DRAFT

Santa Ana Watershed Project Authority

Santa Ana River Regional Bacteria Monitoring Program Annual Report: 2023-2024

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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
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
MPN	Most Probable Number
MSAR	Middle Santa Ana River
OCPHL	Orange County Public Health 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
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
SQSS	Stormwater Quality Standards Study
SSV	Single Sample Value

STV	Statistical Threshold Value
State Water Board	State Water Resources Control Board
Task Force	MSAR TMDL / Regional Water Quality Task Force
TMDL	MSAR Bacteria Indicator Total Maximum Daily Limit
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEP	Urban Source Evaluation Plan
WLA	Wasteload Allocation
WQO	Water Quality Objective

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 a Basin Plan Amendment (BPA)[1] 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 the Basin Plan were approved by the Environmental Protection Agency (EPA) Region 9 in April 2015 and allowed for the watershed stakeholders to focus resources on areas of highest priority to protect public health. The BPA required development and implementation of a Regional Bacteria Monitoring Program (RBMP). The SQSS Task Force was retired, and a new Task Force was formed to oversee the RBMP - a program of routine bacteriological data collection and review 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 anti-degradation requirements in the absence of a numeric water quality objectives (WQOs).

For each of these priority categories, data is synthesized at a summary level and key interpretive findings from this 2023-2024 annual report are highlighted in the following sections.

Priority 1 – Waterbody Segments with Greatest Risk of Exposure

Fecal bacteria conditions in Priority 1 waters during the 2023-2024 warm and cool dry sampling seasons were generally low and support recreational use, except at two SAR sites (WW-S1: Santa Ana River Reach 3 at MWD Crossing and WW-S4: Santa Ana River Reach 3 at Pedley Avenue) (**Figure ES.1**). These two Santa Ana River sites are being addressed through implementation of Comprehensive Bacteria Reduction Plans (CBRP) in the MSAR TMDL (CDM 2011a, 2011b).[2],[3]

[1] https://www.epa.gov/sites/default/files/2015-06/documents/ca8-recreational.pdf

[2] https://www.sawpa.gov/wp-content/uploads/2018/04/2011_CBRP_San-Bernardino-County-MS4-Program.pdf

[3] https://www.sawpa.gov/wp-content/uploads/2018/04/2011_CBRP_Riverside-County-MS4-Program.pdf

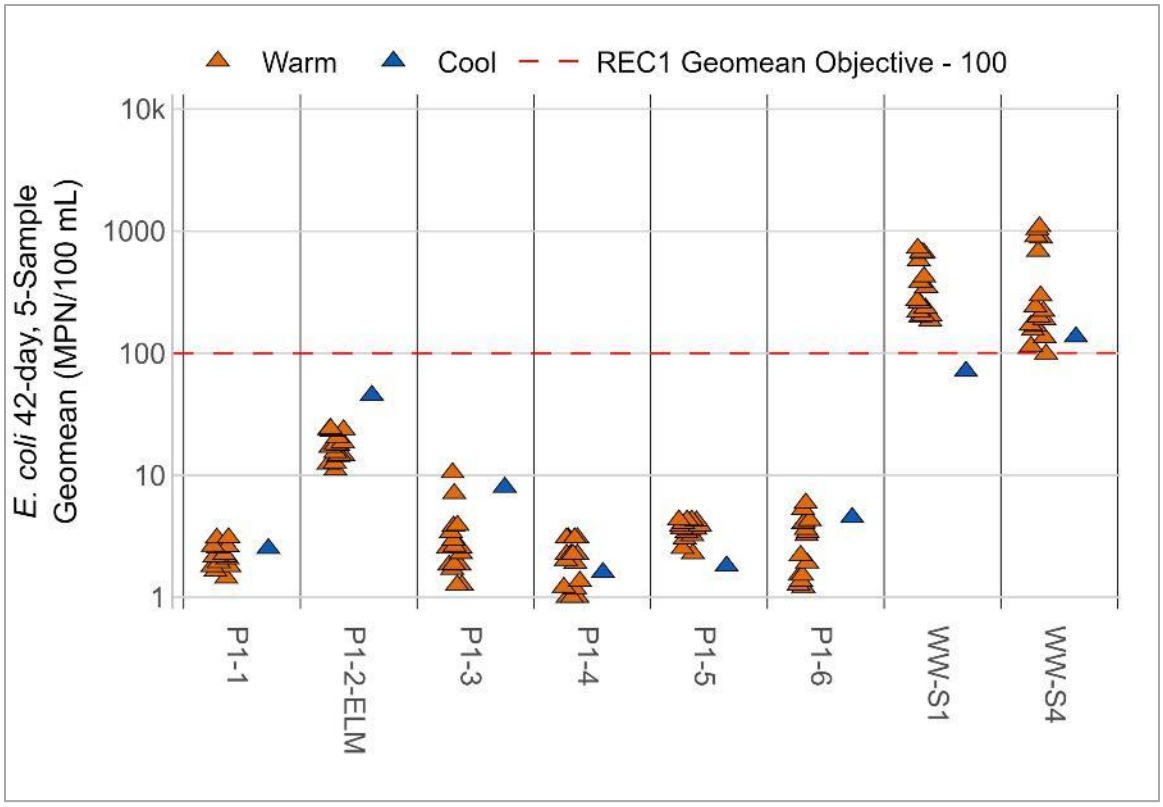

Figure ES.1. *E. coli* Geomean Concentrations in Priority 1 Waters during Dry Weather in Warm (20 consecutive weeks) and Cool (5 consecutive weeks) Seasons in 2023-2024

