to Santa Ana River Reach 3 from an unknown in-stream source (Section 4.3.1), the Pig2Bac marker was only detected in one of 10 samples. The one detection occurred during the final week of sampling after a construction project along the levee in the vicinity of Mission Avenue was initiated. Meanwhile, *E. coli* concentrations were elevated relative to downstream sites in all 10 samples, showing that fresh fecal deposits from feral pigs were not an important source during 2022 contributing to the *E. coli* fecal bacteria load that enters Reach 3 of the Santa Ana River at this location.

Table ES-1. *E. coli* Concentration (MPN/100 mL) and Pig2Bac Assay (Gene Copies/100 mL, gc/100 mL) Results from MSAR Watershed Sites, May through September 2022 (ND = Non-Detect, BDL = Below Detection Limit)

Sample Date	WW-M6		WW-S4		WW-S1		WW-MISSION	
	E. coli	Pig2Bac	*E. coli*	Pig2Bac	*E. coli*	Pig2Bac	*E. coli*	Pig2Bac
5/12/2022	110	ND	140	795	460	1,072	63	ND
5/26/2022	230	ND	200	438	680	7,629	800	ND
6/9/2022	74	ND	880	1,599	350	3,057	1,100	ND
6/27/2022	86	ND	190	1,161	310	4,099	190	ND
6/30/2022	98	ND	210	962	440	1,843	1,400	ND
7/14/2022	63	ND	340	2,042	280	1,044	780	ND
7/28/2022	41	ND	150	1,692	410	1,364	840	ND
8/11/2022	140	ND	230	1,802	460	2,728	1,300	ND
8/25/2022	180	ND	85	295	270	5,322	1,100	ND
9/8/2022	200	ND	230	1,470	1,100	BDL	840	1,947

Results from 2019-2022 show that dry season geometric means of *E. coli* concentrations at WW-MISSION at the upstream boundary of Reach 3 account for the majority of downstream load measured at WW-S1 and WW-S4 (see 2023 MSAR TMDL Triennial Report for more in-depth data analysis). The MSAR Task Force has shown that a compliance strategy that focuses only on

elimination of all MS4 dry weather flows and associated bacteria load to Santa Ana River Reach 3 would not result in attainment of WQOs. The concentration of *E. coli* at WW-MISSION in the 2022 dry season increased substantially and a similar rise was observed at the downstream TMDL compliance monitoring location WW-S1 (**Figure ES-5**). Historical data show a pattern of rising *E. coli* with distance from the point of POTW discharge 4.5 river miles (RMs) upstream of WW-MISSION (considered as RM 0.0 in **Figure ES-6**).

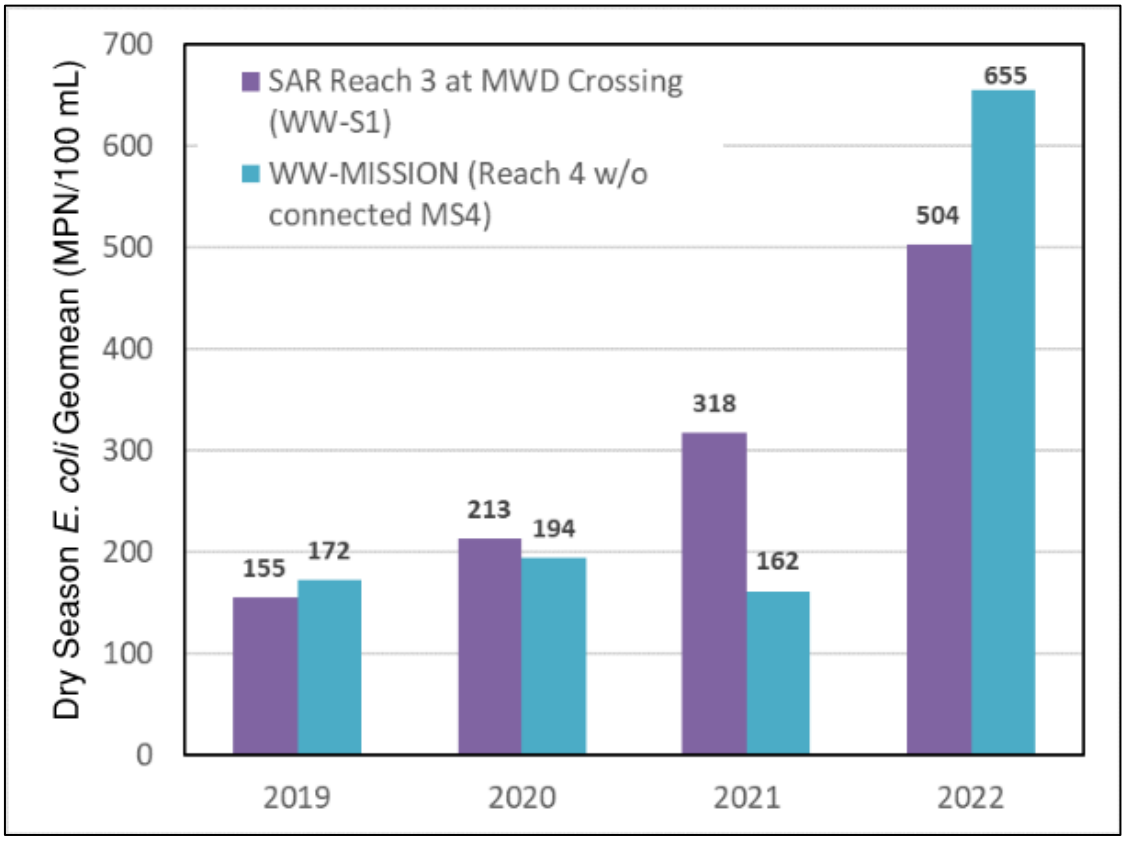

Figure ES-5. Dry Season *E. coli* Geomean Concentration in Santa Ana River Reach 4 at Mission Boulevard Bridge WW-MISSION and Santa Ana River Reach 3 at MWD Crossing WW-S1 (2019-2022)

Multiple special studies by the MSAR TMDL Task Force have investigated potential sources of fecal bacteria but have not identified the sources of bacteria responsible for the majority of *E. coli* load to Reach 3 of the Santa Ana River. These studies have analyzed sources including direct fecal contamination by feral pigs, dogs, humans, gulls, birds, and inputs of urban dry weather flow from MS4 outfalls. The MSAR TMDL Task Force may consider studies to investigate other potential sources to further understanding about the potential causes and degree of controllability of elevated fecal indicator bacteria within the river upstream from any connected MS4 inflows. The State is currently leading a process to connect and advance both science and policy with regard to bacteria in recreational waters.[2] Any further studies within the MSAR waters should coordinate with this statewide effort.

[2] Bacteria | CASQA (https://www.casqa.org/resources/water-quality-priorities/bacteria).

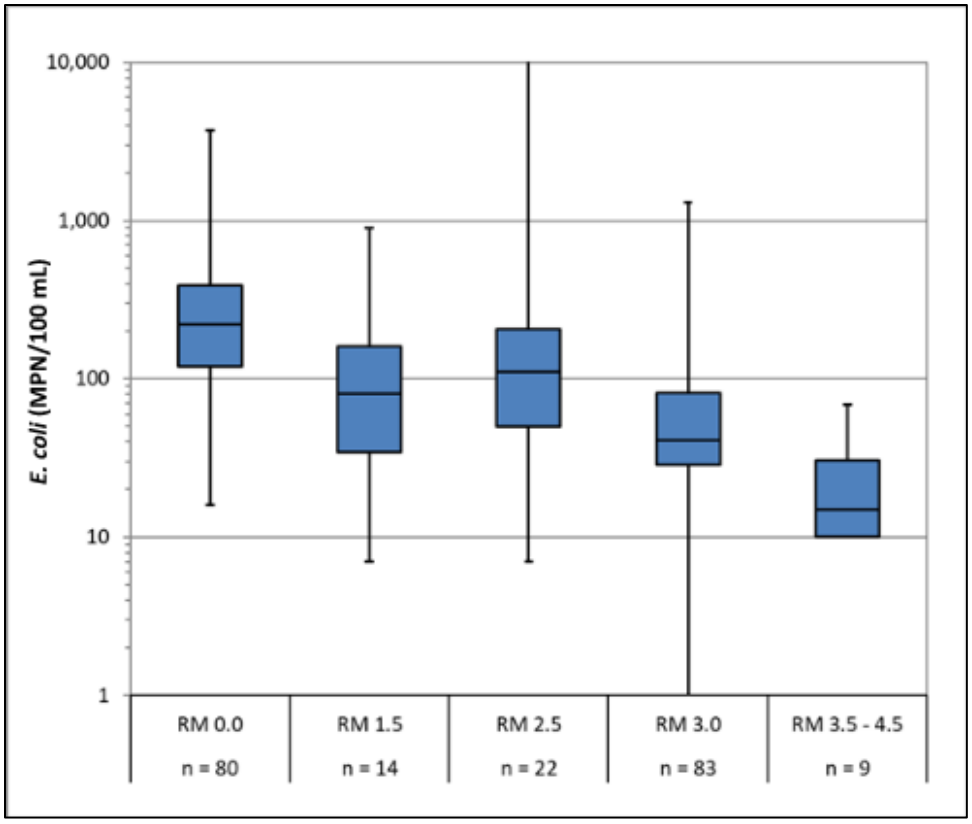

Figure ES-6. 2020-2022 Grab Sample *E. coli* Concentrations in the Santa Ana River Reach 4 from Mission Boulevard Bridge, referred to as RM 0.0 to the POTW Discharge located 4.5 RMs upstream

Conditions in Mill-Cucamonga Creek have improved significantly since the completion of a project to divert a portion of the flow from the Hellman Avenue location for treatment within Mill Creek Wetland and release back to Mill-Cucamonga Creek just upstream of the TMDL compliance monitoring location. Comprehensive analysis of six years of effectiveness monitoring for Mill Creek Wetlands showed a greater than 95 percent reduction in *E. coli* (**Table ES-2**).

Table ES-2. Estimate of Reduction in *E. coli* Load Resulting from Implementation of the Mill Creek Wetlands Best Management Practice, 2017-2022 (n = 50)

Mill Creek Wetlands (MCW)	Flow (cfs)	*E. coli* Concentration (MPN/100 mL)	*E. coli* Load (Billion MPN/Day)
Influent	2.5	629	38.3
Effluent	0.7	77	1.3
Median Removal (%) in MCW	71%	88%	97%

cfs = cubic feet per second

Priority 3 – Bacteria Impaired Waters Without an Existing TMDL

The Task Force has collaborated with the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) to collect five consecutive-week samples each dry season to characterize current fecal bacteria concentrations in waters that were added to the 303(d) list but do not have a TMDL. In some cases, the basis for original 303(d) listing involved data collected over 15 years ago and new monitoring data collected through this RBMP has provided updated information. **Figure ES-7** shows the results from the 2022 dry season sampling.

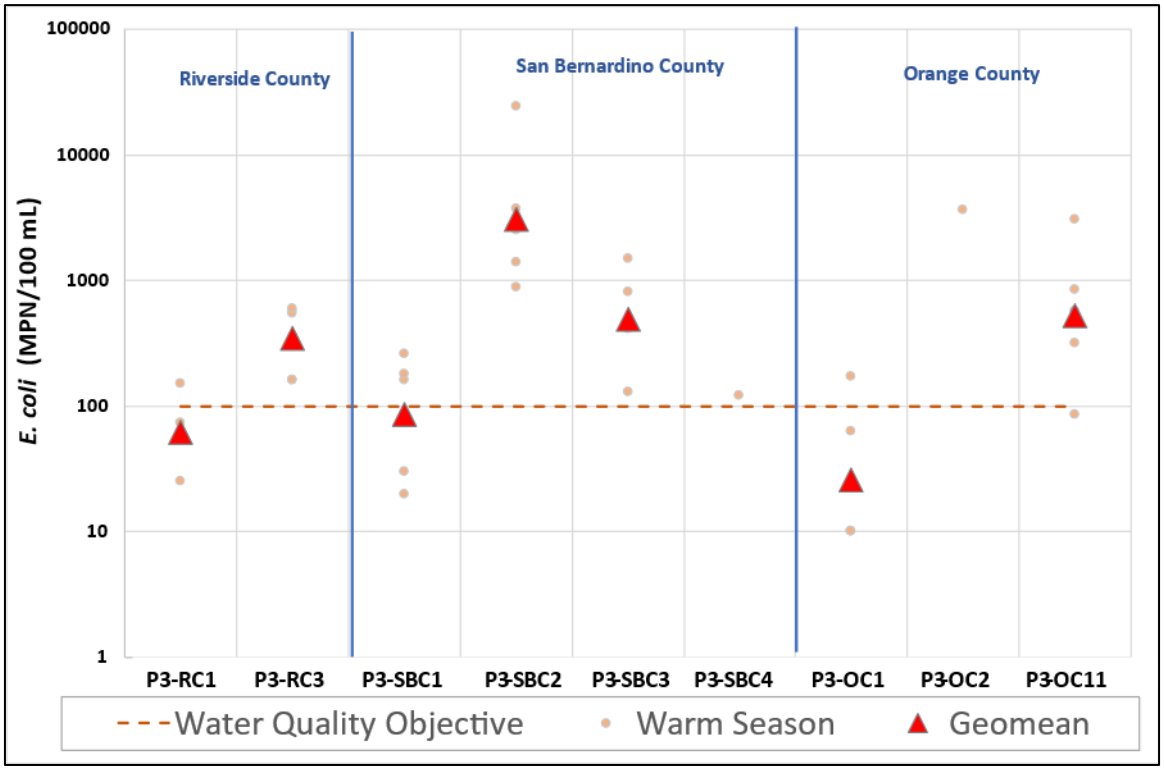

Figure ES-7. Distribution of *E. coli* Concentration Measurements at Priority 3 Sites

The geometric mean of *E. coli* concentrations at Goldenstar Creek met WQOs, a significant reduction in the 2022 dry season compared to previous years 2017-2022 (**Figure ES-8**). Ongoing special studies and cleanup activities within the channel may have contributed to the improved water quality condition.

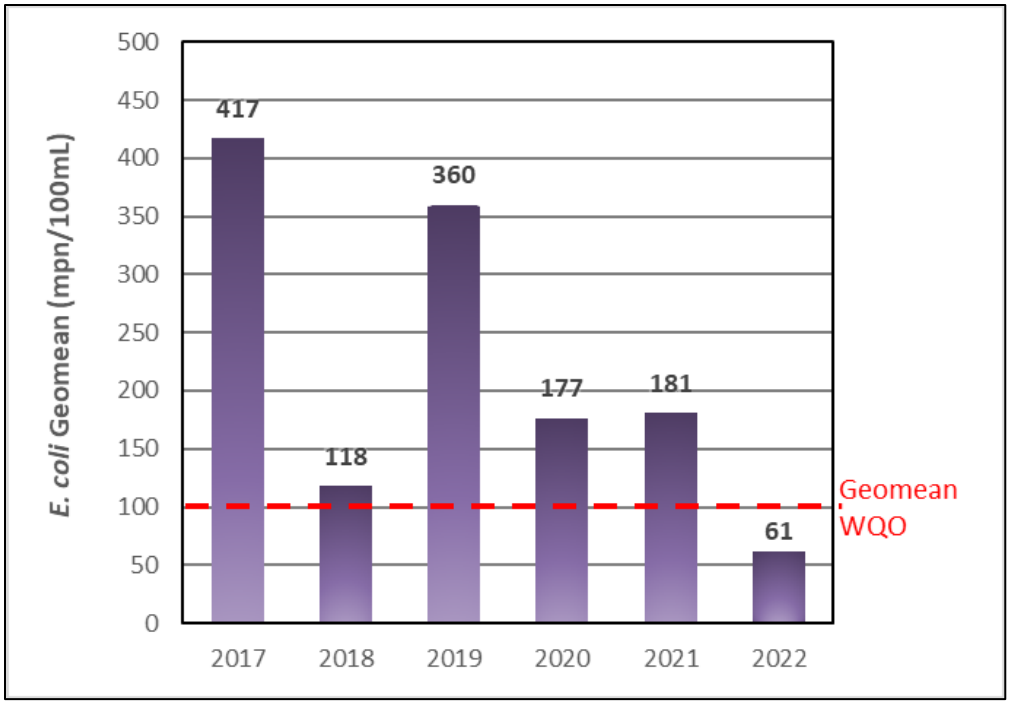

Figure ES-8. Geometric Mean of *E. coli* in Dry Season Samples Collected in Goldenstar Creek

Priority 4 – Waters Re-Designated as REC2 Only

A key component to the 2012 BPA involved the completion of six UAAs that served as the basis for EPA approval of changes to the beneficial use from REC1 and REC2 to REC2 Only in eight waterbodies: Cucamonga Creek Reach 1, Temescal Creek Reach 1a and 1b, Santa Ana-Delhi Channel Reaches 1 and 2, Greenville-Banning Channel Reach 1, and tidal prisms for Greenville-Banning and Santa Ana-Delhi Channels.

The Basin Plan describes REC2 Only waters as having "…relatively brief incidental or accidental water contact that is limited primarily to the body extremities (e.g., hands or feet) is generally deemed REC 2 because ingestion is not considered reasonably possible." Numeric WQOs included in the Basin Plan for REC2 Only waters serve to meet antidegradation policy requirements. Statistical analysis of historical datasets on the re-designated waters was performed to derive an antidegradation target as a statistical threshold value (STV) set at the 75th percentile of the data distribution. Each year, the RBMP collects a single sample in these waters to be compared with the site-specific thresholds. If there is an exceedance, follow-up samples are collected to assess if the event falls within the natural variability of the historical data.

In 2022-2023 monitoring period, no exceedances of antidegradation threshold values occurred in Cucamonga Creek 1 (P4-SBC1) or Temescal Creek at Lincoln Avenue (P4-RC2). Antidegradation threshold values were exceeded at Greenville-Banning Channel and Delhi Channel stations. Orange County conducted the required monthly follow-up sampling, which found that the degradation is not occurring at the Greenville-Banning Channel (P4-OC3) nor the Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) stations. Monthly sampling beginning October 2022 at the Santa Ana-Delhi Channel upstream of Irvine Avenue (P4-OC1) has alternated being above and below the antidegradation target so monthly sampling will continue there.

Retrospective

The RBMP Task Force is continuing to collaborate on common objectives to protect recreational use in the region's inland surface waters. We have used collective understanding of the watershed and scientific advancements to address fecal bacteria impairments and used the tools afforded in the Clean Water Act to prioritize use of resources to protect public health. The RBMP Task Force is collaborating with the Santa Ana Water Board to ensure that the monitoring program is adapted to respond to several key regulatory activities including the 2022 California Bacteria Summit, 2024 Integrated List of Waters for Santa Ana region (once approved), MS4 permit reissuance, and limited Basin Plan amendment for the MSAR bacteria TMDL. In addition, the Task Force has continued to stay at the forefront of environmental science and technology through the implementation of innovative studies using bacterial DNA sampling to determine or eliminate causes for degraded water quality.

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Section 1
Introduction

The Santa Ana River Watershed Regional Bacteria Monitoring Program (RBMP) was developed to achieve the following objectives through bacteria monitoring:

- Provide the data needed to determine if water quality is safe when and where people are most likely to engage in water contact recreation.
- Facilitate the Total Maximum Daily Load (TMDL) implementation process and track progress toward attainment of applicable water quality standards, where water quality is impaired due to excessive bacterial indicator levels.
- Apply a risk-based implementation strategy to allocate public resources in a manner that is expected to produce the greatest public health benefit.

1.1 Regulatory Background

The Santa Ana River RBMP supports the implementation of several regulatory-related activities associated with the protection of recreational uses in the Santa Ana River Watershed, including the amendment to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* and the Middle Santa Ana River (MSAR) Bacteria TMDL. Each of the activities addressed by the Santa Ana River RBMP is described below.

1.1.1 Basin Plan Amendment

On June 15, 2012, the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) adopted the Basin Plan Amendment (BPA) to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region.*[3] This BPA resulted in the following key modifications to the Basin Plan for the Santa Ana region:[4]

- Addition of "Primary Contact Recreation" as an alternative name for the REC1 (water contact recreation) beneficial use.
- Addition of narrative text clarifying the nature of REC1 activities, and the bacteria objectives established to protect these activities.
- Differentiation of inland surface REC1 waters on the basis of frequency of use and other characteristics for the purposes of assigning applicable single sample maximum values.
- Revision of REC1/REC2 (non-contact water recreation) designations for specific inland surface waters based on the results of completed Use Attainability Analysis (UAA).

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[3] Santa Ana Water Board Resolution: R8-2012-0001, June 15, 2012.

[4] Santa Ana Basin Plan Chapter 5, Page 5-92; http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2016/Chapter_5_February_2016.pdf.

- Revision of water quality objectives (WQOs) to protect the REC1 use of inland freshwaters.
- Identification of criteria for temporary suspension of recreation use designations and objectives (high flow suspension).

Santa Ana Water Board staff developed the BPA in collaboration with the Stormwater Quality Standards Task Force (SWQSTF), composed of representatives from various stakeholder interests, including the Santa Ana Watershed Project Authority (SAWPA); the counties of Orange, Riverside, and San Bernardino; Orange County Coastkeeper; Inland Empire Waterkeeper; and the Environmental Protection Agency (EPA) Region 9. The BPA was approved by the State Water Resources Control Board (State Water Board) on January 21, 2014[5] and the California Office of Administrative Law on July 2, 2014.[6] However, the EPA did not approve all provisions of the BPA, which required revisions in the form of letters. The EPA issued its comment letter on April 8, 2015, and provided a letter of clarification on August 3, 2015.[7]

The BPA required the establishment of a comprehensive monitoring program to support implementation of the changes to the Basin Plan.[8] The Santa Ana River RBMP fulfills this requirement.

1.1.2 Statewide Bacteria Provisions

On August 7, 2018, the State Water Board adopted *Bacteria Provisions and a Water Quality Standards Policy for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (Statewide Bacteria Provisions).[9] The Statewide Bacteria Provisions developed new statewide numeric WQOs for bacteria to protect primary contact recreation beneficial use, as follows:

- *E. coli*: For all waters where the salinity is equal to or less than 1 part per thousand (ppth), 95 percent or more of the time, a six-week rolling geometric mean of at least five samples not to exceed 100 colony forming units (cfu)/100 mL, calculated weekly, and a statistical threshold value (STV) of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.
- Enterococcus: For all waters where the salinity is greater than 1 ppth, 5 percent or more of the time, a six-week rolling geometric mean of at least five samples not to exceed 30 cfu/100mL, calculated weekly, and a STV of 110 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

The Statewide Bacteria Provisions supersede numeric WQOs for REC1 use contained in regional Basin Plans, except for cases involving a site-specific standard or if an existing TMDL was developed with targets based on prior regional Basin Plan REC1 WQOs (such as the MSAR Bacteria TMDL). **Section 2.1.1** describes the MSAR Bacteria TMDL and associated numeric

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5 State Water Board Resolution: 2014-0005, January 21, 2014.

6 Office of Administrative Law: #2014-0520-02 S; July 2, 2014.

7 http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.shtml

8 Santa Ana Basin Plan Chapter 5, Page 5-114; http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2016/Chapter_5_February_2016.pdf.

9 State Water Board Resolution: 2014-0005, January 21, 2014.

targets, which differ from those included in the Statewide Bacteria Provisions. This comprehensive monitoring program was developed to facilitate data collection needed to evaluate both TMDL numeric targets and Statewide Bacteria Provisions WQOs for the TMDL waters. Compliance metrics, however, are based solely on the TMDL numeric targets.

Lastly, the Statewide Bacteria Provisions do not supersede narrative WQOs in regional Basin Plans. The BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* is composed of predominantly narrative criteria, which remain in effect for the Santa Ana region. The narrative criteria in the BPA are largely consistent with narrative criteria contained in the Statewide Bacteria Provisions.

1.1.3 Antidegradation Targets

The BPA established site-specific antidegradation targets for waterbodies with only a REC2 designation. For each of these waterbodies, the REC1 beneficial use was de-designated through an approved UAA. The antidegradation targets serve as triggers for additional monitoring or efforts to prevent degradation of water quality in REC2 waterbodies. The targets were developed using a statistical method that fits historical dry weather data to a lognormal distribution. The 75th percentile of the fitted lognormal distribution was selected as the antidegradation target when relying on a single sample result. **Table 1-1** summarizes the antidegradation targets for the REC2 waterbodies included in the Santa Ana River RBMP.

Table 1-1. Antidegradation 75th Percentile Targets for Waterbodies with a REC2 Only Designation in the Santa Ana River RBMP

Waterbody	*E. coli* (MPN/100 mL)	Enterococcus (MPN/100 mL)
Temescal Creek Reach 1a/1b	725 MPN/100 mL	
Santa Ana-Delhi Channel Reach 1/2	1,067 MPN/100 mL	
Santa Ana-Delhi Channel in Tidal Prism[1]		464 MPN/100 mL
Greenville-Banning Channel in Tidal Prism[1]		64 MPN/100 mL
Cucamonga Creek Reach 1	1,385 MPN/100 mL	

Note:
MPN = most probably number
[1] Salinity at site is greater than 1 ppth 95 percent or more of the time.

1.2 Monitoring Strategy

One of the principal goals for updating recreational water quality standards in the Santa Ana region was to encourage the most cost-effective allocation of finite public resources. As such, all efforts undertaken to assure compliance with these revised standards should concentrate on projects and programs that are likely to produce the greatest public health benefit.

This risk-based approach, which is designed to guide all aspects of protecting water contact recreation, provides the foundation for this RBMP. Just as it is prudent to prioritize mitigation projects in a manner that assures the greatest public health benefit, it is wise to organize related water quality monitoring efforts along the same lines. The RBMP is structured to direct water quality monitoring resources to the highest priority waterbodies.

1.2.1 Priority Designation

Basin Plan requirements for an RBMP and the risk-based approach described above were used as a basis for developing a monitoring approach that designates monitoring priorities. General principles include:

- The most rigorous monitoring should occur in REC1 waterbodies where the expectation for water contact recreation is the highest. Data collection must occur at a sufficient frequency to demonstrate that these waters are safe for recreation.
- Where a waterbody has an adopted TMDL for bacterial indicators, consider existing monitoring requirements that have already been established to evaluate progress towards achieving attainment with WQOs.
- For waterbodies listed as impaired, but no TMDL has been adopted, monitoring should occur periodically to provide additional data regarding the impairment status of these waterbodies.
- Ensure sufficient sample collection from REC2 Only waters to assess compliance with antidegradation targets established per the BPA.

These general principles provide the foundation for the development of the Santa Ana River RBMP, which prioritizes waterbodies as follows:

- *Priority 1*: Establish a monitoring program that can determine whether bacteria levels are "safe" at those locations where and when people are most likely to engage in water contact recreation. These waters are all Tier A waters per the 2012 BPA (Note: A Priority 1 water may also include impaired waterbodies that are designated Tier A REC1 Waters).
- *Priority 2:* Focus monitoring resources on those waterbodies that have been identified as "impaired" due to excessive bacterial indicator concentrations and a TMDL has already been adopted (Note: A Priority 2 water may also be Priority 1 because it is also a Tier A REC1 Water). Monitoring in these waters focuses on evaluating progress toward attainment with the water quality standard for these impaired waters.
- *Priority 3:* Monitor 303(d)-listed or impaired waterbodies where a TMDL has not yet been developed. For these Priority 3 sites, the RBMP includes periodic sample collection for 5 consecutive weeks on an annual basis. Data from Priority 3 sites are used to evaluate compliance with the Santa Ana region *E. coli* WQOs.
- *Priority 4*: Collect the bacteria indicator data needed to implement the antidegradation targets that have been established for waterbodies designated as REC2 Only. Data from Priority 4 sites are used to evaluate compliance with the site-specific antidegradation targets (Table 1-1).

1.2.2 Monitoring Plan and Quality Assurance Project Plan

To support the watershed-wide Santa Ana River RBMP, the MSAR TMDL Task Force was expanded to include Santa Ana River watershed stakeholders and formed the MSAR TMDL / Regional Water Quality Monitoring Task Force (Task Force). The Task Force stakeholders worked collaboratively to prepare the Santa Ana River RBMP Monitoring Plan (Monitoring Plan) and Quality Assurance Project Plan (QAPP)[9] to support this monitoring program. The monitoring documents were last updated in 2022.

1.2.3 Annual Report

This Annual Report summarizes the results of the 2022-2023 monitoring efforts. Annual Reports summarizing monitoring efforts from 2016-2022 are available from SAWPA.[10] Previous seasonal water quality reports prepared only for the sites subject to the MSAR Bacteria TMDL (2007–2015) are also available.[11] Additional information and analysis of MSAR bacteria data can be found in the 2023 MSAR TMDL Triennial Report,[12] which synthesizes decades of microbial source tracking data, mass balance analysis, and best management practice (BMP) effectiveness assessment, and provides recommendations for watershed management activities toward achieving the TMDL.

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[10] State Water Board Resolution: 2018-0038, August 7, 2018.

[11] https://sawpa.org/task-forces/regional-water-quality-monitoring-task-force/#geographic-setting.

[12] MSAR-TMDL-2023-Triennial-Report_Final_021123.pdf (sawpa.org).

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Section 2

Santa Ana River Study Area

This section describes the study area and identifies the monitoring locations sampled during the 2022-2023 monitoring year. The Monitoring Plan and QAPP provide a more detailed characterization of the watershed.

2.1 Physical Characteristics

The Santa Ana River watershed encompasses approximately 2,840 square miles of Orange, Riverside, San Bernardino, and a small portion of Los Angeles Counties (**Figure 2-1**). The mainstem Santa Ana River is the primary waterbody in the watershed. It flows in a generally southwest direction for nearly 100 miles from its headwaters to the Pacific Ocean.

2.1.1 Middle Santa Ana River Bacteria TMDL

Currently, one bacteria TMDL has been adopted for inland freshwater streams in the Santa Ana River Watershed: the MSAR Bacteria TMDL, which was adopted by Santa Ana Water Board in 2005[13] and became effective when approved by the EPA on May 16, 2007. Due to exceedances of the fecal coliform objective established to protect REC1 use during the 1990s, the Santa Ana Water Board added the following waterbodies in the MSAR watershed to the state 303(d) list of impaired waters.

- Santa Ana River Reach 3 – Prado Dam to Mission Boulevard.
- Chino Creek Reach 1 – Santa Ana River confluence to beginning of hard lined channel south of Los Serranos Road.
- Chino Creek Reach 2 – Beginning of hard-lined channel south of Los Serranos Road to confluence with San Antonio Creek.
- Mill Creek (Prado Area) – Natural stream from Cucamonga Creek Reach 1 to Prado Basin.
- Cucamonga Creek, Reach 1 – Confluence with Mill Creek to 23rd Street in City of Upland.
- Prado Park Lake

The TMDL established compliance targets for both fecal coliform and *E. coli*:

- Fecal coliform: 5-sample/30-day logarithmic mean less than 180 organisms/100 mL and not more than 10 percent of the samples exceed 360 organisms/100 mL for any 30-day period.
- *E. coli*: 5-sample/30-day logarithmic mean less than 113 organisms/100 mL and not more than 10 percent of the samples exceed 212 organisms/100 mL for any 30-day period.

[13] Santa Ana Water Board Resolution: R8-2005-0001, August 26, 2005.

Per the TMDL, the above compliance targets for fecal coliform become ineffective upon EPA approval of the BPA.[14]

To focus MSAR Bacteria TMDL implementation activities, stakeholders established the MSAR Watershed TMDL Task Force (MSAR TMDL Task Force) to coordinate TMDL implementation activities designed to manage or eliminate sources of bacterial indicators to waterbodies listed as impaired. The MSAR TMDL Task Force includes representation by key watershed stakeholders, including urban stormwater dischargers, agricultural operators, and the Santa Ana Water Board.

The MSAR Bacteria TMDL required urban and agricultural dischargers to implement a watershed-wide bacterial indicator compliance monitoring program by November 2007.[15] Stakeholders worked collaboratively through the MSAR TMDL Task Force to develop this program and prepared the MSAR Water Quality Monitoring Plan and associated QAPP for submittal to the Santa Ana Water Board. The MSAR TMDL Task Force implemented the TMDL monitoring program in July 2007; the Santa Ana Water Board formally approved the monitoring program documents in April 2008.[16] This TMDL monitoring program has been incorporated into the Santa Ana River RBMP.

The MSAR Bacteria TMDL also required the development and implementation of source evaluation plans by urban and agricultural dischargers within six months of the TMDL effective date. These urban and agricultural source evaluations plans [USEP and Agricultural Source Evaluation Plan (AgSEP), respectively] were approved by the Santa Ana Water Board in 2008. These programs were incorporated into the Santa Ana River RBMP Monitoring Plan and QAPP.[17]

2.1.2 Major Geographic Subareas

The Santa Ana River watershed can be divided into major geographic subareas:

- San Jacinto River and Temescal Creek Region – This area covers much of the south central and southeastern portions of the watershed and is located mostly within Riverside County. The San Jacinto River drains an area of approximately 780 square miles to Canyon Lake and Lake Elsinore. Often flows from the upper San Jacinto River watershed are captured by Mystic Lake, which is a natural sump or hydrologic barrier to flows moving further downstream to Canyon Lake or Lake Elsinore. Downstream of Lake Elsinore, Temescal Creek carries surface flow, when it occurs, from below Lake Elsinore to where it drains into the Prado Basin Management Zone.

- Santa Ana River above Prado Dam and Chino Basin Region – This area includes much of the north central and northeastern portions of the watershed and is located mostly within San Bernardino County. This region drains to the Prado Basin Management Zone where Prado Dam captures all surface flows from this region and the Temescal Creek watershed.

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[14] Page 3 of 15 of Attachment A to Santa Ana Water Board Resolution R8-2005-0001.

[15] Page 6 of 15, Table 5-9 of Attachment A to Santa Ana Water Board Resolution R8-2005-0001.

[16] Santa Ana Water Board Resolution: R8-2008-0044; April 18, 2008.

[17] Santa Ana River Watershed Bacteria Monitoring Plan and QAPP: https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2019/New/Chapter_5_June_2019.pdf.

- The Santa Ana River headwaters are in the San Bernardino Mountains in the northeastern part of the watershed. Major tributaries to the Santa Ana River in this region include Warm Creek, Lytle Creek, and San Timoteo Creek.
- In the north central portion, several major Santa Ana River tributaries arise in the San Gabriel Mountains and drain generally south into the Chino Basin before their confluence with the Santa Ana River, including Day Creek, Cucamonga Creek, and San Antonio Creek. Many of these drainages carry little to no flow during dry conditions because of the presence of extensive recharge basins in this region.
- The Prado Basin Management Zone above Prado Dam is a flood control basin that captures all flows from the upper part of the Santa Ana River Watershed. For the most part the basin is an undisturbed, dense riparian wetland.
- Santa Ana River below Prado Dam and Coastal Plains Region – This area covers the western portion of the Santa Ana River watershed and includes coastal waterbodies that are not part of the Santa Ana River drainage area. This area is located in Orange County. Below Prado Dam, the Santa Ana River flows through the Santa Ana Mountains before crossing the coastal plain and emptying into the Pacific Ocean near Huntington Beach. Groundwater recharge areas near the City of Anaheim capture water in the Santa Ana River and the river is often dry below this area. Other watersheds on the Coastal Plain include Newport Bay, Anaheim Bay-Huntington Harbor, and Coyote Creek.

2.1.3 Middle Santa Ana River Watershed

The MSAR watershed exists within the region of the Santa Ana River above Prado Dam and Chino Basin Region and covers approximately 488 square miles. The MSAR watershed lies largely in the southwestern corner of San Bernardino County and the northwestern corner of Riverside County. A small part of Los Angeles County (Pomona/Claremont area) is also included. Per the TMDL, the MSAR watershed includes three sub–watersheds (**Figure 2-2**):

- Chino Basin (San Bernardino County, Los Angeles County, and Riverside Counties) – Surface drainage in this area, which is directed to Chino Creek and Mill-Cucamonga Creek, flows generally southward, from the San Gabriel Mountains, and west or southwestward, from the San Bernardino Mountains, toward the Santa Ana River and the Prado Management Zone.
- Riverside Watershed (Riverside County) – Surface drainage in this area is generally westward or southeastward from the City of Riverside and the community of Rubidoux to Reach 3 of the Santa Ana River.
- Temescal Canyon Watershed (Riverside County) – Surface drainage in this area is generally northwest to Temescal Creek (however, note that Temescal Creek is not included as an impaired waterbody in the MSAR Bacteria TMDL).

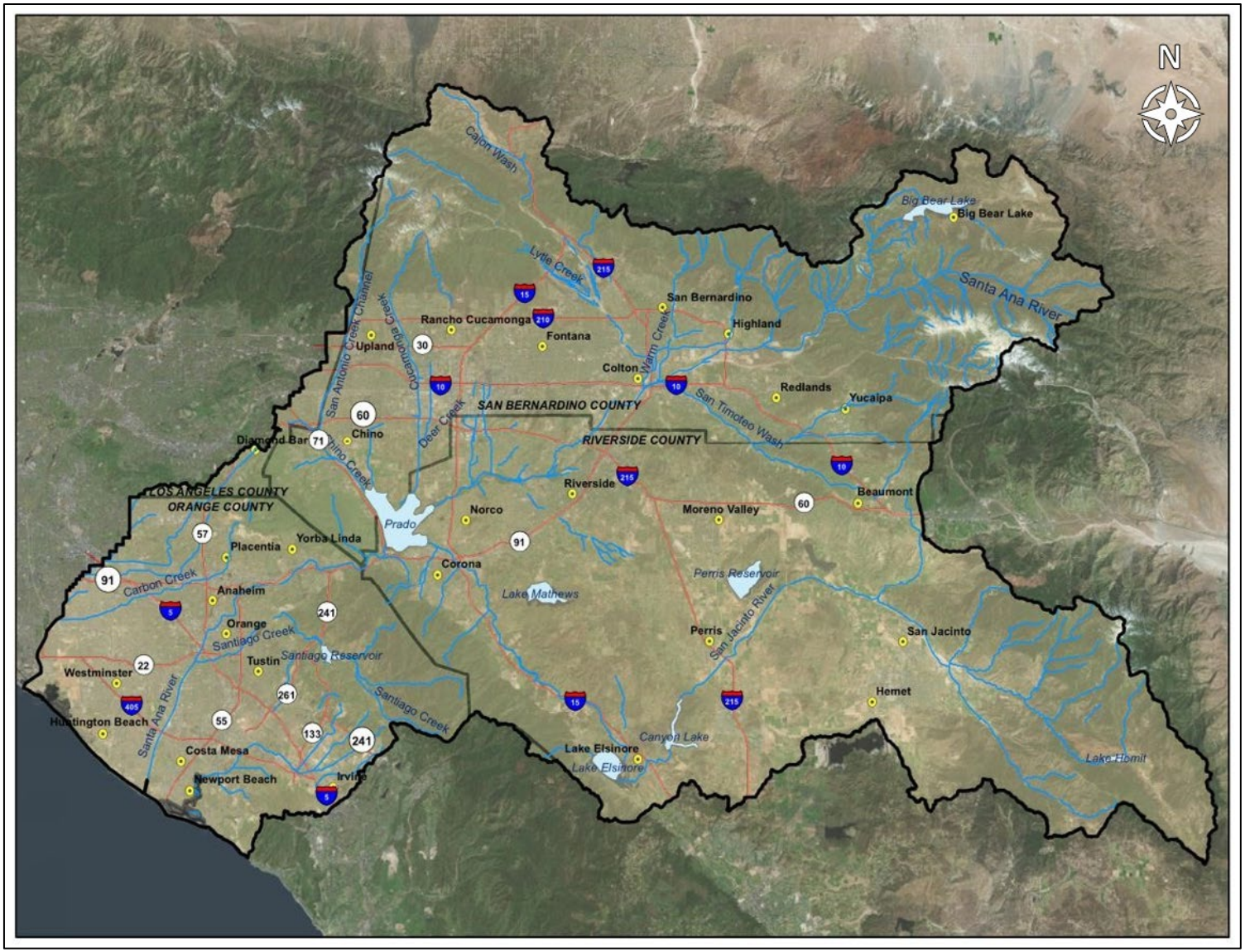

Figure 2-1. Santa Ana River Watershed and Location of Orange, Riverside, and San Bernardino Counties
(Source: SAWPA)

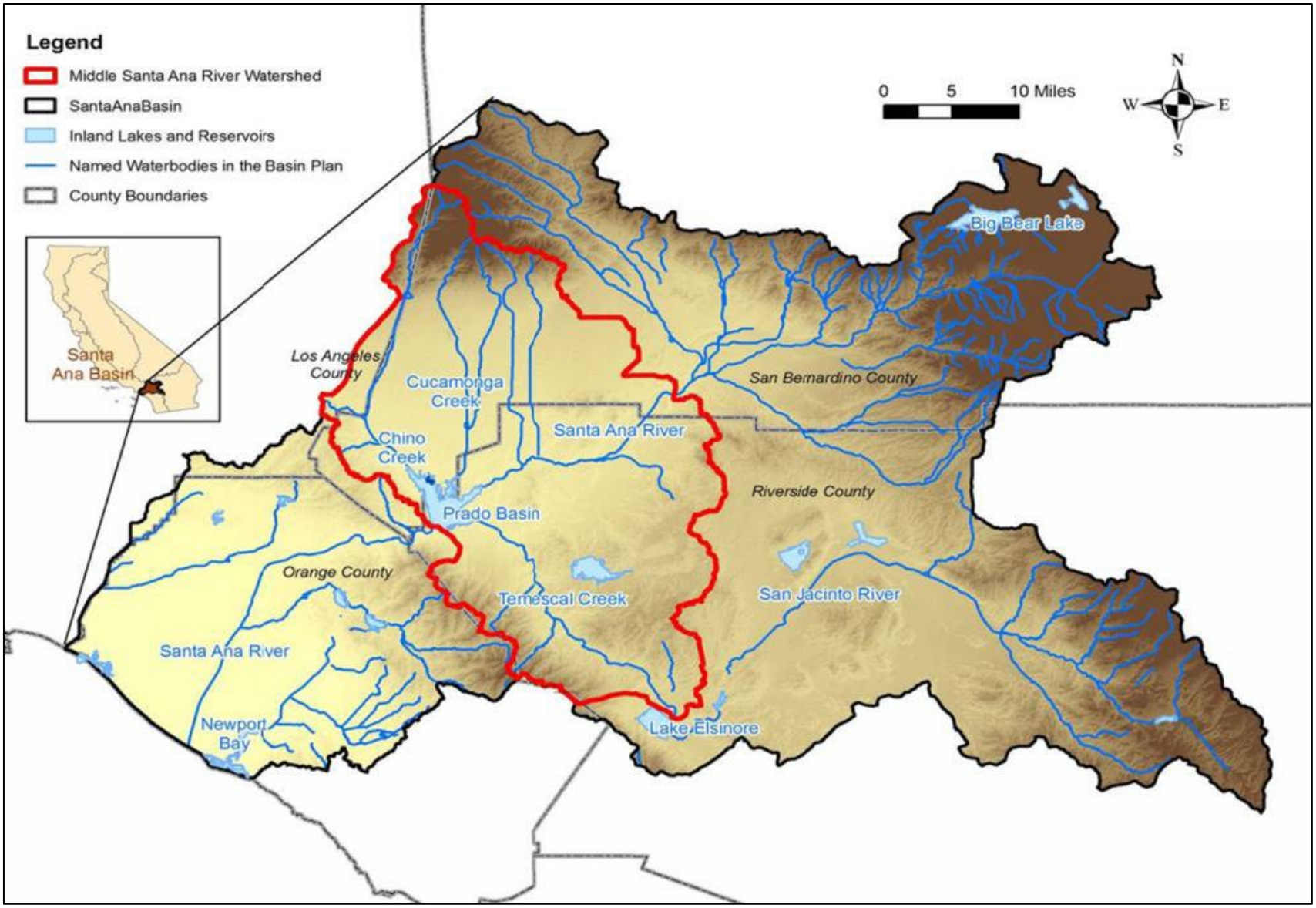

Figure 2-2. Middle Santa Ana River Watershed

Land uses in the MSAR watershed include urban, agriculture, and open space. Although originally developed as an agricultural area, the watershed continues to urbanize rapidly. Incorporated cities in the MSAR watershed include Chino, Chino Hills, Claremont, Corona, Eastvale, Fontana, Jurupa Valley, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, Riverside, and Upland. In addition, there are several pockets of urbanized unincorporated areas. Open space areas include National Forest lands and State Park lands.