The previous (2022-2023) annual RMBP[4] report highlighted conditions of concern at two other Priority 1 locations during 2022: Lytle Creek (P1-6) and Lake Elsinore (P1-2-ELM); monitoring data from 2023 showed improved conditions at both locations. A significant reduction in *E. coli* concentration was observed in 2023 relative to 2022 for Lytle Creek (**Figure ES.2**). The reduced concentrations over the 25 weekly samples are most likely due to a completely different baseflow regime in the creek in 2023 relative to 2022. Flowrates measured at the downstream Lytle Creek US Geographic Survey (USGS) gauge (Station #11062000: Lytle Creek near Fontana, California) corresponding to sample dates ranged from 0.1 to 5.2 cubic feet per second (cfs) in 2022 and from 27 to 105 cfs in 2023.

The 2022 monitoring report also pointed to elevated fecal bacteria at P1-2 (Lake Elsinore at the Elm Grove Beach site) and recommended further investigation. Source investigation was completed in February 2022 in the vicinity of Elm Grove Beach (see Section 4.5.2 of the 2022-2023 annual RBMP report for details).

[4] https://sawpa.gov/wp-content/uploads/2023/09/FINAL-SAR-RMP-2022-2023-Annual-Report_Clean_WP_508.pdf

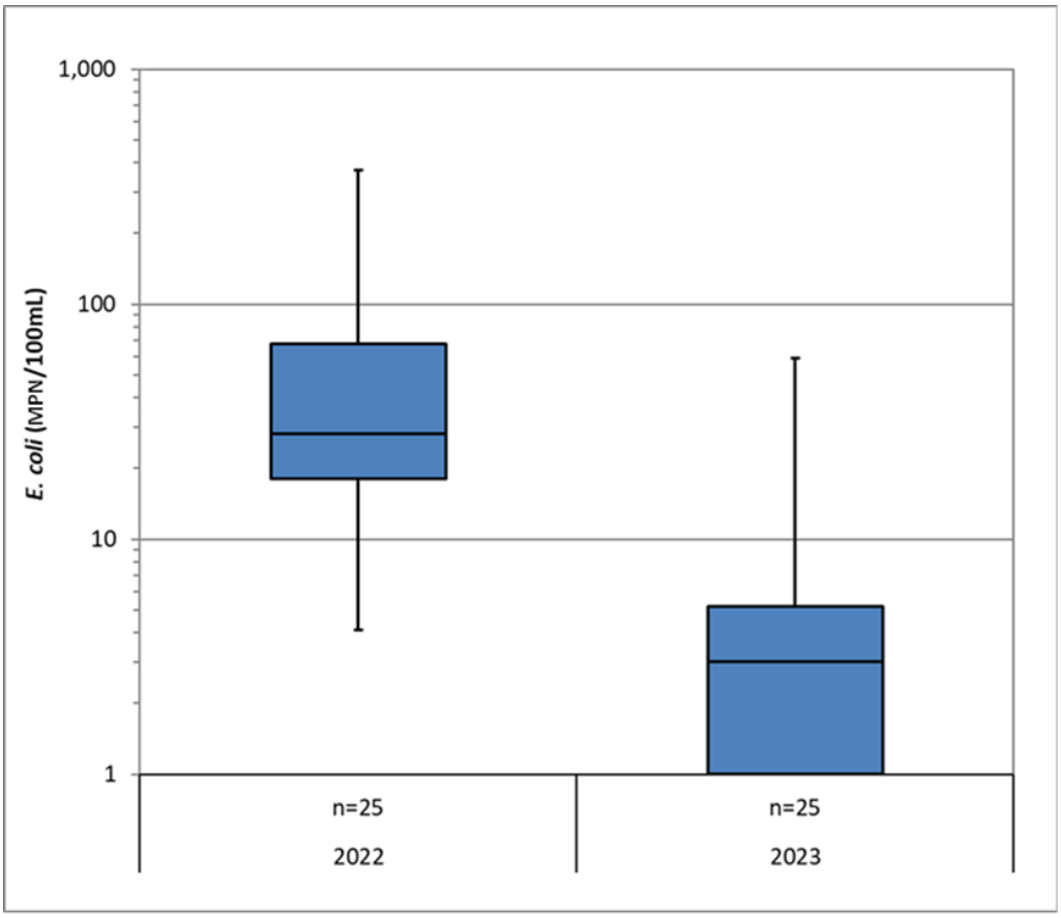

Figure ES.2. *E. coli* Concentrations at Lytle Creek Priority 1 sites in 2022 compared with 2023

Sampling on Lake Elsinore for enterococcus was conducted at Launch Pointe (P1-2) for the 2019-2020 and 2020-2021 monitoring periods. Since then, the Task Force supported the movement of the Lake Elsinore site to Elm Grove Beach as part of an effort to consolidate general assessment monitoring by Riverside County Health Department and this RBMP. Historically, the Health Department monitored multiple beach sites around the lake with a less frequent sampling schedule than provided by the RBMP. As of this report, three years of data collection at Elm Grove Beach has been completed with a total sample size of 75 grab samples (60 during warm season and 15 during cool season). During this period, an increase in fecal bacteria was observed in fall of 2021 and extended through the 2022 monitoring period. Source investigation in February 2022 observed that the condition was isolated to Elm Grove Beach and not indicative of widespread bacterial contamination in the lake. A population of unhoused persons in the abandoned Elsinore Valley Municipal Water District (EVMWD) effluent channel was suspected as an important source of fecal bacteria and cleanup activities were completed in June 2023. Review of enterococcus results from 2023 sampling shows that conditions have improved to levels that meet REC1 WQOs (**Figure ES.3**). Monitoring for the upcoming season is recommended to return to Launch Point, which is the Regional Board approved Priority 1 monitoring site for Lake Elsinore.

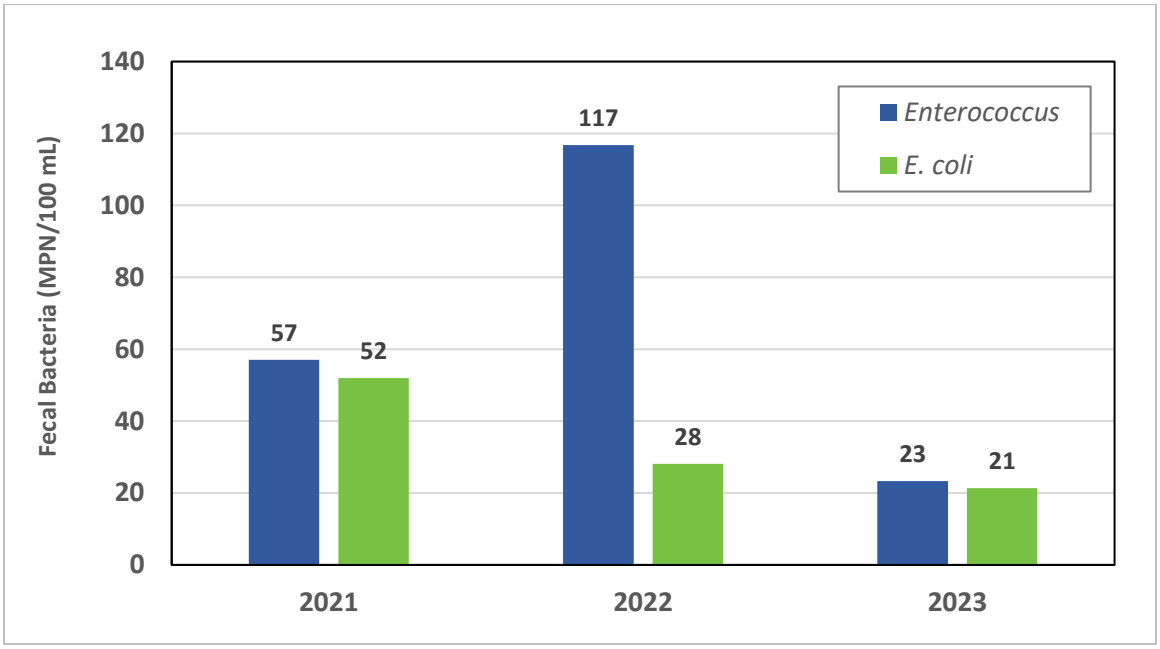

Figure ES.3. Annual Geomeans for Enterococcus and *E. Coli* Concentration at Elm Grove Beach in Lake Elsinore

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. In 2023, no Priority 2 site attained TMDL waste load allocations (WLAs) during the dry season, with rolling geomean compliance percentages reported in **Table ES.1**. **Figure ES.4** shows the calculated geomean concentrations for dry weather during the warm and cool seasons. For dry weather samples during the cool season, sufficient data is collected to allow for calculation of a single geomean at each site (**Table ES.1**) and shown by the blue triangles in **Figure ES.4**. Note that the Santa Ana River at Mission Blvd Bridge site (WW-MISSION) is included with Priority 2 monitoring summaries, however, the site is not used to assess TMDL compliance. Instead, this site provides an understanding of load from upstream sources, comprised of non-MS4 flows during typical dry weather conditions.

Table ES.1. Frequency of Compliance with MSAR TMDL WLAs/LAs for *E. coli* Geomean (113 MPN/100 mL) for the 2023 Dry Weather Samples

Site ID	Site	Warm, Dry Season Geomean WLA/LA Compliance Frequency (%)	Cool, Dry Season Geomean WLA/LA Compliance Frequency (%) (n=1)
WW-C3	Prado Park Lake	69% (n=13)	100%
WW-C7	Chino Creek at Central Avenue	0% (n=13)	0%
WW-M6	Mill-Cucamonga Creek	50% (n=14)	100%
WW-S1	Santa Ana River at MWD Crossing	0% (n=14)	100%
WW-S4	Santa Ana River at Pedley Avenue	14% (n=14)	0%