2.1.4 Rainfall

Rainfall varies considerably across the watershed with highest average rainfall occurring in the upper mountain areas of the watershed (San Gabriel, San Bernardino, and San Jacinto mountains) (**Figure 2-3**). Historical average annual rainfall in the northern and eastern areas can be more than 35 inches but is much lower in the lowland regions and central parts of the watershed. In these areas that include Chino and Prado Basin, average annual rainfall ranges from approximately 11 to 19 inches.

Key rainfall gages in the Santa Ana River watershed were identified and considered representative of the variability across the watershed (**Figure 2-4**). **Table 2-1** provides the locations of key rainfall gages in the Santa Ana River watershed[18] and **Table 2-2** summarizes the total monthly rainfall data from each location for the 2022-2023 monitoring year.

Table 2-1. Location of Key Rainfall Gages in the Santa Ana River Watershed

Station No.	Station Name	Source	Latitude	Longitude
178	Riverside North	RCFC&WCD	34.0028	-117.3778
179	Riverside South	RCFC&WCD	33.9511	-117.3875
35	Corona	RCFC&WCD	33.8450	-117.5744
131	Norco	RCFC&WCD	33.9215	-117.5724
067	Elsinore	RCFC&WCD	33.6686	-117.3306
90	Idyllwild	RCFC&WCD	33.7472	-116.7144
9022	Fawnskin	SBCFCD	34.2726	-116.9718
2965	Lytle Creek Canyon	SBCFCD	34.2164	-117.4553
2808	Highland Plunge Creek	SBCFCD	34.1120	-117.1278
61	Tustin-Irvine Ranch	OCPW	33.7200	-117.7231
169	Corona del Mar	OCPW	33.6093	-117.8583
219	Costa Mesa Water District	OCPW	33.6453	-117.9336
163	Yorba Reservoir	OCPW	33.8719	-117.8112
5	Buena Park	OCPW	33.8571	-117.9923

[18] Data provided by Orange County Public Works (OCPW), Riverside County Flood Control & Water Conservation District (RCFC&WCD), and San Bernardino County Flood Control District (SBCFCD).

Table 2-2. Monthly Rainfall Totals (inches) During 2022 at Key Rainfall Gages

Station No.	Rainfall Gage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
178	Riverside North	0.02	0.06	0.33	0.24	0.00	0.00	0.00	0.00	0.15	0.28	1.60	1.37	4.05
179	Riverside South	0.07	0.02	0.61	0.31	0.00	0.00	0.00	0.00	0.19	0.39	1.24	1.32	4.15
35	Corona	0.05	0.55	0.59	0.35	0.06	0.00	0.00	0.00	0.22	0.40	2.38	1.95	6.55
131	Norco	0.02	0.18	0.37	0.03	0.01	0.07	0.00	0.00	0.13	0.30	1.35	1.24	3.70
67	Elsinore	0.22	0.26	0.54	0.16	0.01	0.06	0.02	0.01	1.07	0.57	0.98	1.16	5.06
90	Idyllwild	0.54	1.96	2.34	1.09	0.00	0.07	0.53	1.64	2.50	0.81	4.33	2.23	18.04
9022	Fawnskin	0.63	1.14	2.01	0.39	0.00	0.35	1.69	1.34	0.75	0.51	5.08	2.32	16.21
2965	Lytle Creek Canyon	0.12	0.98	1.18	0.47	0.00	0.00	0.00	0.04	0.39	0.31	4.06	4.33	11.88
2808	Highland Plunge Creek	0.94	0.35	1.65	0.55	0.24	0.00	0.00	0.16	0.31	0.59	1.73	1.42	7.94
61	Tustin-Irvine Ranch	0.06	0.21	0.82	0.19	0.00	0.00	0.00	0.00	0.35	0.65	1.82	3.68	7.78
169	Corona del Mar	0.05	0.23	1.27	0.07	0.03	0.01	0.00	0.00	0.19	0.37	1.01	2.89	6.12
219	Costa Mesa Water District	0.04	0.06	0.72	0.44	0.01	0.03	0.00	0.00	0.20	0.45	1.15	3.53	6.63
163	Yorba Reservoir	0.03	0.32	0.8	0.25	0.00	0.01	0.00	0.00	0.20	0.38	2.19	3.72	7.90
5	Buena Park	0.14	0.13	0.59	0.15	0.00	0.01	0.00	0.00	0.21	0.33	1.41	3.32	6.29

Note: Rainfall data from Orange County rain gages are being processed and will be included in the final version of this report.

During the 2022 monitoring season, rainfall varied throughout the watershed with a continuation of the years-long drought for most of the year and then heavier precipitation recorded in the upper watershed and during winter months. Rainfall totals in 2022 for November and December were larger than typical for the area with multiple large precipitation events impacting the Santa Ana River watershed. This continued for the remainder of the winter months in the beginning of 2023 and had a hydrologically significant impact on the area. While smaller storms occurred during the summer months, all dry weather monitoring adhered to the dry weather condition established in the Monitoring Plan, which states that dry weather samples be collected only if there is no measurable rainfall in the preceding 72-hour period. This resulted in some discontinuities in the geomean calculations for several of the Priority 2 sites despite all samples being collected.

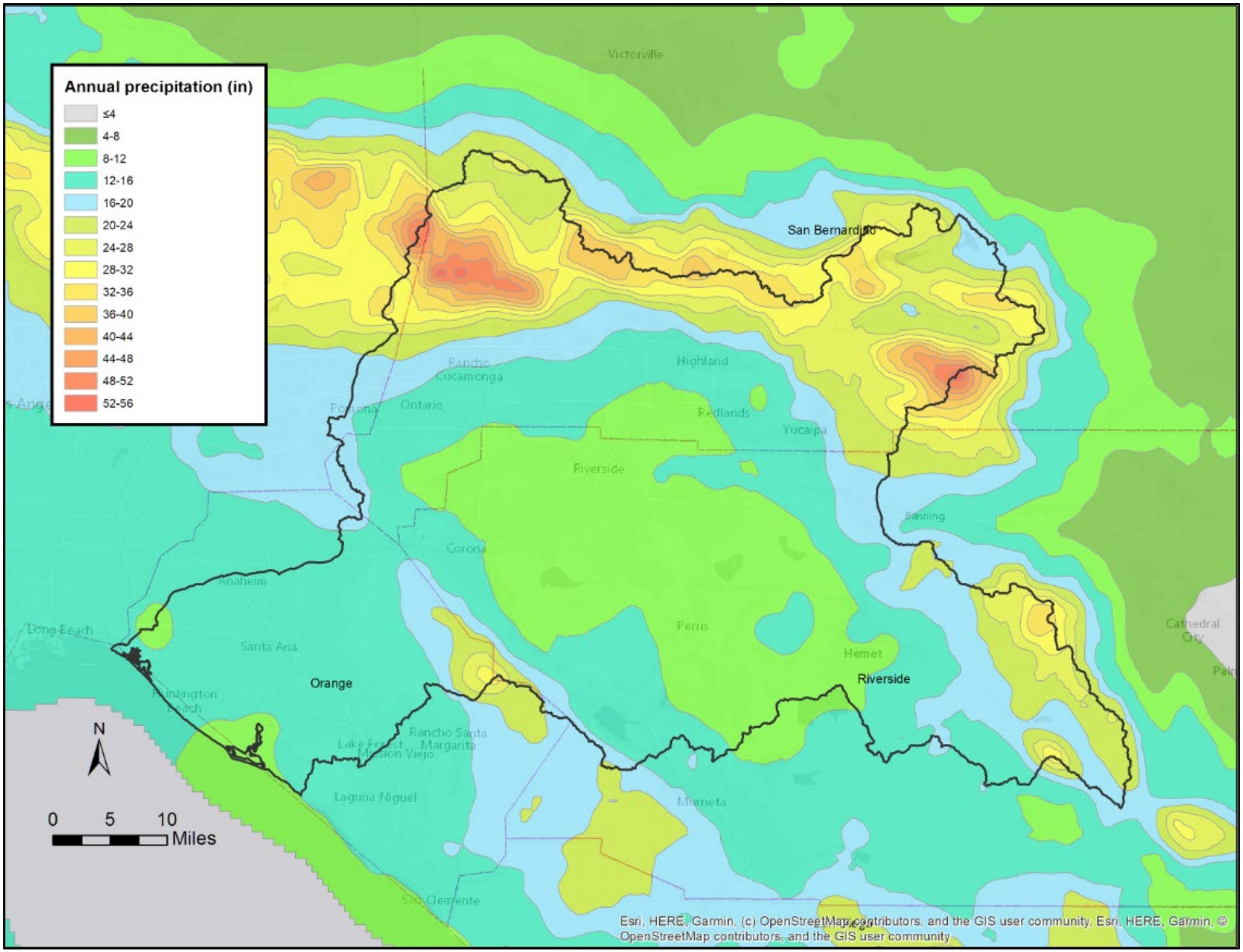

Figure 2-3. Historical Average Annual Rainfall in the Santa Ana River Watershed from 1980-2019

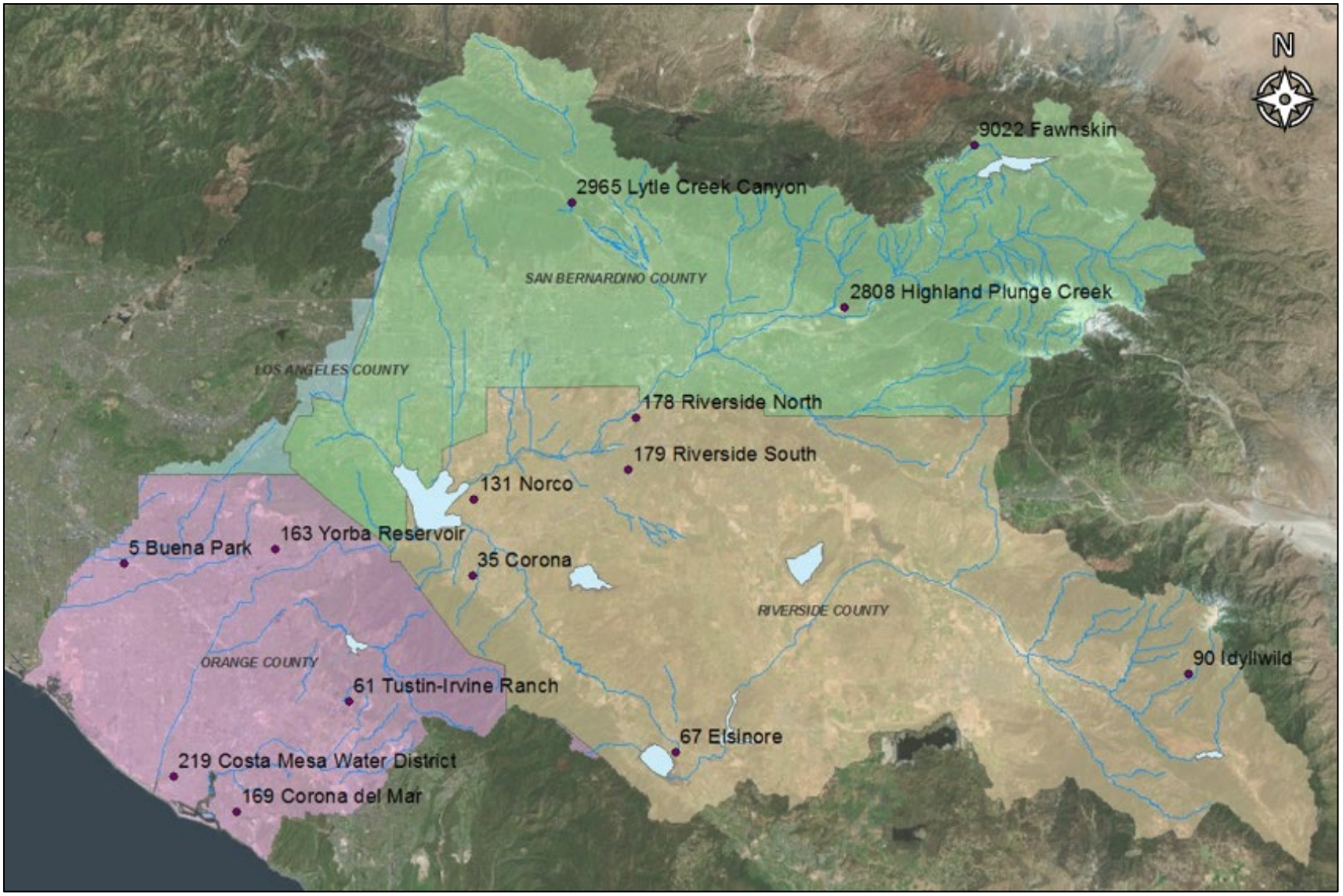

Figure 2-4. Key Rainfall Gages

2.2 Monitoring Locations

The following sections describe the monitoring sites based on priority designations described in Section 1.2.1.

2.2.1 Priority 1

Eight monitoring sites, identified as REC1 Tier A waters, are included for Priority 1 monitoring. This includes four lakes: Big Bear Lake, Lake Perris, Canyon Lake, and Lake Elsinore; and four flowing water sites: Santa Ana River Reach 3 (two sites), Lytle Creek, and Mill Creek Reach 2. Five sites are in Riverside County and three sites are in San Bernardino County (**Table 2-3**, **Figure 2-5**).

Because the two Priority 1 Santa Ana River sites (MWD Crossing and Pedley Avenue) are also MSAR Bacteria TMDL compliance sites, data collected from these Priority 1 sites are also used for evaluating compliance with the MSAR Bacteria TMDL.

Table 2-3. Priority 1 REC 1 Tier A Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P1-1	Canyon Lake at Holiday Harbor	Riverside	33.6808	-117.2724
P1-2-ELM	Lake Elsinore[1]	Riverside	33.6664	-117.3356
P1-3	Lake Perris	Riverside	33.8618	-117.1928
P1-4	Big Bear Lake at Swim Beach	San Bernardino	34.2485	-116.9061
P1-5	Mill Creek Reach 2	San Bernardino	34.0891	-116.9247
P1-6	Lytle Creek (Middle Fork)	San Bernardino	34.2480	-117.5110
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside	33.9552	-117.5327

Note:
[1] In 2021, the sampling location for Lake Elsinore was changed from the boat ramp to Elm Grove Beach.

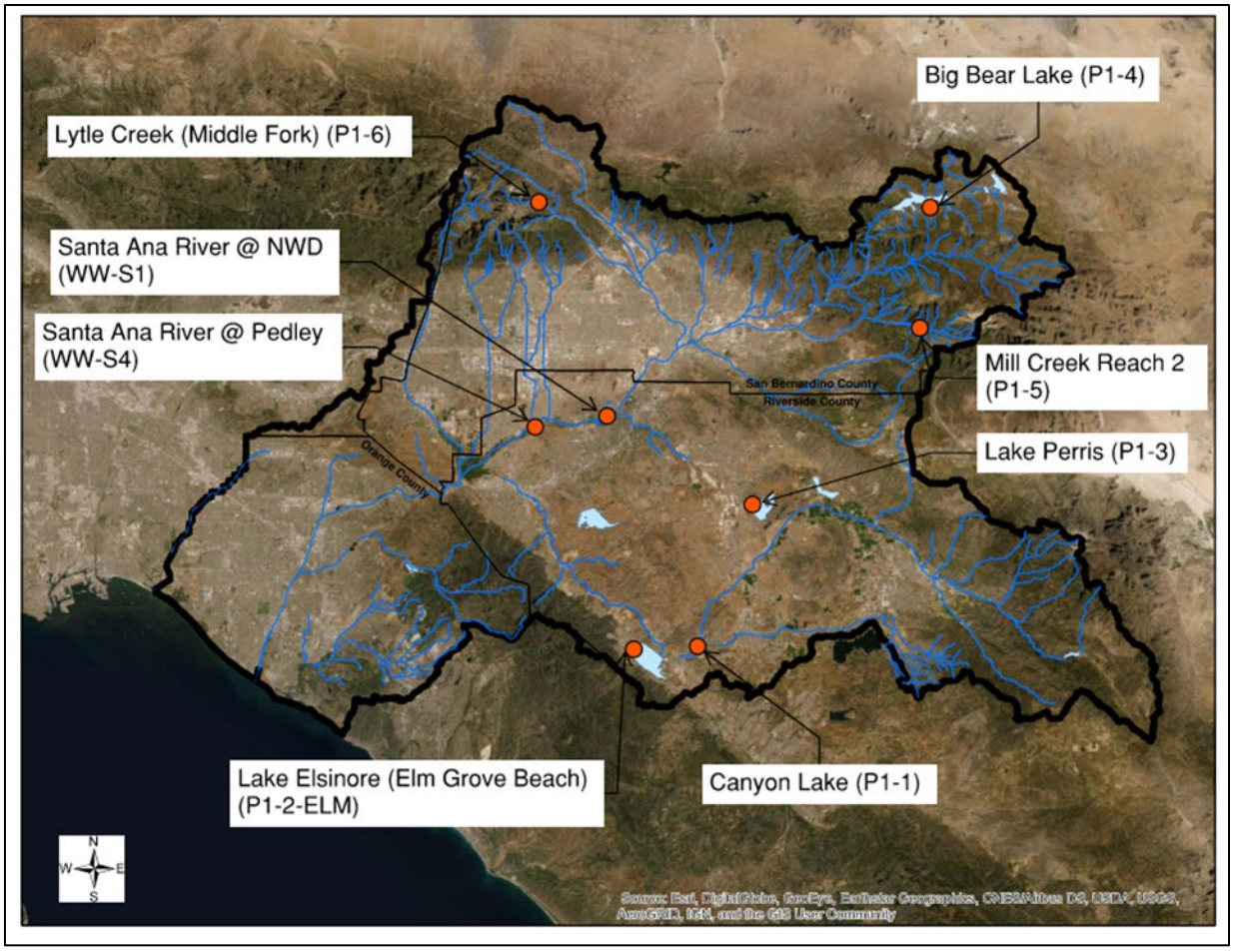

Figure 2-5. Priority 1 Monitoring Sites

2.2.2 Priority 2

Priority 2 monitoring sites are primarily the same monitoring sites previously established for evaluating compliance with the numeric targets in the MSAR Bacteria TMDL: two Santa Ana River Reach 3 sites (at MWD Crossing and at Pedley Avenue), and one site each on Mill-Cucamonga Creek, Chino Creek, and Prado Park Lake[19] (**Table 2-4**, **Figure 2-6**). As discussed in Section 2.2.1, the two Santa Ana River sites are also Priority 1 waters, i.e., as Tier A waters, they are locations where the risk of exposure to pathogens during recreational activities is highest. Santa Ana River at Mission Boulevard Bridge was added to the Priority 2 sampling to help define bacteria levels entering the MSAR Reach 3 but does not have a TMDL compliance target.

[19] See Section 4.1.1 in the Monitoring Plan for the original basis for the selection of these monitoring sites.

Table 2-4. Priority 2 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
WW-M6	Mill-Cucamonga Creek below Wetlands	San Bernardino	33.9268	-117.6250
WW-C7	Chino Creek at Central Avenue	San Bernardino	33.9737	-117.6889
WW-C3	Prado Park Lake	San Bernardino	33.9400	-117.6473
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside	33.9552	-117.5327
MISSION	Santa Ana River at Mission Blvd. Bridge	Riverside	33.9833	-117.4018

Figure 2-6. Priority 2 Monitoring Sites

2.2.3 Priority 3

In the Santa Ana River watershed, 23 waterbodies are currently on the 303(d) List as impaired for indicator bacteria, but for which no TMDL has been adopted. Eight waterbodies were not included in the original RBMP for reasons described in Section 3.3.3.2 of the Monitoring Plan. As described in the Priority 3 sampling plan modifications technical memorandum,[20] samples and measurements were not collected from Buck Gully (P3-OC3), Los Trancos Creek (P3-OC5),

[20] CDM Smith, 2021. Modifications to Sampling Program for Bacteria Impaired without TMDL "Priority 3" Waters. Draft Technical Memorandum dated July 2, 2021.

Morning Canyon (P3-OC6), Peters Canyon Wash (P3-OC7), San Diego Creek Reach 1 (P3-OC8), and San Diego Creek (Reach 2) based on the determination of utilizing source investigation studies determine and mitigate or eliminate cause of impairment. Of the nine waterbodies that are currently monitored in the RBMP in 2022-2023, three are in Orange County, two are in Riverside County, and four are in San Bernardino County (**Figure 2-7**). San Timoteo Creek Reach 3 (P3-RC3) was added in the 2020-2021 sampling season based on the 2014/16 303(d) listing. **Table 2-5** provides the location of each Priority 3 monitoring site. Previous water quality data and the basis for listing these monitoring sites are described in the Monitoring Plan.

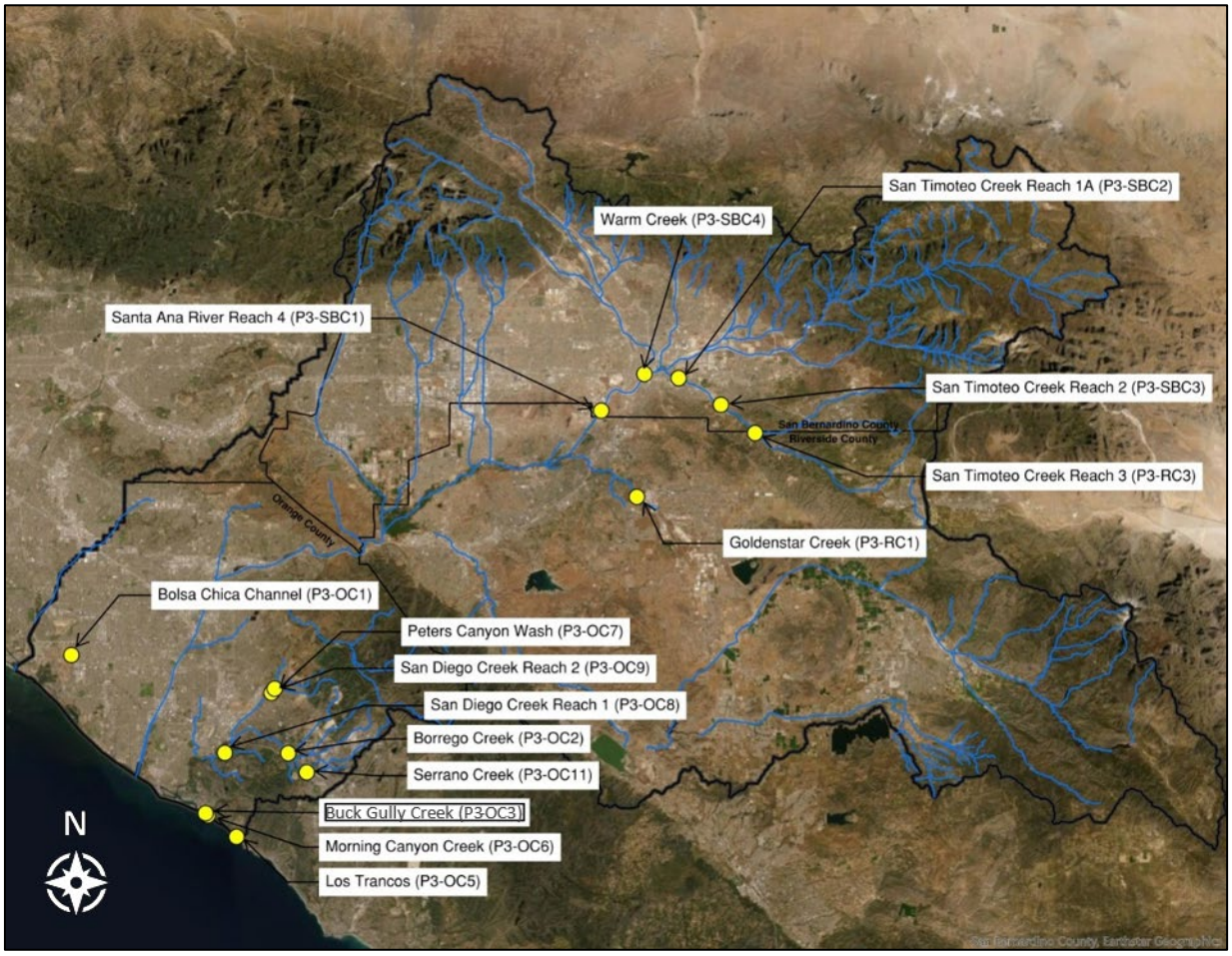

Figure 2-7. Priority 3 Monitoring Sites

Table 2-5. Priority 3 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	Orange	33.7596	-118.0430
P3-OC2	Borrego Creek upstream of Barranca Parkway	Orange	33.6546	-117.7321
P3-OC3	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	Orange	33.5900	-117.8684
P3-OC5	Los Trancos Creek at Crystal Cove State Park	Orange	33.5760	-117.8406
P3-OC6	Morning Canyon Creek at Morning Canyon Beach	Orange	33.5876	-117.8658
P3-OC7	Peters Canyon Wash downstream of Barranca Parkway	Orange	33.6908	-117.82404
P3-OC8	San Diego Creek downstream of Campus Drive (Reach 1)	Orange	33.6553	-117.8454
P3-OC9	San Diego Creek at Harvard Avenue (Reach 1)	Orange	33.6880	-117.8187
P3-OC11	Serrano Creek upstream of Barranca/Alton Parkway	Orange	33.6483	-117.7248
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	Riverside	33.8964	-117.3586
P3-RC3	San Timoteo Creek Reach 3	Riverside	34.0025	-117.1645
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	San Bernardino	34.0248	-117.3628
P3-SBC2	San Timoteo Creek Reach 1A at Anderson St.	San Bernardino	34.0615	-117.2629
P3-SBC3	San Timoteo Creek Reach 2 at San Timoteo Canyon Rd.	San Bernardino	34.0615	-117.2629
P3-SBC4	Warm Creek below Fairway Dr.	San Bernardino	34.0646	-117.3072

2.2.4 Priority 4

Four waterbodies designated REC2 Only as a result of approved UAAs were monitored as Priority 4 sites. San Bernardino County and Riverside County each have one Priority 4 waterbody. The remaining two Priority 4 waterbodies are in Orange County with one waterbody having two sites. These sites are summarized in **Table 2-6** and **Figure 2-8** and described as follows:

- *Santa Ana-Delhi Channel* – The Santa Ana-Delhi Channel has three reaches (Reaches 1 and 2, Tidal Prism) that are REC2 Only. The Santa Ana-Delhi Channel has two monitoring sites to provide sample results from freshwater and tidal prism areas: (a) upstream of Irvine Avenue (P4-OC1) and (b) within the tidal prism at the Bicycle Bridge (P4-OC2).

- *Greenville-Banning Channel Tidal Prism Segment* – The 1.2-mile segment extending upstream of the confluence between Santa Ana River and Greenville-Banning Channel is designated REC2 Only. The monitoring site is located at an access ramp approximately 60 meters downstream of the trash boom below the rubber diversion dam.

- *Temescal Creek* – The monitoring site is located on the concrete section of Temescal Channel just upstream of the Lincoln Avenue Bridge.

- *Cucamonga Creek Reach 1* – Cucamonga Creek Reach 1 extends from the confluence with Mill Creek in the Prado area to near 23rd Street in the City of Upland. The monitoring site for Cucamonga Creek Reach 1 is at Hellman Road.

Table 2-6. Priority 4 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P4-RC2	Temescal Creek at Lincoln Avenue	Riverside	33.8941	-117.5772
P4-OC1	Santa Ana-Delhi Channel Upstream of Irvine Avenue	Orange	33.6602	-117.8810
P4-OC2	Santa Ana-Delhi Channel in Tidal Prism	Orange	33.6529	-117.8837
P4-OC3	Greenville-Banning Channel in Tidal Prism	Orange	33.6594	-117.9479
P4-SBC1	Cucamonga Creek at Hellman Avenue	San Bernardino	33.9493	-117.6104

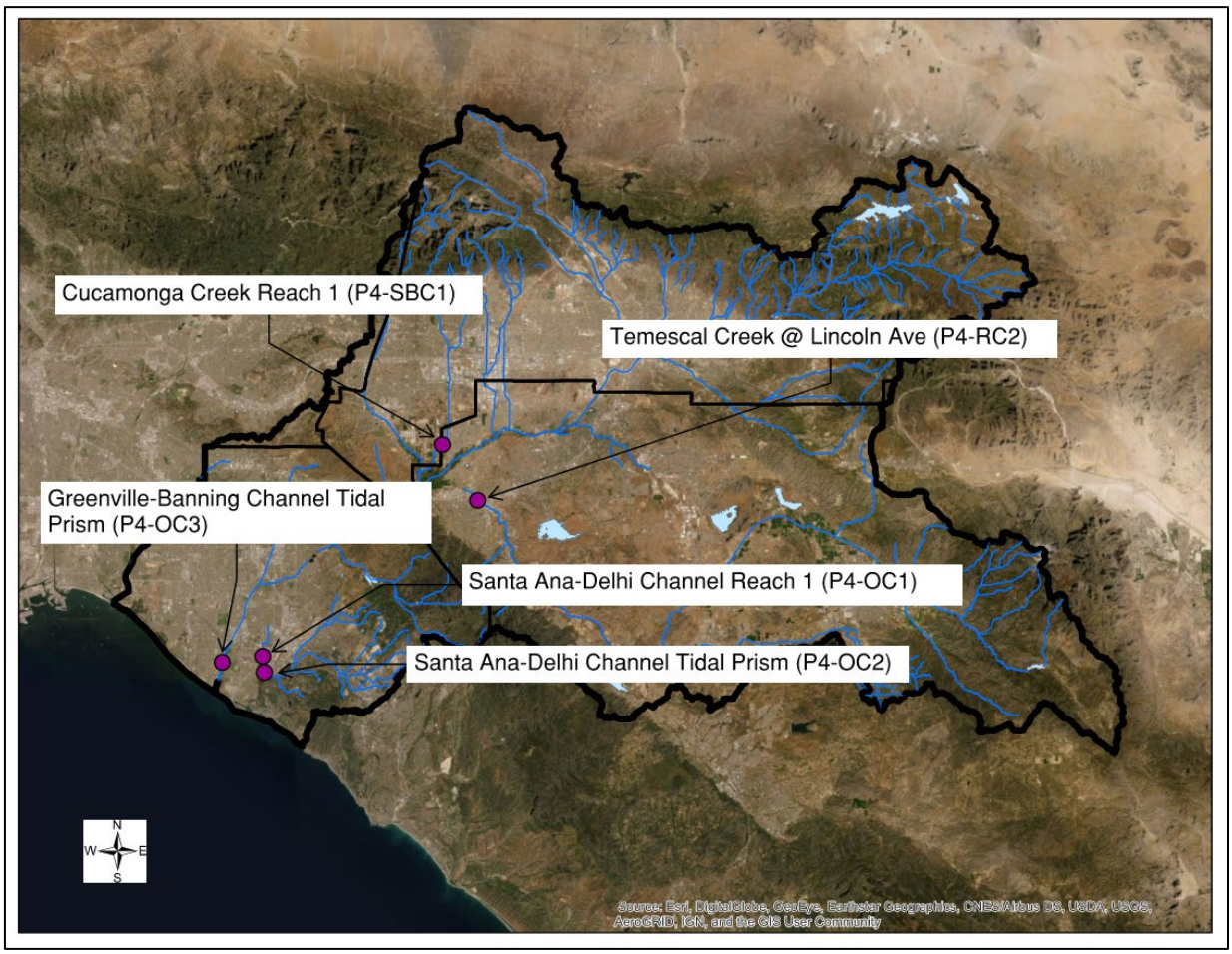

Figure 2-8. Priority 4 Monitoring Sites (top: Riverside County and San Bernardino County; bottom: Orange County)

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Section 3
Methods

The RBMP Monitoring Plan and QAPP provide detailed information regarding the collection and analysis of field measurements and water quality samples. The following sections summarize these methods.

3.1 Sample Frequency

3.1.1 Dry Weather

Dry weather sample collection occurs during both warm, dry (April 1 – September 30) and cool, dry (October 1 – November 30) season periods. Target sample dates for each year of the monitoring program are established in Section 3.3 of the Monitoring Plan and are summarized in this section. Dry weather, warm season monitoring was conducted at most sites over a 20-week period from May 8 through September 20, 2022. Dry weather, cool season monitoring occurred over a five-week period from October 16, 2022 through November 20, 2022. Dry weather conditions are defined as no measurable rainfall within a 72-hour period prior to sampling.

During dry weather monitoring, the frequency of sample collection for each priority level varies as follows:

- Priority 1 and Priority 2 sites were monitored weekly for 20 consecutive weeks during the warm, dry season and for five consecutive weeks during the cool, dry season.
- Priority 3 sites were monitored weekly for five consecutive weeks during the warm or cool, dry seasons. The nine Priority 3 sites were separated into five groups to maximize efficiency during sample collection periods.
- Priority 4 sites were sampled once per year between June 21 and September 21. Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), and Greenville Banning Channel (P4-OC3) did not meet the site-specific antidegradation target in 2022 and required monthly follow-up samples. All other Priority 4 sites met their antidegradation targets in 2022 and did not require additional sampling.

3.1.2 Wet Weather

Wet weather sample collection occurs during the wet season (November 1 – March 31). Per the MSAR Bacteria TMDL, wet weather monitoring is conducted for one storm event per wet season. For that storm event, samples are collected from Priority 2 sites on the day of the storm event as well as 24, 48, and 72 hours after the onset of the storm; this is a change from previous monitoring seasons (through the 2020-2021 monitoring season) when the samples were collected the day of the event and 48, 72, and 96 hours after the onset of the storm. The change to the sampling timing protocol was made to be able to better track the decline in bacteria concentrations following events.

During the 2022-2023 wet season, the November 8, 2022 storm was monitored with samples collected on November 8, 9, 10, and 11.

3.1.3 Summary of Sample Collection Effort

In general, the 2022-2023 monitoring program was successful in meeting the requirements except for some events where site conditions could not accommodate sampling. Differences between planned and executed sampling events are summarized in **Table 3-1**.

Table 3-1. Summary of Water Quality Sample Collection Activity

Priority	Planned/Collected	Dry Weather	Wet Weather
Priority 1	Planned	200	0
	Collected	200[1]	0
Priority 2	Planned	150	20
	Collected	150	20
Priority 3	Planned	40	0
	Collected	37[2]	0
Priority 4	Planned	5	0
	Collected	23[3]	0

Notes:

1 All 25 samples at Lake Elsinore (P1-2-ELM) were collected but there was a laboratory error resulting in a missing Enterococcus result for one sample during the cool, dry season.

2 Warm Creek (P3-SBC4) only had one of five samples taken due to insufficient flow. An additional sample unplanned sample at Borrego Creek (P3-OC2) was taken.3 Additional samples collected at Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) and Greenville-Banning Channel (P4-OC3) due to an exceedance of the antidegradation targets in the initial sample.

3.2 Sample Analysis

Monitoring at each site included recording field measurements and collection of water quality samples. OCPW staff monitored all sites located in Orange County under their jurisdiction, while CDM Smith and CWE, on behalf of the MSAR TMDL / Regional WQ Monitoring Task Force, monitored all sites located in Riverside County and San Bernardino County. The following water quality data were gathered from each site:

- Field measurements:[21] temperature, pH, dissolved oxygen (DO), conductivity, turbidity, and flow.
- Laboratory analysis: total suspended solids (TSS), bacteria (*E. coli* or Enterococcus).
- *E. coli* is quantified at all but two sites in this RBMP where Enterococcus is collected instead.
- Enterococcus is quantified where salinities is persistently greater than 1ppth: Lake Elsinore (P1-2-ELM) and two Orange County sites, Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) and Greenville-Banning Channel in Tidal Prism (P4-OC3).

[21] For the monitoring stations in lakes, field parameters are collected at the surface near the shore.

3.3 Sample Handling

Sample collection and laboratory delivery followed approved chain-of-custody (COC) procedures, holding time requirements, and required storage procedures for each water quality sample as described in the Monitoring Plan and QAPP. Samples collected from Riverside County and San Bernardino County were analyzed for Enterococcus, *E. coli* and TSS concentrations by Babcock Laboratories, Inc. (Babcock). Samples collected from Orange County by OCPW were analyzed by the Orange County Health Care Agency Water Quality Laboratory (OCPHL) for *E. coli* and by Weck Laboratories and Enthalpy Analytical for TSS. **Appendix C** includes a summary of quality assurance/quality control (QA/QC) activities conducted during the period covered by this report, including field blanks and field duplicates.

3.4 Data Handling

CDM Smith and SAWPA maintain a file of all laboratory and field data records (e.g., data sheets, chain-of-custody forms) as required by the QAPP. CDM Smith's field contractor (CWE), OCPW, and the Santa Ana Water Board provided CDM Smith all field measurements and laboratory results, laboratory reports, field forms, photos, and COCs. CDM Smith compiled the field measurements and laboratory analysis results into a project database that is compatible with guidelines and formats established by the California Surface Water Ambient Monitoring Program for the California Environmental Data Exchange Network (CEDEN). CDM Smith conducts a QA/QC review of the data for completion and compatibility with the databases. After the QA/QC review, CDM Smith submits the data annually to CEDEN and to SAWPA.

3.5 Data Analysis

Data analysis relied primarily on the use of descriptive and correlation statistics. For any statistical analyses, the bacterial indicator data were assumed to be log-normally distributed as was observed in previous studies.[22] Accordingly, prior to conducting statistical analyses, the bacterial indicator data were log transformed.

[22] Middle Santa Ana River Bacterial Indicator TMDL Data Analysis Report, prepared by CDM Smith on behalf of the Task Force. March 19, 2009. http://www.sawpa.org/wp-content/uploads/2015/02/FinalDataAnalysisReport_033109.pdf.

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Section 4
Results

This section summarizes the results of data analyses of the 2022-2023 dataset, which includes the 2022 dry season and the 2022-2023 wet season. Where appropriate to provide context, data results are compared to water quality results previously reported for the same locations. **Appendix A** (Table A-1 through Table A-34) summarizes the water quality results observed at each site for the sample period covered by this report.

E. coli concentrations observed at each site are summarized and compliance is assessed using water quality standards or antidegradation targets established by the BPA and numeric targets established by the MSAR Bacteria TMDL. Data analysis relied primarily on the use of descriptive and correlation statistics.

4.1 Priority 1

4.1.1 Water Quality Observations

Water quality parameters measured in the field during the warm, dry and cool, wet seasons at Priority 1 sites (**Table 4-1**) are summarized in **Figure 4-1** through **Figure 4-7** with key observations described below:

- **pH** - The WQO for pH established in the Basin Plan allows pH to range between 6.5 and 8.5 S.U. **Figure 4-1** shows that no sites had any measurements below the allowable range, with all exceedances measured at a value greater than 8.5. The highest exceedance percentage occurred at Lake Elsinore at Elm Grove Beach (P1-2-ELM) where 100 percent of the samples were greater than the allowable limit. The largest range and highest values occurred at Big Bear Lake (P1-4) with pH reaching 10.1 in the middle of the warm, dry season. Elevated pH values in lakes are typically correlated with high concentrations of algae. In contrast, the four riverine Priority 1 sites were within or just slight over the allowable pH range.
- **Water temperature** - **Figure 4-2** shows distribution of water temperature by station demonstrating that water temperature has a direct relationship with cooler ambient air temperatures (median less than 20°C) at higher elevations and higher ambient air temperatures (median greater than 23°C) in lower elevations. Likewise, water temperature responds directly to the seasonal ambient temperatures of the wet and dry seasons.

- **Dissolved oxygen** - **Figure 4-3** shows that the majority of DO levels range from 6 to 10 mg/L. WQOs for minimum DO for waterbodies with the WARM and COLD habitat beneficial use designations are 5 mg/L and 6 mg/L, respectively.[23] These standards were met at all Priority 1 sites except for Canyon Lake (P1-1) where four of the five samples, or 80 percent of measurements taken during the cool, dry season fell below COLD habitat beneficial use. DO in Big Bear Lake improved compared the previous sampling year, with no WQO violations compared to 10 percent previously.

- **Conductivity** - **Figure 4-4** depicts conductivity data, which appears to vary based on geography as sites located in the upper portions of the watershed (Mill Creek Reach 2, Big Bear Lake, and Lytle Creek) have lower conductivity (less than 300 µS/cm at two sites and less than 500 µS/cm at Big Bear Lake) than sites located in the downstream portions of the watershed (500 to 1,121 µS/cm). Dry weather, flow in waterbodies in the upper watershed generally consist of groundwater baseflow in dry conditions supplemented with snow melt; these flows generally have not accumulated many salts from geology, agricultural or urban runoff, and human wastewater via septic systems or treated effluent, and thus, have lower conductivity values. Flow in waterbodies in the lower watershed include more of these inputs, which commonly have higher salt concentrations. Lake Elsinore exhibits particularly high conductivity ranging in 2022 from about 3,000 to 4,400 µS/cm, which is not unusual for a terminal lake with ongoing evapo-concentration. The 2022 high value of the conductivity increased some compared to the previous sampling year consistent with on-going drought conditions during the dry period. The water level is also kept artificially high with the addition of treated effluent known to be high in TDS.

- **Turbidity and TSS** - **Figure 4-5** shows turbidity at six of the eight sites were generally low to moderate. Canyon Lake and Lytle Creek had the lowest measurement of turbidity (less than 2 NTU). The next four stations with low to moderate turbidity (generally less than 25 NTU) were Lake Perris, Mill Creek Reach 2, and the two Santa Ana River Reach 3 locations, though the latter three locations have single values between 50-100 NTU. The remaining stations that generally had high and more variable turbidity were Lake Elsinore (16 NTU to 338 NTU) and Big Bear Lake (6 NTU to 32 NTU). Seasonal variability is higher in the lake monitoring sites as the warm samples typically result in higher values corresponding to high algal presence than the cool samples.

  TSS at the eight sites generally follow those of turbidity, where TSS had the highest values and greatest variability at Lake Elsinore and single sample values were high (~1,000 mg/L) at the two Santa Ana River Reach 3 sites which is consistent with the single high turbidity values seen there.

- **Flow – Figure 4-7** provides the measured flow data at the stream sites only. Flow is lower at the upstream sites, Mill Creek Reach 2 (1 to 11 cubic feet per second [cfs]) and Lytle Creek (0 to 7 cfs). Flow is greatest in the Santa Ana River, which is fed by POTW effluent.

[23] Basin Plan Chapters 3 and 4. WARM represents warm freshwater habitat while COLD represents cold freshwater habitat.

Table 4-1. Priority 1 Monitoring Sites

Site ID	Site Description	County
P1-1	Canyon Lake at Holiday Harbor	Riverside
P1-2-ELM	Lake Elsinore at Elm Grove Beach	Riverside
P1-3	Lake Perris	Riverside
P1-4	Big Bear Lake at Swim Beach	San Bernardino
P1-5	Mill Creek Reach 2	San Bernardino
P1-6	Lytle Creek (Middle Fork)	San Bernardino
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside

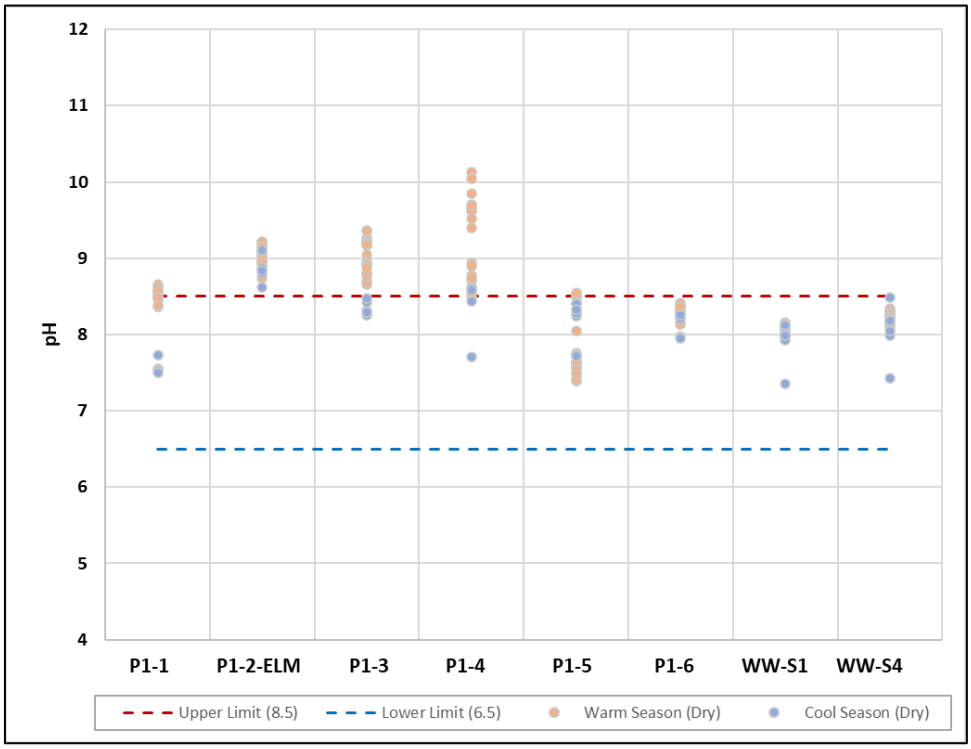

Figure 4-1. Distribution of pH Measurements at Priority 1 Sites

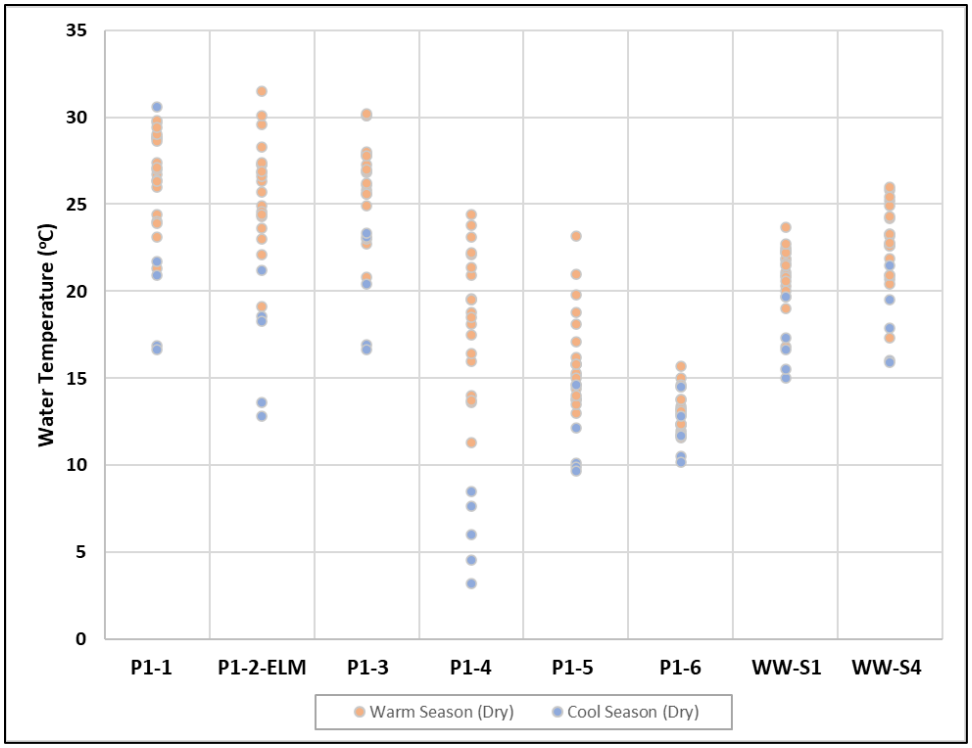

Figure 4-2. Distribution of Water Temperature Measurements at Priority 1 Sites

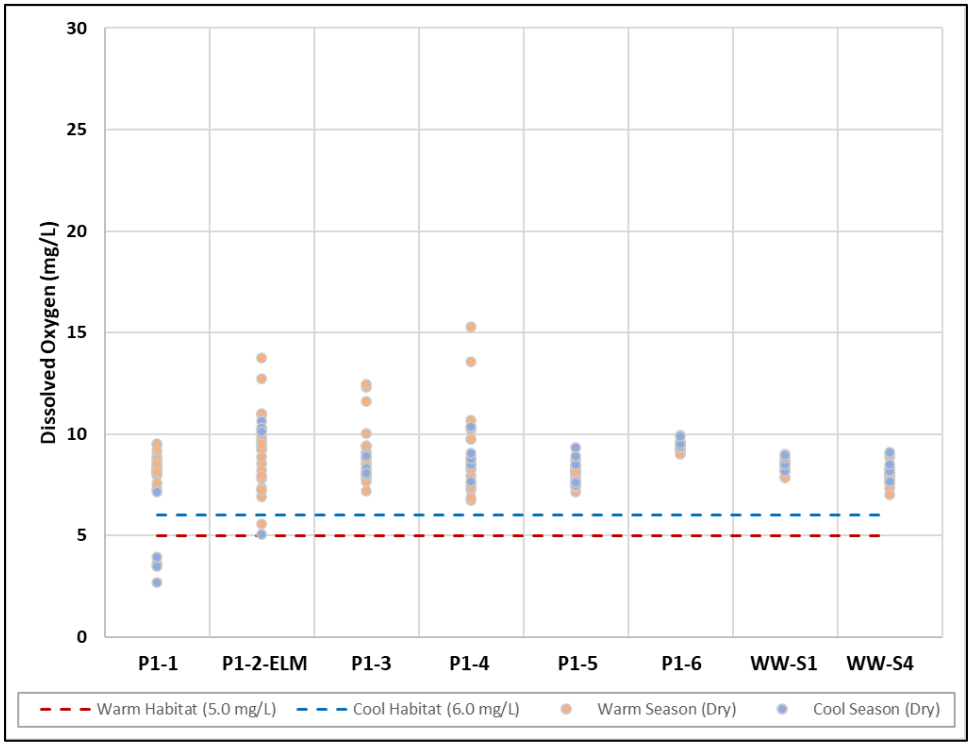

Figure 4-3. Distribution of Dissolved Oxygen Measurements at Priority 1 Sites

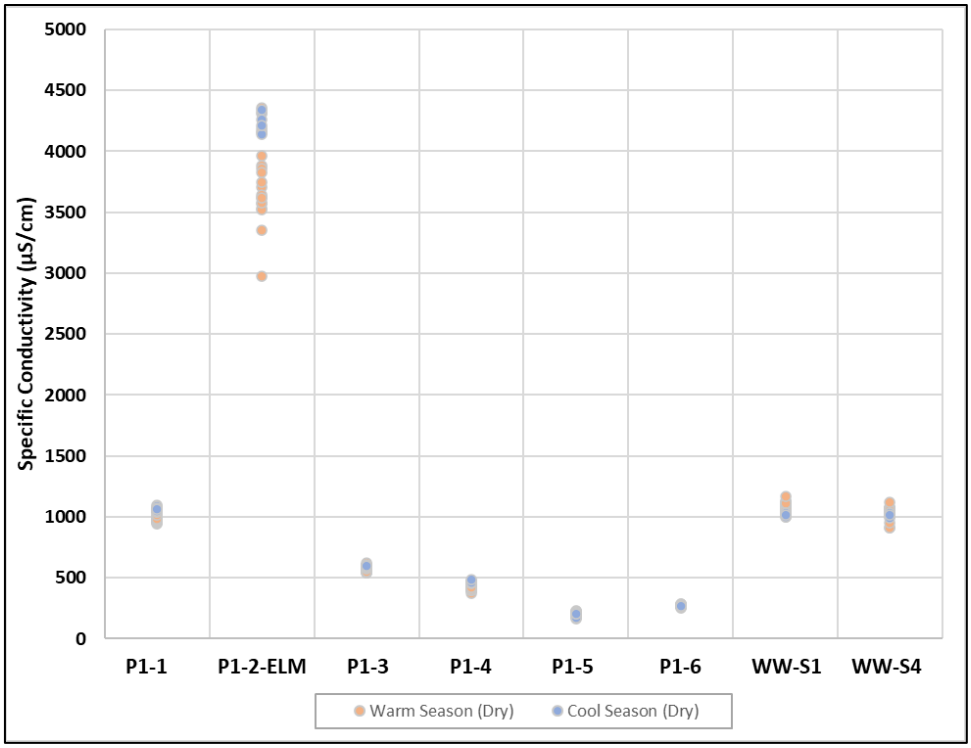

Figure 4-4. Distribution of Specific Conductivity Measurements at Priority 1 Sites

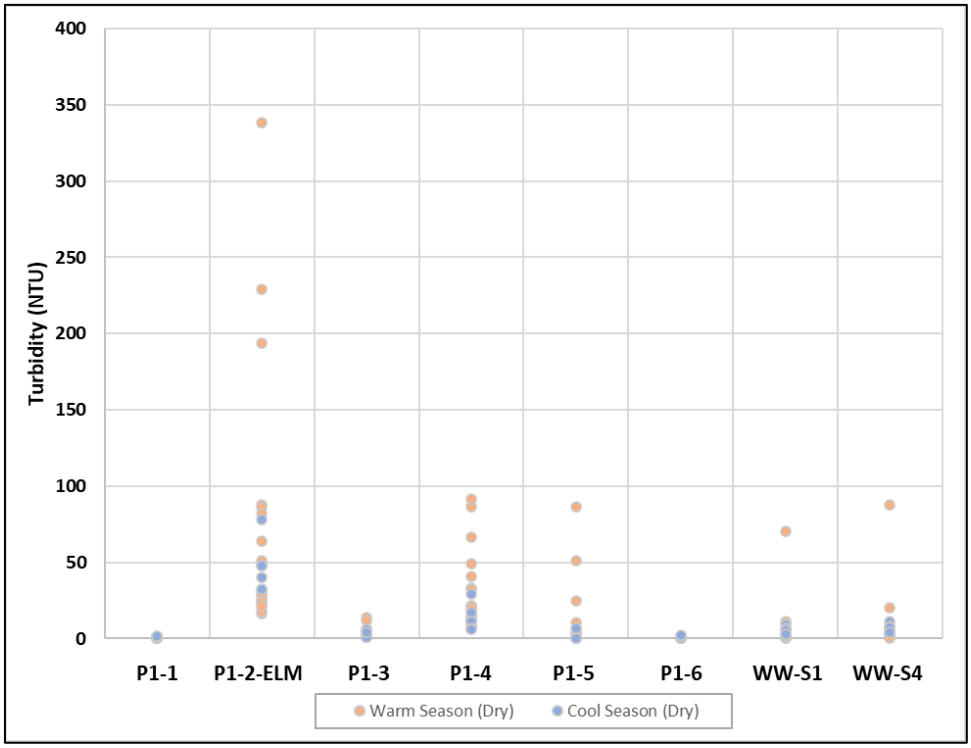

Figure 4-5. Distribution of Turbidity Measurements at Priority 1 Sites

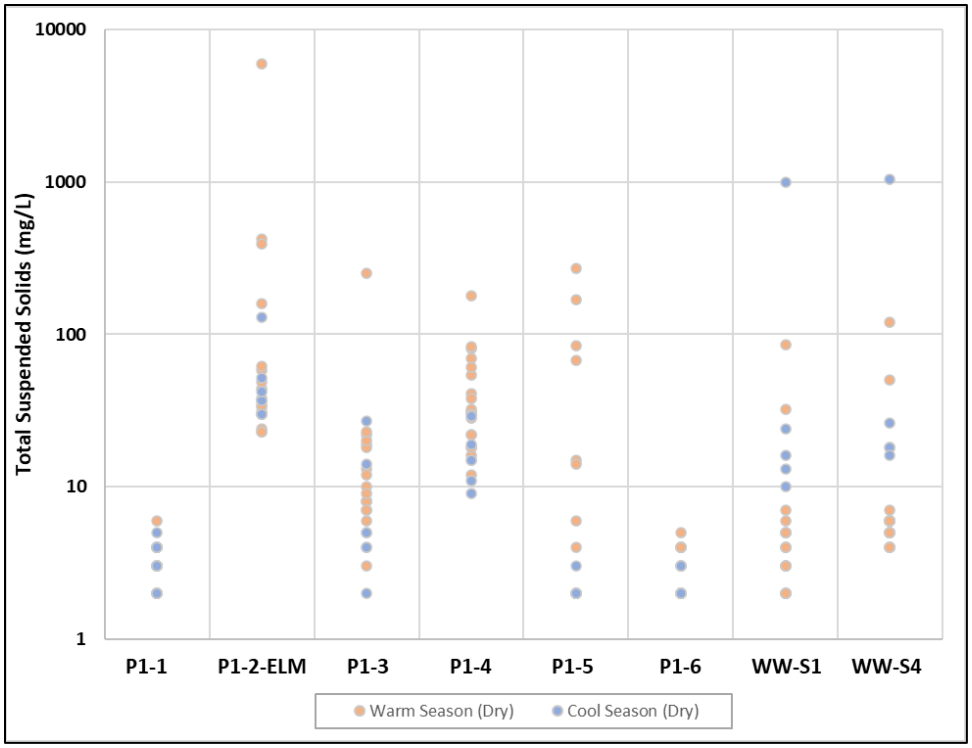

Figure 4-6. Distribution of TSS Measurements at Priority 1 Sites

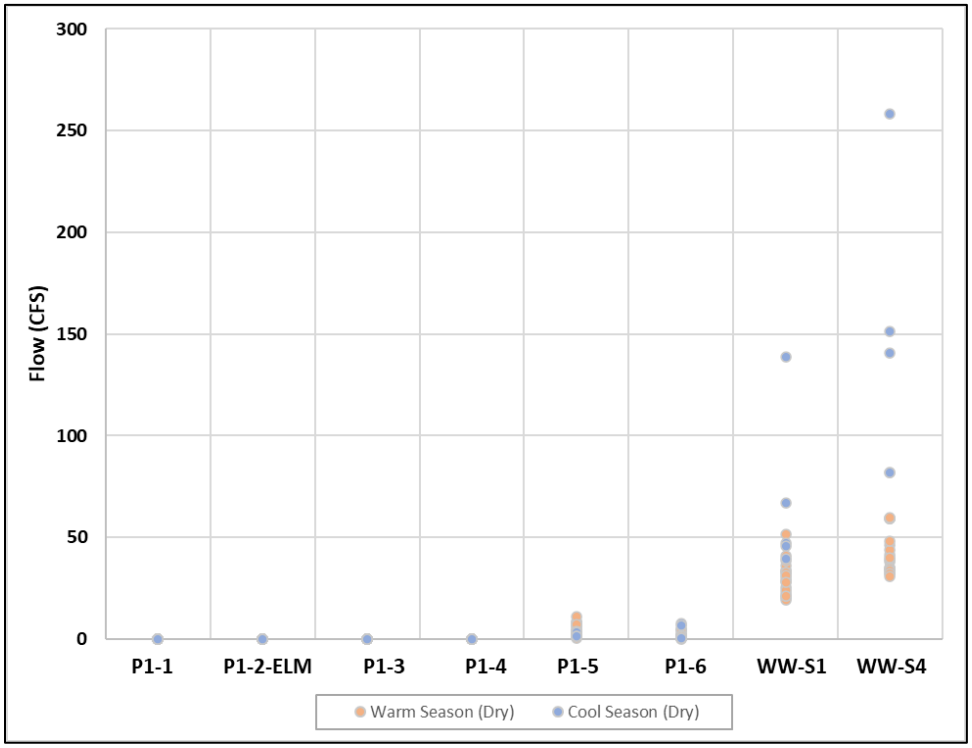

Figure 4-7. Distribution of Flow Measurements at Priority 1 Sites

*Note that lake sites are not monitored for flow and are assumed to have a flow rate of zero.

4.1.2 Bacteria Characterization

This section presents the bacteria data from the Priority 1 sites. Accompanying figures also include the bacteria WQOs; bacteria compliance analysis against the WQOs is presented in Section 4.1.3.

Figure 4-8 presents the distribution of the 5-sample rolling geomeans of *E. coli* concentrations observed at Priority 1 sites during the warm, dry and cool, dry seasons. Geomeans from the warm, dry season are 5-sample, 6-week rolling geomeans, while the geomean from the cool, dry season is a single 5-week geomean. When sample concentrations were below the laboratory detection limit, one-half of that detection limit was used to calculate the geometric mean.

All of the Santa Ana River sites (WW-S1 and WW-S4) geomean data were above the REC1 objective of 100 MPN/100 mL.

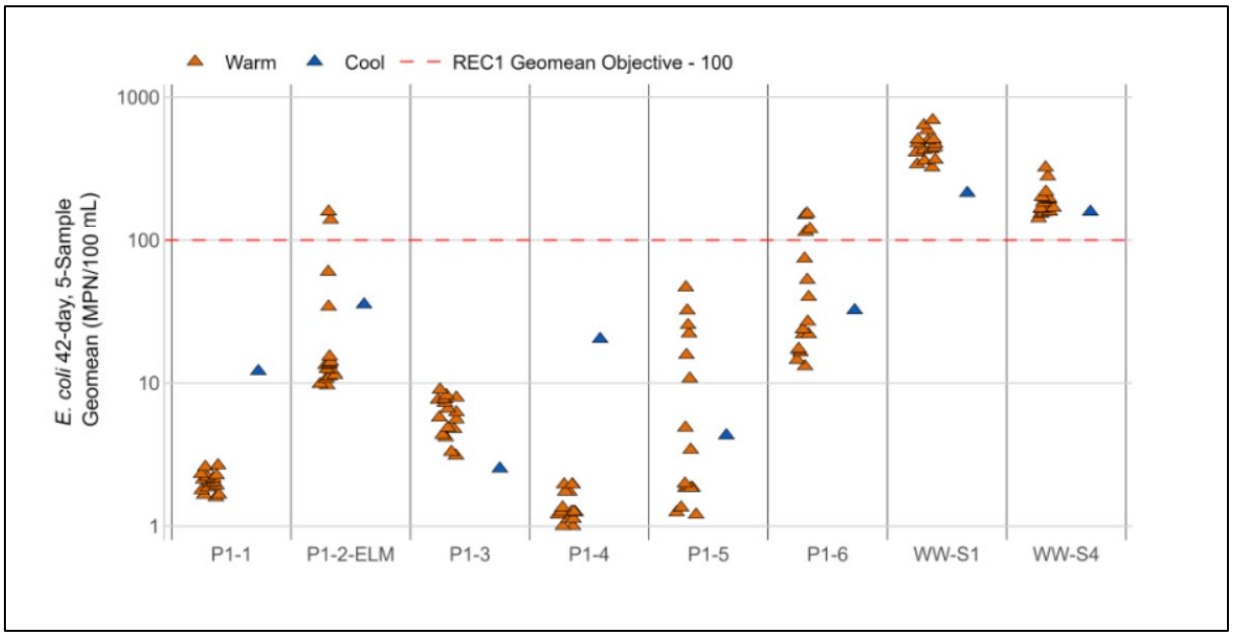

Figure 4-8. Distribution of *E. coli Geomean* Concentrations at Priority 1 Sites

Figure 4-9, **Figure 4-10**, and **Figure 4-12** through **Figure 4-17** show the individual and geomean *E. coli* concentrations for each Priority 1 site; **Figure 4-11** presents the individual and geomean Enterococcus concentrations at Lake Elsinore.

Key observations from the Priority 1 site data include:

Bacteria levels were consistently very low at several sites. All but four samples were less than 10 MPN/100 mL at Canyon Lake (P1-1); of those four samples, one was just above 10 MPN/100 mL in the warm season and the other three were between 10 and 25 MPN/100 mL in the cool season. Lake Perris (P1-3) and Big Bear Lake (P1-4) also had consistently low bacteria levels, with each only having a handful of samples between 10 and 100 MPN/100 mL, with Big Bear Lake having one sample slightly higher than 100 MPN/100 mL.

Both Mill Creek Ranch (P1-5) and Lytle Creek (P1-6) had low *E. coli* values at the start of the warm, dry season which increased steadily rising to their highest levels in September. Most of the individual values and all geomean values were less than 100 MPN/100 mL. However, Mill Creek had an individual value above 100 MPN/100 mL, and Lytle Creek had four individual and four geomean values above 100 MPN/100 mL. Cool, dry season samples were variable at Mill Creek Ranch but decreased in time and remained under 100 MPN/100 mL. At Lytle Creek the cool, dry season values were comparable to the warm, dry season range.

Prior to 2022, Lytle Creek (P1-6) had not exceeded WQOs over the period of record for the RBMP. The four exceedances occurred in the final four weeks of monitoring program implementation (August 30 – September 20, 2022). The cumulative impact of recreational use within the riparian zones of inland streams over the course of the dry season could be a source of *E. coli* bacteria through direct fecal contamination or indirectly, such as from increased trash accumulation attracting other animals.

At two of the lake sites (P1-1 and P1-4), the cool, dry season samples had slightly higher *E. coli* concentrations than in the warm, dry season.

Enterococcus values at the Lake Elsinore at Elm Grove Beach station were higher than values typically seen at Lake Elsinore at the previous sampling location at the boat ramp: in 2019 and 2020 only 2 of 50 samples exceeded STV threshold of 110 MPN/100 mL, while in 2022, 100 percent of the 42-day 5-sample, calculated geomean concentrations were above the REC1 WQO. The pattern in the Enterococcus geomean concentrations also differed from those for *E. coli* during the warm, dry season; the *E. coli* concentrations were steady until late August when the concentrations increased into late September, while the Enterococcus concentrations showed a steadier increase.

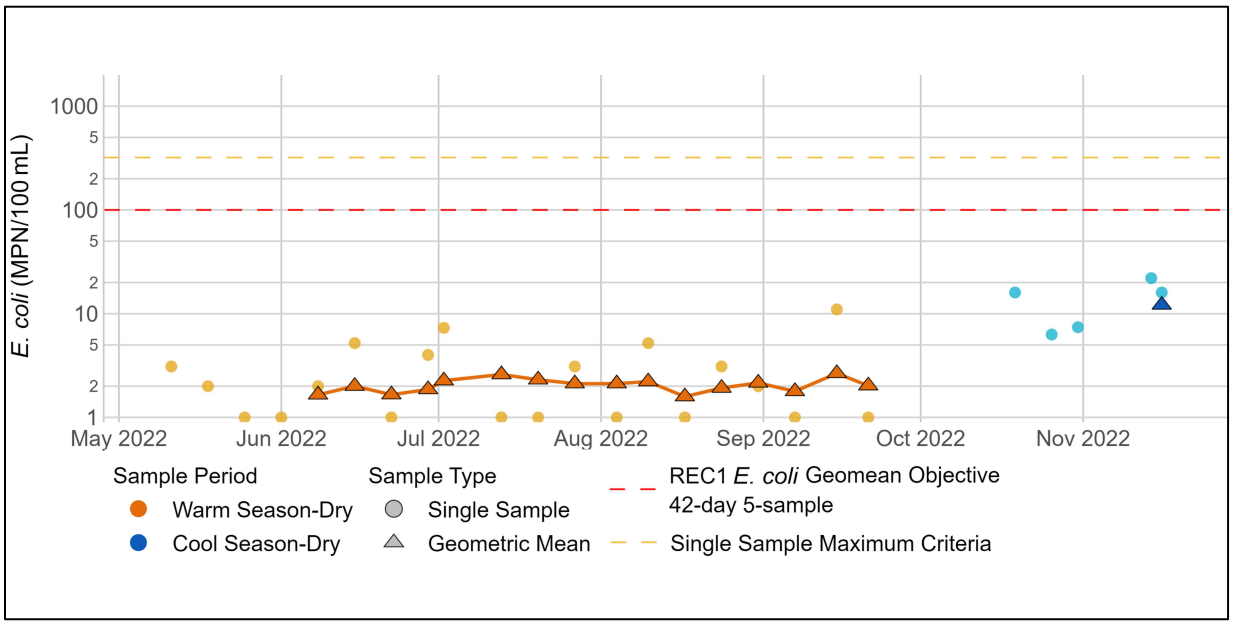

Figure 4-9. *E. coli* Concentrations and Geomeans at Canyon Lake at Holiday Harbor (P1-1)

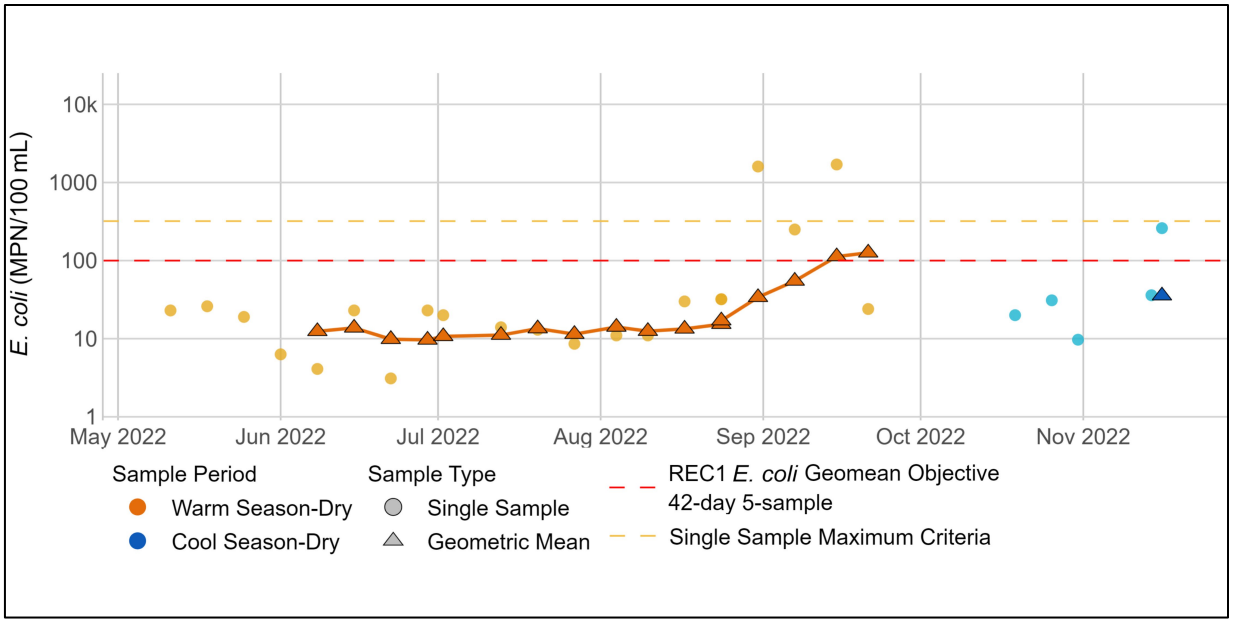

Figure 4-10. *E. coli* Concentrations and Geomeans at Lake Elsinore at Elm Grove Beach (P1-2-ELM)

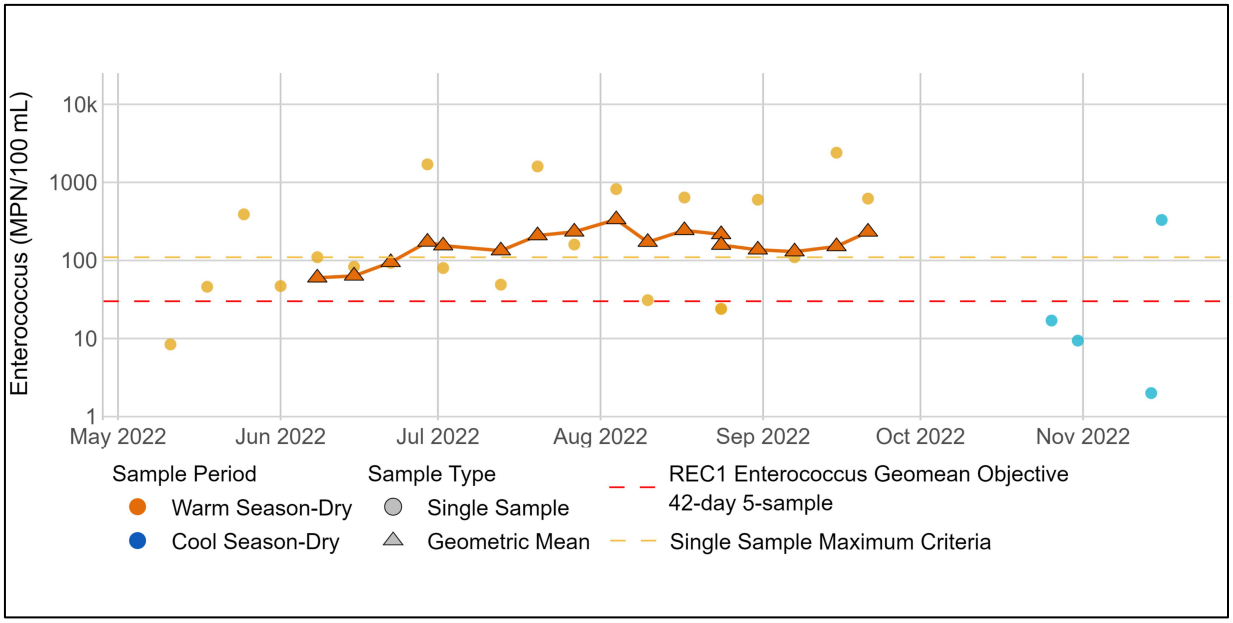

Figure 4-11. Enterococcus Concentrations and Geomeans at Lake Elsinore at Elm Grove Beach (P1-2-ELM)

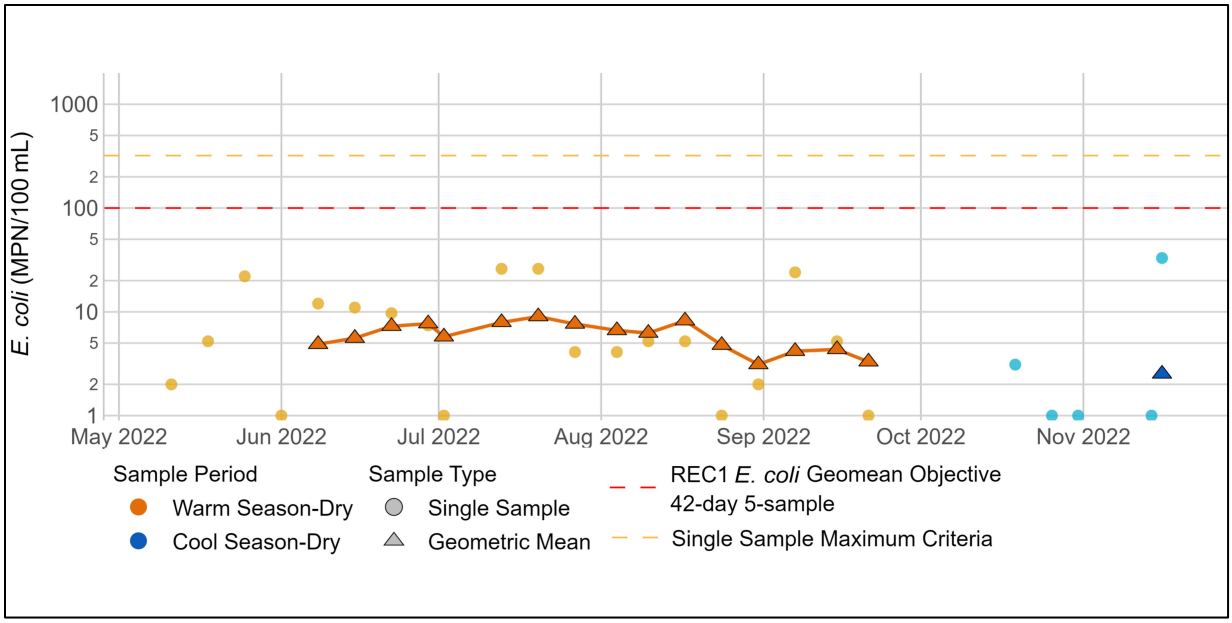

Figure 4-12. *E. coli* Concentrations and Geomeans at Lake Perris (P1-3)

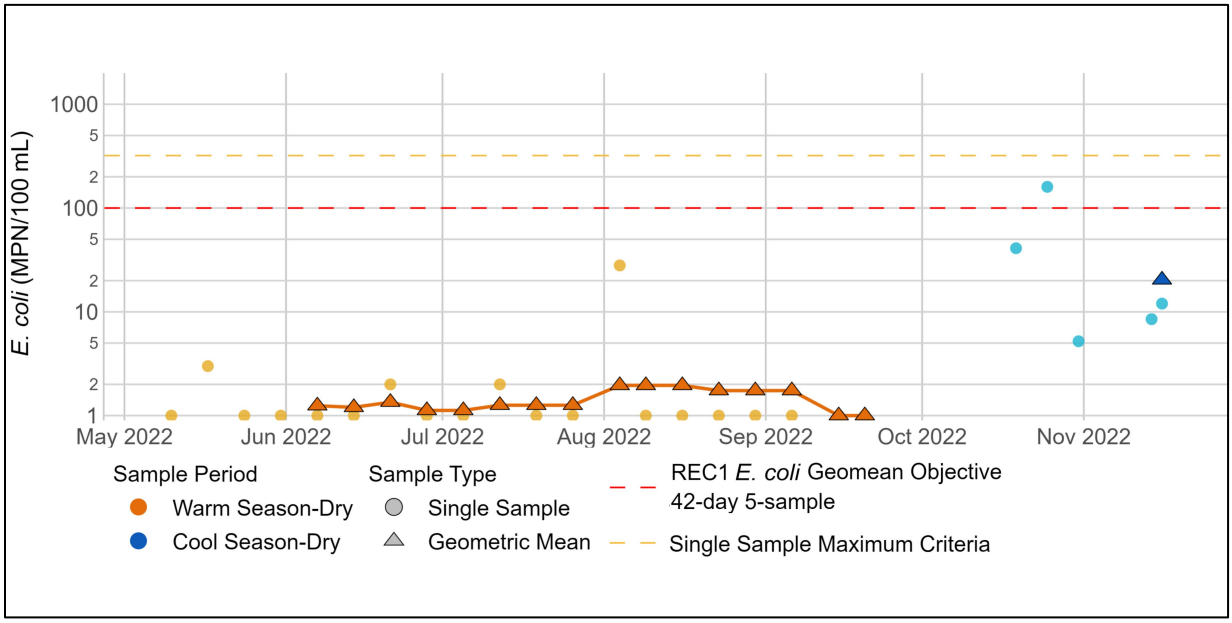

Figure 4-13. *E. coli* Concentrations and Geomeans at Big Bear Lake (P1-4)

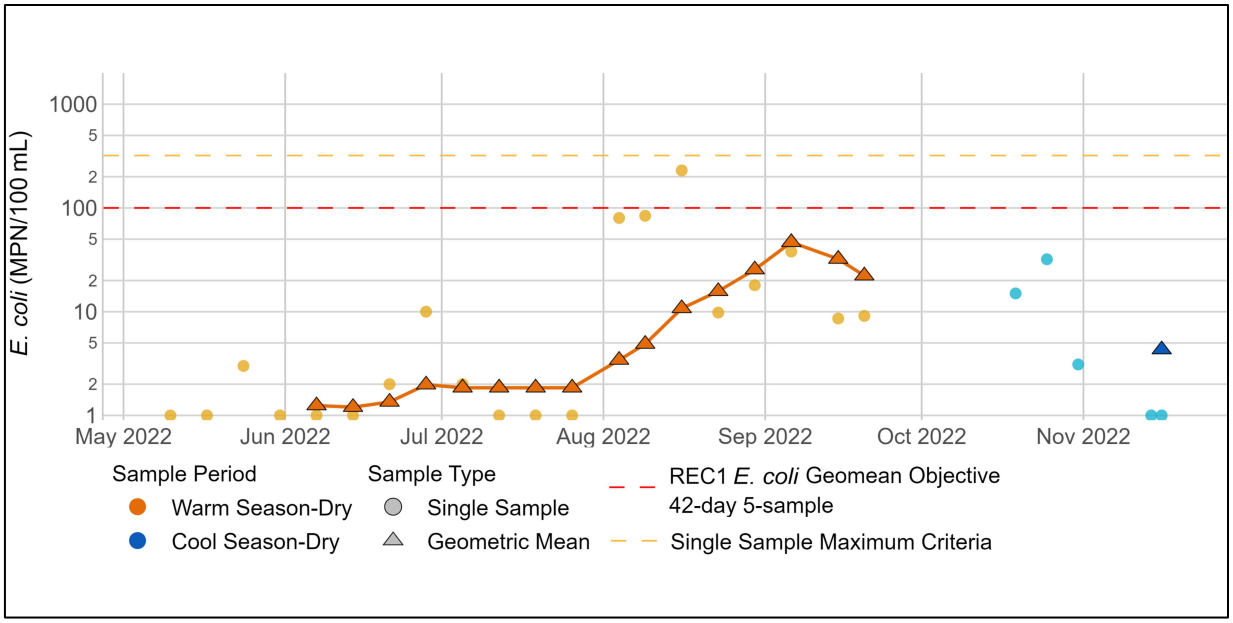

Figure 4-14. *E. coli* Concentrations and Geomeans at Mill Creek Reach 2 (P1-5)

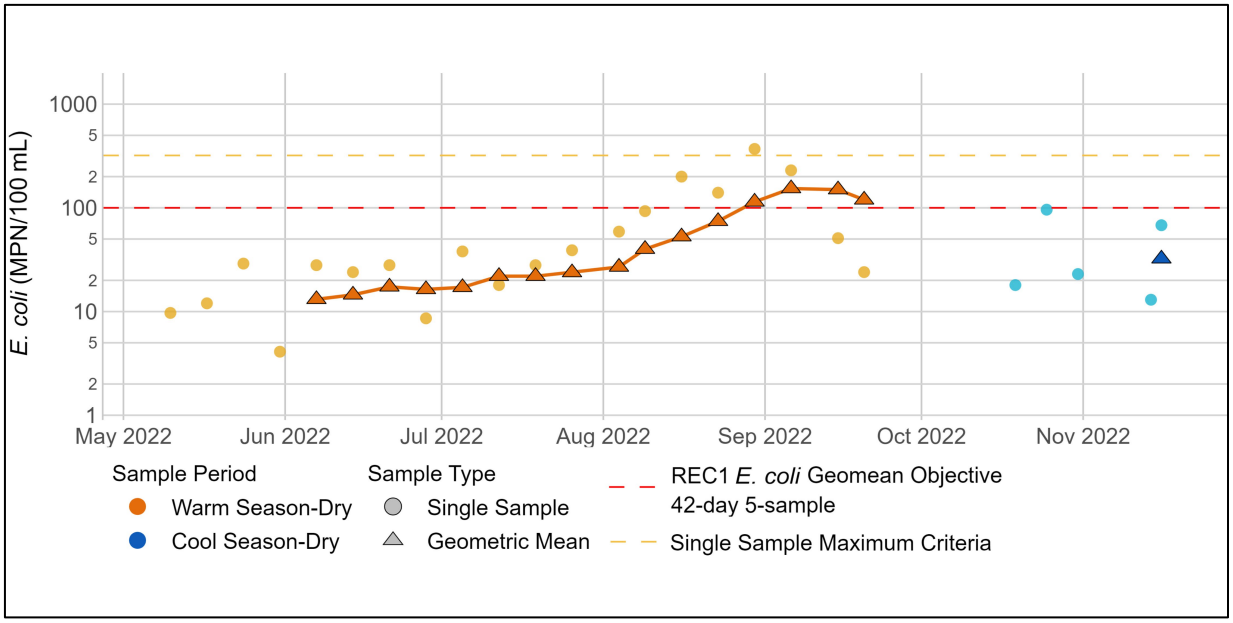

Figure 4-15. *E. coli* Concentrations and Geomeans at Lytle Creek (P1-6)

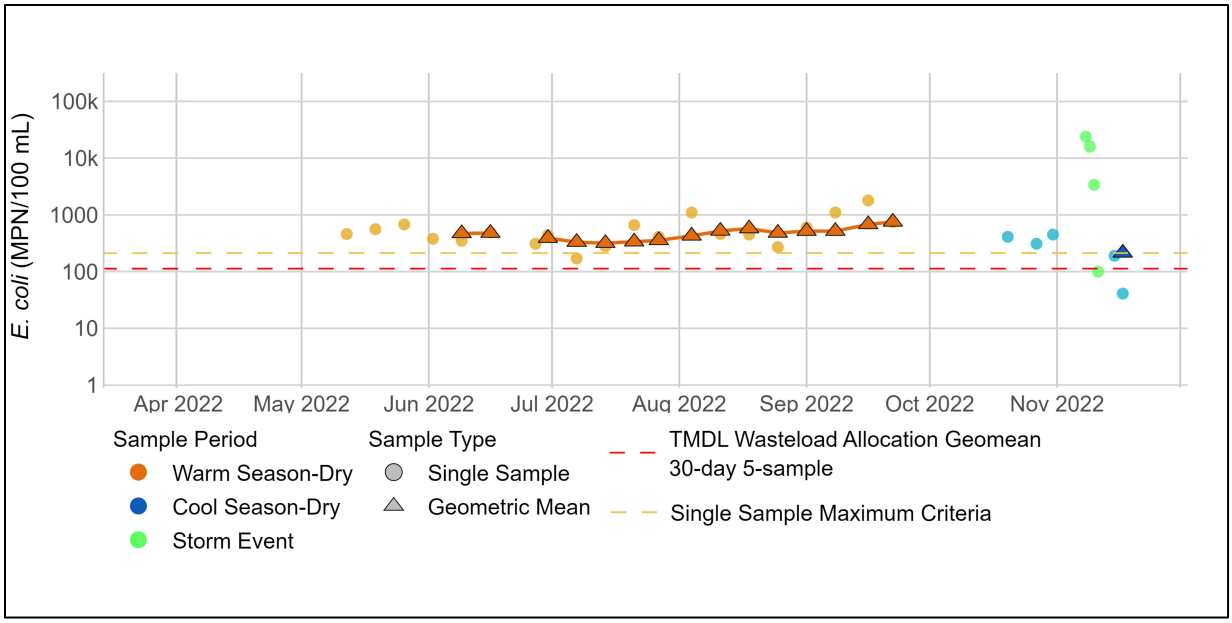

Figure 4-16. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

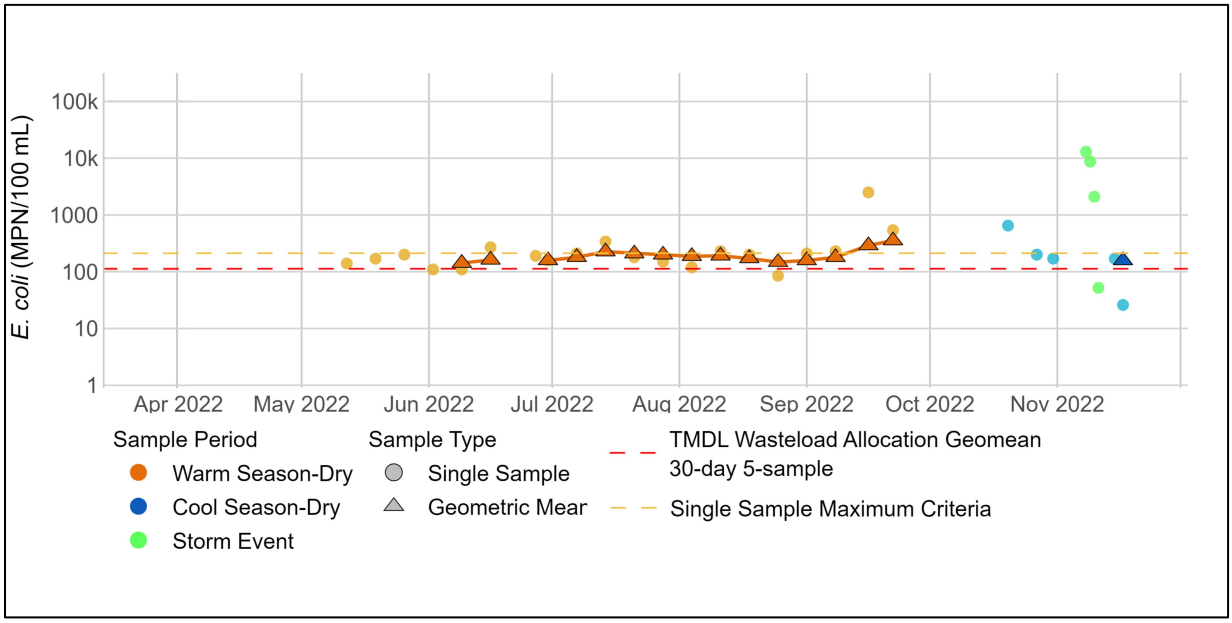

Figure 4-17. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

4.1.3 Bacteria Compliance Analysis

Table 4-2 presents the monitoring season frequency of exceedance with the applicable Statewide Bacteria Provision for REC-1 waters. The compliance analysis compares 2022 measured data to the Statewide Bacteria Provisions for REC-1 waters:

- *E. coli*: For all waters where the salinity is equal to or less than 1 ppth, 95 percent or more of the time, a six-week rolling geometric mean not to exceed 100 cfu/100 mL, calculated

weekly, and a STV of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

- Enterococcus: For all waters where the salinity is greater than 1 ppth, 5 percent or more of the time, a six-week rolling geometric mean not to exceed 30 cfu/100 mL, calculated weekly, and a STV of 110 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

Half of the monitoring locations had no exceedances for either the geomean or STV WQOs: Canyon Lake (P1-1), Lake Perris (P1-3), Big Bear Lake (P1-4), and Mill Creek Reach 2 (P1-5).