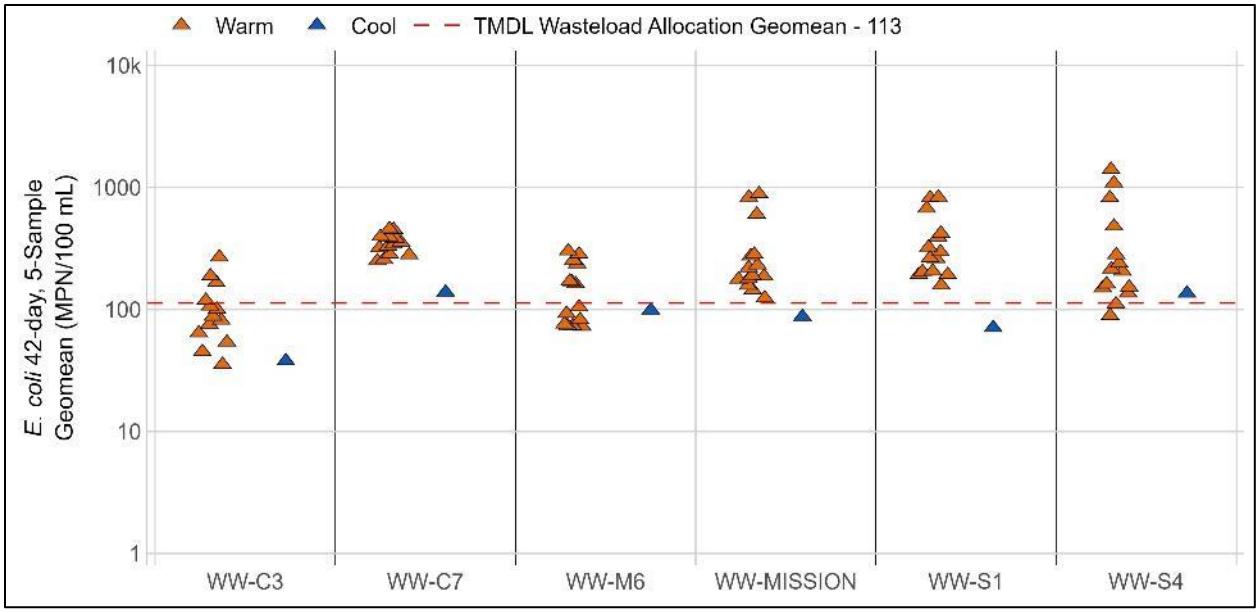

Figure ES.4. *E. coli* (MPN/100 mL) Geomeans for Priority 2 Waters in Dry Conditions during 2023

Long-term monitoring data show that warm season geometric means of *E. coli* concentrations upstream from any MS4 outfalls with measured inflow account for the majority of downstream load measured at the TMDL compliance sites (**Figure ES.5**). This finding is based on a large dataset collected over five years from the Priority 2 site Santa Ana River at Mission Blvd Bridge (WW-MISSION) (n=86) and a Priority 3 site within Reach 4 (P3-SBC1: Santa Ana River above S. Riverside Avenue Bridge). The significant source of bacteria not associated with MS4 discharges during typical dry weather conditions shows that elimination of MS4 dry weather flows to Reach 3 of the Santa Ana River would not result in attainment of WQOs.

Figure ES.5 provides 2023 geometric means of *E. coli* during the warm dry season compared with long-term site geomeans. Changes in 2023 could be attributed to construction activity within the river bottom prior to the 2023 dry season that involved homeless encampment cleanups, reworking the sediment of the riverbed, and rerouting of the low flow channel away from levees. Details of the construction and zones of work within the river bottom were reported by Riverside County Flood Control and Water Conservation District (RCFC&WCD) in April 2023.[5] A significant increase in 2023 *E. coli* levels was observed at P3-SBC1 (Santa Ana River Reach 4 above S. Riverside Avenue Bridge) relative to historical levels within Reach 4 prior to the transition to Reach 3 at Mission Avenue; this could be associated with movement of an in-stream source (e.g., wildlife, homeless encampments, swimmers, etc.) away from the construction in the vicinity of the Mission Avenue Bridge. The 2023 MSAR TMDL Triennial Report[6] provides more in-depth analysis of the segment of the Santa Ana River upstream from Mission Avenue, including recommendations for further study to either identify a controllable source to

[5] https://sawpa.gov/wp-content/uploads/2023/04/4.17.2023-Riverside-Levees-Presentation.pdf

[6] GEI Consultants, Inc. and CDM Smith Inc. February 2023. Final Report: Middle Santa Ana River Bacterial Indicator TMDLs: 2023 Triennial Review. Prepared for the Santa Ana Watershed Project Authority.

be eliminated or to determine the portion of upstream loading that may be associated with uncontrollable[7] sources.

Conditions in Mill-Cucamonga Creek (WW-M6) have improved 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* (more details on the 10-week synoptic surveys used to estimate this reduced loading are provided in the 2023 Triennial TMDL Report).