The four sites that exceeded the geomean WQO were Lytle Creek (P1-6) with 24 percent exceedance frequency, Lake Elsinore at Elm Grove Beach (P1-2-ELM), Santa Ana River at MWD Crossing (WW-S1), and Santa Ana River at Pedley Avenue (WW-S4) with 100 percent exceedance frequencies.

The same four sites also had individual samples that exceeded the STV. Nine samples at Santa Ana River at MWD Crossing (WW-S1) and three samples at Santa Ana River at Pedley Avenue (WW-S4) exceeded the 90th percentile STV. The percentage of samples exceeding the STV per month is shown in **Table 4-3**.

In addition, eight samples at Lake Elsinore at Elm Grove Beach exceeded the Enterococcus single sample STV criteria of 110 MPN/100 mL and two samples were at the STV criteria of 110 MPN/ 100 mL. At Lytle Creek one sample exceeded the *E. coli* single sample STV criteria of 320 MPN/ 100 mL.

Table 4-2. 2022-2023 Monitoring Season Frequency of Exceedance with *E. coli* Geomean (100 MPN/ 100 mL) and STV (320 MPN/100 mL) or Enterococcus Geomean (30 MPN/100 mL) and STV (110 MPN/100 mL) Water Quality Objective During the 2022 Dry Weather Samples

Site ID	Site	Geometric Mean Criterion Exceedance Frequency (%)	STV Criterion Exceedance Frequency (%)
P1-1	Canyon Lake	0	0
P1-2-ELM	Lake Elsinore at Elm Grove Beach[1]	100	54
P1-3	Lake Perris	0	0
P1-4	Big Bear Lake	0	0
P1-5	Mill Creek Reach 2	0	0
P1-6	Lytle Creek (Middle Fork)	24	4
WW-S1	Santa Ana River Reach 3 at MWD Crossing	100	72
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	100	16

Note:
[1] Lake Elsinore Water Quality Objective compliance values are calculated using Enterococcus.

Table 4-3. Monthly Frequency of Exceedance of STV (320 MPN/100 mL) Water Quality Objective During the 2022 Dry Weather Samples for the Santa Ana River Sites

Month	Number of Samples Collected	STV Criterion Exceedance Frequency (%)	
		Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue
May	3	100	0
June	5	80	0
July	4	50	25
August	4	75	0
September	4	100	50
October	3	67	33
November	2	0	0

4.2 Priority 2

4.2.1 Water Quality Observations

Water quality parameters measured in the field at Priority 2 sites (**Table 4-4**) are summarized in **Figure 4-18** through **Figure 4-24**. Key observations are summarized as follows:

- **pH** - **Figure 4-18** shows that all the pH measurements were above the lower allowable limit of 6.5 S.U., however, 52 percent of measurements taken at Prado Park Lake Outlet exceeded the upper limit of 8.5 S.U.; Prado Park Lake measurements ranged from 7.8 to 9.2. At the other five sites all measurements were within the allowable limits.

- **Water temperature** – Maximum water temperatures at several Priority 2 sites were several degrees higher than they were in the previous year; for instance, at Prado Park Lake the maximum temperature in the 2021-22 season was 25°C, while this year the temperature topped out at about 28°C. Similar 2-4°C temperature increases were seen at all Priority 2 stations except WW-S1(Santa Ana Reach 3 @ MWD Crossing) (**Figure 4-19**). On average, temperatures are higher in the upstream mainstem Santa Ana River (MISSION) and decrease as flow continues downstream (WW-S4 and WW-S1).

- **Dissolved oxygen** - All Priority 2 sites are designated with the WARM beneficial use and should meet a minimum DO level of 5 mg/L. All DO levels from the three Santa Ana River sites are greater than 5 mg/L (**Figure 4-20**), while eight dry weather samples from Chino Creek, five samples from Prado Park Lake and two samples from Mill Cucamonga Creek were below 5 mg/L. Low DO levels at Chino Creek and Mill Cucamonga Creek are typical of those seen in previous years while low DO levels were not seen at Prado Park Lake in the previous year. DO levels at Prado Park Lake decreased throughout the warm, dry season before returning to levels above the minimum DO level during the cool, dry season. This can likely be attributed to higher water temperature (higher water temperatures have lower oxygen saturation levels) and the low flow condition at Prado

Park Lake during the summer months (water column and sediment oxygen demands have more impact with less water volume), and a lack of oxygenated water input.

- **Specific conductivity** - **Figure 4-21** shows that specific conductivity is similar at the three Santa Ana River sites, generally increasing as flow continues downstream, ranging from 813 µS/cm to 1167 µS/cm. Specific conductivity in Prado Park Lake, Chino Creek, and Mill Cucamonga Creek rose during the summer months as a result of evapo-concentration.

- **Turbidity and TSS** – **Figure 4-22** and **Figure 4-23** show that turbidity and TSS are similar with low to moderate ranges for most of the sites except at Prado Park Lake and Mission Avenue bridge. Prado Park Lake showed the largest variations with turbidity ranges from 1.8 to 39.0 NTU and total suspended solids from 2 to 55 mg/L. All three mainstem Santa Ana River sites experienced elevated turbidity and TSS the week of November 06, 2022 due to wet weather conditions four days prior to sampling.

- **Flow** – Measured flow is lowest at Prado Park Lake (spill from the lake) with rates ranging from 0.6 to 8.5 cfs. Chino and Mill-Cucamonga Creeks had slightly higher but similar ranges of flow (2.0 to 93.8 cfs and 2.6 to 66.7 cfs, respectively). Flow is higher in the Santa Ana River and highest at the most downstream site Santa Ana River at Pedley Avenue (**Figure 4-24**). Maximum flow at Santa Ana River at Pedley Avenue (258 cfs) is approximately 86 percent higher than the maximum flow at Santa Ana River at MWD Crossing (138.7 cfs) due to effluent discharge from Riverside Water Quality Control Plant (WQCP).

Table 4-4. Priority 2 Monitoring Sites

Site ID	Site Description	County
WW-C3	Prado Park Lake	San Bernardino
WW-C7	Chino Creek at Central Avenue	San Bernardino
WW-M6	Mill-Cucamonga Creek below Wetlands	San Bernardino
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside
MISSION	Santa Ana River at Mission Blvd. Bridge	Riverside

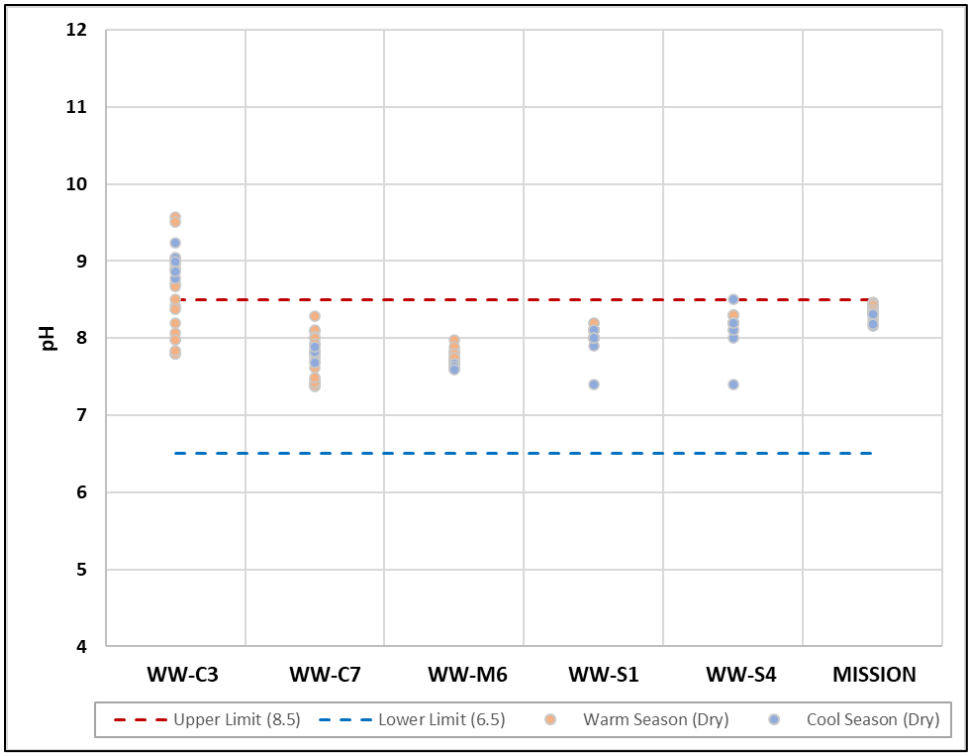

Figure 4-18. Distribution of pH Measurements at Priority 2 Sites

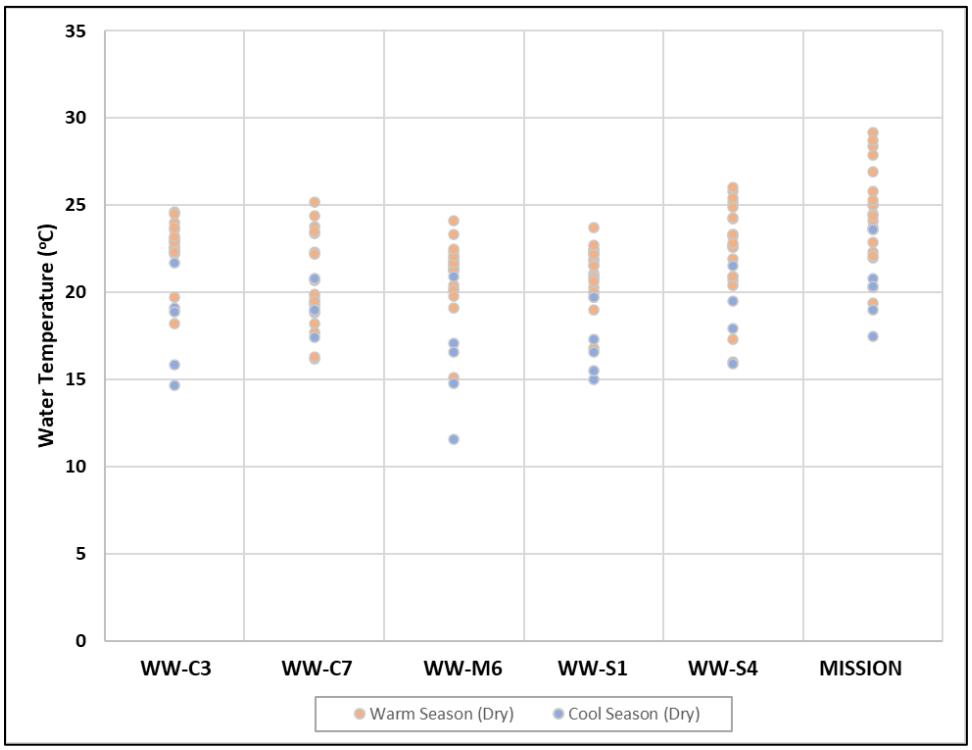

Figure 4-19. Distribution of Water Temperature Measurements at Priority 2 Sites

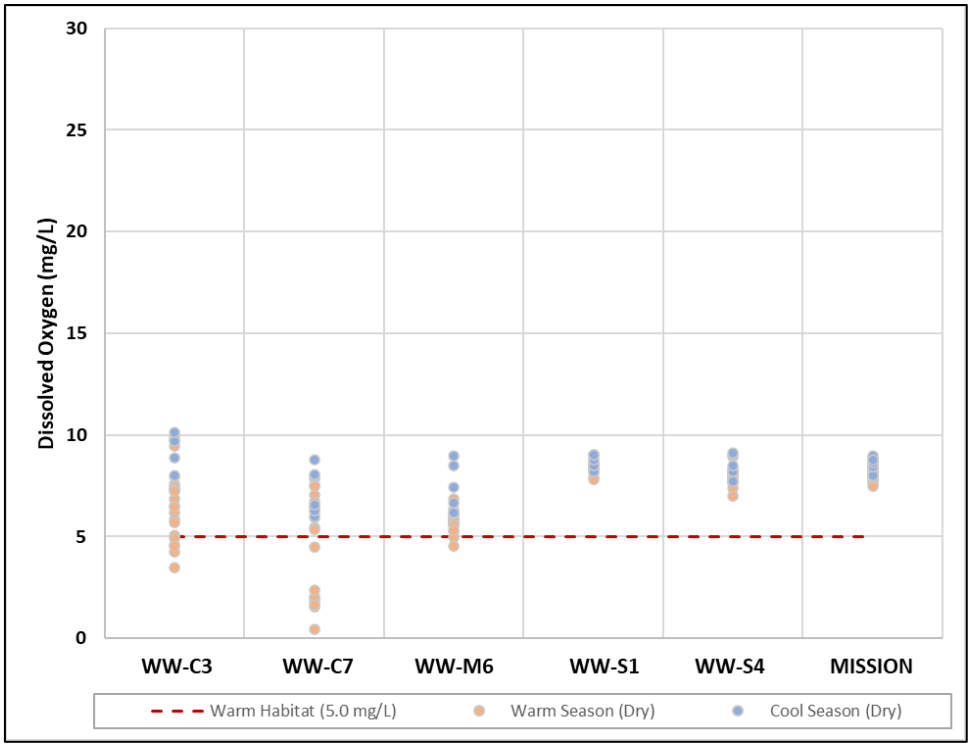

Figure 4-20. Distribution of Dissolved Oxygen Measurements at Priority 2 Sites

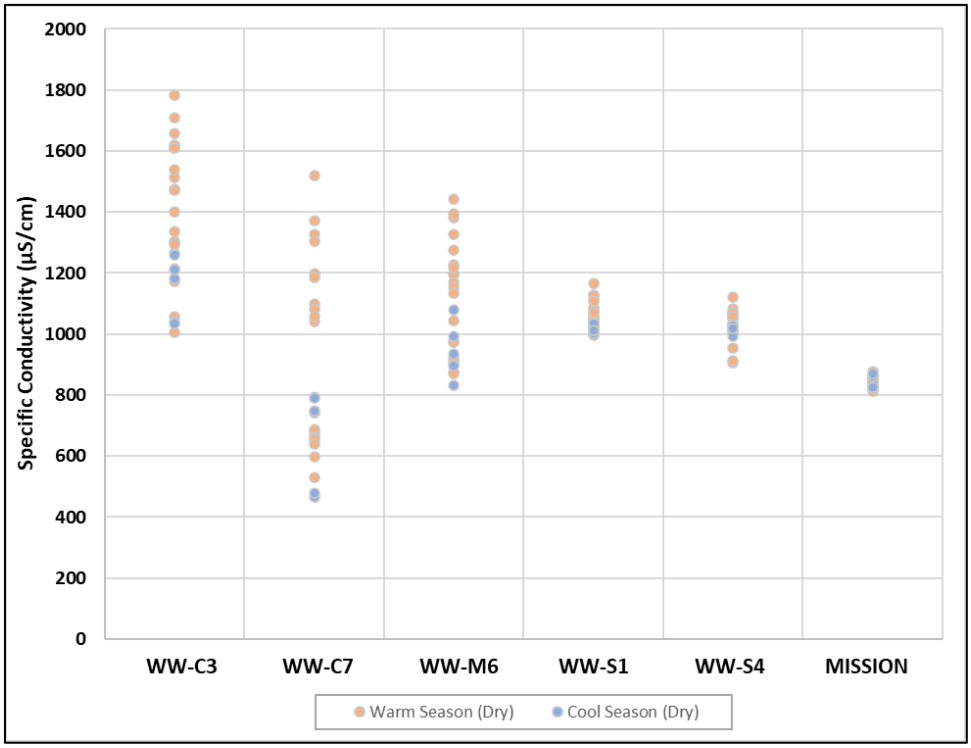

Figure 4-21. Distribution of Specific Conductivity Measurements at Priority 2 Sites

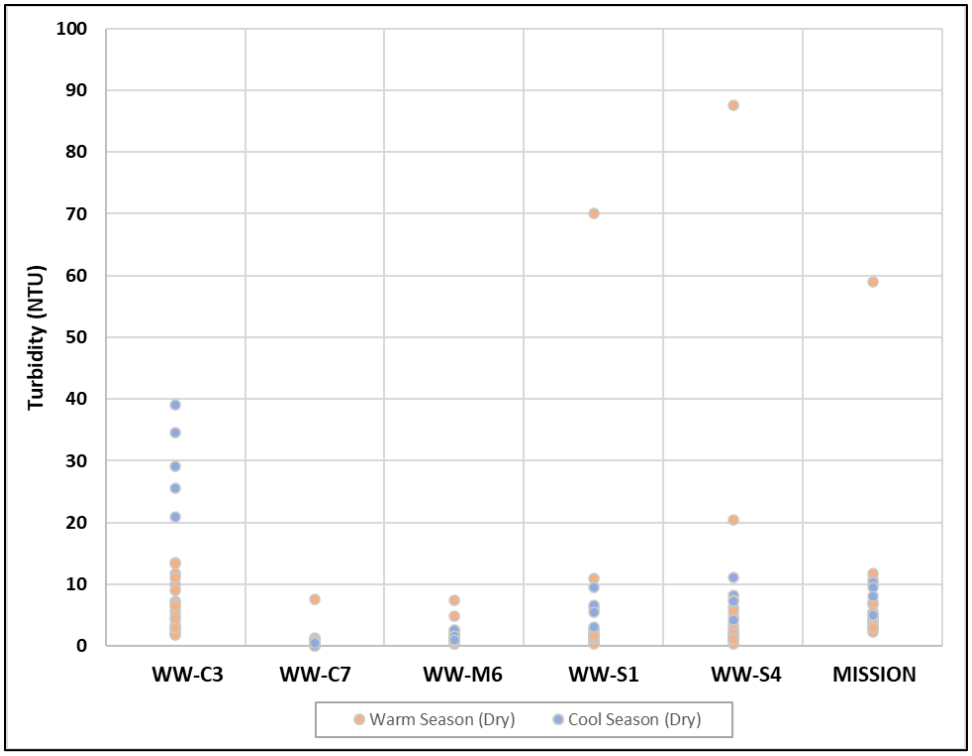

Figure 4-22. Distribution of Turbidity Measurements at Priority 2 Sites

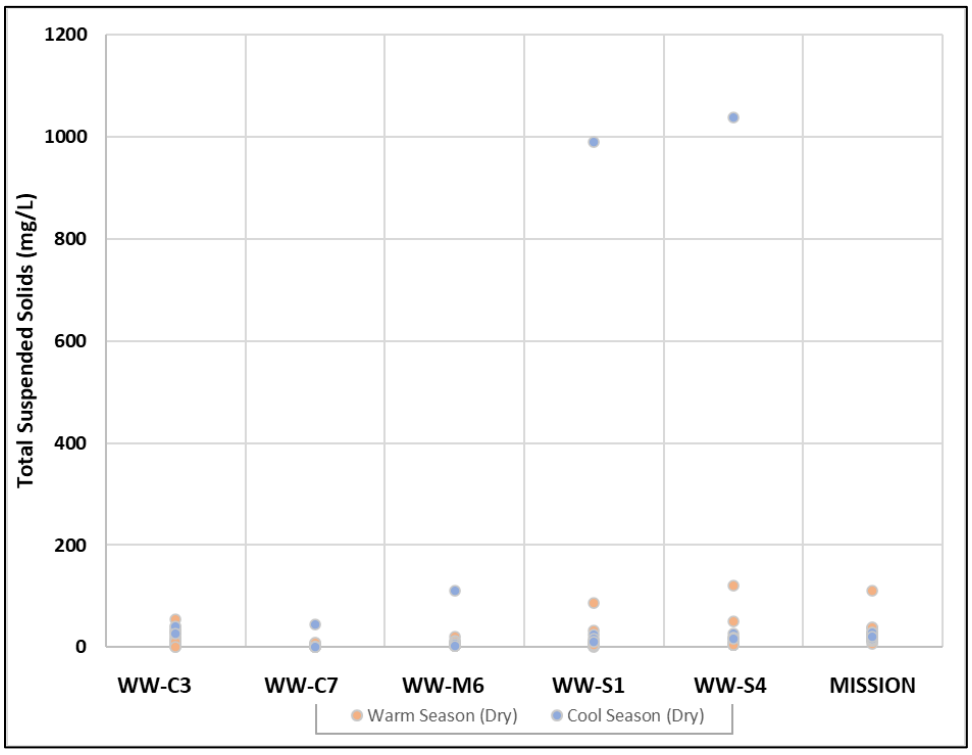

Figure 4-23. Distribution of TSS Measurements at Priority 2 Sites

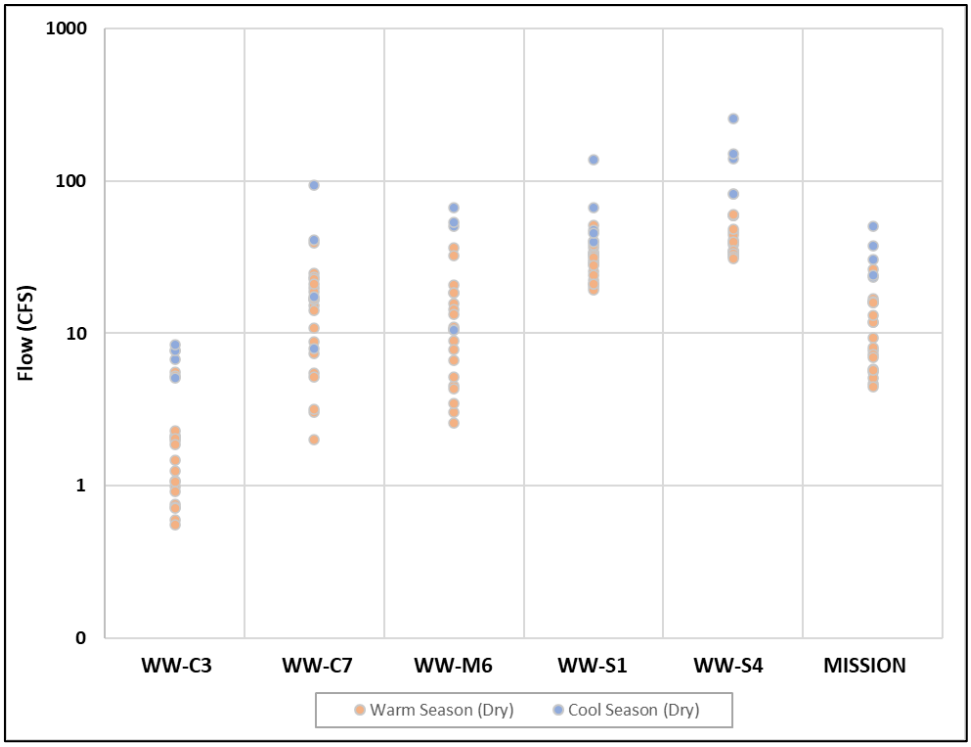

Figure 4-24. Distribution of Flow Measurements at Priority 2 Sites

4.2.2 Bacteria Characterization

Figure 4-25 summarizes the distribution of the geomeans of *E. coli* concentrations observed at Priority 2 sites during the warm, dry and cool, dry seasons. **Figure 4-26** through **Figure 4-31** show the individual and rolling geomean *E. coli* concentrations during the 2022-2023 monitoring period.

The figures include geomeans that were calculated using a five-sample minimum, 30-day geomean per the 2005 TMDL requirements. Please note that except for Prado Park Lake and Chino Creek there is a discontinuation in the geomean calculation for all sites in mid-June due to a wet weather event causing the delay of weekly sampling; Prado Park Lake and Chino Creek were sampled in the affected week prior to the rain event. Make-up at the other Priority 2 sites were collected the following week and the geomean calculation was able to continue in July.

4.2.2.1 Dry Weather

Figure 4-25 shows the distribution of the calculated geomeans throughout the warm, dry season. All sites had geomeans calculated above 113 MPN/ 100 mL WLA, with the three Santa Ana River sites having all their geomean values above that threshold. All sites except Chino Creek (WW-C7) were above the WLA during the cool, dry season.

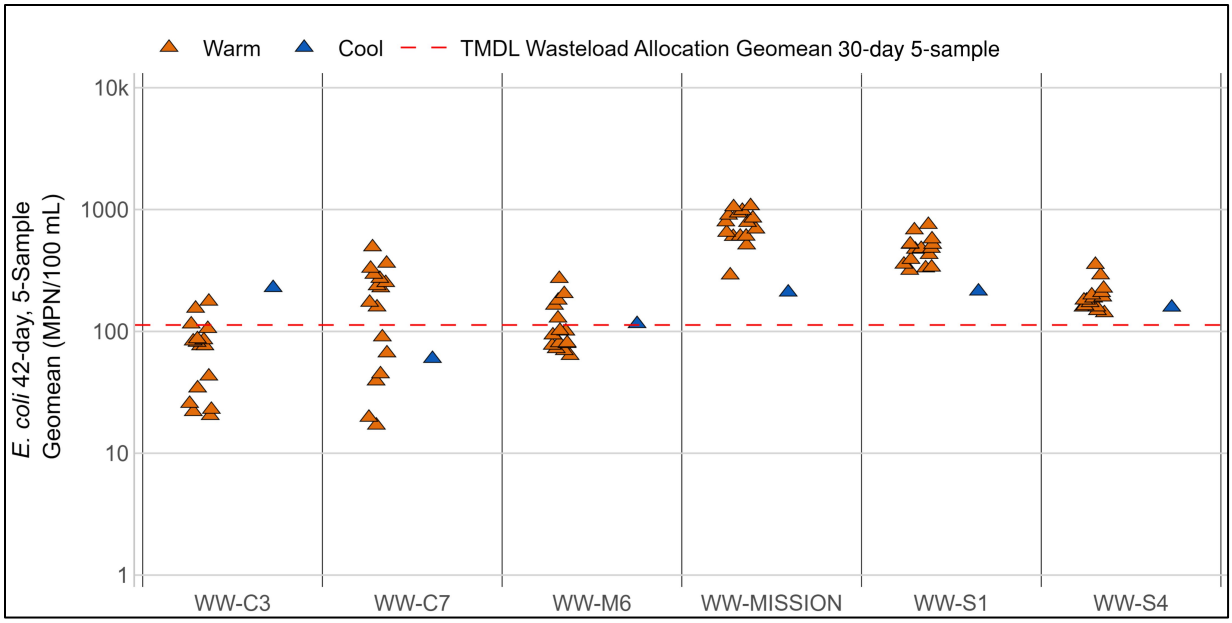

Figure 4-25. Distribution of *E. coli* Concentrations at Priority 2 Sites

Figure 4-26 through **Figure 4-31** show the Priority 2 individual site results for the sample concentrations and rolling geomeans.

Chino Creek Central Avenue had the highest single sample *E. coli* concentration of 5,200 MPN/100 mL during the 2022 warm, dry season.

E. coli concentrations at Prado Park Lake ranged from 5 to 280 MPN/100 mL (**Figure 4-26**). Bacteria concentrations were elevated in the first week of the warm, dry season then steadily declined. In July, the bacteria concentrations began to increase and remained elevated through September except for one sample mid-August. The bacteria concentrations were the highest in the beginning of the cool, dry season then fell below the WLA in November. It was noted that Prado Park Lake experienced little flow input through the summer and saw a decreased water level. This likely contributed to the elevated bacteria concentration seen in the later summer months.

Bacteria data at Chino Creek (**Figure 4-27**) followed the reverse pattern of Prado Park Lake with geomean values above the TMDL threshold until mid-August when concentrations decreased and geomeans remained below the threshold for the remainder of the 2022 monitoring period.

At Mill-Cucamonga Creek (**Figure 4-28**), the geomean values at the start of the sampling season were slightly above the TMDL threshold and then dipped below the threshold for July and August before rising again above the threshold for the remainder of the 2022 warm, dry monitoring period. The cool, dry geomean was below the threshold.

For the Santa Ana River monitoring sites (**Figure 4-29** through **Figure 4-31**), *E. coli* concentrations exceeded the geometric mean criteria by a large margin (30-day rolling geomeans ranged from 317 to 752 MPN/100 mL), consistent with results from previous sampling periods. Bacteria concentrations at Santa Ana River at Mission Blvd Bridge were consistently higher than

the previous two years when the site was added to the RBMP. Beginning in September 2022, the U.S. Army Corps of Engineers embarked on a levee rehabilitation project to repair damages to the Santa Ana River levee caused by storm events and migration of the river thalweg. This has led to major disruption of the area upstream of Mission Blvd and will continue to have an impact on the site moving forward as the geomorphology of the area has changed drastically.

The 2019 dry season Synoptic Study found that uncontrollable sources that are not conveyed through the MS4 account for the majority (77%) of the total bacteria load in Reach 3 of the Santa Ana River. The 2019 study also showed no relationship between *E. coli* concentration and presence of human HF 183 marker within the receiving waters. This finding strongly suggests that the *E. coli* observed in the Santa Ana River is coming from natural or uncontrollable sources (e.g., sediment releases, wildlife, feral pigs) than controllable sources (e.g., MS4 discharges). Following the 2019 Synoptic Study, several special studies were conducted in the area including the addition of the feral pig study to the RBMP for the 2022 dry season sampling. Additional information can be found on this study in Section 4.5.1. The reader is referred to the Middle Santa Ana River Synoptic Study and 2023 MSAR TMDL Triennial Report for more detail on this source analysis.

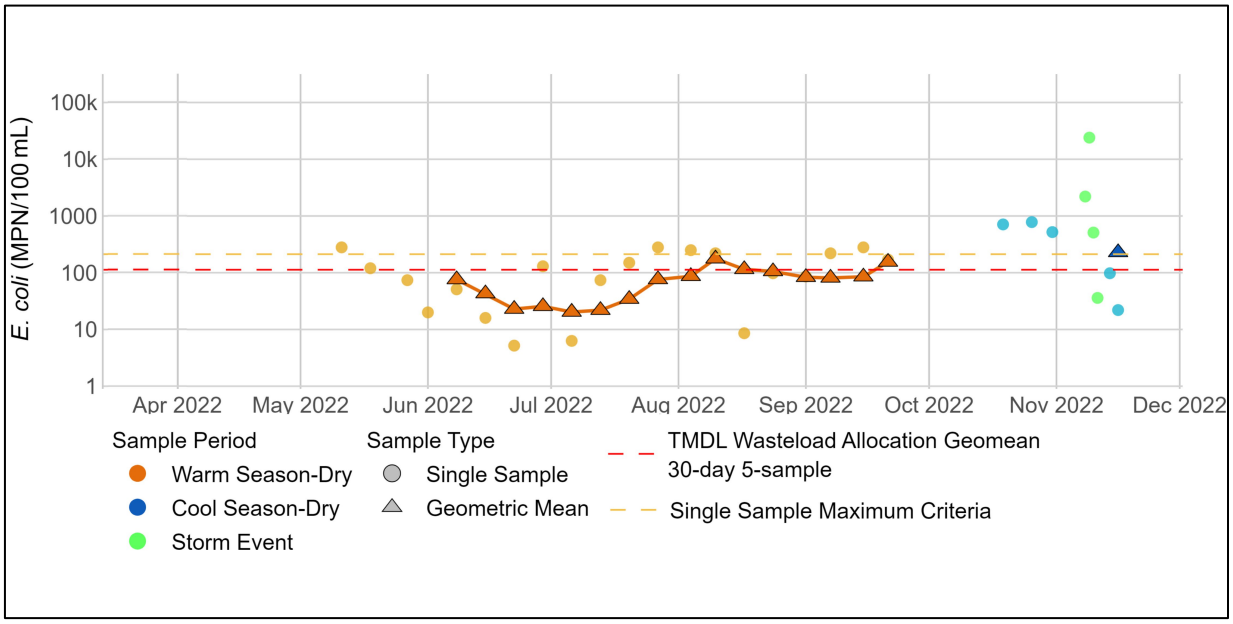

Figure 4-26. *E. coli* Concentrations and Geomeans at Prado Park Lake (WW-C3)

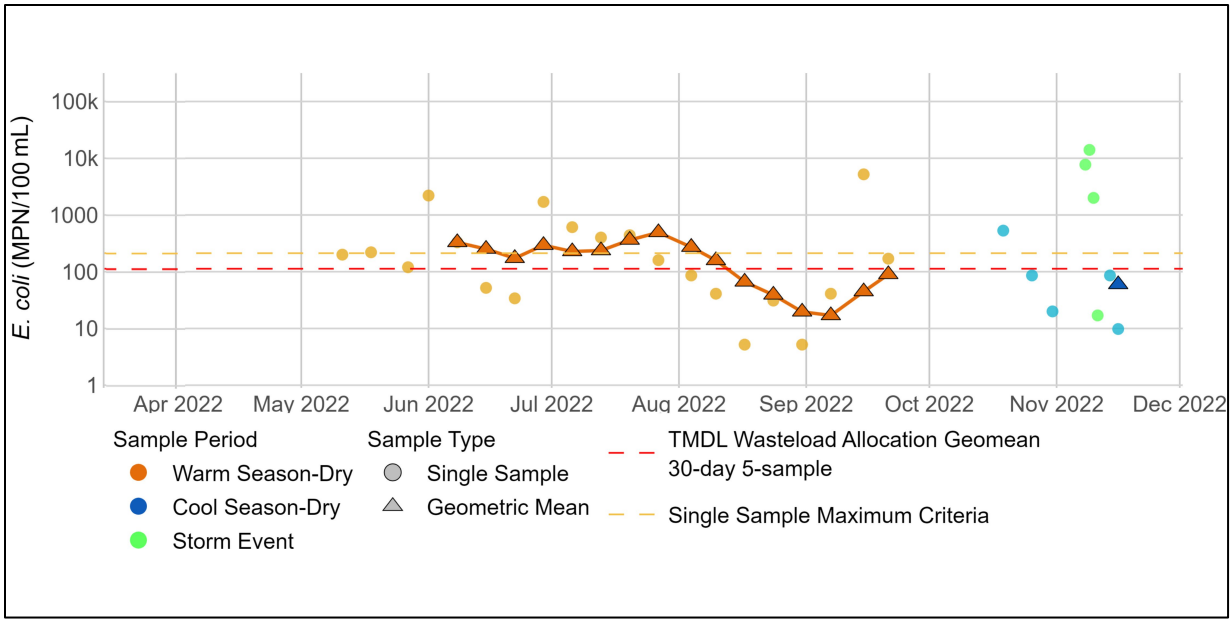

Figure 4-27. *E. coli* Concentrations and Geomeans at Chino Creek at Central Avenue (WW-C7)

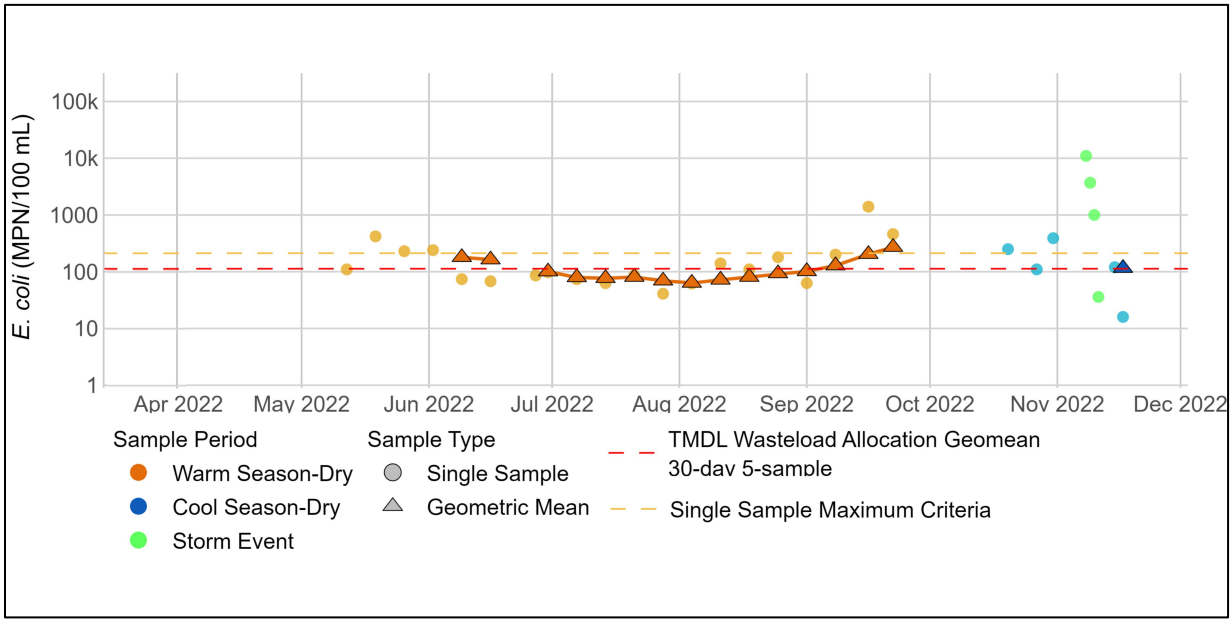

Figure 4-28. *E. coli* Concentrations and Geomeans at Mill-Cucamonga Creek Below Wetlands (WW-M6)