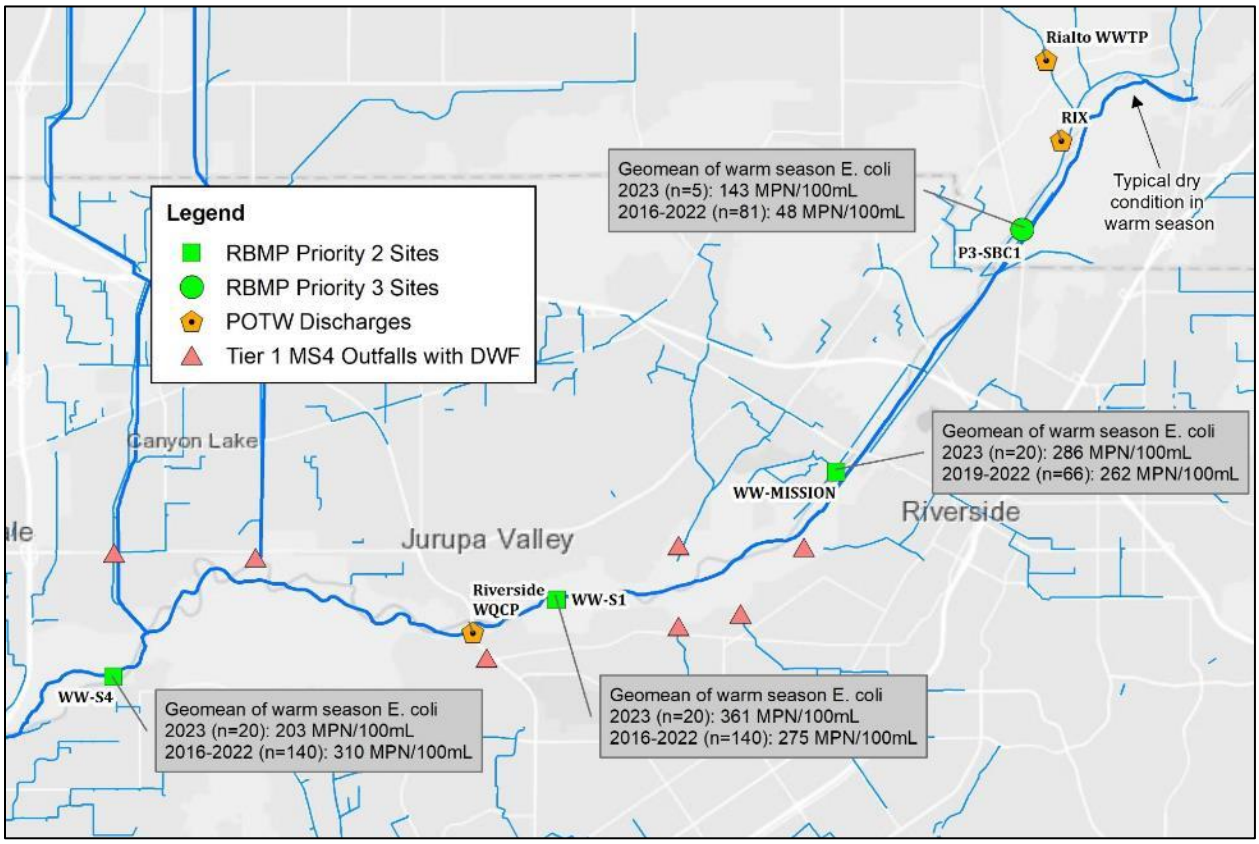

Figure ES.5. Warm Season, Dry Weather *E. coli* Geomean Concentrations at RBMP Sites in Santa Ana River from POTW Discharges into Typically Dry Streambed Downstream to TMDL Compliance Monitoring Locations

Annual precipitation in 2023 was the largest in over 20 years as measured at Ontario International Airport (21.9 inches). The very wet hydrologic year caused elevated dry weather flows throughout the watershed during periods between precipitation events. For example, flow in the Santa Ana River at MWD Crossing was greater than 80 cfs over the entire month of May 2023, significantly larger than in May 2022 when flow ranged from 24 to 31 cfs (commensurate with POTW effluent rates). Additionally, the watershed experienced atypical wet weather in August with Hurricane Hilary (August 20, 2023).

[7] Includes the following as expressed in the Basin Plan: wildlife activity and waste, bacterial regrowth within sediment or biofilm, resuspension from disturbed sediment, marine vegetation (wrack) along high tide line, concentrations (flocks) of semi-wild waterfowl, and shedding during swimming.

Increased baseflow from the mountains or groundwater can serve to dilute bacteria loads and thereby create an improved water quality such as was shown for the Priority 1 site on Lytle Creek (see **Figure ES.2**). Conversely, elevated baseflow during 2023 may have provided temporary pathways to mobilize sources of fecal bacteria that are typically hydrologically disconnected in dry weather. For example, results from monitoring during dry weather conditions on August 25, 2023, five days after Hurricane Hilary, were found to have very high concentrations of *E. coli* at all Priority 2 sites with flowing waters (excluding Prado Park Lake).

For the Priority 2 sites, a single wet weather event is sampled each year and involves the collection of four grab samples: (a) the first sample is collected during active wet weather; and (b) three follow-up samples are collected at approximately 24, 48, and 72 hours after collection of the first sample. The intent of the timing of the sampling intervals is to collect follow-up samples during wet weather, especially during longer duration storms, or when multiple rain events occur within the 72-hour sampling event. Flow data were evaluated to determine whether a sample was collected during active wet weather or post-storm. Specifically, USGS gauge data at 15-minute intervals were used to estimate the time that passed between a return to the pre-wet weather event flow condition and the time that a post-storm sample was collected.

This hydrograph analysis, using best professional judgement, was conducted for all storm events sampled by the MSAR Task Force since 2007 to determine which follow-up samples were collected during active wet weather or post-storm, that is whether flow had returned to pre-wet weather event conditions. Analysis of the full set of post-storm samples shows that *E. coli* concentrations decline most sharply within the first 24 hours following a return to a pre-event flow condition for all the impaired waters (**Figure ES.6**). Thus, it is possible that controls implemented to address dry weather *E. coli* loads may also provide significant protection to potential swimmers 24 hours post-storm.