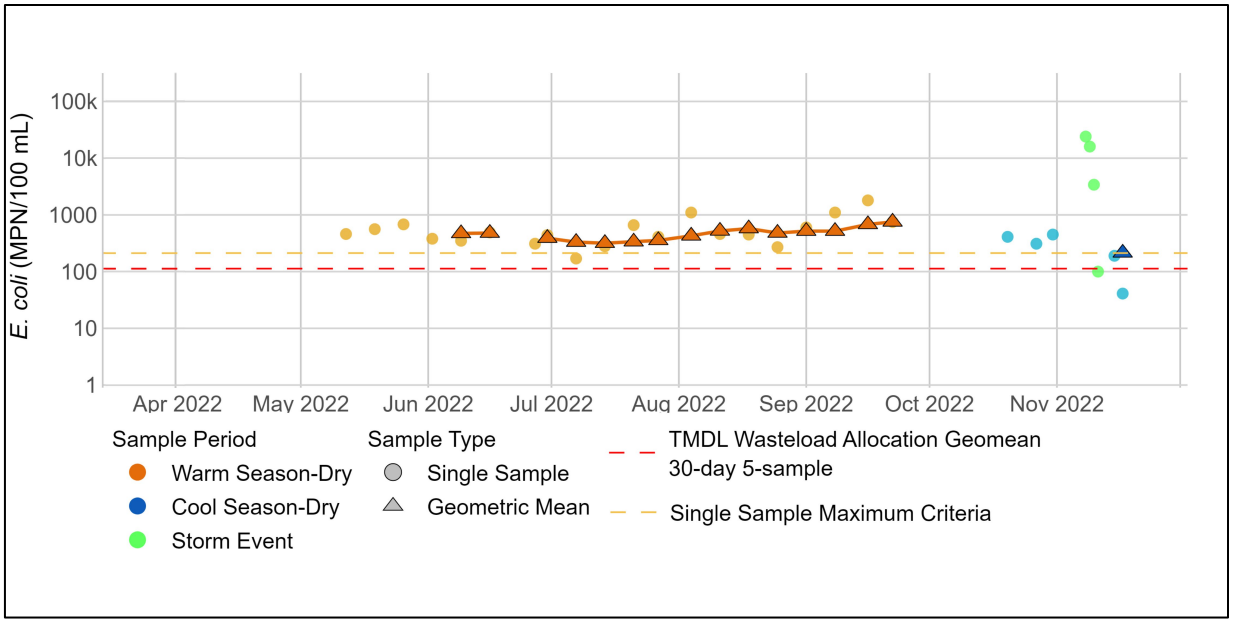

Figure 4-29. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

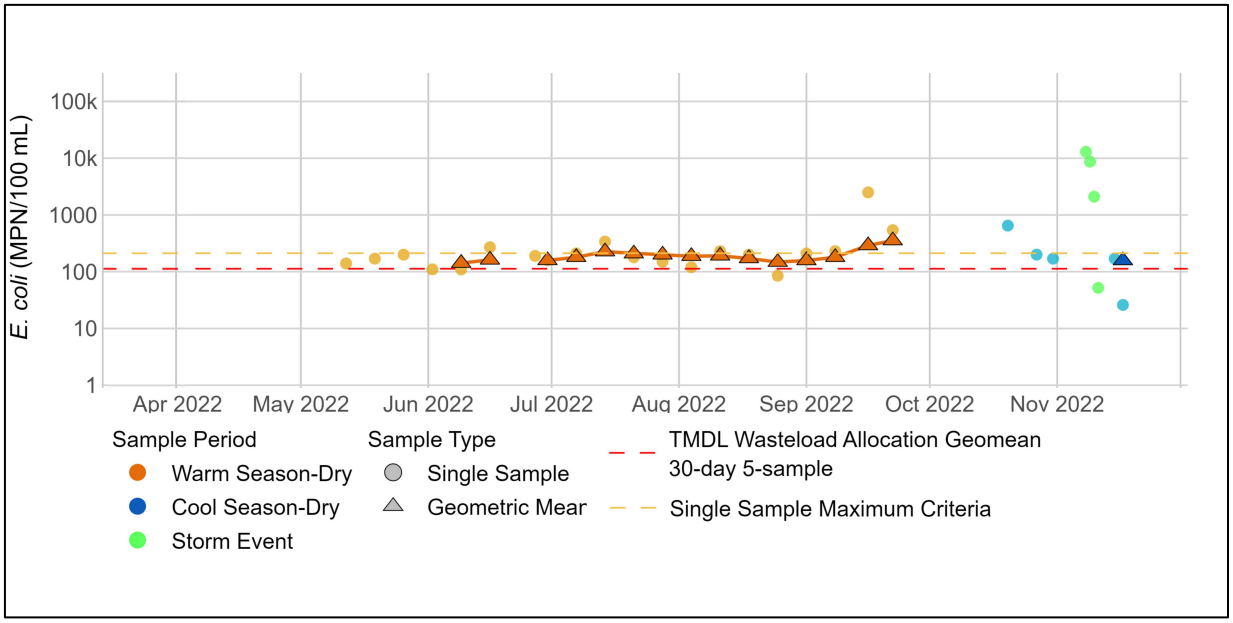

Figure 4-30. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

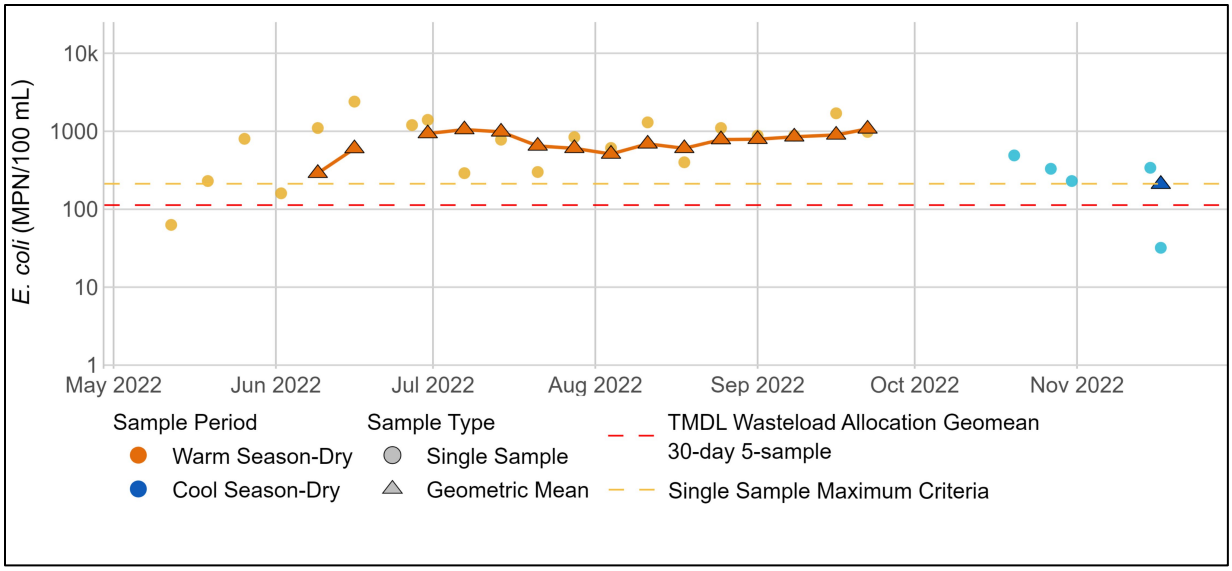

Figure 4-31. *E. coli* Concentrations and Geomeans at Santa Ana River at Mission Avenue (MISSION)

4.2.2.2 Wet Weather 2022-2023 Event

Samples collected for the November 8, 2022 storm event are summarized in **Table 4-5**. **Figure 4-32** and **Figure 4-33** display changing *E. coli* concentrations at two stations over the sampling period. Historical wet weather analysis showed that bacteria levels in the MSAR waterbodies return to pre-event levels 24-48 hours following a returning to dry weather flow conditions, see **Figure 4-34**.

Table 4-5. *E. coli* Concentrations (MPN/100 mL) Observed During the 2022-2023 Storm Event

Site	11/8/2022 During Storm	11/9/2022 24 hours after storm start	11/10/2022 48 hours after storm start	11/11/2022 72 hours after storm start
Prado Park Lake (WW-C3)	2,200	24,000	510	36
Chino Creek at Central Avenue (WW-C7)	7,700	14,000	2,000	17
Mill-Cucamonga Creek below Wetlands (WW-M6)	11,000	3,700	1,000	36
Santa Ana River Reach 3 at MWD Crossing (WW-S1)	24,000	16,000	3,400	100
Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	13,000	8,700	2,100	52

To provide better understanding of post-storm bacteria characterization and to better support data analysis for future wet weather CBRP implementation, the wet weather sampling procedure was adjusted from samples being taken every 0, 48, 72, and 96 hours to 0, 24, 48, and 72 hours. This provides greater definition for bacteria levels immediately after the storm and reduces likelihood of a follow-up event interfering with scheduled post storm sampling. For the November 8, 2022 event, the highest bacteria concentrations were observed during the 0 hour sampling event followed by gradual reduction of bacteria concentrations with the exception of Prado Park Lake and Chino Creek which saw an increase in bacteria concentrations following the

storm. It should be noted that the bacteria levels seen during and immediately after the event were low and were followed by the bacteria concentrations returning to typical values. As shown **Figure 4-32**, the initial sample collected at Chino creek was before the peak flow was experienced at Chino creek. It is believed that missing the peak of the event caused lower bacteria concentrations as the upper reaches of the drainage area had not yet drained.

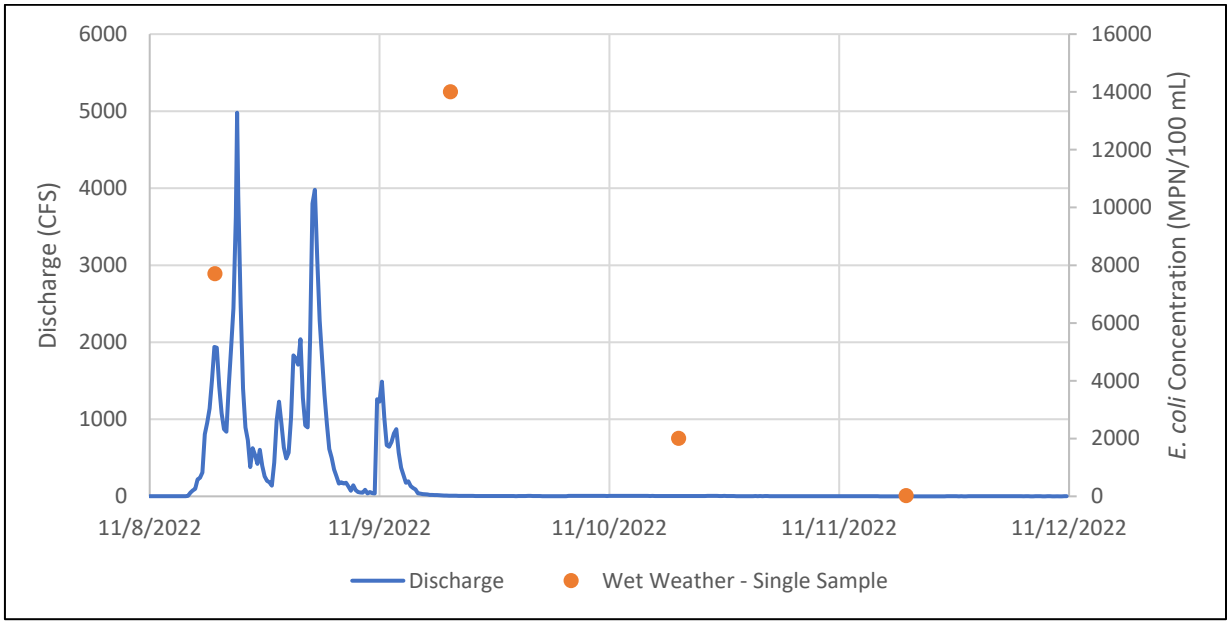

Figure 4-32. *E. coli* Concentrations Observed at Chino Creek During and After the November 8, 2022 Storm Event

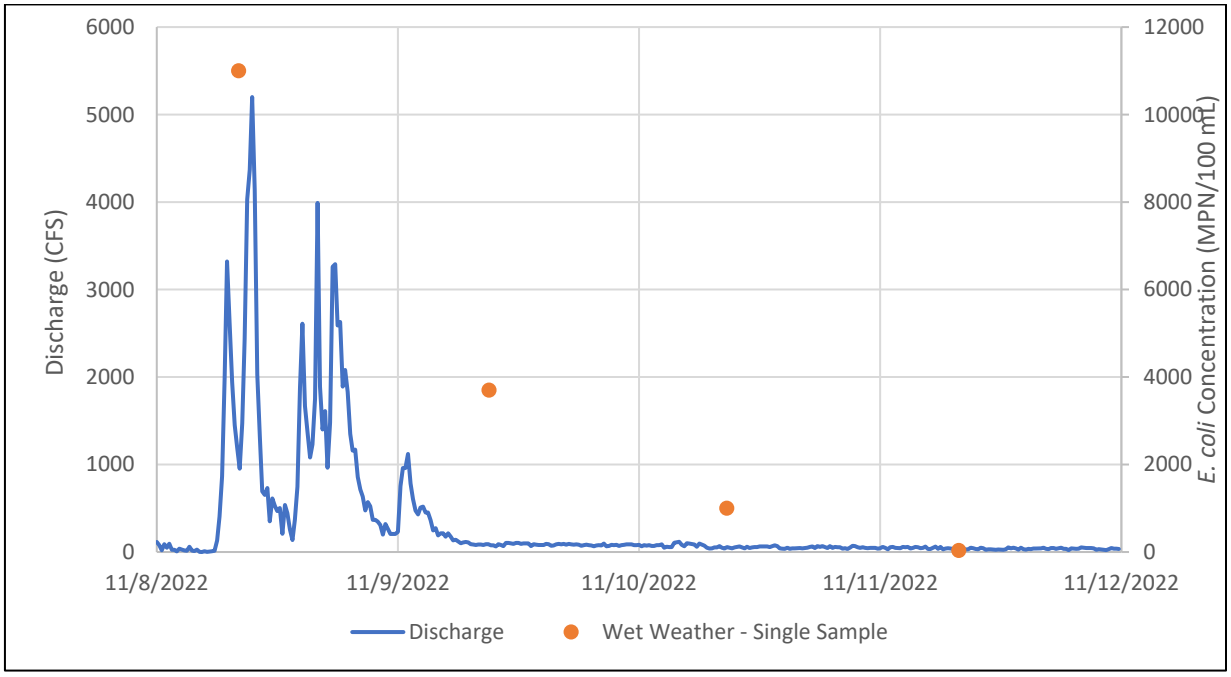

Figure 4-33. *E. coli* Concentrations Observed at Mill-Cucamonga Creek During and After the November 8, 2022 Storm Event

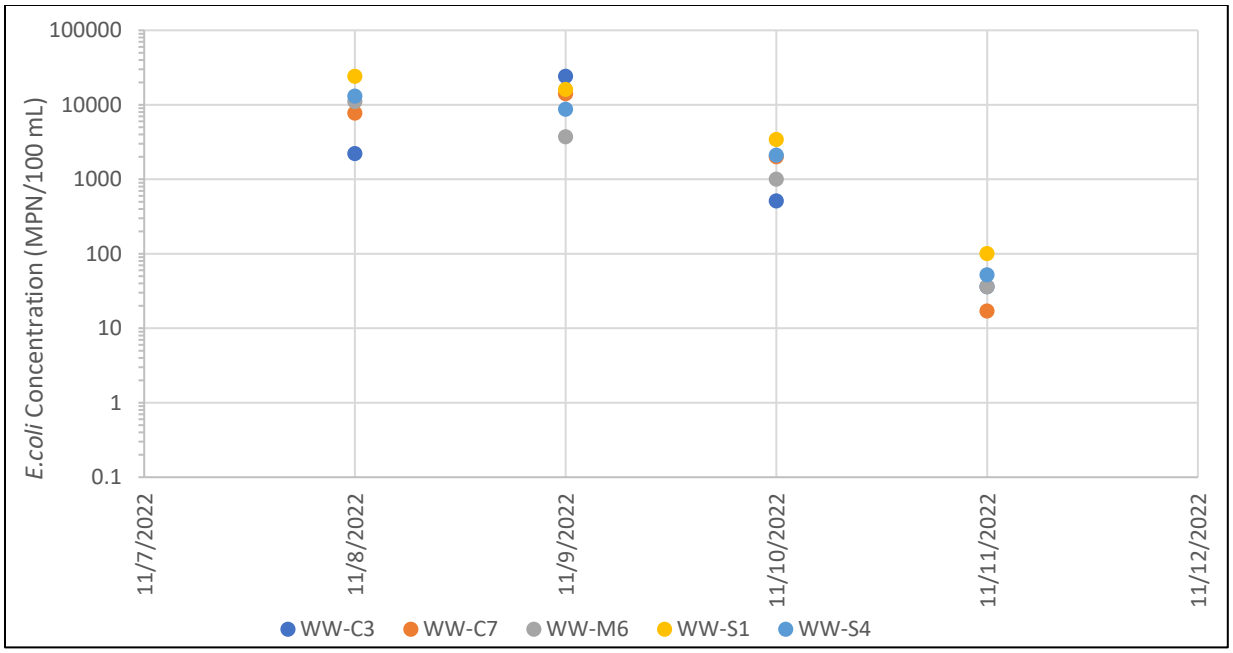

Figure 4-34. Post-storm Event *E. coli* Sample Concentrations from MSAR TMDL Waters

4.2.3 Compliance Analysis

The compliance analysis compares the *E. coli* geomeans to the MSAR Bacteria TMDL geomean WLAs/LAs of 113 organisms/100 mL for a 5-sample/30-day geomean (Section 1.2.1) and STV WLA of 212 organisms/100 mL. Geometric means were calculated only when at least five sample results were available from the previous 30-day period.

Most of the Priority 2 geomeans exceeded the MSAR TMDL WLAs/LAs (**Table 4-6**), including all geomeans calculated at the Santa Ana River sites in both season conditions. All cool, dry season geomeans exceeded the geomean WLA except at Chino Creek at Central Avenue. In the warm, dry season, some of the geomeans calculated at Prado Park Lake, Chino Creek, and Mill-Cucamonga Creek exceeded the TMDL WLA/LA limit.

Table 4-6 and **Table 4-7** shows the STV exceedances by month. Exceedances occurred during most months at several sites, except November where all sample results met the STV goal of 212 MPN/100 mL.

Table 4-6. Frequency of Exceedance with MSAR TMDL WLAs/LAs for *E. coli* (113 MPN/100 mL) for the 2022 Dry Weather Samples

Site ID	Site	Warm, Dry Season Geomean WLA/LA Exceedance Frequency (%) (n=16[1])	Cool, Dry Season Geomean WLA/LA Exceedance Frequency (%) (n=1)
WW-C3	Prado Park Lake	19%	100%
WW-C7	Chino Creek at Central Avenue	63%	0%
WW-M6	Mill-Cucamonga Creek	31%	100%
WW-S1	Santa Ana River at MWD Crossing	100%	100%
WW-S4	Santa Ana River at Pedley Avenue	100%	100%

Note:
[1] Mill-Cucamonga Creek, Santa Ana River at MWD Crossing, and Santa Ana River at Pedley Avenue were calculated out of 15 geomean calculations due fifth samples being collected outside of 30 day geomean calculation period.

Table 4-7. Monthly Frequency of Exceedance of STV (212 MPN/100 mL) During the 2022 Dry Weather Samples for the Santa Ana River Sites

Month	Number of Samples Collected	STV Criterion Exceedance Frequency (%)				
		Prado Park Lake	Chino Creek at Central Avenue	Mill-Cucamonga Creek	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue
May	3	33%	33%	67%	100%	0%
June	5	0%	40%	20%	100%	20%
July	4	25%	75%	0%	75%	25%
August	4	50%	0%	0%	100%	25%
September	4	50%	25%[1]	50%	100%	75%
October	3	100%	33%	67%	100%	33%
November	2	0%	0%	0%	0%	0%

Note:
[1] The sample taken on August 31st included in September total to match sampling of other sites which were taken September 1st.

4.3 Priority 3

In the 2022-2023 sampling season, monitoring continued and samples were collected, at 7 of the original 15 Priority 3 sites. Samples and measurements were not collected from Buck Gully (P3-OC3), Los Trancos Creek (P3-OC5), Morning Canyon (P3-OC6), Peters Canyon Wash (P3-OC7), San Diego Creek Reach 1 (P3-OC8), San Diego Creek (Reach 2) based on the determination that source investigation studies should be used to determine and mitigate or eliminate cause of impairment. As noted in section 4.5, separate source investigation studies have been conducted separately for Newport Bay Watershed under the Fecal Coliform TMDL TSO. Sampling at Bolsa Chica Channel (P3-OC1) began in the 2022-2023 sampling season as Orange County continues to assess possible upstream sources of bacteria concentrations in a source investigation study.

Orange County continued sampling at Borrego Creek (P3-OC2) and Serrano Creek (P3-OC11) to monitoring the locations as the upstream drainage areas have experienced significant development. For the first time since the establishment of the RBMP program, Borrego Creek (P3-OC2) had dry weather flow during one of the five weeks it was monitored.

4.3.1 Water Quality Observations

Figure 4-35 through **Figure 4-41** summarize water quality field measurements at Priority 3 sites (**Table 4-8**). Sites where no samples were collected during the 2022-2023 dry season are not included on the figures. Key findings are summarized below.

- **pH** - **Figure 4-35** presents pH measurements. During the dry, warm sampling period, pH observations were generally within the allowable range (6.5 to 8.5 S.U.) except for San Timoteo Creek at P3-SBC2 and P3-SBC3, which saw increasing pH as flow moved down the reach prior to entering the mainstem of the Santa Ana River. Serrano Creek (P3-OC11) saw the highest pH levels (ranging from 8.5 to 10.2) with four of the five samples exceeding the upper pH limit.
- **Water temperature** - **Figure 4-36** shows water temperatures generally range from 20°C to 29°C with the highest temperatures (27.3 to 28.2°C) observed at Santa Ana River Reach 4 (P3-SBC1).
- **Dissolved oxygen** - **Figure 4-37** shows that DO levels at all sites met the WQO for a minimum of 5 mg/L for WARM use except for one sample at Bolsa Chica channel (P3-OC1), which was measured slightly below the 5 mg/L limit.
- **Conductivity** - Conductivity ranged from 558 to 2,517 µS/cm at the San Timoteo Creek sites, Santa Ana River Reach 4 (P3-SBC1), and Warm Creek (P3-SBC4). Warm Creek has low flow throughout the dry season and only one sample was able to be collected; low flow contributed to the elevated conductivity measurement. Conductivity ranged between 2,196 and 2,364 µS/cm at Goldenstar Creek.
- **Turbidity and TSS** - **Figure 4-39** shows that turbidity levels are generally low with all samples except for one at San Timoteo Creek Reach 2 (P3-SBC3) and three samples at San Timoteo Creek Reach 3 (P3-RC3) being less than 10 NTU. Similar to turbidity, **Figure 4-40** shows that TSS is generally low at all sites except at San Timoteo Creek Reach 2 (P3-SBC3) and San Timoteo Creek Reach 3 (P3-RC3) where three samples ranged from 3 to 48 mg/L.
- **Flow** - **Figure 4-41** shows that flow was low at all of the Priority 3 sites (less than 10 cfs) except for Santa Ana River Reach 4 (P3-SBC1),San Timoteo Creek Reach 3 (P3-RC3), and one measurement at Goldenstar Creek (P3-RC1). Flow was not measured at the three Orange County sites due to instrument failure and sampler error.

Table 4-8. Priority 3 Monitoring Sites

Site ID	Site Description	County	Sampled in 2022-2023 by RMBP Program
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	Orange	Yes
P3-OC2	Borrego Creek upstream of Barranca Parkway	Orange	Yes
P3-OC3	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	Orange	No[1]
P3-OC5	Los Trancos Creek at Crystal Cove State Park	Orange	No[1]
P3-OC6	Morning Canyon Creek at Morning Canyon Beach	Orange	No[1]
P3-OC7	Peters Canyon Wash downstream of Barranca Parkway	Orange	No[1]
P3-OC8	San Diego Creek downstream of Campus Drive (Reach 1)	Orange	No[1]
P3-OC9	San Diego Creek at Harvard Avenue (Reach 2)	Orange	No[1]
P3-OC11	Serrano Creek upstream of Barranca/Alton Parkway	Orange	Yes
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	Riverside	Yes
P3-RC3	San Timoteo Creek Reach 3	Riverside	Yes
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	San Bernardino	Yes
P3-SBC2	San Timoteo Creek Reach 1A at Anderson St.	San Bernardino	Yes
P3-SBC3	San Timoteo Creek Reach 2 at San Timoteo Canyon Rd.	San Bernardino	Yes
P3-SBC4	Warm Creek below Fairway Dr.	San Bernardino	Yes

Note:

[1] Sites not sampled per Priority 3 Tech Memo recommendations, as waterbody characterized, and source investigations are beginning. Los Trancos, Morning Canyon, and Peters Canyon Wash were not part of the Fecal Coliform TMDL TSO source investigation efforts. These coastal sites had historically been covered by the Santa Ana Water Board and City of Newport Beach.

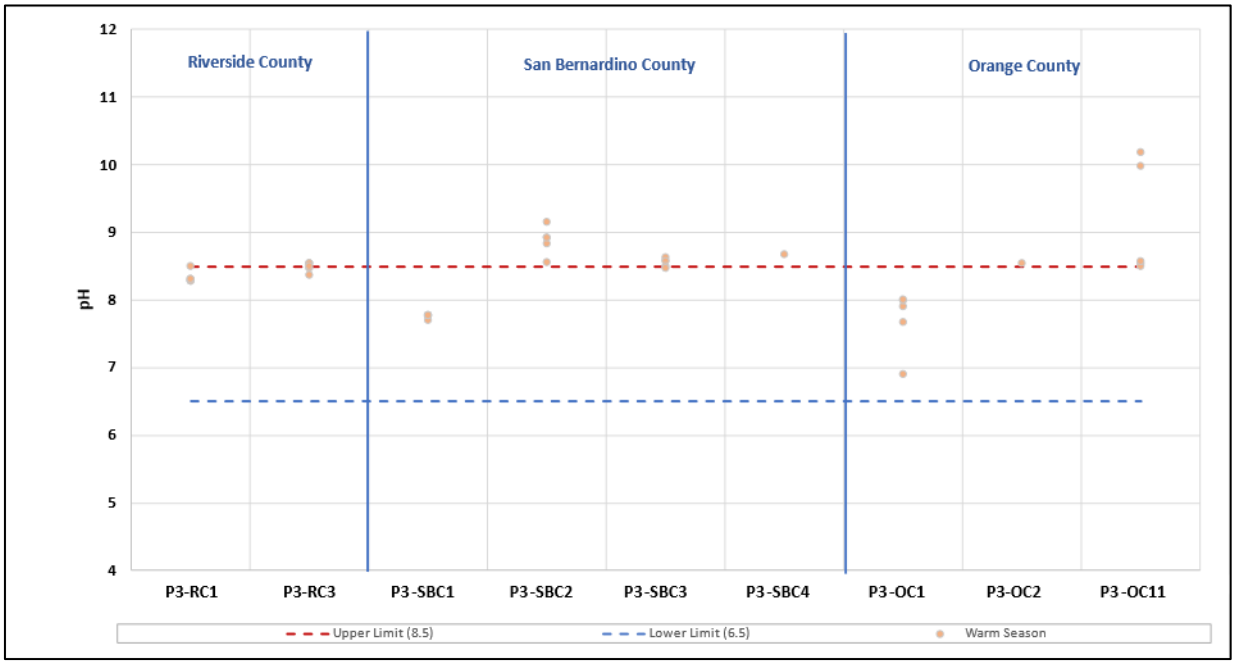

Figure 4-35. Distribution of pH Measurements at Priority 3 Sites

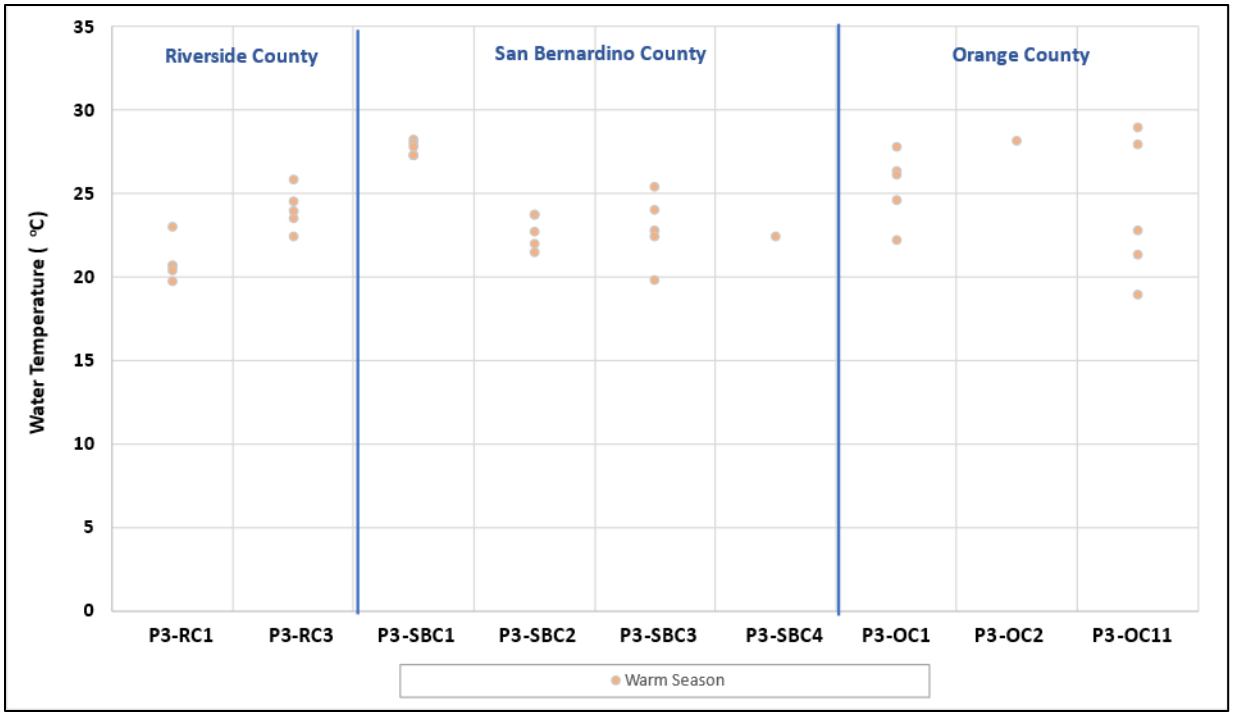

Figure 4-36. Distribution of Water Temperature Measurements at Priority 3 Sites

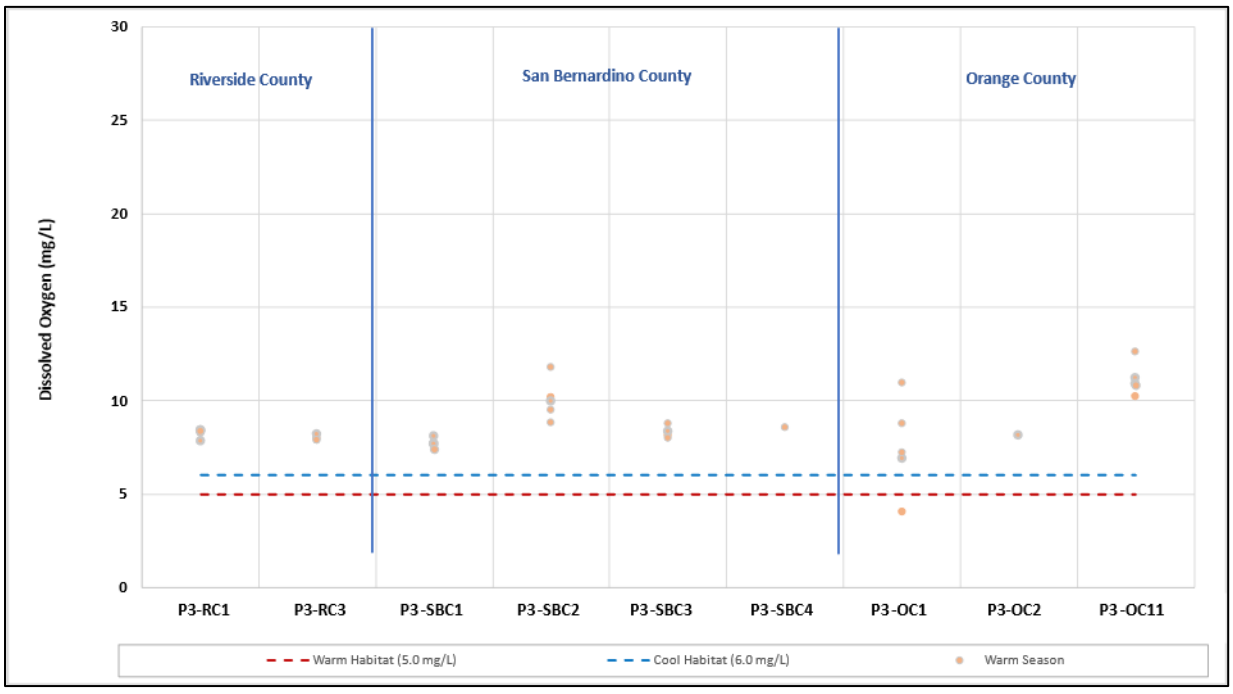

Figure 4-37. Distribution of Dissolved Oxygen Measurements at Priority 3 Sites

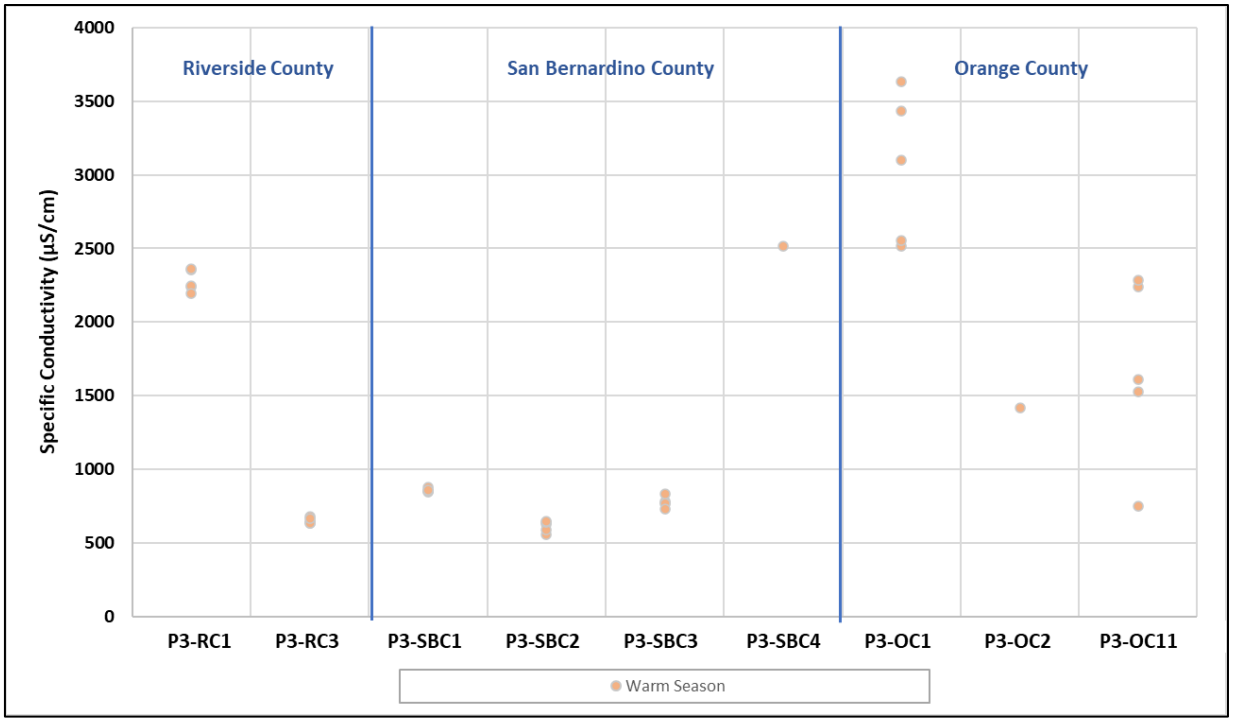

Figure 4-38. Distribution of Specific Conductivity Measurements at Priority 3 Sites

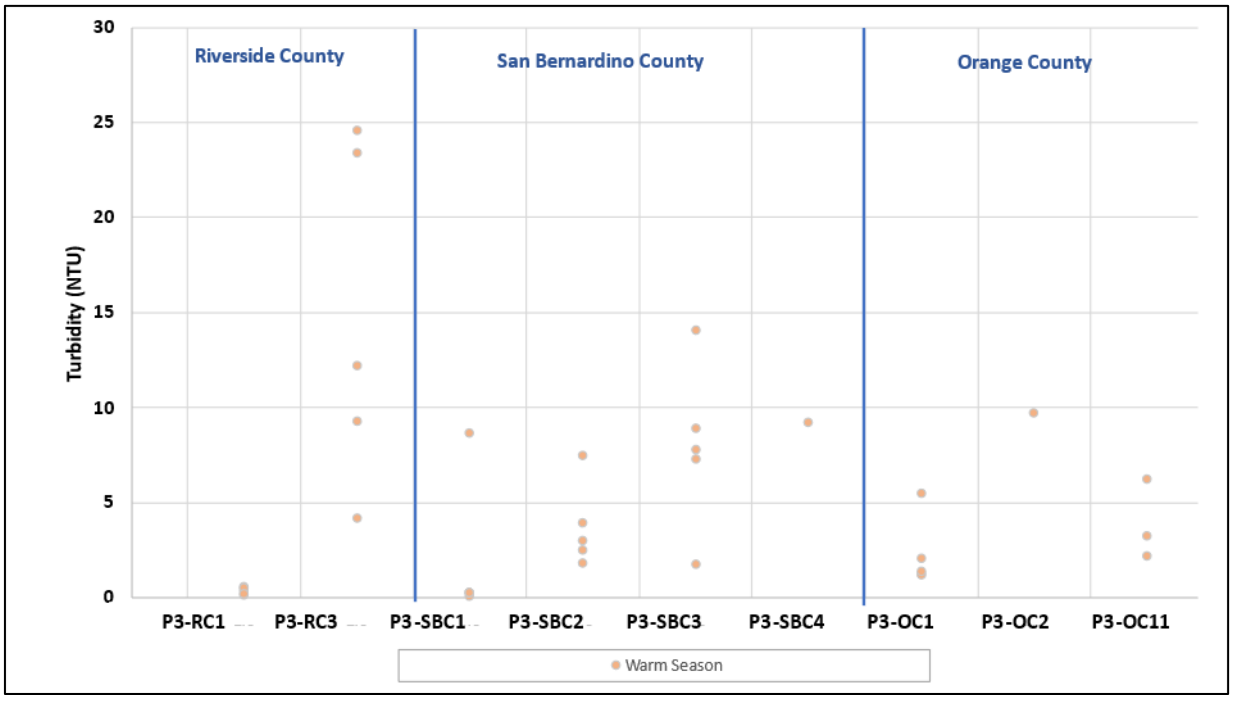

Figure 4-39. Distribution of Turbidity Measurements at Priority 3 Sites

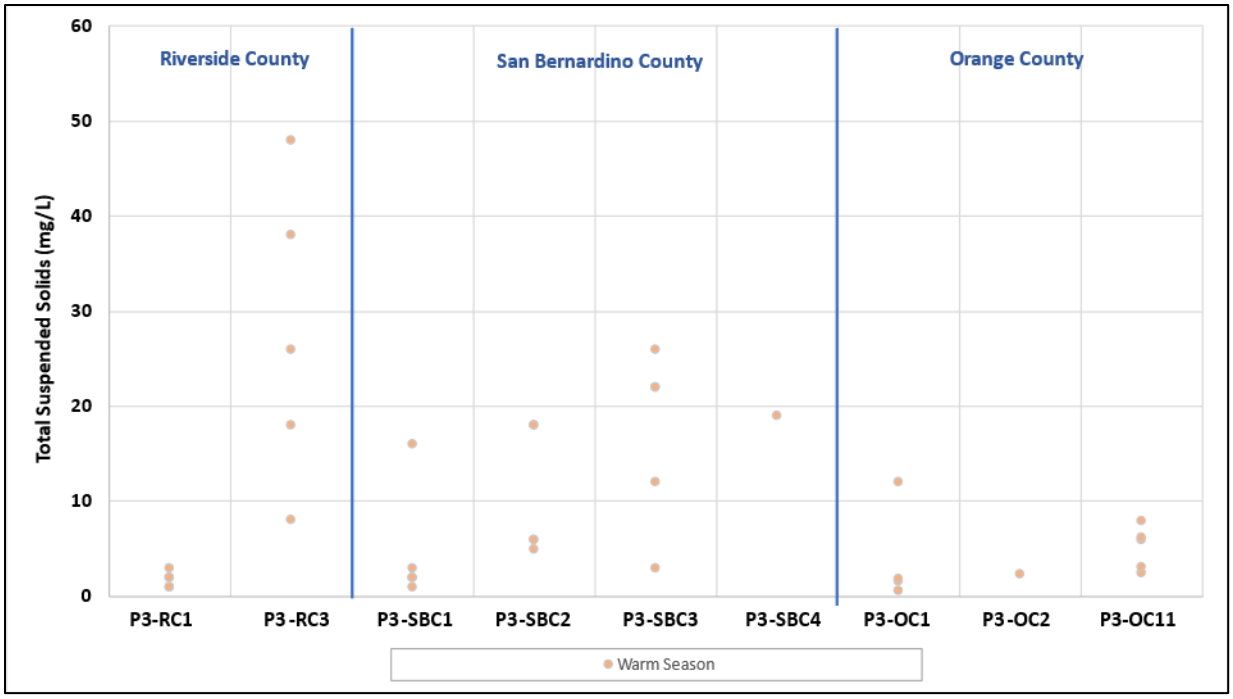

Figure 4-40. Distribution of TSS Measurements at Priority 3 Sites

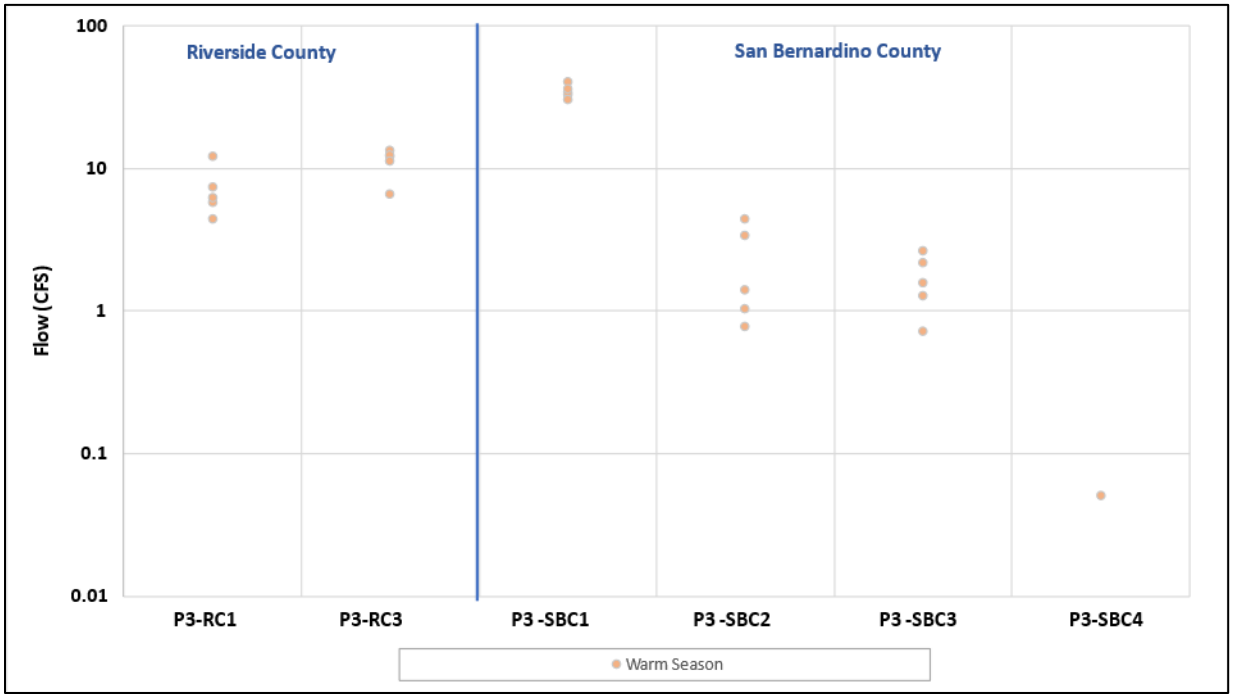

Figure 4-41. Distribution of Flow Measurements at Priority 3 Sites

*Note that Orange County sites were not monitored for flow due to instrument failure and sampler error.