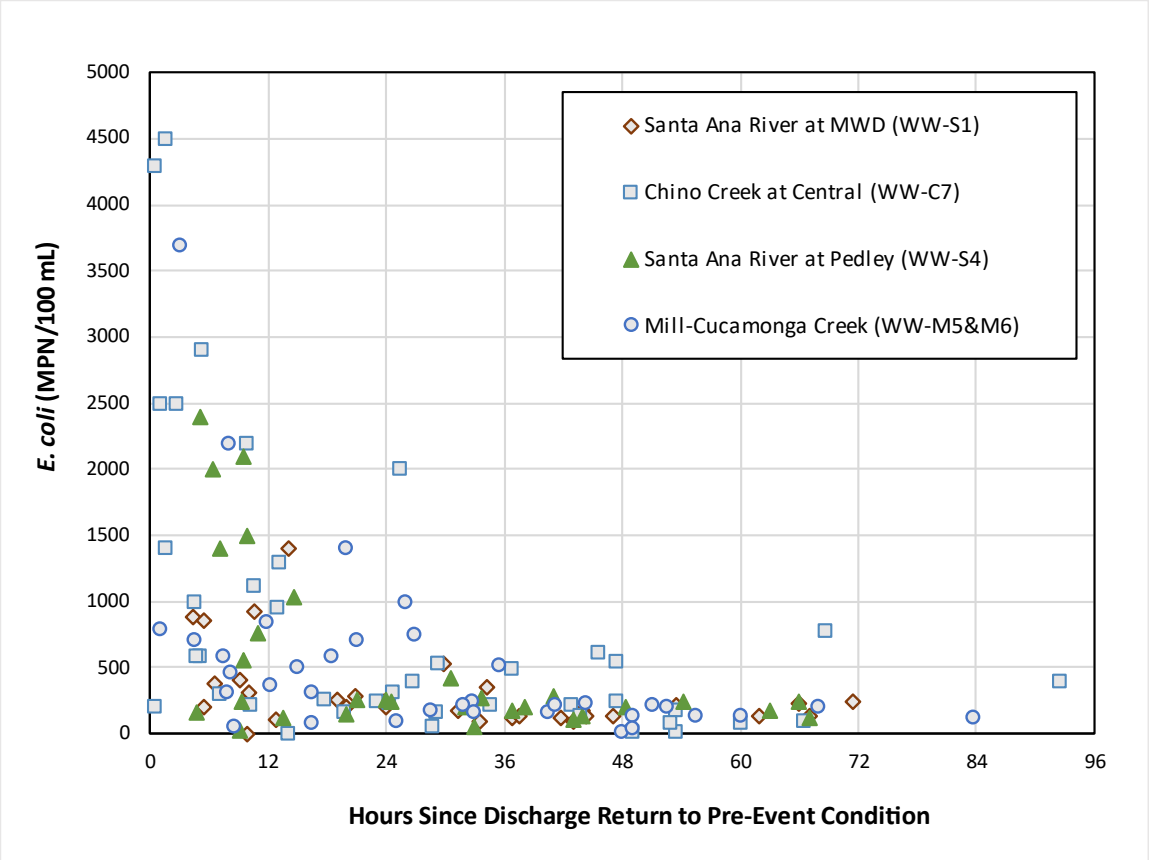

Figure ES.6. *E. coli* Concentrations for All Post-storm Samples Based on the Time Since the Return of Pre-Wet Weather Event Flow Conditions (2007-2023)

Priority 3 – Bacteria Impaired Waters Without an Existing TMDL

The Task Force has collaborated with the Regional 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 about 20 years ago and new monitoring data collected through this RBMP has provided updated information. **Figure ES.7** shows the results from the 2023 dry season sampling.