4.3.2 Bacteria Characterization

Figure 4-42 displays the 2022 5-week geomeans and individual *E. coli* concentrations at Priority 3 sites during dry weather. The figure shows that five Priority 3 sites were higher than the

Statewide Bacteria Provision geomean WQO of 100 organisms/100 mL: San Timoteo Creek Reach 1A (P3-SBC2), San Timoteo Creek Reach 2 (P3-SBC3), San Timoteo Creek Reach 3 (P3-RC3), Warm Creek (P3-SBC4), and Serrano Creek (P3-OC11). Goldenstar Creek (P3-RC1), Santa Ana River Reach 3 (P3-SBC1), and Bolsa Chica Channel (P3-OC1) met the standard. The 2022 dry season is the first since the inception of the RBMP when Goldenstar Creek (P3-RC1) met this standard, marking the continuation of improving water quality seen in previous years. This may be attributed to ongoing cleanup efforts and special studies. Goldenstar Creek will continue to be monitored and continued compliance could result in the possible de-listing of the site from the 303d list.

Bacteria levels in San Timoteo Creek increased as sampling continued through the downstream reaches before entering the Santa Ana River (P3-SBC2, 3, and 4). The upper reaches (San Timoteo Creek Reaches 2 and 3) have primarily rural and agricultural inputs and had bacteria concentrations ranging from 130 to 1,500 MPN/100 mL. San Timoteo Creek Reach 1A (P3-SBC2) had a bacteria range from 880 to 24,000 MPN/100 mL.

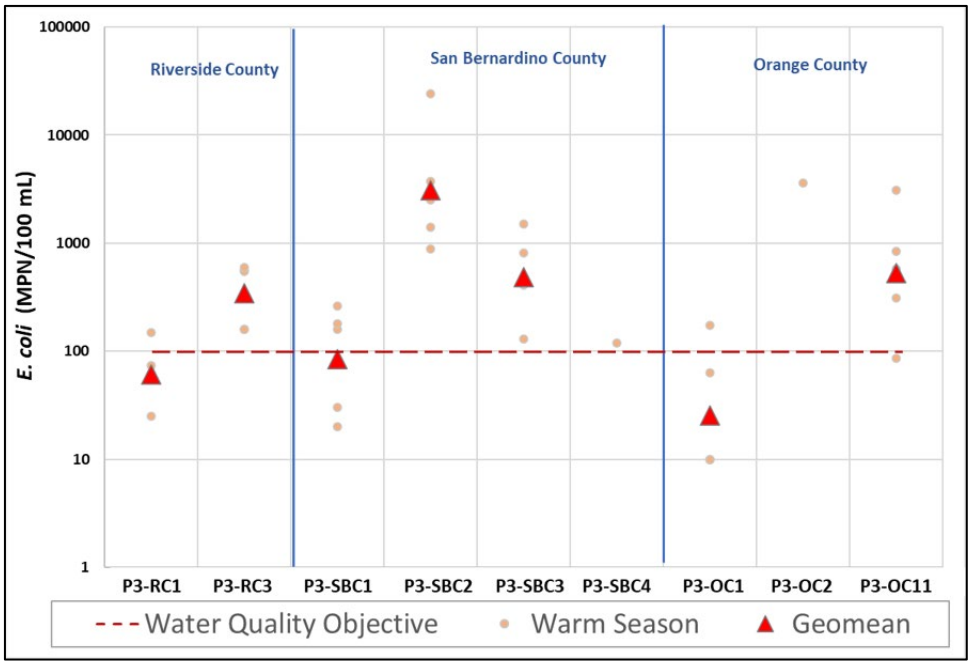

Figure 4-42. Distribution of *E. coli* Concentration Measurements at Priority 3 Sites

4.4 Priority 4

The 2015 BPA includes provisions applicable to waters with completed UAAs supporting change of beneficial use from REC1 to REC2 Only to assure bacteria water quality conditions do not degrade from baseline levels as a result of controllable factors.[24] A statistical analysis of historical data (2002-2011) was completed to estimate a baseline of bacterial water quality including geometric mean, median, standard deviation, coefficient-of-variation, maximum value, and 75th percentile density. The 75th percentile density serves as the antidegradation target, meaning that

[24] https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.html.

3 of 4 samples in data collected after the 2015 BPA must fall below these values to infer no degradation.

4.4.1 Water Quality Observations

Each Priority 4 site (**Table 4-9**) is sampled once each year to evaluate compliance with the antidegradation target established for each waterbody. **Table 4-10** summarizes the water quality field parameters from each Priority 4 site in 2022.

Table 4-9. Priority 4 Monitoring Sites

Site ID	Site Description	County
P4-OC1	Santa Ana-Delhi Channel Upstream of Irvine Avenue	Orange
P4-OC2	Santa Ana-Delhi Channel in Tidal Prism	Orange
P4-OC3	Greenville-Banning Channel in Tidal Prism	Orange
P4-RC2	Temescal Creek at Lincoln Avenue	Riverside
P4-SBC1	Cucamonga Creek at Hellman Avenue	San Bernardino

Table 4-10. Summary of Water Quality Data Collected from Priority 4 Sites

Parameter	Santa Ana-Delhi Channel (P4-OC1)	Santa Ana-Delhi Channel in Tidal Prism (P4-OC2)	Greenville-Banning Channel in Tidal Prism (P4-OC3)	Temescal Creek at Lincoln Avenue (P4-RC2)	Cucamonga Creek at Hellman Avenue (P4-SBC1)
Sample Date	9/15/2022	9/15/2022	1/26/2022	7/8/2022	7/8/2022
pH	7.47	7.49	8.35	9.03	8.68
Water Temperature (°C)	22.7	25.4	26.8	24.1	21.5
Dissolved Oxygen (mg/L)	7.18	5.09	6.93	12.46	11.33
Conductivity (µS/cm)	2,086	30,747	44,865	1,271	786
Turbidity (NTU)	1.78	5.49	4.36	2.48	0.92
TSS (mg/L)	8.3	17	8.9	4	4
Flow (cfs)	1.27	N/A	N/A	6.29	5.74

4.4.2 Bacteria Characterization

Priority 4 water quality sample results were compared to site-specific single sample antidegradation targets (**Table 4-11**, **Figure 4-43**). Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), and Greenville-Banning Channel in Tidal Prism (P4-OC3) exceeded their antidegradation targets of 1067, 464, and 64 MPN/100mL respectively. The other two Priority 4 sites met their antidegradation targets.

As shown in **Table 4-12** and **Table 4-13**, the two Santa Ana-Delhi sample locations had *E. coli* concentrations in September 2022 that exceeded the antidegradation target, and thus, began the two of the three required monthly follow up samples in October. The station at the Tidal Prism (P4-OC2) had sufficient low concentration follow-up samples to show that degradation is not occurring, while the station at (P4-OC1) continued to have periodic exceedances of the antidegradation target and requires continued monthly sampling.

Greenville-Banning Channel exceeded the antidegradation target during the 2021-2022 (**Table 4-14**) sampling year and Orange County continued monthly sampling into the current sampling year. Based on the most recent three samples collected, Orange County can now end follow up samples at this site. The follow-up samples offer insight into the bacteria condition at the site throughout the year and can be further analyzed to identify potential sources of bacteria.

Table 4-11. Antidegradation Targets for Priority 4 Sites

Site ID	Site Description	Single Sample Antidegradation Target (MPN/100 mL)	*E.coli* Sample Result	*Enterococcus* Sample Result	Sample Date
P4-OC1[1]	Santa Ana-Delhi Channel Upstream of Irvine Avenue	1067	(108 - 19,863)		9/15/2022, Monthly
P4-OC2[1]	Santa Ana-Delhi Channel in Tidal Prism	464		(31 – 1,391)	9/15/2022, Monthly
P4-OC3[1]	Greenville-Banning Channel in Tidal Prism	64		(ND – 627)	Monthly
P4-RC2	Temescal Creek at Lincoln Avenue	725	22		7/08/2022
P4-SBC1	Cucamonga Creek at Hellman Avenue	1,385	340		7/08/2022

Note:

[1] Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), and Greenville-Banning Channel in Tidal Prism (P4-OC3) exceeded their respective antidegradation targets and Orange County is continuing to collect monthly samples. Results are shown in **Table 4-12** through **Table 4-14**.

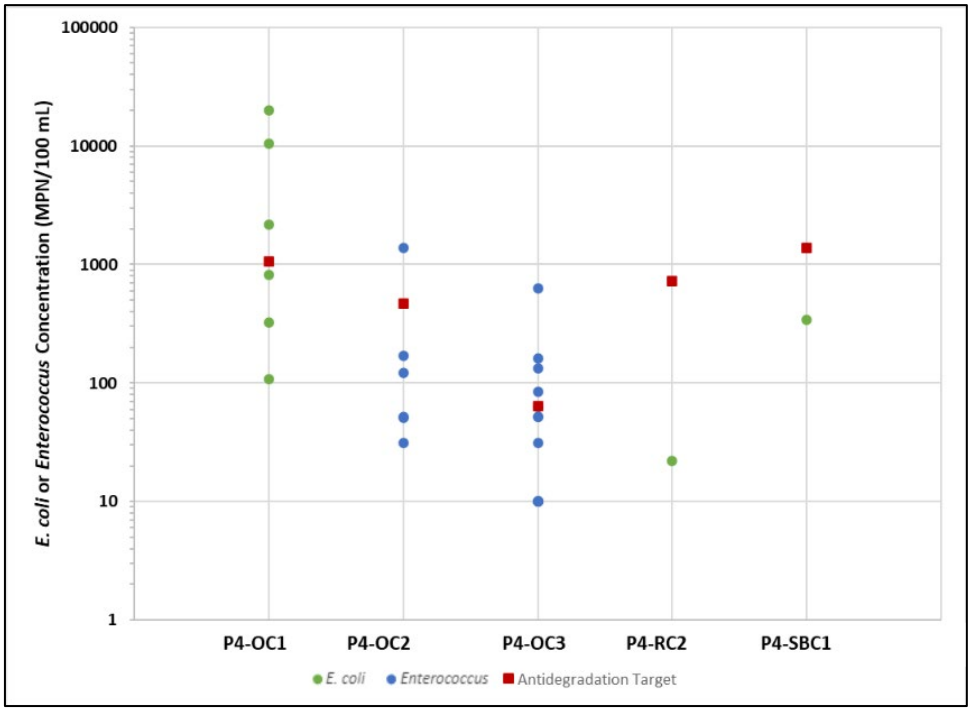

Figure 4-43. Monitoring Results and Antidegradation Targets for Priority 4 Sites

Table 4-12. Monthly Follow-Up Sampling at Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1)

Sample Requirement	Sample Date	*E. coli* Concentration (MPN/100 mL)
2022 Annual Sample	9/15/2022	2,187[1]
Required Monthly Follow-up Samples[2]	10/31/2022	323
	11/29/2022	19,863[1]
	1/26/2023	813
	2/22/2023	10,462[1]
	3/28/2023	108

Notes:
1 This sample exceeded the antidegradation target for Santa Ana-Delhi Channel Upstream of Irvine Avenue of 1,067 MPN/100mL.
2 Orange County is continuing to collect monthly samples to assess possible degradation of Santa Ana-Delhi Channel Upstream of Irvine Avenue.

Table 4-13. Monthly Follow-Up Sampling at Santa Ana-Delhi Channel in Tidal Prism (P4-OC2)

Sample Requirement	Sample Date	*Enterococcus* Concentration (MPN/100 mL)
2022 Annual Sample	9/15/2022	1391[1]
Required Monthly Follow-up Samples[2]	10/31/2022	169
	11/29/2022	52
	1/26/2023	121
	2/22/2023	31
	3/28/2023	51

Notes:
1 This sample exceeded the antidegradation target for Santa Ana-Delhi Channel in Tidal Prism of 464 MPN/100mL.
2 Orange County collected sufficient follow-up samples to show that degradation is not occurring in Santa Ana-Delhi Channel in Tidal Prism.

Table 4-14. Monthly Follow-Up Sampling at Greenville-Banning Channel in Tidal Prism (P4-OC3)

Sample Requirement	Sample Date	*Enterococcus* Concentration (MPN/100 mL)
Required Monthly Follow-up Samples[2]	1/26/2022	132[1]
	2/28/2022	10
	3/24/2022	84[1]
	4/28/2022	160[1]
	5/25/2022	52
	6/30/2022	10
	7/25/2022	10
	8/18/2022	10
	9/15/2022	627[1]
	10/31/2022	10
	11/29/2022	52
	1/26/2023	63
	2/22/2023	10
	3/28/2023	31

Notes:
1 This sample exceeded the antidegradation target for Greenville-Banning Channel in Tidal Prism of 64 MPN/100mL.
2 Orange County collected sufficient samples to show degradation is not occurring in the Greenville-Banning Channel.

4.5 Related Activities and Study Results

In the 2022-2023 RBMP sampling year, related activities or studies were conducted to affect or investigate bacteria sources:

Riverside Levees Rehabilitation Project – Flooding in in December 2011 through January 2012 resulted in damage to the Riverside levees and RCFC&WCD requested rehabilitation assistance from USACE. The construction project began in September 2022 and is projected to take four years to complete. The extent of the project is shown in **Figure 4-44**. As regards to reducing bacteria sources in the MSAR region, the project includes:

- Removal of trash – over 500,000 pounds of trash was removed in the first year from the southern bank of the Santa Ana River.
- Services provided to the unhoused population along the southern bank to have them leave the construction easement for their safety.
- Clearing and grubbing of riparian vegetation (which will be replanted).
- Construction that results in dredging and filling the channel bottom and in some places relocating the river's thalweg.

It is anticipated that this project may result in reduced bacteria concentrations in the Santa Ana River due to removal of sources and refreshing the river's sediments; monitoring data collected in the 2023-2024 monitoring season will be evaluated to determine if changes occur.

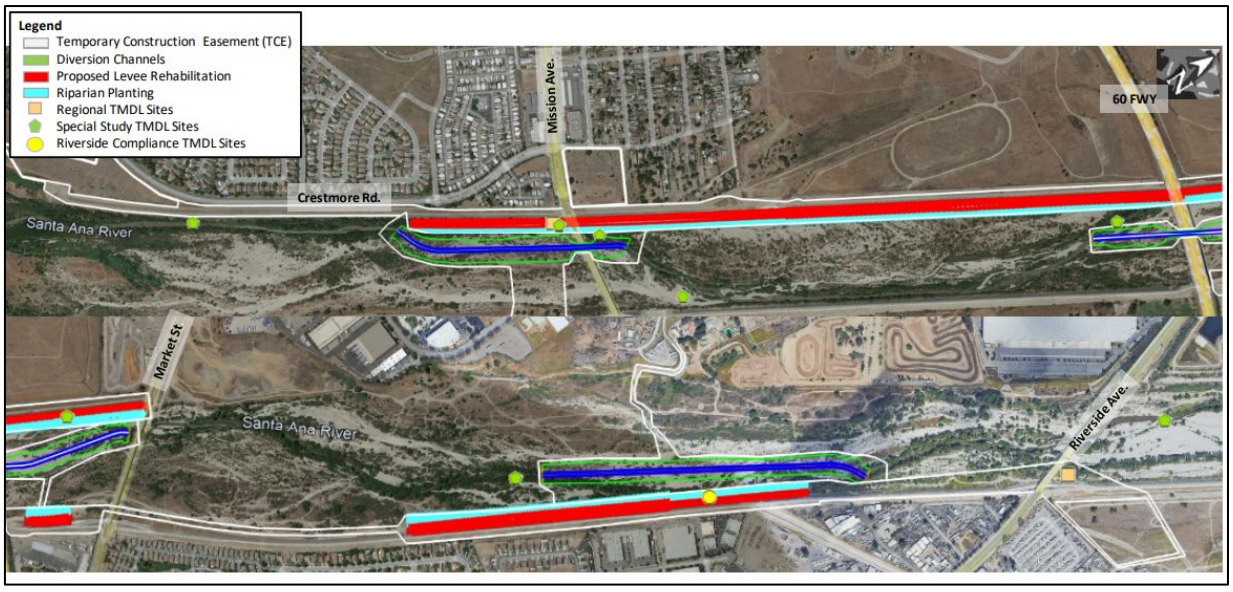

Figure 4-44. Riverside Levees Rehabilitation Project

Pig Marker Study – This study was added to the RBMP as a follow up to results from the 2019-2022 MSAR Homeless Encampment Studies, with the goal of further assessing the impact of feral pigs at several MSAR sites.

Chris Basin – SBCFD completed a regional treatment project in Chris Basin to reroute the dry weather flow to increase hydraulic residence time and increase opportunities for bacterial decay. After the first year of operation, anticipated load reductions have not yet been observed. Additional study is recommended to understand bacteria concentrations.

Newport Bay Source Investigation Study[25]- Orange County is continuing to work on the Newport Bay source investigation study including the Upper and Lower Newport Bay. Sites that had been previously included as part of the RBMP, such as San Diego Creek Reaches 1 and 2, are being included as part of the comprehensive assessment of bacteria sources. It is also worth highlighting that the Santa Ana-Delhi Channel Diversion Project may affect monitoring results in the coming year.

Bacteria Source ID at Lake Elsinore Flood Control Channel and Lake Sampling - The City of Lake Elsinore conducted a site visit and source investigation at the flood control channel and in the lake near the channel to investigate possible sources of high enterococci samples measured at the Elm Grove Beach RBMP station in the 2021-2022 sampling season.

The results of the pig marker and bacteria source ID at Lake Elsinore studies are provided below. The bacteria source identification work in Newport Bay is ongoing, and the results of the Chris Basin study is provided in the 2023 MSAR Triennial Report.

4.5.1 Homeless Encampment and Pig Marker Studies in Santa Ana River

4.5.1.1 Predecessor Studies

Starting in 2019, SAWPA and its member agencies have commissioned a sequence of studies on the potential impacts of homeless encampment activities and identification of bacteria sources in the upper Santa Ana River watershed. Early studies[26] surveyed encampments and prepared a monitoring program at three of the five encampment areas (**Figure 4-45** shows the sampling locations).

[25] An update on Newport Bay Source Investigation Study report was filed with the Santa Ana Water Board on February 7, 2023.

[26] Studies include the "2020 Homeless Study" and SAWPA 2020b: https://sawpa.org/owow/dci-program/services/owow-dci-assessment-of-homelessness-and-water-quality/.

Figure 4-45. Santa Ana River Monitoring Sites for the Homeless Encampment Study to Evaluate Impacts from Encampments on Water Quality

Figure Notes: MSB = Market Street Bridge; MBB = Mission Boulevard Bridge; VBB = Van Buren Boulevard Bridge; 1= upstream site; 2 = downstream site; see Figure 2-2 in SAWPA 2022c.

The monitoring program with four dry weather sampling events was authorized by SAWPA in partnership with the RCFC&WCD and San Bernardino County Department of Public Works. Sampling events included field measurements, collection of water quality samples to evaluate bacterial indicators and presence of human sources of bacteria, and Rapid Trash Assessments[27] After two rounds of sampling high levels of *E. coli* were found but not the human marker HF-183.

Water quality data results consistently indicated only a limited presence of human sources of bacteria Santa Ana River Reach 3, but the concentration of *E. coli* bacteria was steadily increasing from upstream to downstream. Following a discussion with local stakeholders regarding other potential sources of bacteria in the river, two additional bacteria source assays were added to the study:

- **Dogs (DG37 assay)** – Dogs were frequently observed around homeless camps by the monitoring team.

[27] San Francisco Bay Regional Water Quality Control Board [San Francisco Bay Board] 2004.

- **Feral pigs (Pig2Bac assay)** – It is well known by local stakeholders that a population of feral pigs resides within the Santa Ana River riparian corridor; accordingly, they may be an important source of fecal bacteria in the impaired waters.

Results from the last two events showed high concentrations of the Pig2Bac marker in all samples collected from downstream of the Mission Boulevard Bridge and at sites upstream and downstream sites Van Buren Bridge. Given the small sample size (n = 12), the MSAR Task Force approved collection of additional samples for the pig marker.

4.5.1.2 2022 Pig Marker Study

During the RBMP's 2022 dry weather sampling campaign, samples were collected every other week for analysis of the pig marker concurrent with the routine RBMP monitoring from the following Santa Ana River sites: WW-MISSION, WW-S1 and WW-S4; and the Mill-Cucamonga Creek site: WW-M6 (**Figure 4-46**). Samples were sent to Weston Labs for qPCR analysis of the Pig2Bac marker (samples have been archived at the laboratory and may be used for additional assays if requested by the Task Force).

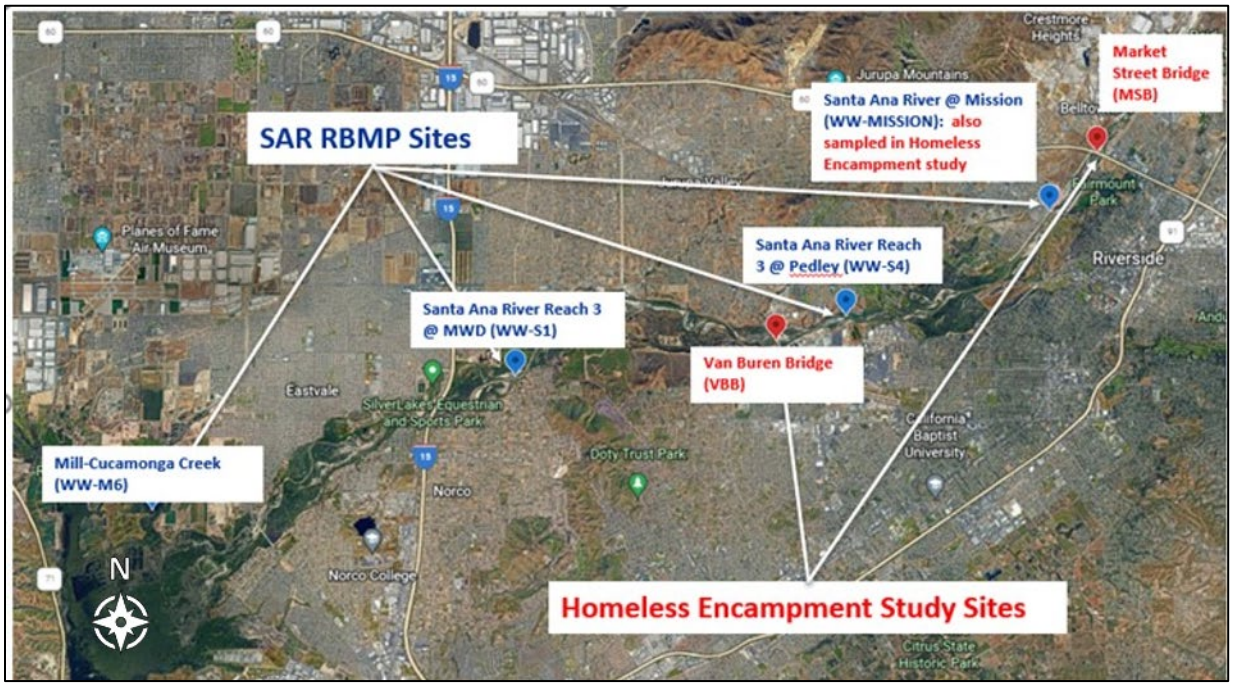

Figure 4-46. Locations of the 2022 Santa Ana River RMBP Sampling Locations where Samples for Pig Marker were also Collected, along with 2021 Sample Locations

Table 4-15 summaries the results from the Pig2Bac analysis of water samples. The study[28] found that the concentration of Bacteroides from feral pigs varies significantly from site to site. Specifically,

[28] Further analysis can be found in the MSAR TMDL Triennial Report. (https://sawpa.org/wp-content/uploads/2023/02/MSAR-TMDL-2023-Triennial-Report_Final_021123.pdf).

- No detections of the Pig2Bac marker were observed at the Mill-Cucamonga Creek (WW-M6) TMDL compliance site.
- Consistent detections (ranging from 295 – 5,322 gc/100 mL) were observed at the Santa Ana River MWD Crossing (WW-S1) and Pedley Avenue (WW-S4) sites, indicating that feral pigs may be a potentially important source of *E. coli* at these sites.
- At the WW-MISSION site, which has been shown to generate the majority of dry weather *E. coli* load to Santa Ana River Reach 3 from an unknown in-stream source, the Pig2Bac marker was only detected in one of 10 samples. Meanwhile, *E. coli* concentrations were elevated relative to downstream sites in all 10 samples, showing that fresh fecal deposits from feral pigs were not an important source in the summer 2022 contributing to the *E. coli* fecal bacteria load that enters Reach 3 of the Santa Ana River at this location. One possible explanation for the change from the 2021 monitoring results (Section 4.5.1.1) is that the initial work to prepare the southern portion of the river for the levee rehabilitation project (trash removal and vegetation grubbing) discouraged pig presence at this location.

Table 4-15. *E. coli* Concentration (MPN/100 mL) and Pig2Bac Assay (Gene Copies/100 mL) measured at the MSAR Watershed Sites, May through September 2022 (ND = Non-Detect, BDL = Below Detection Limit)

Sample Date	*WW-M6*		WW-S4		WW-S1		WW-MISSION	
	E. coli	Pig2Bac	*E. coli*	Pig2Bac	*E. coli*	Pig2Bac	*E. coli*	Pig2Bac
5/12/2022	110	ND	140	795	460	1,072	63	ND
5/26/2022	230	ND	200	438	680	7,629	800	ND
6/9/2022	74	ND	880	1,599	350	3,057	1,100	ND
6/27/2022	86	ND	190	1,161	310	4,099	190	ND
6/30/2022	98	ND	210	962	440	1,843	1,400	ND
7/14/2022	63	ND	340	2,042	280	1,044	780	ND
7/28/2022	41	ND	150	1,692	410	1,364	840	ND
8/11/2022	140	ND	230	1,802	460	2,728	1,300	ND
8/25/2022	180	ND	85	295	270	5,322	1,100	ND
9/8/2022	200	ND	230	1,470	1,100	BDL	840	1,947

4.5.2 City of Lake Elsinore – Bacteria Source ID Site Visit and Sampling

Beginning in the 2021-2022 RBMP sampling period, the compliance sampling location at Lake Elsinore was moved to Elm Grove Beach in consultation with the City of Lake Elsinore to assess water quality where people actively recreate and meet the Priority 1 criteria of sampling where there is a greater risk exposure for contact recreation. Bacteria concentrations seen at the new location were higher than those measured previously at the boat launch sampling point

(**Figure 4-47** shows the sampling locations and provides two years of Enterococcus data at each sampling location).

CDM Smith began coordinating with the City of Lake Elsinore to determine potential causes. One hypothesis was the Elsinore Valley Municipal Water District (EVMWD) discharge point east of Elm Grove Beach, which had recently been changed from a discharge to the open flood control channel near the treatment plant, discharged near the Lake Elsinore shore to a pipe with an outfall location close to the previous discharge location.

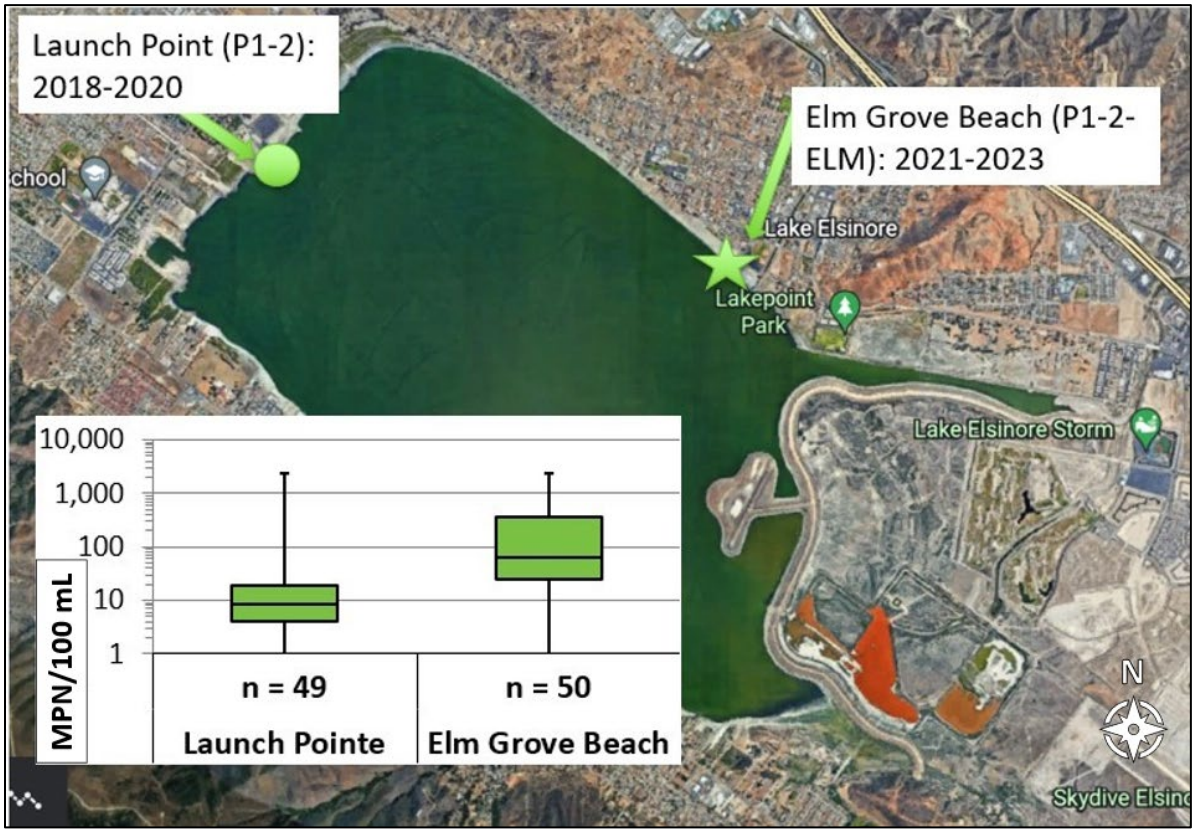

Figure 4-47. Enterococcus Concentrations at Lake Elsinore at Launch Pointe (2019-2020) and Elm Grove Beach (2021-2022)

The city conducted a one-day sampling program on February 17, 2022 to collect samples at four locations along the flood control channel and three locations on the lake shore. These sites were analyzed for field parameters, ammonia, Enterococcus, and HF-183 human marker. The analytical laboratory results from the study are provided in **Table 4-16**.

The samples representing the EVMWD discharge (in the channel at new outfall @ LE shore and in the lake "at new discharge") are similar with higher levels of ammonia and HF-183 marker than at the other sampling locations; these results along with the non-detect Enterococcus levels indicate that the discharge is not related to detected Enterococcus levels measured at all but one of the other stations. The higher levels of HF-183 in the disinfected effluent likely represents DNA from non-viable bacteria post disinfection. Detections of Enterococcus and HF-183 in the channel at the old outfall location suggest there is a human source of bacteria between Summer Avenue

and the lake. The city has stated that there is a known homeless encampment in the area, which could be a potential source of bacteria.

Table 4-16. City of Lake Elsinore February 17, 2022 Study Results (ND = Non-Detect, BLOQ = Below Limit of Quantification)

Location	Station	Ammonia (mg/L as NH3)	Enterococcus (MPN/100 mL)	HF-183 (copies/100 mL)
Channel	Dam near initial discharge	<0.4	200	ND (<37)
	Summer Avenue	0.7	<10	ND (<37)
	Old outfall @ LE shore	<0.4	220	177
	New outfall @ LE shore	5.0	<10	1377
Lake Shore	North of discharge	<0.4	120	BLOQ (<34)
	At new discharge	4.5	<10	1768
	South of discharge	<0.4	30	114

The sampling locations for the Lake Elsinore Fecal Bacteria Study are shown in **Figure 4-48**.

Figure 4-48. Lake Elsinore Fecal Bacteria Study sampling stations

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Section 5

Recommendations for 2023-2024 Monitoring Program Season

This section describes recommended updates to the RBMP Monitoring Plan for the 2023-2024 monitoring year.

- CDM Smith will continue to coordinate with the City of Lake Elsinore about bacteria source investigations at Elm Grove Beach.
- Utilize bacteria database at Santa Ana-Delhi Channel Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), and Greenville-Banning Channel (P4-OC3) to assess potential causes for intermittent elevated bacteria concentrations. It is also worth highlighting that the Santa Ana-Delhi Channel diversion may impact P4-OC1 and P4-OC2.
- Track the Riverside levee rehabilitation construction activities so that potential changes to bacteria sources (trash cleanup, homeless encampment activity, and changes to the river's sediment) can be correlated with *E. coli* concentrations at the MSAR stations measured in the coming year.
- Review the available data from the Greenville Banning Channel (P4-OC3) to determine if an analysis to change the antidegradation target should be considered. It is also worth highlighting that the antidegradation target was met earlier this season.
- Track the process for the finalization of the 2024 Integrated Listing cycle as the draft included a new 303(d) listing for fecal bacteria in the Santa Ana region: Perris Valley Channel. If this location is included in the final list and there is dry weather flow present at Nuevo Road, the RBMP may need to be updated to include a new station for Perris Valley Channel for Priority 3 monitoring in the 2024 dry season.

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Appendix A

Data Summary

Table A-1 through Table A-27 summarize the water quality results obtained for *E. coli*, Enterococcus, TSS, and field measurements from Priority 1, Priority 2, and Priority 3 sites during 2022 dry weather sampling activities and storm event. Data from Priority 4 sites are included in Section 4.4 and are not reproduced in this appendix. Table A-28 through Table A-30 summarize the daily mean flow measured at key USGS gages in the Santa Ana River watershed.

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Table A-1. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 1 Lake Sites during the 2022 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean; BDL = below detection limit)

Week Beginning Date	Canyon Lake (P1-1)		Lake Elsinore (P1-2)		Lake Perris (P1-3)		Big Bear Lake (P1-4)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomeans
5/8/2022	3.1	--	23	--	2	--	1	--
5/15/2022	2	--	26	--	5.2	--	3	--
5/22/2022	1	--	19	--	22	--	BDL	--
5/29/2022	1	--	6.3	--	1	--	BDL	--
6/5/2022	2	1.7	4.1	12.4	12	4.9	BDL	0.8
6/12/2022	5.2	1.5	23	9.8	11	7.3	BDL	0.8
6/19/2022	BDL	1.6	3.1	11.1	9.7	6.0	2	0.9
6/26/2022	4	1.7	23	11.1	7.4	7.3	BDL	0.8
7/3/2022	7.3	2.0	20	10.7	1	5.8	1	0.7
7/10/2022	BDL	1.9	14	10.2	26	5.9	2	0.8
7/17/2022	BDL	1.7	13	11.4	26	9.4	BDL	0.8
7/24/2022	3.1	1.9	8.6	14.8	4.1	7.3	1	0.9
7/31/2022	1	1.4	11	11.4	4.1	7.0	28	1.6
8/7/2022	BDL	1.4	BDL	10.2	BDL	6.4	1	1.5
8/14/2022	1	1.3	30	10.6	5.2	4.8	BDL	1.5
8/21/2022	3.1	1.1	32	18.4	1	5.3	1	1.5
8/28/2022	2	1.2	>1600	26.4	2	5.2	1	1.3
9/4/2022	1	1.6	250	48.6	24	4.2	BDL	1.4
9/11/2022	BDL	1.9	1700	32.1	5.2	3.1	1	1.3
9/18/2022	11	2.8	0.5	61.4	BDL	2.6	BDL	0.7
10/16/2022	16	--	20	--	3.1	--	41	--
10/23/2022	6.3	--	31	--	1	--	160	--
10/30/2022	7.4	--	9.7	--	1	--	5.2	--
11/6/2022	22	--	36	--	BDL	--	8.5	--
11/13/2022	16	13.8	260	45	33	6	12	20

Table A-2. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 1 Stream Sites during the 2022 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean; BDL = below detection limit)

Week Beginning Date	Mill Creek Reach 2 (P1-5)		Lytle Creek (P1-6)		Santa Ana River @ MWD Crossing (WW-S1)		Santa Ana River @ Pedley Avenue (WW-S4)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean
5/8/2022	BDL	--	9.7	--	460	--	140	--
5/15/2022	1	--	12	--	560	--	170	--
5/22/2022	3	--	29	--	680	--	200	--
5/29/2022	1	--	4.1	--	380	--	110	--
6/5/2022	1	1.1	28	13.1	350	471.5	880	215.1
6/12/2022	BDL	1.0	24	14.5	490	474.5	270	223.4
6/19/2022	2	1.1	28	15.9	310	446.5	190	218.3
6/26/2022	10	1.6	8.6	15.7	440	443.7	160	222.5
7/3/2022	2	1.8	38	18.5	170	374.2	210	229.3
7/10/2022	BDL	1.8	18	18.4	280	360.9	340	240.9
7/17/2022	BDL	1.8	28	22.7	660	357.8	180	217.4
7/24/2022	BDL	2.1	39	23.8	410	347.4	150	197.1
7/31/2022	80	7.5	59	27.1	1100	429.0	120	182.6
8/7/2022	84	19.1	93	32.1	460	432.2	230	193.9
8/14/2022	230	41.9	200	50.3	450	505.3	200	152.7
8/21/2022	9.8	62.4	140	60.7	270	505.3	85	152.7
8/28/2022	18	48.7	370	93.4	600	497.3	210	156.7
9/4/2022	38	46.7	230	126.2	1100	557.0	230	165.5
9/11/2022	8.6	36.7	51	131.1	1800	688.1	2500	247.4
9/18/2022	9.1	26.9	24	115.3	750	651.5	540	306.6
10/16/2022	15	--	18	--	410	--	650	--
10/23/2022	32	--	96	--	310	--	200	--
10/30/2022	3.1	--	23	--	450	--	170	--
11/6/2022	--	--	13	--	10875	--	5963	--
11/13/2022	--	11	68	32	1800	1023	98	419

Table A-3. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 2 Sites during the 2022 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean)

Week Beginning Date	Prado Park Lake Outlet (WW-C3)		Chino Creek @ Central Avenue (WW-C7)		Mill-Cucamonga Creek Below Wetlands (WW-M6)		Santa Ana River @ MWD Crossing (WW-S1)		Santa Ana River @ Pedley Avenue (WW-S4)		Santa Ana River @ Mission Avenue (MISSION)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean
5/8/2022	280	--	200	--	110	--	460	--	140	--	63.0	--
5/15/2022	120	--	220	--	420	--	560	--	170	--	230.0	--
5/22/2022	74	--	120	--	230	--	680	--	200	--	800.0	--
5/29/2022	20	--	2200	--	240	--	380	--	110	--	160.0	--
6/5/2022	51	76.0	330	328.6	74	180.0	350	471.5	880	215.1	1100.0	289.7
6/12/2022	16	58.6	52	241.7	68	153.0	490	474.5	270	223.4	>2400.0	412.1
6/19/2022	5.2	41.5	34	182.6	86	140.9	310	446.5	190	218.3	1200.0	480.1
6/26/2022	130	37.2	1700	247.9	98	138.6	440	443.7	160	222.5	1400.0	747.6
7/3/2022	6.3	24.4	610	286.8	74	108.2	170	374.2	210	229.3	290.0	772.8
7/10/2022	74	28.0	400	299.0	63	101.1	280	360.9	340	240.9	780.0	773.7
7/17/2022	150	30.2	440	261.9	86	78.3	660	357.8	180	217.4	300.0	805.7
7/24/2022	280	48.6	160	315.9	41	71.9	410	347.4	150	197.1	840.0	676.4
7/31/2022	250	92.7	86	368.7	62	68.1	1100	429.0	120	182.6	610.0	604.3
8/7/2022	BDL	59.0	BDL	140.5	140	72.3	460	432.2	230	193.9	1300.0	596.8
8/14/2022	8.6	95.6	5.2	41.5	110	92.0	450	505.3	200	152.7	400.0	666.8
8/21/2022	98	95.6	31	41.5	180	92.0	270	505.3	85	152.7	1100.0	666.8
8/28/2022	86	101.8	5.2	27.9	63	87.3	600	497.3	210	156.7	880.0	797.8
9/4/2022	220	117.7	41	58.9	200	98.3	1100	557.0	230	165.5	840.0	803.7
9/11/2022	280	134.4	5200	69.9	1400	162.8	1800	688.1	2500	247.4	1700.0	888.9
9/18/2022	--	158.1	--	69.9	460	216.8	750	651.5	540	306.6	980.0	951.2
10/16/2022	710	--	530	--	250	--	410	--	650	--	490.0	--
10/23/2022	780	--	86	--	110	--	310	--	200	--	330.0	--
10/30/2022	520	--	20	--	390	--	450	--	170	--	230.0	--
11/6/2022	6686	--	5929	--	3934	--	10875	--	5963	--	340.0	--
11/13/2022	60	593.0714102	48	178.5463163	68	310.1330954	1800	1022.850041	98	419.0025169	32.0	209.6106527

Table A-4. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 3 Sites during the 2022 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean ["GM"])

Week Beginning Date	Goldenstar Creek		San Timoteo Creek Reach 3		Santa Ana River Reach 3		San Timoteo Creek Reach 1A		San Timoteo Creek Reach 2		Warm Creek		Bolsa Chica Channel		Serrano Creek	
	(P3-RC1)		(P3-RC3)		(P3-SBC1)		(P3-SBC2)		(P3-SBC3)		(P3-SBC4)		(P3-OC1)		(P3-OC11)	
	Result	GM	Result	GM	Result	GM	Result	GM	Result	GM	Result	GM	Result	GM	Result	GM
5/1/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7/10/2022	--	--	570	--	--	--	880	--	130	--	--	--	10	--	--	--
7/17/2022	--	--	550	--	--	--	3700	--	810	--	120	--	173	--	--	--
7/24/2022	--	--	160	--	--	--	>24000	--	410	--	--		10	--	--	--
7/31/2022	--	--	600	--	--	--	2500	--	1500	--	--	--	10	--	--	--
8/7/2022	--	--	160	--	--		1400	--	420	--	--	--	63	--	--	--
8/14/2022	25	--	--	344	160	--	--	3072	--	486	--	--	--	26	839	--
8/21/2022	150	--	--	--	20	--	--	--	--	--	--	--	--	--	86	--
8/28/2022	54	--	--	--	30	--	--	--	--	--	--	--	--	--	--	--
9/4/2022	74	--	--	--	180	--	--	--	--	--	--	--	--	--	313	--
9/11/2022	58	--	--	--	260	--	--	--	--	--	--	--	--	--	3076	--
9/18/2022	--	61	--	--	--	85	--	--	--	--	--	--	--	--	573	--
9/25/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	525
10/2/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-5. *Enterococcus* (MPN/100 mL) Concentrations Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Lake Elsinore at Elm Grove Beach (P1-2-ELM)	
	Result	Geomean
5/8/2022	8.4	--
5/15/2022	46	--
5/22/2022	390	--
5/29/2022	47	--
6/5/2022	110	60
6/12/2022	83	63
6/19/2022	93	95
6/26/2022	1700	173
7/3/2022	80	155
7/10/2022	49	133
7/17/2022	1600	209
7/24/2022	160	233
7/31/2022	820	334
8/7/2022	31	172
8/14/2022	640	243
8/21/2022	24	215
8/28/2022	600	183
9/4/2022	110	172
9/11/2022	2400	206
9/18/2022	620	339
9/25/2022	17	--
10/2/2022	9.4	--
10/9/2022	2	--
10/16/2022	330	--

Table A-6. Total Suspended Solids (mg/L) Concentrations Observed at Priority 1 Sites during the 2022 Dry Season (BDL = below detection limit)

Week Beginning Date	Canyon Lake	Lake Elsinore	Lake Perris	Big Bear Lake	Mill Creek Reach 2	Lytle Creek	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue
	(P1-1)	(P1-2)	(P1-3)	(P1-4)	(P1-5)	(P1-6)	(WW-S1)	(WW-S4)
5/8/2022	4	30	5	54	BDL (2)	BDL (2)	2	6
5/15/2022	2	30	22	28	BDL (2)	3	6	6
5/22/2022	6	24	19	15	BDL (2)	4	2	5
5/29/2022	4	23	18	12	BDL (2)	BDL (2)	4	6
6/5/2022	3	38	8	31	2	BDL (2)	7	7
6/12/2022	3	31	20	18	2	3	BDL (2)	6
6/19/2022	4	44	7	16	2	BDL (2)	2	6
6/26/2022	3	37	10	22	2	BDL (2)	5	6
7/3/2022	3	33	13	18	BDL (2)	2	3	6
7/10/2022	3	160	6	22	2	4	5	4
7/17/2022	4	37	250	69	BDL (2)	BDL (2)	2	5
7/24/2022	2	23	8	31	BDL (2)	4	4	5
7/31/2022	2	34	8	61	84	4	3	4
8/7/2022	BDL (2)	BDL (5)	BDL (2)	80	270	2	2	5
8/14/2022	2	420	23	180	170	2	3	6
8/21/2022	2	49	4	41	15	2	3	4
8/28/2022	4	6000	12	83	6	5	4	4
9/4/2022	BDL (2)	390	7	38	4	4	5	5
9/11/2022	3	58	3	32	67	3	86	120
9/18/2022	BDL (2)	BDL (5)	--	30	14	BDL (2)	32	50
10/16/2022	2	30	27	15	3	2	24	26
10/23/2022	4	52	4	29	2	2	13	18
10/30/2022	3	37	2	19	2	2	16	18
11/6/2022	4	42	5	9	BDL (1)	2	990	1039
11/13/2022	5	130	14	11	BDL (1)	3	10	16

Table A-7. Total Suspended Solids (mg/L) Concentrations Observed at Priority 2 Sites during the 2022 Dry Season (BDL = below detection limit)

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(WW-MISSION)
5/8/2022	12	4	2	2	6	6.0
5/15/2022	9	4	4	6	6	12.0
5/22/2022	41	8	5	2	5	12.0
5/29/2022	30	5	4	4	6	12.0
6/5/2022	22	2	6	7	7	15.0
6/12/2022	16	4	4	BDL (2)	6	12.0
6/19/2022	12	3	4	2	6	36.0
6/26/2022	10	4	BDL (2)	5	6	18.0
7/3/2022	10	2	2	3	6	18.0
7/10/2022	10	2	21	5	4	29.0
7/17/2022	2	2	2	2	5	21.0
7/24/2022	12	3	6	4	5	21.0
7/31/2022	4	3	2	3	4	14.0
8/7/2022	c	BDL (2)	4	2	5	18.0
8/14/2022	2	2	3	3	6	22.0
8/21/2022	18	4	5	3	4	27.0
8/28/2022	55	2	8	4	4	16.0
9/4/2022	2	3	7	5	5	38.0
9/11/2022	10	8	12	86	120	110.0
9/18/2022	0.5	BDL (2)	10	32	50	38.0
10/16/2022	28	BDL (2)	4	24	26	26.0
10/23/2022	33	BDL (2)	2	13	18	16.0
10/30/2022	34	BDL (1)	6	16	18	28.0
11/6/2022	41	44	110	990	1039	28.0
11/13/2022	27	1	3	10	16	20.0

Table A-8. Total Suspended Solids (mg/L) Concentrations Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	48	--	18	22	--	12	--	--
7/17/2022	--	38	--	6	12	19	1.6	--	--
7/24/2022	--	26	--	6	26	--	--	--	--
7/31/2022	--	18	--	18	22	--	0.6	--	--
8/7/2022	--	8	--	5	3	--	1.9	--	--
8/14/2022	2	--	2	--	--	--	--	--	5.9
8/21/2022	1	--	1	--	--	--	--	--	6.2
8/28/2022	1	--	2	--	--	--	--	--	--
9/4/2022	3	--	3	--	--	--	--	2.3	2.4
9/11/2022	2	--	16	--	--	--	--	--	7.9
9/18/2022	--	--	--	--	--	--	--	--	3.1
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-9. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)
5/8/2022	8.4	9.4	10.0	8.3	8.7	9.6	9.0	8.9
5/15/2022	9.5	9.7	12.3	7.5	8.5	9.5	8.4	8.0
5/22/2022	9.5	8.6	12.4	6.7	8.4	9.5	8.7	8.3
5/29/2022	9.2	9.7	11.6	8.4	8.3	9.6	8.5	8.3
6/5/2022	8.9	11.0	9.5	7.2	8.3	9.3	8.3	8.0
6/12/2022	8.7	7.3	9.1	8.6	8.2	9.4	8.2	7.9
6/19/2022	8.3	9.9	9.4	8.8	8.3	9.4	8.2	7.9
6/26/2022	8.8	9.2	9.1	8.0	8.2	9.4	8.3	7.9
7/3/2022	8.2	9.2	8.5	8.6	8.1	9.4	8.3	8.0
7/10/2022	8.1	7.8	8.6	9.8	8.3	9.4	8.4	7.7
7/17/2022	8.2	6.9	7.9	10.3	8.0	9.3	8.3	7.9
7/24/2022	8.3	8.9	8.0	8.4	7.6	9.4	8.3	7.8
7/31/2022	8.0	8.2	8.1	7.4	8.2	9.3	8.3	7.7
8/7/2022	8.0	7.2	8.8	13.6	7.8	9.3	8.4	7.7
8/14/2022	8.1	13.8	8.8	15.3	7.9	9.2	8.6	7.6
8/21/2022	8.2	8.0	7.9	10.7	7.7	9.2	8.2	8.2
8/28/2022	8.6	5.6	8.0	10.2	7.1	9.1	8.4	7.4
9/4/2022	8.1	11.0	7.9	6.9	7.4	9.0	7.9	7.0
9/11/2022	7.3	9.5	7.2	9.8	8.4	9.6	7.8	7.7
9/18/2022	7.6	12.7	7.7	8.3	8.2	9.3	8.2	8.0
10/16/2022	7.2	5.1	8.0	7.7	8.5	9.4	8.2	7.7
10/23/2022	3.6	10.6	8.3	8.5	8.9	9.6	8.5	8.2
10/30/2022	3.9	10.2	8.0	8.8	9.4	9.5	8.8	8.5
11/6/2022	2.7	10.3	8.1	9.1	7.5	9.9	9.0	9.0
11/13/2022	3.5	10.1	8.9	10.4	7.6	9.9	9.0	9.1

Table A-10. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(WW-MISSION)
5/8/2022	7.59	6.4	6.8	9.0	8.9	8.9
5/15/2022	6.84	5.5	5.6	8.4	8.0	8.7
5/22/2022	9.89	4.5	5.2	8.7	8.3	8.5
5/29/2022	9.43	7.8	6.3	8.5	8.3	8.4
6/5/2022	7.94	7.9	6.0	8.3	8.0	8.0
6/12/2022	7.34	7.5	5.9	8.2	7.9	7.9
6/19/2022	7.43	7.0	5.8	8.2	7.9	8.1
6/26/2022	6.2	6.3	5.0	8.3	7.9	8.2
7/3/2022	6.53	6.7	5.9	8.3	8.0	8.3
7/10/2022	7.3	7.5	5.8	8.4	7.7	7.7
7/17/2022	5.82	6.5	5.8	8.3	7.9	8.2
7/24/2022	5.68	5.9	5.7	8.3	7.8	8.5
7/31/2022	4.61	1.53	4.56	8.3	7.7	8.1
8/7/2022	5.07	1.9	5.7	8.4	7.7	8.1
8/14/2022	4.24	2.0	5.8	8.6	7.6	7.8
8/21/2022	4.92	2.0	5.8	8.2	8.2	8.0
8/28/2022	3.49	5.4	5.8	8.4	7.4	7.6
9/4/2022	4.52	2.4	5.6	7.9	7.0	7.5
9/11/2022	6.5	0.5	5.3	7.8	7.7	7.9
9/18/2022	7.2	1.7	6.2	8.2	8.0	8.2
10/16/2022	8.0	6.0	6.2	8.2	7.7	8.0
10/23/2022	8.9	6.3	6.7	8.5	8.2	8.4
10/30/2022	9.7	6.5	7.5	8.8	8.5	8.6
11/6/2022	9.7	8.1	8.5	9.0	9.0	9.0
11/13/2022	10.2	8.8	9.0	9.0	9.1	8.8

Table A-11. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	8.02	--	10.17	8.13	--	14.21	--	--
7/17/2022	--	7.98	--	11.79	8.37	8.58	4.05	--	--
7/24/2022	--	8.18	--	9.96	8.38	--	6.93	--	--
7/31/2022	--	7.91	--	9.52	7.99	--	10.93	--	--
8/7/2022	--	7.89	--	8.83	8.75	--	7.2	--	--
8/14/2022	8.42	--	8.12	--	--	--	--	--	11.23
8/21/2022	8.27	--	7.74	--	--	--	--	--	12.64
8/28/2022	8.40	--	7.68	--	--	--	--	--	--
9/4/2022	7.83	--	7.69	--	--	--	--	8.14	10.92
9/11/2022	8.37	--	7.39	--	--	--	--	--	10.8
9/18/2022	--	--	--	--	--	--	--	--	10.22
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-12. pH (standard units) Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ MISSION
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(WW-MISSION)
5/8/2022	8.5	9.0	8.7	8.6	7.7	8.4
5/15/2022	8.6	9.0	8.7	8.6	7.7	8.3
5/22/2022	8.7	8.9	8.7	8.5	7.4	8.2
5/29/2022	8.6	9.2	8.8	8.7	7.5	8.3
6/5/2022	8.6	9.2	9.0	8.5	7.6	8.3
6/12/2022	8.6	9.2	9.3	8.9	7.8	8.3
6/19/2022	8.6	9.2	9.4	8.9	7.6	8.3
6/26/2022	8.6	9.1	9.4	9.6	7.4	8.4
7/3/2022	8.5	9.1	9.2	9.7	7.6	8.2
7/10/2022	8.5	9.1	9.3	9.6	7.7	8.4
7/17/2022	8.6	9.0	9.2	9.6	8.1	8.4
7/24/2022	8.6	9.0	9.2	10.1	7.5	8.3
7/31/2022	8.5	8.9	9.2	9.9	7.5	8.2
8/7/2022	8.5	9.2	9.2	9.7	7.7	8.4
8/14/2022	8.5	8.7	9.0	9.5	8.5	8.3
8/21/2022	8.5	9.0	8.9	10.0	8.4	8.2
8/28/2022	8.5	8.9	8.9	9.7	8.5	8.3
9/4/2022	8.5	9.0	8.8	9.4	8.5	8.0
9/11/2022	8.4	9.0	8.8	8.8	8.3	8.1
9/18/2022	8.4	9.2	8.9	8.7	8.6	8.4
10/16/2022	7.7	8.9	8.3	8.6	8.4	8.2
10/23/2022	7.6	9.1	8.4	8.6	8.2	8.2
10/30/2022	7.6	8.8	8.3	8.6	8.3	8.3
11/6/2022	7.5	8.8	8.3	8.4	8.3	8.3
11/13/2022	7.5	8.6	8.5	7.7	7.7	8.0

Table A-13. pH (standard units) Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)	Santa Ana River @ MISSION (WW-MISSION)
5/8/2022	8.41	7.7	7.7	8.1	8.2	8.4
5/15/2022	8.37	7.6	7.8	8.1	8.2	8.4
5/22/2022	9.57	7.7	7.6	8.0	8.2	8.4
5/29/2022	9.5	8.1	7.8	8.1	8.3	8.3
6/5/2022	8.9	8.3	8.0	8.1	8.2	8.4
6/12/2022	8.89	8.1	7.9	8.1	8.3	8.4
6/19/2022	8.97	8.1	7.8	8.0	8.2	8.4
6/26/2022	8.19	7.9	7.6	8.1	8.3	8.4
7/3/2022	8.5	8.0	7.7	8.0	8.2	8.4
7/10/2022	8.71	8.0	7.7	8.2	8.3	8.4
7/17/2022	7.99	8.0	7.8	8.1	8.3	8.4
7/24/2022	8.07	7.9	7.7	8.1	8.2	8.5
7/31/2022	7.81	7.4	7.6	8.0	8.1	8.4
8/7/2022	7.98	7.4	7.8	8.2	8.2	8.4
8/14/2022	7.79	7.4	7.7	8.0	8.1	8.4
8/21/2022	7.8	7.4	7.7	8.0	8.2	8.4
8/28/2022	7.8	7.8	7.7	8.0	8.2	8.4
9/4/2022	7.84	7.5	7.7	8.1	8.2	8.4
9/11/2022	8.7	7.4	7.7	8.0	8.1	8.3
9/18/2022	9.0	7.5	7.6	8.0	8.2	8.3
10/16/2022	9.0	7.8	7.6	7.9	8.0	8.2
10/23/2022	9.0	7.8	7.7	8.1	8.5	8.3
10/30/2022	9.2	7.8	7.7	8.0	8.1	8.3
11/6/2022	8.8	7.7	7.6	8.0	8.2	8.2
11/13/2022	8.9	7.9	7.6	7.4	7.4	8.2

Table A-14. pH (standard units) Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	8.54	--	8.91	8.58	--	7.67	--	--
7/17/2022	--	8.47	--	9.14	8.63	8.67	6.9	--	--
7/24/2022	--	8.53	--	8.83	8.56	--	7.9	--	--
7/31/2022	--	8.5	--	8.92	8.49	--	7.98	--	--
8/7/2022	--	8.36	--	8.55	8.46	--	8	--	--
8/14/2022	8.28	--	7.77	--	--	--	--	--	8.54
8/21/2022	8.27	--	7.69	--	--	--	--	--	10.18
8/28/2022	8.30	--	7.76	--	--	--	--	--	--
9/4/2022	8.30	--	7.76	--	--	--	--	8.53	9.98
9/11/2022	8.50	--	7.76	--	--	--	--	--	8.49
9/18/2022	--	--	--	--	--	--	--	--	8.57
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-15. Turbidity (NTU) Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)
5/8/2022	8.5	9.0	9.0	8.7	8.0	8.4	8.2	8.3
5/15/2022	8.6	9.0	9.3	8.6	7.8	8.3	8.1	8.2
5/22/2022	8.7	8.8	9.4	9	7.6	8.3	8.1	8.2
5/29/2022	8.6	9.0	9.5	8.9	7.6	8.3	8.1	8.2
6/5/2022	8.6	9.0	9.4	9	7.7	8.4	8.1	8.2
6/12/2022	8.6	8.8	9.3	9	7.6	8.3	8.1	8.2
6/19/2022	8.6	9.0	9.4	9.1	7.7	8.5	8.1	8.3
6/26/2022	8.6	8.9	9.2	9	7.5	8.3	8.1	8.3
7/3/2022	8.5	9.0	9.2	9.1	7.6	8.4	8.1	8.3
7/10/2022	8.5	8.8	9.1	9	7.6	8.4	8.1	8.2
7/17/2022	8.6	8.8	9.0	9	8	8.4	8.1	8.3
7/24/2022	8.6	9.0	9.0	10	7.5	8.4	8.1	8.3
7/31/2022	8.5	8.9	8.9	10	7.6	8.3	8.1	8.2
8/7/2022	8.5	8.9	9.0	10	8.1	8.3	8.1	8.3
8/14/2022	8.5	9.1	9.0	10	8.3	8.4	8.1	8.3
8/21/2022	8.5	8.9	9.0	9.5	8.3	8.3	8.1	8.2
8/28/2022	8.5	8.9	8.9	9.4	8.3	8.5	8.1	8.2
9/4/2022	8.5	9.2	9.0	9.5	8.3	8.4	8.1	8.2
9/11/2022	8.4	9.1	8.8	9.3	8.3	8.3	8.0	8.2
9/18/2022	8.4	9.2	8.8	9	8.4	8.4	8.1	8.2
10/16/2022	7.7	8.9	8.6	9.3	8.4	8.4	8.0	8.1
10/23/2022	7.6	9.1	8.6	8.8	8.3	8.3	8.0	8.1
10/30/2022	7.6	9.1	8.5	8.9	8.2	8.3	8.1	8.2
11/6/2022	7.5	9.1	8.3	9	7.4	8.4	8.0	8.1
11/13/2022	7.5	9.1	8.3	9	7.2	8.3	7.9	8.1

Table A-16. Turbidity (NTU) Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission Ave
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(MISSION)
5/8/2022	5.7	0.3	0.3	8.2	8.3	7.0
5/15/2022	3.28	0.2	1.2	8.1	8.2	3.0
5/22/2022	10.04	0.4	0.9	8.1	8.2	4.2
5/29/2022	13.47	0.0	1.5	8.1	8.2	4.0
6/5/2022	9.04	0.0	1.0	8.1	8.2	2.8
6/12/2022	7.3	0.3	0.4	8.1	8.2	2.2
6/19/2022	6.98	0.5	1.9	8.1	8.3	9.8
6/26/2022	3.48	1.1	1.2	8.1	8.3	4.4
7/3/2022	4.85	0.7	0.8	8.1	8.3	3.6
7/10/2022	4.35	0.9	0.8	8.1	8.2	3.5
7/17/2022	2.72	0.7	1.0	8.1	8.3	5.3
7/24/2022	2.69	0.8	0.8	8.1	8.3	3.0
7/31/2022	1.88	1.2	2.6	8.1	8.2	7.2
8/7/2022	2.13	1.3	0.9	8.1	8.3	3.0
8/14/2022	1.77	1.0	1.4	8.1	8.3	6.8
8/21/2022	11.7	0.7	2.0	8.1	8.2	6.9
8/28/2022	2.87	0.5	1.5	8.1	8.2	5.5
9/4/2022	6.46	0.6	2.1	8.1	8.2	10.8
9/11/2022	13.3	7.5	7.4	8.0	8.2	59.0
9/18/2022	11.1	0.6	4.9	8.1	8.2	11.8
10/16/2022	34.6	0.1	1.4	8.0	8.1	10.3
10/23/2022	29.1	0.2	1.6	8.0	8.1	4.8
10/30/2022	39.0	0.1	2.6	8.1	8.2	9.5
11/6/2022	21.0	0.0	1.7	8.0	8.1	8.1
11/13/2022	25.6	0.5	1.0	7.9	8.1	5.0

Table A-17. Turbidity (NTU) Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	23.36	--	7.46	8.88	--	1.24	--	--
7/17/2022	--	24.56	--	3.92	7.29	9.18	1.19	--	--
7/24/2022	--	9.26	--	2.49	7.77	--	1.35	--	--
7/31/2022	--	12.19	--	2.99	14.05	--	2.06	--	--
8/7/2022	--	4.17	--	1.8	1.75	--	5.47	--	--
8/14/2022	0.11	--	0.03	--	--	--	--	--	3.22
8/21/2022	0.57	--	0.22	--	--	--	--	--	--
8/28/2022	0.38	--	0.22	--	--	--	--	--	--
9/4/2022	0.51	--	0.23	--	--	--	--	9.7	6.2
9/11/2022	0.16	--	8.64	--	--	--	--	--	2.2
9/18/2022	--	--	--	--	--	--	--	--	--
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-18. Water Temperature (°C) Concentrations Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)
5/8/2022	21.3	19.1	20.8	11.3	13.0	11.6	16.8	17.3
5/15/2022	23.1	22.1	22.7	13.6	13.8	12.0	19.0	20.7
5/22/2022	24.4	24.3	24.9	18.8	13.8	12.3	20.3	20.9
5/29/2022	24.0	23.6	23	14.0	13.5	11.8	19.7	20.4
6/5/2022	26.7	26.3	25.8	23.1	15.8	13.4	22.2	22.7
6/12/2022	27.0	25.7	25.6	16.0	14.4	12.3	22.3	22.6
6/19/2022	26.0	24.9	26.1	16.4	14.0	12.4	21.1	23.2
6/26/2022	27.4	26.8	26.8	20.9	15.2	13.0	22.4	23.3
7/3/2022	27.1	24.6	26.2	17.5	14.6	12.4	20.9	22.6
7/10/2022	28.8	27.3	27.8	22.1	16.2	13.2	23.7	25.2
7/17/2022	29.7	28.3	27.9	22.2	15.3	13.2	21.8	23.3
7/24/2022	28.8	26.6	27.3	19.6	15.8	12.9	20.8	22.8
7/31/2022	28.9	27.3	26.9	19.5	17.1	15.0	21.9	24.2
8/7/2022	28.6	27.4	28	19.5	18.8	13.1	21.6	24.3
8/14/2022	29.8	29.6	30.1	24.4	18.1	13.8	22.5	25.8
8/21/2022	29.0	26.9	27.8	21.4	19.8	14.6	21.5	24.9
8/28/2022	29.4	30.1	30.1	23.8	23.2	14.5	22.2	25.4
9/4/2022	26.4	31.5	30.2	18.1	21.0	15.7	22.7	26.0
9/11/2022	26.3	23.0	25.6	18.5	15.0	11.7	20.6	21.9
9/18/2022	23.9	24.4	27	13.7	15.8	13.8	20.0	20.9
10/16/2022	21.7	21.2	23.1	8.5	14.6	14.5	19.7	21.5
10/23/2022	20.9	18.6	23.3	7.6	12.2	11.7	17.3	19.5
10/30/2022	16.9	18.3	20.4	6.0	10.1	12.8	16.6	17.9
11/6/2022	16.7	13.6	16.9	4.6	9.9	10.5	15.0	16.0
11/13/2022	30.6	12.8	16.7	3.2	9.7	10.2	15.5	15.9

Table A-19. Water Temperature (°C) Concentrations Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission Ave
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(MISSION)
5/8/2022	18.2	16.2	15.1	16.8	17.3	19.4
5/15/2022	19.7	19.8	20.2	19.0	20.7	20.3
5/22/2022	23	19.3	20.4	20.3	20.9	22.3
5/29/2022	22.5	16.3	20.1	19.7	20.4	22.0
6/5/2022	23.1	20.7	21.6	22.2	22.7	25.8
6/12/2022	23.1	18.2	21.8	22.3	22.6	26.9
6/19/2022	23.6	19.4	22.3	21.1	23.2	25.0
6/26/2022	22.2	19.5	23.3	22.4	23.3	24.5
7/3/2022	22.6	18.8	19.8	20.9	22.6	23.7
7/10/2022	24.6	17.7	21.3	23.7	25.2	29.2
7/17/2022	22.9	19.9	21.3	21.8	23.3	24.1
7/24/2022	22.5	19.5	21.5	20.8	22.8	22.9
7/31/2022	22.6	23.8	2.2	21.9	24.2	24.4
8/7/2022	22.3	24.4	21.3	21.6	24.3	25.0
8/14/2022	22.9	23.4	21.3	22.5	25.8	28.4
8/21/2022	22.3	23.5	21.7	21.5	24.9	25.3
8/28/2022	23.2	22.3	22.1	22.2	25.4	28.7
9/4/2022	24.5	25.2	24.1	22.7	26.0	27.9
9/11/2022	24.0	22.2	22.5	20.6	21.9	23.6
9/18/2022	23.7	20.8	19.1	20.0	20.9	22.1
10/16/2022	21.7	20.8	20.9	19.7	21.5	23.6
10/23/2022	19.1	19.0	17.1	17.3	19.5	20.8
10/30/2022	18.9	18.9	16.6	16.6	17.9	20.4
11/6/2022	15.8	19.0	14.8	15.0	16.0	17.5
11/13/2022	14.7	17.4	11.6	15.5	15.9	19.0

Table A-20. Water Temperature (°C) Concentrations Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
4/17/2022	--	--	--	--	--	--	22.4	--	--
5/1/2022	--	--	--	--	--	--	24.4	--	--
5/8/2022	--	--	--	--	--	--	16.6	--	--
5/15/2022	--	--	--	--	--	--	17.6	--	--
5/22/2022	--	--	--	--	--	--	19.6	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	25.8	--	23.7	25.4	--	22.2	--	--
7/17/2022	--	23.5	--	22.7	22.8	22.4	7.79	--	--
7/24/2022	--	23.9	--	21.5	22.4	--	24.57	--	--
7/31/2022	--	24.5	--	23.7	24	--	26.35	--	--
8/7/2022	--	22.4	--	22	19.8	--	26.1	--	--
8/14/2022	20.7	--	27.3	--	--	--	--	--	22.8
8/21/2022	20.7	--	27.3	--	--	--	--	--	28.96
8/28/2022	20.4	--	28.2	--	--	--	--	--	--
9/4/2022	23.0	--	28	--	--	--	--	28.17	27.93
9/11/2022	19.7	--	27.8	--	--	--	--	--	21.33
9/18/2022	--	--	--	--	--	--	20.6	--	18.96
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-21. Conductivity (µS/cm) Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)
5/8/2022	939	3615	567	458	226	266	1020	1029
5/15/2022	955	3572	567	465	226	287	1041	1056
5/22/2022	953	2979	550	469	221	267	1035	1034
5/29/2022	962	3528	544	458	219	266	1041	907
6/5/2022	960	3704	544	459	215	265	1037	911
6/12/2022	985	3521	557	463	217	268	1073	954
6/19/2022	965	3883	547	453	210	262	1053	1032
6/26/2022	994	3644	558	467	214	269	108	1068
7/3/2022	996	3743	560	448	213	268	1087	1065
7/10/2022	1007	3961	568	425	211	268	1083	1063
7/17/2022	972	3578	546	399	202	256	1053	1013
7/24/2022	985	3619	553	374	206	259	1071	1031
7/31/2022	1014	3856	570	419	206	276	1107	1069
8/7/2022	1047	4152	587	397	164	272	1128	1081
8/14/2022	1036	3823	584	398	198	267	1110	1055
8/21/2022	1058	4310	594	398	199	282	1126	1069
8/28/2022	1040	4192	584	402	197	265	1109	1057
9/4/2022	1096	4356	618	418	210	279	1167	1121
9/11/2022	1047	3355	588	434	183	270	996	1004
9/18/2022	1071	4162	603	422	189	275	1020	1022
10/16/2022	1066	4137	595	450	183	278	1005	1007
10/23/2022	1084	4318	609	471	180	285	1025	1030
10/30/2022	1070	4264	598	462	175	276	1034	1028
11/6/2022	1046	4208	597	459	208	270	1002	994
11/13/2022	1061	4340	599	486	207	266	1012	1018

Table A-22. Conductivity (µS/cm) Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission Ave
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(MISSION)
5/8/2022	1784	1098	1195	1020	1029	829.0
5/15/2022	1707.3	1083	975	1041	1056	837.0
5/22/2022	1004	1327	1044	1035	1034	827.7
5/29/2022	1057	792	901	1041	907	832.0
6/5/2022	1302.7	598	973	1037	911	827.7
6/12/2022	1293	680	913	1073	954	846.3
6/19/2022	1214	681	875	1053	1032	831.3
6/26/2022	1514	687	923	108	1068	846.0
7/3/2022	1401	665	1199	1087	1065	848.0
7/10/2022	1264.7	657	1168	1083	1063	851.0
7/17/2022	1538.3	655	1226	1053	1013	820.0
7/24/2022	1474	638	871	1071	1031	813.0
7/31/2022	1619	1199	1381	1107	1069	850.0
8/7/2022	1470	1370	1393	1128	1081	858.0
8/14/2022	1614	1521	1444	1110	1055	844.7
8/21/2022	1620	1184	1274	1126	1069	861.0
8/28/2022	1610	528	1218	1109	1057	839.3
9/4/2022	1659	1305	1152	1167	1121	877.0
9/11/2022	1335	1039	1134	996	1004	848.0
9/18/2022	1172	1056	1326	1020	1022	854.0
10/16/2022	1042	466	832	1005	1007	838.7
10/23/2022	1181	479	1078	1025	1030	861.0
10/30/2022	1036	743	933	1034	1028	870.3
11/6/2022	1260	790	897	1002	994	822.7
11/13/2022	1209	747	991	1012	1018	826.0

Table A-23. Conductivity (µS/cm) Observed at Priority 3 Sites during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	642.7	--	627	778.3	--	3634	--	--
7/17/2022	--	630.7	--	558.3	765	2517.3	3435	--	--
7/24/2022	--	633	--	585	771	--	2515	--	--
7/31/2022	--	678.3	--	641.7	731.3	--	3103	--	--
8/7/2022	--	666	--	644	832	--	2554	--	--
8/14/2022	2242	--	842	--	--	--	--	--	2238
8/21/2022	2244	--	853	--	--	--	--	--	1612
8/28/2022	2196	--	853.3	--	--	--	--	--	--
9/4/2022	2353	--	878	--	--	--	--	1418	750
9/11/2022	2364	--	855	--	--	--	--	--	1523
9/18/2022	--	--	--	--	--	--	--	--	2286
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-24. Flow (cfs) Observed at Priority 1 Sites during the 2022 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	Santa Ana River @ MWD Crossing (WW-S1)	Santa Ana River @ Pedley Avenue (WW-S4)
5/8/2022	NA	NA	NA	NA	6.8	4.7	33.8	59.0
5/15/2022	NA	NA	NA	NA	2.4	1.6	25.7	32.3
5/22/2022	NA	NA	NA	NA	4.9	4.9	40.7	41.2
5/29/2022	NA	NA	NA	NA	1.7	2.2	33.7	46.3
6/5/2022	NA	NA	NA	NA	2.0	3.7	28.5	59.2
6/12/2022	NA	NA	NA	NA	1.9	1.8	22.5	34.4
6/19/2022	NA	NA	NA	NA	2.2	1.8	20.2	38.0
6/26/2022	NA	NA	NA	NA	1.7	1.6	19.3	39.0
7/3/2022	NA	NA	NA	NA	3.8	1.0	36.2	43.9
7/10/2022	NA	NA	NA	NA	0.5	0.5	51.3	81.7
7/17/2022	NA	NA	NA	NA	1.9	0.9	21.2	39.9
7/24/2022	NA	NA	NA	NA	1.2	0.7	30.1	33.5
7/31/2022	NA	NA	NA	NA	8.6	0.5	24.0	35.1
8/7/2022	NA	NA	NA	NA	8.2	1.1	29.1	34.8
8/14/2022	NA	NA	NA	NA	11.0	0.8	32.7	59.4
8/21/2022	NA	NA	NA	NA	5.7	0.4	21.1	59.8
8/28/2022	NA	NA	NA	NA	7.2	0.2	32.6	33.5
9/4/2022	NA	NA	NA	NA	1.9	0.2	31.3	32.0
9/11/2022	NA	NA	NA	NA	2.6	1.3	28.1	30.8
9/18/2022	NA	NA	NA	NA	2.0	0.3	38.3	48.4
10/16/2022	NA	NA	NA	NA	--	--	47.2	--
10/23/2022	NA	NA	NA	NA	4.0	0.2	39.6	81.7
10/30/2022	NA	NA	NA	NA	3.4	0.5	45.8	140.9
11/6/2022	NA	NA	NA	NA	1.4	7.5	138.7	258.3
11/13/2022	NA	NA	NA	NA	1.6	6.6	67.1	151.3

Table A-25. Flow (cfs) Observed at Priority 2 Sites during the 2022 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	Santa Ana River @ MWD Crossing	Santa Ana River @ Pedley Avenue	Santa Ana River @ Mission Ave
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)	(MISSION)
5/8/2022	2.1	10.8	11	34	59	16.1
5/15/2022	1.99	8.9	8.9	26	32	11.9
5/22/2022	5.54	7.4	11.0	41	41	15.8
5/29/2022	5.26	24.7	20.6	34	46	11.9
6/5/2022	2.12	39.4	18.4	29	59	17.0
6/12/2022	2.28	23	36.2	23	34	16.1
6/19/2022	2.02	15.3	15.8	20	38	16.0
6/26/2022	0.98	20	10.6	19	39	7.8
7/3/2022	1.07	16.6	2.6	36	44	9.3
7/10/2022	1.85	22.8	7.9	51	82	4.7
7/17/2022	1.25	18.7	7	21	40	8.1
7/24/2022	0.6	17	4.6	30	34	5.9
7/31/2022	0.76	5.5	3.0	24	35	5.6
8/7/2022	1.06	2.0	3.5	29	35	5.1
8/14/2022	0.55	16.9	14	33	59	4.5
8/21/2022	0.91	5.2	13	21	60	7.3
8/28/2022	0.72	21.0	18	33	34	5.7
9/4/2022	0.71	14.2	32.4	31	32	7.0
9/11/2022	1.5	3.1	5.2	28	31	13.2
9/18/2022	7.7	3.2	4.3	38	48	26.3
10/16/2022	--	--	--	47	--	23.4
10/23/2022	5.1	17.3	10.6	40	82	30.4
10/30/2022	6.7	8.0	50	46	141	24.2
11/6/2022	7.71	40.7	67	139	258	37.7
11/13/2022	8.5	93.8	54	67	151	50.6

Table A-26. Flow (cfs) Observed at Priority 3 sites in Orange County during the 2022 Dry Season

Week Beginning Date	Goldenstar Creek	San Timoteo Creek Reach 3	Santa Ana River Reach 3	San Timoteo Creek Reach 1A	San Timoteo Creek Reach 2	Warm Creek	Bolsa Chica Channel	Borrego Creek	Serrano Creek
	(P3-RC1)	(P3-RC3)	(P3-SBC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)	(P3-OC1)	(P3-OC2)	(P3-OC11)
5/1/2022	--	--	--	--	--	--	--	--	--
5/8/2022	--	--	--	--	--	--	--	--	--
5/15/2022	--	--	--	--	--	--	--	--	--
5/22/2022	--	--	--	--	--	--	--	--	--
5/29/2022	--	--	--	--	--	--	--	--	--
6/5/2022	--	--	--	--	--	--	--	--	--
6/12/2022	--	--	--	--	--	--	--	--	--
6/19/2022	--	--	--	--	--	--	--	--	--
6/26/2022	--	--	--	--	--	--	--	--	--
7/3/2022	--	--	--	--	--	--	--	--	--
7/10/2022	--	13.23	--	4.38	2.17	--	NA	--	--
7/17/2022	--	12.01	--	3.35	1.56	0.05	NA	--	--
7/24/2022	--	12.42	--	1.03	1.28	--	NA	--	--
7/31/2022	--	6.55	--	1.39	2.61	--	NA	--	--
8/7/2022	--	11.23	--	0.77	0.71	--	NA	--	--
8/14/2022	7.38	--	40.2	--	--	--	--	--	NA
8/21/2022	4.43	--	32.83	--	--	--	--	--	NA
8/28/2022	5.79	--	33.7	--	--	--	--	--	--
9/4/2022	6.14	--	35.55	--	--	--	--	NA	NA
9/11/2022	12.16	--	30.24	--	--	--	--	--	NA
9/18/2022	--	--	--	--	--	--	--	--	NA
9/25/2022	--	--	--	--	--	--	--	--	--
10/2/2022	--	--	--	--	--	--	--	--	--
10/9/2022	--	--	--	--	--	--	--	--	--
10/16/2022	--	--	--	--	--	--	--	--	--

Table A-27. Water Quality Data from Priority 2 Sites during the 2022-2023 Storm Event

Date	*E. coli* (MPN/100 mL)	TSS (mg/L)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Flow (cfs)	pH	Water Temperature (°C)	Turbidity (NTU)
Prado Park Lake (WW-C3)								
11/8/2022	2200	33	1024	9.5	9.7	8.9	17.8	43
11/9/2022	24000	60	1113	9.6	14.0	8.9	17.3	62
11/10/2022	510	40	1152	10.1	15.0	8.9	17.2	35
11/11/2022	36	32	1110	9.5	4.0	8.9	16.6	34
Chino Creek at Central Avenue (WW-C7)								
11/8/2022	7700	130	63	10.1	N/A	8.03	15.1	68.6
11/9/2022	14000	10	508	9.7	N/A	7.8	14.5	11
11/10/2022	2000	33	683	9.1	N/A	7.8	15.5	1
11/11/2022	17	2	807	8.0	90.2	7.6	18.8	0
Mill-Cucamonga Creek below Treatment Wetlands (WW-M6)								
11/8/2022	11000	210	97	9.7	N/A	8.5	15.2	80
11/9/2022	3700	180	312	9.2	N/A	7.9	15.5	155
11/10/2022	1000	31	416	9.1	N/A	7.6	15.0	41
11/11/2022	36	16	529	8.9	N/A	7.5	14.8	11
Santa Ana River at MWD Crossing (WW-S1)								
11/8/2022	24,000	430	299	8.3	N/A	7.7	16.3	194
11/9/2022	16000	2200	332	9.1	N/A	7.9	13.9	1483
11/10/2022	3,400	340	663	8.4	N/A	7.9	15.8	346
11/11/2022	100	58	895	8.3	116.0	7.9	16.2	27
Santa Ana River at Pedley Avenue (WW-S4)								
11/8/2022	13000	140	148	9.5	N/A	7.8	15.2	78
11/9/2022	8700	3600	305	9.0	N/A	7.9	14.0	2059
11/10/2022	2100	370	630	8.7	N/A	7.9	16.0	391
11/11/2022	52	47	707	8.8	143.0	8.0	15.4	21

Table A-28. 2021 Daily Mean Flow (cfs), Chino Creek at Schaeffer Avenue, as Measured by the USGS gage 11073360

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	276.7[A]	157[A]	115.4[A]	81.3[A]	57.5[A]	160.2[A]	160.2[A]	45.6[A]	69.8[A]	107.7[A]	41.9[P]	127.5[P]
2	240.2[A]	131.8[A]	127.8[A]	72.3[A]	69.7[A]	85.3[A]	85.3[A]	44.7[A]	31.6[A]	30.1[A]	1595.9[P]	301.9[P]
3	180.5[A]	87.3[A]	112[A]	64.9[A]	65.7[A]	247.9[A]	247.9[A]	45.8[A]	32.7[A]	27[A]	71[P]	87.8[P]
4	175.5[A]	89.7[A]	145.4[A]	63.1[A]	67.8[A]	247.3[A]	247.3[A]	44.2[A]	32.2[A]	34.3[A]	68.7[P]	163.3[P]
5	189.6[A]	90.5[A]	113[A]	63[A]	67.6[A]	244.8[A]	244.8[A]	49[A]	37.1[A]	40[P]	62.7[P]	297.7[P]
6	140.5[A]	95.3[A]	118.7[A]	65.5[A]	66.4[A]	256.6[A]	256.6[A]	43.4[A]	33.7[A]	31.2[P]	60[P]	67[P]
7	135.7[A]	92[A]	114.5[A]	58.1[A]	69[A]	247[A]	247[A]	41.1[A]	44.3[A]	51.6[P]	970.4[P]	81.8[P]
8	128.7[A]	119.5[A]	147.8[A]	59[A]	61[A]	240.7[A]	240.7[A]	40.8[A]	92.6[A]	39.1[P]	81589.3[P]	83[P]
9	180.9[A]	83.6[A]	142.9[A]	62.3[A]	63.7[A]	246.6[A]	246.6[A]	40.5[A]	745.6[A]	39.3[P]	9932[P]	24.1[P]
10	133.1[A]	101.1[A]	137[A]	59.3[A]	68.3[A]	268[A]	268[A]	44.9[A]	291.3[A]	34.4[P]	364.6[P]	24.8[P]
11	112.6[A]	96.2[A]	137.9[A]	113.1[A]	55.3[A]	276.3[A]	276.3[A]	42.7[A]	5077[A]	38.5[P]	100.5[P]	28956.2[P]
12	104.1[A]	86.5[A]	116.3[A]	235.3[A]	61.4[A]	271.2[A]	271.2[A]	48[A]	216.1[A]	70.6[P]	64[P]	2858.9[P]
13	109.2[A]	77.2[A]	96.6[A]	52.6[A]	58.2[A]	279.4[A]	279.4[A]	63.8[A]	68.8[A]	41.3[P]	59.2[P]	93.5[P]
14	100.5[A]	79.3[A]	110.9[A]	41.4[A]	49.7[A]	295.9[A]	295.9[A]	61.9[A]	44.8[A]	48.8[P]	71.2[P]	48.7[P]
15	102.2[A]	834[A]	105.7[A]	53.5[A]	60.9[A]	270.7[A]	270.7[A]	47.8[A]	36.6[A]	3532.2[P]	80.8[P]	66.7[P]
16	103.8[A]	113.4[A]	109.3[A]	54.3[A]	67.2[A]	274.7[A]	274.7[A]	31.4[A]	60.6[A]	499.6[P]	71.9[P]	64.1[P]
17	317.1[A]	93.2[A]	106[A]	66[A]	63.1[A]	256.3[A]	256.3[A]	35.9[A]	41.2[A]	98.1[P]	85.7[P]	33.7[P]
18	126.7[A]	107[A]	114.1[A]	50.4[A]	98.2[A]	272.7[A]	272.7[A]	74.5[A]	56.5[A]	69.6[P]	72.8[P]	38.5[P]
19	91.2[A]	81.2[A]	121.2[A]	48.3[A]	98.3[A]	251.9[A]	251.9[A]	93.5[A]	52.1[A]	52.6[P]	69.3[P]	40.7[P]
20	87.9[A]	89.4[A]	237.8[A]	52.5[A]	54.4[A]	262.3[A]	262.3[A]	56.5[A]	108.5[A]	107.1[P]	60.1[P]	31.8[P]
21	90.4[A]	88.8[A]	121.6[A]	48.5[A]	47.7[A]	282.2[A]	282.2[A]	29.4[A]	162.4[A]	49.7[P]	64.2[P]	27.3[P]
22	88.7[A]	308.8[A]	123.3[A]	3401.6[A]	44.1[A]	2870.6[A]	2870.6[A]	70.6[A]	163[A]	63.5[P]	62.5[P]	31.3[P]
23	117.1[A]	595.9[A]	114.3[A]	78.5[A]	51[A]	267.6[A]	267.6[A]	34.4[A]	43.9[A]	81.8[P]	58.8[P]	32.1[P]
24	173.2[A]	100.7[A]	113.2[A]	64.9[A]	47.1[A]	254.3[A]	254.3[A]	34.7[A]	66[A]	33.9[P]	70.5[P]	27[P]
25	104[A]	109.9[A]	123.6[A]	117.4[A]	56.4[A]	256.6[A]	256.6[A]	34.7[A]	189.8[A]	33.1[P]	74.3[P]	26.1[P]
26	111.4[A]	102.2[A]	123.6[A]	64.5[A]	101.8[A]	270[A]	270[A]	37[A]	43.3[A]	37.3[P]	86.2[P]	26.9[P]
27	105.7[A]	102.5[A]	123.8[A]	64.6[A]	211.9[A]	135.5[A]	135.5[A]	42.7[A]	42.8[A]	51.3[P]	78.7[P]	1411.3[P]
28	118.6[A]	119.8[A]	21130.3[A]	64.8[A]	208.6[A]	292.3[A]	292.3[A]	32.2[A]	50[A]	47.4[P]	102.5[P]	1867.9[P]
29	123.4[A]		6477.4[A]	62.4[A]	215[A]	308.4[A]	308.4[A]	51.7[A]	44[A]	42.5[P]	83.3[P]	47.9[P]