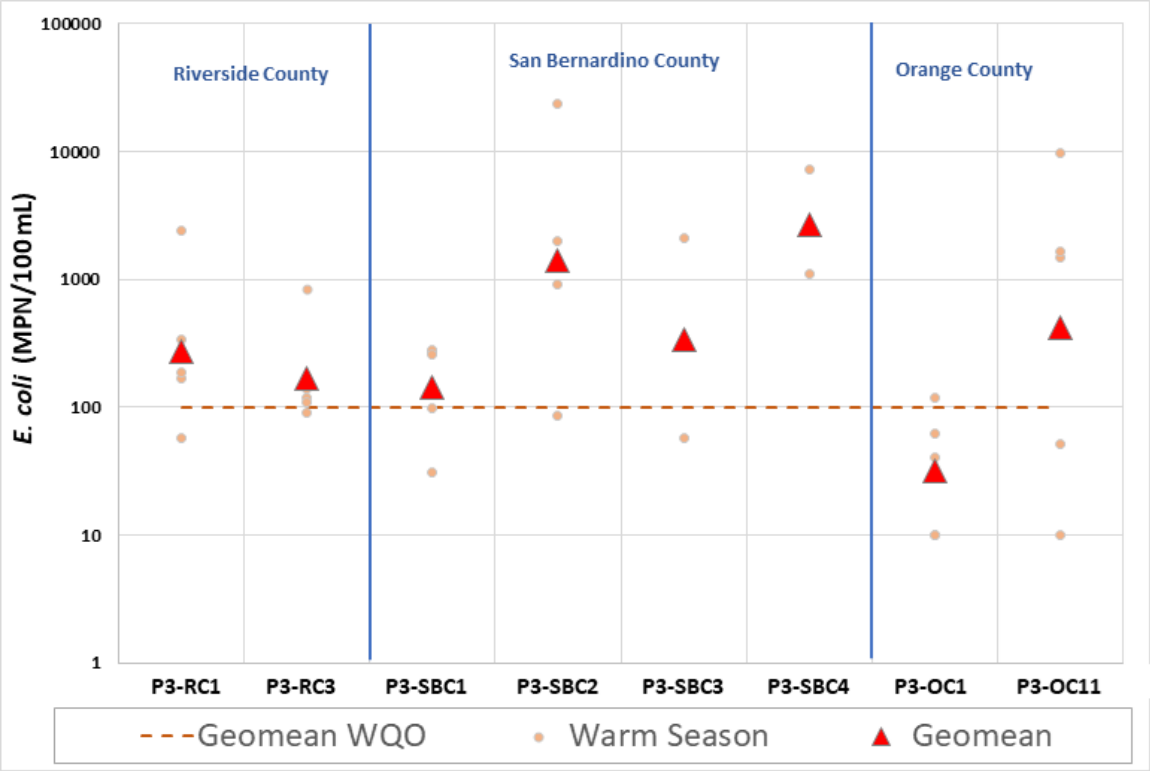

Figure ES.7. Distribution of *E. Coli* Concentration Measurements at Priority 3 Sites

The geometric mean of *E. coli* concentrations at Goldenstar Creek (P3-RC1) met WQOs in the 2022 dry season but data from 2023 results shows this may not be a long-term trend and continued monitoring for this site is recommended. Bolsa Chica Channel (P3-OC1) met the geomean WQO for *E. coli* in 2023 as was also demonstrated in previous years. Monitoring within Reach 4 of the Santa Ana River near the San Bernardino / Riverside County boundary is discussed under the Priority 2 sites in the context of RBMP program-wide sampling within the Santa Ana River (**Figure ES.5**). Lastly, monitoring from three sites along San Timoteo Creek began in the 2020 warm season following their addition to the 303(d) list of impaired waters for fecal bacteria. Results show an increase in *E. coli* concentration from upstream (P3-RC3 on Reach 2 within Riverside County) to downstream segments (P3-SB3 and then P3-SB2 in San Bernardino County)
(**Figure ES.8**).

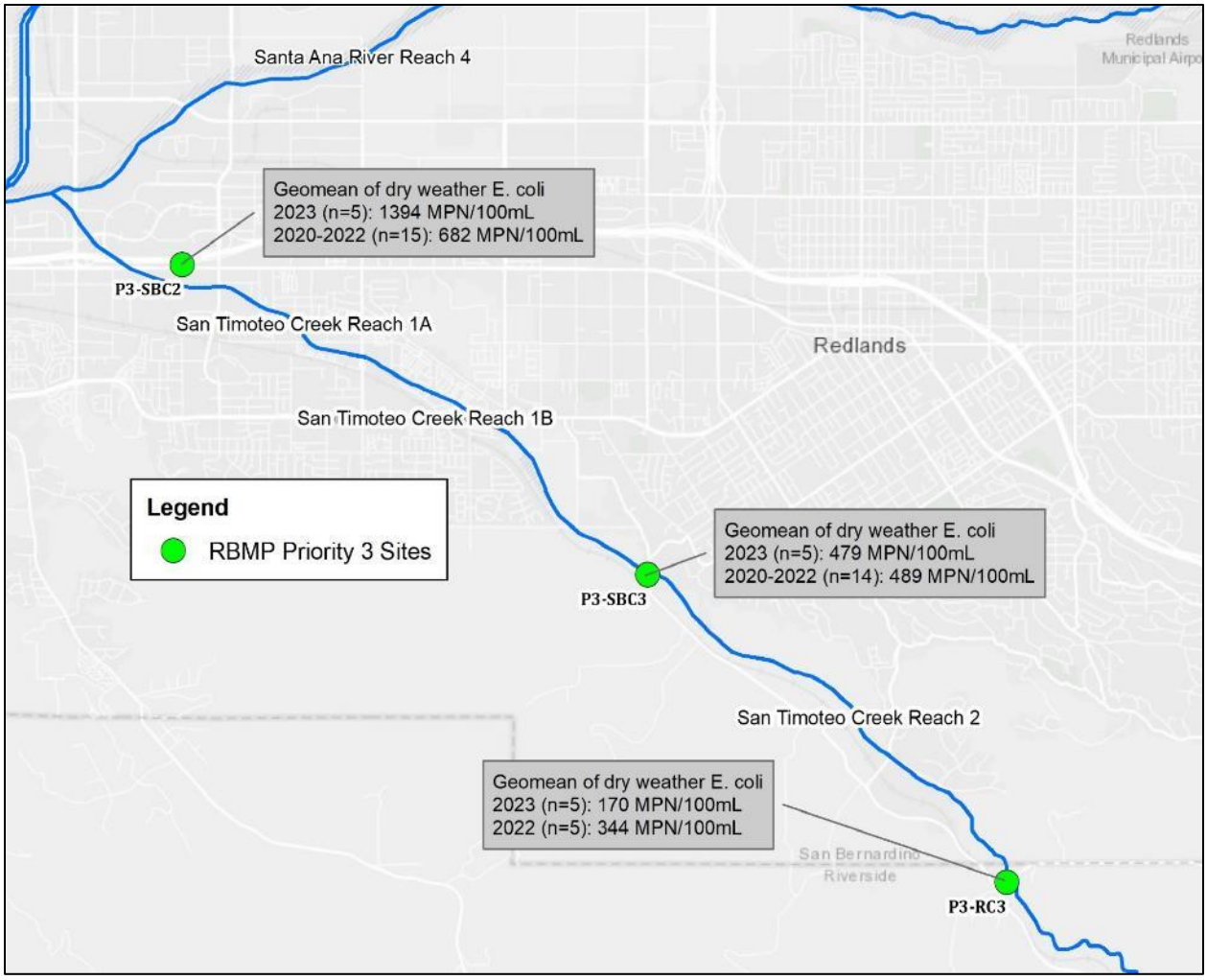

Figure ES.8. Current (2023) and Long-term *E. Coli* Geomean Concentrations during Warm Season, Dry Weather at Priority 3 Sites on San Timoteo Creek