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
30	107.7[A]		112.9[A]	56.4[A]	219.5[A]	310.3[A]	310.3[A]	46.5[A]	47.7[A]	40.1[P]	91.9[P]	61.8[P]
31	124.2[A]		103.1[A]		231.9[A]		9160.1[A]	35.9[A]				16089.2[P]
COUNT	**31**	**28**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**317.1**	**834.0**	**21130.3**	**3401.6**	**231.9**	**2870.6**	**9160.1**	**93.5**	**5077.0**	**3532.2**	**81589.3**	**28956.2**
MIN	**87.9**	**77.2**	**96.6**	**41.4**	**44.1**	**85.3**	**85.3**	**29.4**	**31.6**	**27.0**	**41.9**	**24.1**

[P] Data are considered "Provisional data subject to revision"

Table A-29. 2021 Daily Mean Flow (cfs), Cucamonga Creek near Mira Loma, as Measured by the USGS gage 11073495

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	80.6[A]	20.5[A]	24.2[A]	19.9[A]	31.8[A]	15.1[A]	15.1[A]	10.6[A]	0.5[A]	6.3[A]	0[P]	48.3[P]
2	75[A]	19.5[A]	30.3[A]	20.6[A]	21.5[A]	19.7[A]	19.7[A]	1.5[A]	0.1[A]	5.1[A]	6.2[P]	30.3[P]
3	79.1[A]	25.2[A]	54.2[A]	26.5[A]	5.5[A]	3.9[A]	3.9[A]	3.3[A]	0.7[A]	6.1[A]	0[P]	25.6[P]
4	68.9[A]	15[A]	173.5[A]	29.5[A]	4.6[A]	22.4[A]	22.4[A]	5.7[A]	1[A]	7.2[A]	0[P]	32[P]
5	72.8[A]	7.1[A]	78.2[A]	23.5[A]	5[A]	34.7[A]	34.7[A]	3.2[A]	3[A]	7.8[A]	0.8[P]	30.2[P]
6	79.6[A]	8.3[A]	48[A]	22.5[A]	4.3[A]	32.8[A]	32.8[A]	6.2[A]	3.3[A]	8.9[A]	3.1[P]	15.2[P]
7	74.4[A]	7.5[A]	41.9[A]	14.5[A]	5.7[A]	51.6[A]	51.6[A]	24.2[A]	5.9[A]	10.1[P]	34.6[P]	8.2[P]
8	72.3[A]	13[A]	13.6[A]	29.7[A]	8.5[A]	34.2[A]	34.2[A]	13.4[A]	10.1[A]	6.2[P]	1027[P]	8.6[P]
9	66.4[A]	14.6[A]	2.4[A]	26.8[A]	5.6[A]	11.8[A]	11.8[A]	9.6[A]	18.4[A]	11.2[P]	174.6[P]	18.9[P]
10	56.4[A]	46.3[A]	6.9[A]	18.2[A]	6.3[A]	20.9[A]	20.9[A]	4.9[A]	10.6[A]	18.7[P]	59.3[P]	19.6[P]
11	42.9[A]	80.3[A]	6.5[A]	14.1[A]	4.3[A]	15[A]	15[A]	9[A]	271.2[A]	18.1[P]	40.4[P]	712.1[P]
12	31.1[A]	67.8[A]	8[A]	18.2[A]	7.6[A]	16.7[A]	16.7[A]	7.6[A]	49.7[A]	13.8[P]	31.8[P]	141.7[P]
13	24.9[A]	68.8[A]	27.1[A]	13.8[A]	4.1[A]	7.8[A]	7.8[A]	8.4[A]	47.1[A]	13.3[P]	31.8[P]	135.5[P]
14	21.5[A]	46.8[A]	26.9[A]	16[A]	1.9[A]	27.7[A]	27.7[A]	11.9[A]	12.9[A]	2.8[P]	45.6[P]	110.7[P]
15	20.9[A]	85.6[A]	13[A]	13.1[A]	7.3[A]	20.6[A]	20.6[A]	9.2[A]	8[A]	19.1[P]	41.9[P]	80.8[P]
16	20.5[A]	28.3[A]	32.4[A]	12.7[A]	4.9[A]	26.9[A]	26.9[A]	9.4[A]	4.4[A]	19.3[P]	62.5[P]	59.6[P]
17	28.3[A]	14.2[A]	48.5[A]	14.4[A]	8.4[A]	33.5[A]	33.5[A]	6.1[A]	3.7[A]	3.3[P]	77.1[P]	57.6[P]
18	23.4[A]	15.2[A]	50.9[A]	9.4[A]	9.3[A]	41.9[A]	41.9[A]	4.7[A]	6.9[A]	7[P]	55.8[P]	40.7[P]
19	28.5[A]	4.6[A]	45[A]	2.9[A]	10.2[A]	39[A]	39[A]	6.5[A]	6.4[A]	6.3[P]	39.7[P]	19.1[P]
20	30.1[A]	6.9[A]	41.1[A]	5.5[A]	5.1[A]	33.8[A]	33.8[A]	8[A]	4[A]	2.3[P]	68.5[P]	18.3[P]
21	17[A]	5.6[A]	9.6[A]	40.2[A]	3.5[A]	33.7[A]	33.7[A]	10.1[A]	2.7[A]	1.2[P]	39.1[P]	43.8[P]
22	27.1[A]	18.7[A]	7.9[A]	99.8[A]	5.7[A]	34.3[A]	34.3[A]	7.8[A]	5.3[A]	2.9[P]	18.8[P]	55.2[P]
23	29.3[A]	28.5[A]	4[A]	33.7[A]	3.4[A]	20.3[A]	20.3[A]	2.6[A]	7.4[A]	3.2[P]	20.3[P]	187.1[P]
24	20.9[A]	15.5[A]	7.6[A]	29.1[A]	0.9[A]	15.3[A]	15.3[A]	4.7[A]	9.2[A]	3.5[P]	39.4[P]	104.4[P]
25	17.6[A]	12.2[A]	0.8[A]	10[A]	3.6[A]	16.5[A]	16.5[A]	15.9[A]	17.7[A]	4.6[P]	33[P]	493.5[P]
26	7[A]	19.3[A]	3.5[A]	10.9[A]	9.5[A]	23.8[A]	23.8[A]	4.4[A]	12[A]	1.6[P]	39.6[P]	500.7[P]
27	5[A]	53.5[A]	18.3[A]	19.3[A]	4.9[A]	14.8[A]	14.8[A]	4.2[A]	7.8[A]	0.3[P]	29.6[P]	134.8[P]
28	4.2[A]	41.7[A]	175.1[A]	25.4[A]	10.5[A]	10.6[A]	10.6[A]	6.2[A]	8.5[A]	1.9[P]	27.4[P]	108[P]
29	5.2[A]		111.4[A]	30.3[A]	12.8[A]	6[A]	6[A]	11.9[A]	7.2[A]	3.9[P]	25.9[P]	15.1[P]
30	10.1[A]		31[A]	19.8[A]	9.6[A]	5.9[A]	5.9[A]	7[A]	6.6[A]	0.6[P]	48.5[P]	29.6[P]
31	4[A]		27.3[A]		13[A]		4.8[A]	5.8[A]				169.4[P]
COUNT	**31**	**28**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**80.6**	**85.6**	**175.1**	**99.8**	**31.8**	**51.6**	**51.6**	**24.2**	**271.2**	**19.3**	**1027.0**	**712.1**
MIN	**4.0**	**4.6**	**0.8**	**2.9**	**0.9**	**3.9**	**3.9**	**1.5**	**0.1**	**0.1**	**0.0**	**8.2**

Table A-30. 2021 Daily Mean Flow (cfs), Santa Ana River at MWD Crossing, as Measured by the USGS gage 11066460

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.58[A]	3.33[A]	3.37[A]	3.41[A]	3.34[A]	3.32[A]	3.32[A]	3.33[A]	3.3[A]	3.34[A]	3.37[P]	3.12[P]
2	3.5[A]	3.33[A]	3.37[A]	3.4[A]	3.34[A]	3.3[A]	3.3[A]	3.33[A]	3.3[A]	3.34[A]	3.39[P]	3.14[P]
3	3.48[A]	3.33[A]	3.38[A]	3.39[A]	3.35[A]	3.3[A]	3.3[A]	3.34[A]	3.3[A]	3.34[A]	3.39[P]	3.14[P]
4	3.45[A]	3.33[A]	3.38[A]	3.38[A]	3.35[A]	3.3[A]	3.3[A]	3.35[A]	3.31[A]	3.32[P]	3.38[P]	3.14[P]
5	3.42[A]	3.33[A]	3.39[A]	3.37[A]	3.34[A]	3.3[A]	3.3[A]	3.35[A]	3.31[A]	3.31[P]	3.38[P]	3.13[P]
6	3.4[A]	3.33[A]	3.4[A]	3.36[A]	3.34[A]	3.3[A]	3.3[A]	3.35[A]	3.31[A]	3.31[P]	3.38[P]	3.13[P]
7	3.39[A]	3.33[A]	3.4[A]	3.34[A]	3.34[A]	3.29[A]	3.29[A]	3.35[A]	3.27[A]	3.31[P]	3.38[P]	3.17[P]
8	3.38[A]	3.33[A]	3.39[A]	3.33[A]	3.34[A]	3.29[A]	3.29[A]	3.35[A]	3.23[A]	3.31[P]	5.88[P]	3.25[P]
9	3.37[A]	3.32[A]	3.38[A]	3.33[A]	3.33[A]	3.29[A]	3.29[A]	3.35[A]	3.24[A]	3.31[P]	5.79[P]	3.24[P]
10	3.36[A]	3.33[A]	3.38[A]	3.34[A]	3.33[A]	3.28[A]	3.28[A]	3.34[A]	3.29[A]	3.31[P]	3.79[P]	3.22[P]
11	3.35[A]	3.33[A]	3.38[A]	3.34[A]	3.33[A]	3.27[A]	3.27[A]	3.34[A]	3.26[A]	3.33[P]	3.42[P]	4.72[P]
12	3.35[A]	3.33[A]	3.39[A]	3.34[A]	3.32[A]	3.28[A]	3.28[A]	3.34[A]	3.79[A]	3.34[P]	3.3[P]	4.42[P]
13	3.35[A]	3.33[A]	3.39[A]	3.33[A]	3.32[A]	3.29[A]	3.29[A]	3.33[A]	3.99[A]	3.35[P]	3.23[P]	3.72[P]
14	3.34[A]	3.32[A]	3.38[A]	3.33[A]	3.32[A]	3.28[A]	3.28[A]	3.34[A]	3.49[A]	3.34[P]	3.19[P]	3.5[P]
15	3.34[A]	3.33[A]	3.38[A]	3.34[A]	3.32[A]	3.28[A]	3.28[A]	3.33[A]	3.46[A]	3.37[P]	3.16[P]	3.44[P]
16	3.34[A]	3.34[A]	3.39[A]	3.34[A]	3.32[A]	3.28[A]	3.28[A]	3.33[A]	3.45[A]	3.72[P]	3.13[P]	3.39[P]
17	3.33[A]	3.34[A]	3.38[A]	3.34[A]	3.33[A]	3.27[A]	3.27[A]	3.33[A]	3.43[A]	3.41[P]	3.15[P]	3.37[P]
18	3.33[A]	3.34[A]	3.38[A]	3.36[A]	3.32[A]	3.28[A]	3.28[A]	3.32[A]	3.42[A]	3.4[P]	3.18[P]	3.34[P]
19	3.33[A]	3.34[A]	3.37[A]	3.35[A]	3.32[A]	3.27[A]	3.27[A]	3.32[A]	3.41[A]	3.39[P]	3.17[P]	3.34[P]
20	3.32[A]	3.35[A]	3.37[A]	3.34[A]	3.33[A]	3.27[A]	3.27[A]	3.32[A]	3.4[A]	3.38[P]	3.16[P]	3.33[P]
21	3.33[A]	3.35[A]	3.37[A]	3.35[A]	3.33[A]	3.26[A]	3.26[A]	3.33[A]	3.38[A]	3.37[P]	3.16[P]	3.33[P]
22	3.33[A]	3.36[A]	3.36[A]	3.47[A]	3.32[A]	3.25[A]	3.25[A]	3.33[A]	3.38[A]	3.37[P]	3.16[P]	3.35[P]
23	3.33[A]	3.37[A]	3.36[A]	3.36[A]	3.32[A]	3.24[A]	3.24[A]	3.32[A]	3.38[A]	3.37[P]	3.15[P]	3.4[P]
24	3.33[A]	3.37[A]	3.36[A]	3.34[A]	3.32[A]	3.25[A]	3.25[A]	3.32[A]	3.37[A]	3.37[P]	3.14[P]	3.4[P]
25	3.34[A]	3.38[A]	3.36[A]	3.35[A]	3.32[A]	3.25[A]	3.25[A]	3.32[A]	3.36[A]	3.37[P]	3.14[P]	3.41[P]
26	3.34[A]	3.38[A]	3.36[A]	3.34[A]	3.32[A]	3.25[A]	3.25[A]	3.31[A]	3.36[A]	3.37[P]	3.13[P]	3.41[P]
27	3.34[A]	3.37[A]	3.36[A]	3.35[A]	3.33[A]	3.25[A]	3.25[A]	3.31[A]	3.35[A]	3.37[P]	3.13[P]	3.38[P]
28	3.33[A]	3.37[A]	3.44[A]	3.35[A]	3.34[A]	3.26[A]	3.26[A]	3.32[A]	3.35[A]	3.37[P]	3.13[P]	3.67[P]
29	3.33[A]		3.99[A]	3.36[A]	3.34[A]	3.27[A]	3.27[A]	3.32[A]	3.35[A]	3.37[P]	3.14[P]	3.35[P]
30	3.33[A]		3.46[A]	3.35[A]	3.33[A]	3.27[A]	3.27[A]	3.32[A]	3.35[A]	3.37[P]	3.13[P]	3.32[P]
31	3.33[A]		3.4[A]		3.33[A]		3.32[A]	3.31[A]				3.33[P]
COUNT	**31**	**28**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**3.6**	**3.4**	**4.0**	**3.5**	**3.3**	**3.3**	**3.3**	**3.4**	**4.0**	**3.7**	**5.9**	**4.7**
MIN	**3.3**	**3.3**	**3.4**	**3.3**	**3.3**	**3.2**	**3.2**	**3.3**	**3.2**	**3.3**	**3.1**	**3.1**

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Appendix B

Quality Assurance and Quality Control Summary

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Introduction

This section provides the Quality Assurance/Quality Control (QA/QC) evaluation for samples and data collected during the period covered by this report, which includes the 2022 dry weather monitoring and 2022-2023 storm monitoring. The basis for this evaluation is the approved QAPP.[29]

Field measurements were made for the following constituents: conductivity, dissolved oxygen, pH, turbidity, water temperature, and flow. Field data were checked to ensure that all required data were gathered and recorded. This check included a data review to ensure correct units of measurements were reported and that reported values were within expected ranges.

Laboratory analyses were conducted for three constituents: *E. coli*, Enterococcus, and TSS. Data validation included a check to ensure that samples were delivered to laboratories within required holding times and that all sample handling and custody protocols were followed. Field/equipment blank and duplicate results were evaluated against various reporting requirements and data were checked to ensure correct units of measurement were reported.

The following sections summarize the results of the QA/QC evaluation for the period covered by this report.

Field Measured Parameters

Completeness

Table B-1 shows number of the dry weather field measurements collected during 2022. Completeness is summarized as follows:

- As four Priority 1 sites are in lakes and two Priority 4 sites are in the tidal zone, there are 260 planned flow measurements (100 fewer than other field parameters).
- Additional samples were collected at Santa Ana-Delhi Upstream of Irvine Avenue (P4-OC1), Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), Greenville-Banning Channel (P4-OC3) due to antidegradation exceedances.

[29] https://sawpa.org/wp-content/uploads/2022/06/FINAL-2022-Revised-SAR-QAPP-w-Apps-6-6-2022.pdf.

Table B-1. Dry Weather Field Parameter Completeness Summary

Parameter	Planned[1]	Collected	% Complete
Conductivity	360	385	106.9%
Dissolved Oxygen	360	385	106.9%
Flow[2]	260	274	109.36%
pH	360	385	106.9%
Temperature	360	385	106.9%
Turbidity	360	385	106.9%

Notes:

1 Planned represents the number of samples planned based on Santa Ana River RBMP Monitoring Plan and does not include special investigations that arise based on results of the routine monitoring program.

2 Flow is not measured at lake sites and sites located in tidal waters. Flow was also not provided for Orange County sites.

Accuracy and Precision

Field staff used a Horiba multi-parameter probe (or equivalent) to collect in situ field measurements for conductivity, dissolved oxygen, pH, and water temperature at all sample locations during each sample event. Turbidity and flow were measured with a Hach Turbidity meter and Marsh-McBirney Flo-Mate meter with top-setting rod, respectively. Field staff calibrated each of the water quality meters prior to each sample event. Table B-2 summarizes the accuracy and repeatability associated with the use of each meter. All field measurement accuracy expectations met the requirements as listed in the QAPP.

Table B-2. Summary of Accuracy and Repeatability Expectations for Field Measurement Meters

Water Quality Constituent	Accuracy	Repeatability
Dissolved Oxygen	± 0.2 mg/L	± 0.1 mg/L
pH	± 0.1 units	± 0.05 units
Conductivity	± 1%	± 0.05%
Water Temperature	± 0.3 °C	±0.1 °C
Turbidity	± 2%	± 1%
Flow	± 2%	N/A

Laboratory Constituents

Table B-3 describes the number of grab water samples planned versus actual samples collected. During the 2022 dry weather season, 25 weeks of sampling at eight Priority 1 sites and five Priority 2 sites was planned from the week of May 8, 2022, through the week of November 21, 2022. During the same period, 5 weeks of sampling at seven Priority 3 sites, and one week of sampling at five Priority 4 sites are also planned. This results in 340 dry weather samples. This Annual Report also includes results from monitoring of a wet weather storm events at the five Priority 2 sites. This results in 20 wet weather samples (5 sites/event and 4 samples per site) for a total of 360 samples during the entire monitoring period covered in this 2022-2023 Annual Report.

Holding time requirements for TSS (7 days), *E. coli* (6 hours), and Enterococcus (6 hours) were met for all samples collected during the 2022-2023 sampling year.

Field/Equipment Blanks

The QAPP calls for a field/equipment blank to be collected at a 5% frequency program wide. Field/equipment blanks were collected at one site for 18 weeks of the RBMP program, resulting in the 5% frequency required. Per the QAPP, the reporting target limits for TSS and bacterial indicators were 2.0 mg/L and 10 MPN/100 mL, respectively. These method sensitivity guidelines were met. All field/equipment blank results were below detectable counts (< 10 MPN/100 mL) for *E. coli*. For TSS, 6 field blanks were reported at or above the detectable limit. Of those 6, only one was above the reporting limit at 4 mg/L.

Field Duplicates

Field staff collected at least one field duplicate during 18 pre-scheduled weeks of the program for a total of 18 TSS field duplicates and 18 indicator bacteria field duplicates. As a result, the frequency of field duplicate collection was 5 percent, which matches the required frequency.

Table B-3. Summary of Grab Sample Collection Activity for Dry and Wet Weather Sample Events and Regularly Sampled Sites

Sample ID	Sample Location	Planned	Collected	Not Collected
P1-1	Canyon Lake at Holiday Harbor	25	25	0
P1-2	Lake Elsinore	25	25	0
P1-3	Lake Perris	25	25	0
P1-4	Big Bear Lake at Swim Beach	25	25	0
P1-5	Mill Creek Reach 2	25	25	0
P1-6	Lytle Creek (Middle Fork)	25	25	0
WW-M6	Mil-Cucamonga Creek below Wetlands	29	29	0
WW-C7	Chino Creek at Central Avenue	29	29	0
WW-C3	Prado Park Lake	29	29	0
WW-S1	Santa Ana River Reach 3 at MWD Crossing	29	29	0
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	29	29	0
MISSION	Santa Ana River at Mission Avenue	25	25	0
P3-OC1	Bolsa Chica Channel	5	5	0
P3-OC2	Borrego Creek	0	1	0
P3-RC1	Goldenstar Creek	5	5	0
P3-RC3	San Timoteo Creek Reach 3	5	5	0
P3-SBC1	Santa Ana River Reach 4	5	5	0

Sample ID	Sample Location	Planned	Collected	Not Collected
P3-SBC2	San Timoteo Creek Reach 1A	5	5	0
P3-SBC4	Warm Creek	5	5	0
P3-OC11	Serrano Creek	0	5	0
P4-RC2	Temescal Creek at Lincoln Avenue	1	1	0
P4-OC1[1]	Santa Ana-Delhi Channel Upstream of Irvine Avenue	1	6	0
P4-OC2[2]	Santa Ana-Delhi Channel in Tidal Prism	1	6	0
P4-OC3[3]	Greenville-Banning Channel in Tidal Prism	1	12	0
P4-SBC1	Cucamonga Creek at Hellman Avenue	1	1	0
Total		**360**	**385**	**0**

Notes:
[1] Additional samples were collected at Priority 4 site Santa Ana-Delhi Channel Upstream of Irvine Avenue.
[2] Additional samples were collected at Priority 4 site Santa Ana-Delhi Channel in Tidal Prism.
[3] Additional samples were collected at the Priority 4 site Greenville-Banning Channel in Tidal Prism.

Each duplicate sample was analyzed for the same parameters as its paired field sample. Results of the field duplicate analyses can be used to assess adherence to field sampling collection protocols and laboratory precision. Table B-4 summarizes the field duplicate analysis results for TSS. Seven duplicate pairs exceeded the QAPP's relative percent difference (RPD) goal of ± 25 percent. One pair of duplicate samples, collected at Chino Creek at Central Avenue the week of 11/8/2022 during a wet weather event when flow was high with floating particulates, have a significant RPD resulting in a large difference in concentration (400 vs 130 mg/L). This is 5 percent of all QA/QC samples and is within a normal frequency. Eight pairs with RPD exceeding ± 25 percent are due to low TSS values; maximum TSS concentration in those pairs is 12 mg/L and the maximum difference in the eight pairs is 6 mg/L. Dividing by the low TSS values artificially results in high RPD values.

To determine the precision of the duplicate analysis for each bacterial indicator the following method was used:[30]

- Calculate the logarithm of each sample and associated duplicate ("laboratory pair").
- Determine the range for each laboratory pair (R_{log}).
- Calculate the mean of the ranges (Mean R_{log}).
- Calculate the precision criterion, where the precision criteria = 3.27 * Mean $R_{log.}$
- Compare R_{log} for each duplicate pair with the calculated precision criterion for the data set to determine if R_{log} is less than the precision criterion.

[30] Standard Methods, Section 9020B, 18th, 19th, or 20th Editions.

Tables B-5 summarizes the field duplicate analysis results for *E. coli*, respectively. One sample exceeded precision criterion.

Table B-4. Results of Field Duplicate Analysis for TSS

Week Beginning Date	Site ID	Site Location	Duplicate Result (mg/L)	Sample Result (mg/L)	RPD (%)
5/8/2022	WW-S1	Santa Ana River at MWD Crossing	4	2	67%
5/15/2022	WW-S4	Santa Ana River Reach 3 at Pedley Avenue	12	6	67%
5/22/2022	WW-MISSION	Santa Ana River at Mission Avenue	11	12	9%
5/29/2022	P1-1	Canyon Lake	4	4	0%
6/5/2022	P1-5	Mill Creek Reach 2	2	2	0%
6/12/2022	WW-C3	Prado Park Lake	19	16	17%
6/19/2022	P1-2ELM	Lake Elsinore at Elm Grove Beach	44	44	0%
6/26/2022	WW-C7	Chino Creek at Central Avenue	>2	4	120%
7/10/2022	P3-RC3	Sant Timoteo Creek Reach 2	38	48	23%
7/17/2022	P3-SBC4	Warm Creek	23	19	19%
7/24/2022	P3-SBC2	Sant Timoteo Creek Reach 1A	2	6	100%
7/31/2022	P1-3	Lake Perris	6	8	29%
8/7/2022	WW-M6	Mil-Cucamonga Creek below Wetlands	4	4	0%
8/14/2022	P1-4	Big Bear Lake at Swim Beach	160	180	12%
8/21/2022	P1-6	Lytle Creek (Middle Fork)	3	5	50%
8/28/2022	WW-S4	Santa Ana River Reach 3 at Pedley Avenue	4	4	0%
9/5/2022	WW-S1	Santa Ana River at MWD Crossing	2	5	86%
11/8/2022	WW-C7	Chino Creek at Central Avenue	400	130	102%

Note: Values with a "<" qualifier reflect results that are below detection limits. For calculation purposes, the value was represented by the detection limit.

Table B-5. Results of Field Duplicate Analysis for *E. coli*

Sample Date	Site ID	Site Location	Duplicate Result (MPN/ 100 mL)	Sample Result (MPN/ 100 mL)	Log of Duplicate Result (L_1)	Log of Sample Result (L_2)	Range of Logs (L_1 - L_2) or (R_{log})
5/8/2022	WW-S1	Santa Ana River at MWD Crossing	430	460	2.6335	2.6628	0.0293
5/15/2022	WW-S4	Santa Ana River Reach 3 at Pedley Avenue	320	170	2.5051	2.2304	0.2747
5/22/2022	WW-MISSION	Santa Ana River at Mission Avenue	71	800	1.8513	2.9031	1.0518
5/29/2022	P1-1	Canyon Lake	<1	1	0.0000	0.0000	0.0000
6/5/2022	P1-5	Mill Creek Reach 2	1	1	0.0000	0.0000	0.0000
6/12/2022	WW-C3	Prado Park Lake	240	16	2.3802	1.2041	1.1761
6/19/2022	P1-2ELM	Lake Elsinore at Elm Grove Beach	1	3.1	0.0000	0.4914	0.4914
6/26/2022	WW-C7	Chino Creek at Central Avenue	1800	1700	3.2553	3.2304	0.0248
7/10/2022	P3-RC3	Sant Timoteo Creek Reach 2	460	570	2.6628	2.7559	0.0931
7/17/2022	P3-SBC4	Warm Creek	170	120	2.2304	2.0792	0.1513
7/24/2022	P3-SBC2	San Timoteo Creek Reach 1A	24000	24000	4.3802	4.3802	0.0000
7/31/2022	P1-3	Lake Perris	3.1	4.1	0.4914	0.6128	0.1214
8/7/2022	WW-M6	Mil-Cucamonga Creek below Wetlands	30	140	1.4771	2.1461	0.6690
8/14/2022	P1-4	Big Bear Lake at Swim Beach	1	<1	0.0000	0.0000	0.0000
8/21/2022	P1-6	Lytle Creek (Middle Fork)	390	370	2.5911	2.5682	0.0229
9/5/2022	WW-S1	Santa Ana River at MWD Crossing	160	1100	2.2041	3.0414	0.8373
11/8/2022	WW-C7	Chino Creek at Central Avenue	17000	7700	4.2304	3.8865	0.3440
						Sum of R_{log}	5.3990
						Mean R_{log}	0.2999
						Precision Criterion (3.27*Mean R_{log})	0.9808

Note: For data values with > qualifier, the data values shown were used for duplicate precision calculations.

Appendix C

Laboratory Quality Assurance and Quality Control Reports

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Quality Assurance / Certification Statement

CDM Smith – SAR Monitoring Program

There were a total of 406 samples submitted, which includes 368 site samples, 19 field duplicate samples and 19 field blanks. Samples were analyzed for Total Suspended Solids, Total Coliform, e. Coli and enterococcus as requested. The sampling period spanned March 2022 through November 2022.

All samples were received in good condition, meeting temperature guidelines of <10 ° C for bacteria testing, <6 ° C for solids testing, or having been sampled and placed on ice immediately and received within 6 hours.

All samples were received within acceptable holding times for the analyses requested.

The samples received under this project were analyzed with Good Laboratory Practices. The following items listed pertain to all samples submitted to our laboratory.

1) The method specified QC was performed on all batches containing project samples.
2) All sample parameters requested were reported, unless otherwise notified.
3) All batch acceptance criteria was met prior to reporting results, except as noted below.

Exceptions to Standard Quality Control Procedures

This report is organized into three sections:

Section I details Batch QC failures. An analytical batch includes the analysis of Method Blanks and Blank Spikes as applicable, also known as Laboratory Control Samples. If a batch has been qualified due to this type of failure, the end user should weigh the results associated with the batch according to its intended use. Often, the presence of trace contamination will have little to no effect on the usefulness of the reported result. Failed Blank Spikes are flagged with "Data Suspect".

Section II lists the qualifiers associated with samples that have been fortified with known quantities of target and/or non-target surrogate compounds, whose purpose is to monitor analyte recovery in "real-world' samples and to note any matrix interference. Also included in this section is precision information provided by duplicate analyses and/or fortified-sample duplicate analyses. Since the information included in this section is unique to each individual sample, the acceptance of the analytical batch is not controlled by the results of these bias and precision parameters.

Section III of the report identifies individual samples that have been qualified for various reasons. Missed holding times, improper sample preservation, etc. must carefully be evaluated using professional judgement regarding the acceptability of the data for its intended use.

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Section I

All Method Blanks and Laboratory Control Samples analyzed for Total Suspended Solids were within acceptance criteria. All Method Blanks analyzed for Total Coliform and E. Coli were within acceptance criteria.

Section II

All project source samples used for duplicates met acceptance criteria for precision, with the following exception.

Sample Name	Lab ID	Analyte	Source Result	Duplicate Result	RPD	RPD Control Limit
WW-C7	C2E1372-01	Total Suspended Solids	4 mg/l	11 mg/l	93	25
WW-M6	C2F0280-01	Total Suspended Solids	4 mg/l	6.5 mg/l	36	25
P1-1	C2F1935-04	Total Suspended Solids	3 mg/l	7 mg/l	80	25
P1-1	C2F3503-04	Total Suspended Solids	3 mg/l	4 mg/l	29	25

Analyte concentration was below range for valid RPD determination.

Field Blanks

The following field blank samples were above the detection limit for the associated analytical method:

Sample Name	Lab Sample ID	Sample Date/Time	Analyte	Result	Units
20220615SAWPAFB	C2F1935-06	06/15/2022 08:00:00	Total Coliform	1.0	MPN/100ml
20220729SAWPAFB	C2G3465-04	07/29/2022 08:30:00	Total Coliform	1.0	MPN/100ml
20220729SAWPAFB	C2G3465-04	07/29/202208:30:00	Total Suspended Solids	11	mg/L
20220804SAWPAFB	C2H0787-06	08/04/2022 09:00:00	Total Coliform	1.0	MPN/100ml
20220811SAWPAFB	C2H1756-05	08/11/2022 07:50:00	Total Suspended Solids	2.0	mg/L
20220825SAWPAFB	C2H3394-06	08/25/2022 08:40:00	Total Coliform	1.0	MPN/100ml
20220830SAWPAFB	C2H3825-04	08/30/2022 09:30:00	Total Coliform	1.0	MPN/100ml

Field Duplicates

Field duplicate precision was not calculated, due to source samples not identified.

Section III

All sample holding times were met, with the exceptions noted below. All samples received had proper preservation. Other sample or data qualifiers necessary are listed below.

The following sample results were qualified:

Sample Name	Lab Sample ID	Sample Date/Time	Analyte	Qualifier
P1-2	C2E3046-03	05/25/2022 09:10:00	Enterococcus	A-01
WW-C7	C2H0787-01	08/04/2022 07:00:00	Total Coliform/ e. coli	N_HTa
WW-C7	C2I2488-01	09/21/2022 07:00:00	Total Coliform/ e. coli	A-01a
WW-C3	C2I2488-02	09/21/2022 07:30:00	Total Coliform/ e. coli	A-01a
P1-2	C2I2488-03	09/21/2022 08:45:00	Total Coliform/ e. coli	A-01a
P1-1	C2I2488-04	09/21/2022 09:20:00	Total Coliform/ e. coli	A-01a
P1-3	C2I2488-05	09/21/2022 10:30:00	Total Coliform/ e. coli	A-01a

Qualifier Definitions

A-01: Sample was incubated at 35*C. Quality control passed.
N_HTa: Sample analyzed outside of the EPA recommended holding time.
A-01a: Sample reading done 2 hours past the incubation time.

The qualifiers contained in the reported results are for informational use. The results associated have been evaluated and believed to be useful in the decision-making process.

All reports were prepared and all analyses were performed in accordance with a system designed to assure that qualified personnel perform the analyses, use specified EPA approved methods and review the data before it is reported.

Amanda Porter

Amanda Porter, Project Manager

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PUBLIC HEALTH SERVICES
PUBLIC HEALTH WATER QUALITY LABORATORY

DATE: **June 22, 2023**

TO: **Orange County Public Works – OC Watersheds**

FROM: Joseph Guzman, Water Lab Supervisor

SUBJECT: **SAR Bacterial Monitoring Program**
QA/QC E. coli and Enterococcus analysis
Season: January 2022 – November 2022

There were 18 sampling events for the 2022 SAR bacterial monitoring. A total of 100 water samples were submitted, including 64 site samples (50 for E. coli and 14 for Enterococcus), 18 field replicates (10 for E. coli and 8 for Enterococcus), and 18 field blanks (12 for E. coli and 11 for Enterococcus). Five field blanks were tested for both E. coli and Enterococcus.

I. Sample Transport Conditions

Acceptable transport conditions for this monitoring program per QAPP is ≤ 4°C for each sampling event. Standard Methods (SM) 9060B 1.a indicates transport conditions should be ≤10°C if transport time will be > 1 hour. SM 9060B 1.a sets no temperature requirements if samples are received in the lab ≤ 1 hour of collection. The table below breaks down the transport conditions for the 100 samples.

Transport Conditions at time of sample receipt	No. of samples	Quality Assurance Criteria Applied	Samples accepted and processed
≤ 4°C	13	QAPP	Yes
>4°C but ≤10°C transport time < 1hr	21	SM 9060B 1.a	Yes
>4°C but ≤10°C transport time > 1hr	66	SM 9060B 1.a	Yes

All 100 samples submitted for this monitoring program were accepted and processed as they were all < 10°C when they arrived at the lab. There were 87 samples in which the transport conditions did not meet the ≤ 4°C requirement of the QAPP, but 21 samples were received within 1hr of the collection time and 66 were received at < 10°C.

II. Transport times

Samples for regulatory monitoring should be submitted to the lab within 6 hours of collection.

The time the samples were received in the lab was noted on the chain of custody (COC) form for each sampling event. All documented transport times were within the allotted 6 hour transport time.

III. Method Blanks

A. Field/Equipment Blanks: 18 field blanks were collected for the SAR Bacterial Monitoring. All sampling events included a field blank.

For *E. coli* and Enterococcus, the 18 field blanks that were collected for SAR monitoring all showed no growth with results reported below the reporting limit of <10 MPN/100ml for SM 9223B and SM 9230D methods.

IV. Field Replicates:

A. Field Replicates

Field replicates for the SAR sampling were collected at a frequency of 20% (10/50) for E. coli and 57% (8/14) for Enterococcus. The replicate samples were analyzed for the same parameters as its paired field sample.

1. For field replicate samples submitted for *E. coli* by SM 9223B analysis (Colilert-18), a precision criteria of 0.2298 (3.27 x 0.0703) was established using SM 9020B.9.c.

Of the 10 replicate samples submitted, all samples were within the established precision criteria.

2. For field replicate samples submitted for Enterococcus by SM 9230D analysis (Enterolert), a precision criteria of 0.6328 (3.27 x 0.1935) was established using SM 9020B.9.c.

Of the 8 replicate samples submitted, 7 of the 8 were within the established precision criteria. For the sample outside the precision criteria, the result for the test sample was 84 MPN/100ml, and the result for the replicate sample was 10 MPN/100ml. The results reported for method SM 9230D are based on most probable number (MPN) and the MPN represents a range of values that fall within a 95% confidence interval per SM 9221C. Applying the 95% confidence interval to the 84 MPN/100ml result gives a range of 22 – 220 MPN/100ml that the true result falls within. When you apply the 95% confidence interval to the 10 MPN/100ml replicate result this gives a range of 3.5 – 22 MPN/100ml that the true result falls

within. Since there is an overlap of the confidence intervals for the replicate results at 22 MPN/100ml, the replicate results would be acceptable.

V. Analytical Methods Reagents and Supplies:

A. *E. coli* with Colilert-18 media (SM 9223B)

Four lots of Idexx Colilert-18 media was used during the SAR monitoring. There are four parameters tested for with each new lot prior to use:

1. *Escherichia coli* culture is used as a positive control with positive reactions for both yellow color production and apple green fluorescence.
2. *Klebsiella pneumoniae* culture is used as a positive control for yellow color production, but negative control for apple green fluorescence.
3. *Psuedomonas aeruginosa* culture used as a negative control, for both yellow color production and apple green fluorescence.
4. 1 packet per new lot of media is set up as a sterility control and to check for auto fluorescence.

Nine lots of sterile 90ml dilution blank water were used to test for E. coli by SM 9223B. There are three parameters tested for with each new lot prior to use:

1. the entire contents of the dilution blank is filtered and the membrane filter is transferred onto a blood agar plate and incubated to check for sterility.
2. the entire contents of the dilution blank is poured into a calibrated graduated cylinder to check that the 90ml aliquot is accurate.
3. pH is checked to make sure it is within specifications.

Six lots of sterile Quanti-tray 2000 trays were available to use to test for E. coli by SM 9223B. Each new lot is checked for sterility and autofluorescence before use.

Eight lots of sterile 10ml pipets were available to use to test for E. coli by SM 9223B. Each new lot of pipets is checked for sterility and that the 10ml volume dispensed by the pipet is accurate.

Three lots of sterile collection bottles were available to use to test for E. coli by SM 9223B. Each new lot of collection bottles is checked for sterility and that the dechlorination effect of the sodium thiosulfate is adequate.

B. Enterococcus with Enterolert media (SM 9230D)

Three lots of Idexx Enterolert media was used during the SAR monitoring. There are four parameters tested for with each new lot prior to use:

1. *Enterococcus faecalis* culture is used as a positive control with positive reaction for blue fluorescence.
2. *Aerococcus viridans* culture is used as a negative control for blue fluorescence.
3. *Serratia marcescens* culture is used as a negative control for blue fluorescence.

4. 1 packet per new lot of media is set up as a sterility control and to check for auto fluorescence.

Nine lots of sterile 90ml dilution blank water were used to test for Enterococcus by SM 9230D. There are three parameters tested for with each new lot prior to use:

1. the entire contents of the dilution blank is filtered and the membrane filter is transferred onto a blood agar plate and incubated to check for sterility.
2. the entire contents of the dilution blank is poured into a calibrated graduated cylinder to check that the 90ml aliquot is accurate.
3. pH is checked to make sure it is within specifications.

Six lots of sterile Quanti-tray 2000 trays were available to use to test for Enterococcus by SM 9230D. Each new lot is checked for sterility before use.

Eight lots of sterile 10ml pipets were available to use to test for Enterococcus by SM 9230D. Each new lot of pipets is checked for sterility and that the 10ml volume dispensed by the pipet is accurate.

Three lots of sterile collection bottles were available to use to test for Enterococcus by SM 9230D. Each new lot of collection bottles is checked for sterility and that the dechlorination effect of the sodium thiosulfate is adequate

All lots of Colilert-18 media, Enterolert media, sterile 90ml dilution water, Quanti-tray 2000 trays, 10ml pipets, and sterile collection bottles used for the SAR monitoring had acceptable quality control results for all parameters tested. QC records are available.

VI. Laboratory Equipment Maintenance and Calibration

Temperatures for the 35°C and 41°C incubators were recorded twice daily on temperature charts. Both incubators were calibrated by a contracted vendor every 6 months and documentation is available for review.
The Quanti-Tray sealer used to seal the Quanti-tray 2000 trays for E. coli and Enterococcus had routine monthly maintenance performed and documentation is available for review.
The UV lamp used to read for fluorescence had routine monthly maintenance performed and documentation is available for review.

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