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 Only 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 anti-degradation target as a statistical threshold value 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 the 2023-2024 monitoring period, exceedances of antidegradation threshold values occurred in Cucamonga Creek 1 at Hellman Avenue (P4-SBC1) and Santa Ana Delhi Channel in Tidal Prism: (P4-OC2) stations. Follow-up sampling in each of these waters is discussed below:

- Cucamonga Creek at Hellman Avenue (P4-SBC1) – The antidegradation threshold of 1,385 Most Probably Number (MPN)/100 milliliters (mL) *E. coli* was exceeded on June 23, 2023, which triggered follow-up sampling. Follow-up sampling included one RBMP sample on July 20 and 10 samples from synoptic surveys that occurred weekly from July 27 through September 28. Results from the follow-up sampling did not reduce the antidegradation threshold exceedance frequency to less than 75 percent. As discussed above, 2023 was a unique hydrologic year with atypical, elevated flow conditions throughout the watershed during the warm season (e.g. Hurricane Hilary occurred between weeks 4 and 5 of the 10-week synoptic survey). The MSAR TMDL Task Force has been actively implementing the dry weather CBRP with a combination of source control and structural projects underway to reduce bacteria loads to Cucamonga Creek (e.g., Chris Basin retrofit). The 10-week synoptic surveys involve flow and water quality sampling along a longitudinal profile within Cucamonga Creek and comprise the source investigation element of the dry weather CBRP. Data summaries and interpretation for bacteria source tracking and elimination as well as outfall prioritization from annual 10-week synoptic surveys in 2017 through 2022 are reported in detail in the 2023 Triennial Report. The MSAR TMDL Task Force will coordinate with its member, San Bernardino County Flood Control District (SBCFCD), to obtain data and re-evaluate conditions within the REC2 Only segment of Cucamonga Creek following the 2024 10-week synoptic survey.
- Santa Ana Delhi Channel in Tidal Prism (P4-OC2) - The antidegradation threshold of 464 MPN/100 mL enterococcus was exceeded on August 30, 2023, which triggered follow-up sampling. Follow-up sampling over three events conducted by Orange County Public Works (OCPW) did not reduce the antidegradation threshold exceedance frequency to less than 75 percent (2 of 4 samples exceeded 464 MPN/100 mL). The Santa Ana Delhi Channel is a key focus area within the Newport Bay Source Investigation program, which will continue to collect data to guide pollution prevention plans to reduce bacteria loading to Newport Bay, including via the REC2 Only segment of Santa Ana Delhi Channel. More detailed information on source investigations is provided in the Task 3B deliverable for the Newport Bay Fecal Coliform TSO R8-2019-0050, amended R8-2023-0063 (OCPW, 2023).[8]

[8] OCPW. Newport Bay Fecal Coliform TMDL Pollution Prevention Plan; Appendix A: Source Investigation Final Report, August 2023.

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 Regional Board to ensure that the monitoring program is adapted to respond to several key regulatory activities including the statewide Bacteria Summits (2022 and upcoming in 2024, the 2024 Integrated List of Waters for Santa Ana region,[9] MS4 permit reissuance, and limited BPA 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.

[9] https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2024-integrated-report.html

1.0 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 RBMP supports the implementation of several regulatory-related activities associated with the protection of recreational uses in the Santa Ana River Watershed, including the Basin Plan Amendment (BPA) 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 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 BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region.*[10] This BPA resulted in the following key modifications to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) for the Santa Ana region:[11]

- 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 UAA.
- Revision of water quality objectives to protect the REC1 use of inland freshwaters.

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

[11] 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

- 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 SQSS Task Force, 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[12] and the California Office of Administrative Law on July 2, 2014.[13] 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.[14]

The BPA required the establishment of a comprehensive monitoring program to support implementation of the changes to the Basin Plan.[15] The 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).[16] The Statewide Bacteria Provisions developed new statewide numeric water quality objectives 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 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 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.

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[12] State Water Board Resolution: 2014-0005, January 21, 2014.

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

[14] http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.shtml

[15] 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

[16] State Water Board. https://www.waterboards.ca.gov/bacterialobjectives/

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 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:
[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 Amendment 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 water quality objectives.
- 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 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* water quality objective.
- *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 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 RBMP Monitoring Plan (Monitoring Plan) and Quality Assurance Project Plan (QAPP) to support this monitoring program. The monitoring documents were last updated in 2022 and are anticipated to be updated or modified as needed prior to the 2024-2025 monitoring year.

1.2.3 Annual Report

This Annual Report summarizes the results of the 2023-2024 monitoring efforts. Annual Reports summarizing monitoring efforts from 2016-2023 are available from SAWPA.

Additional information and analysis of MSAR bacteria data can be found in the 2023 MSAR TMDL Triennial Report,[17] which synthesizes decades of microbial source tracking data, mass balance analysis, and BMP effectiveness assessment, and provides recommendations for watershed management activities toward achieving the TMDL.

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

2.0 Santa Ana River Study Area

This section describes the study area and identifies the monitoring locations sampled during the 2023-2024 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 MSAR 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[18] 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.

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

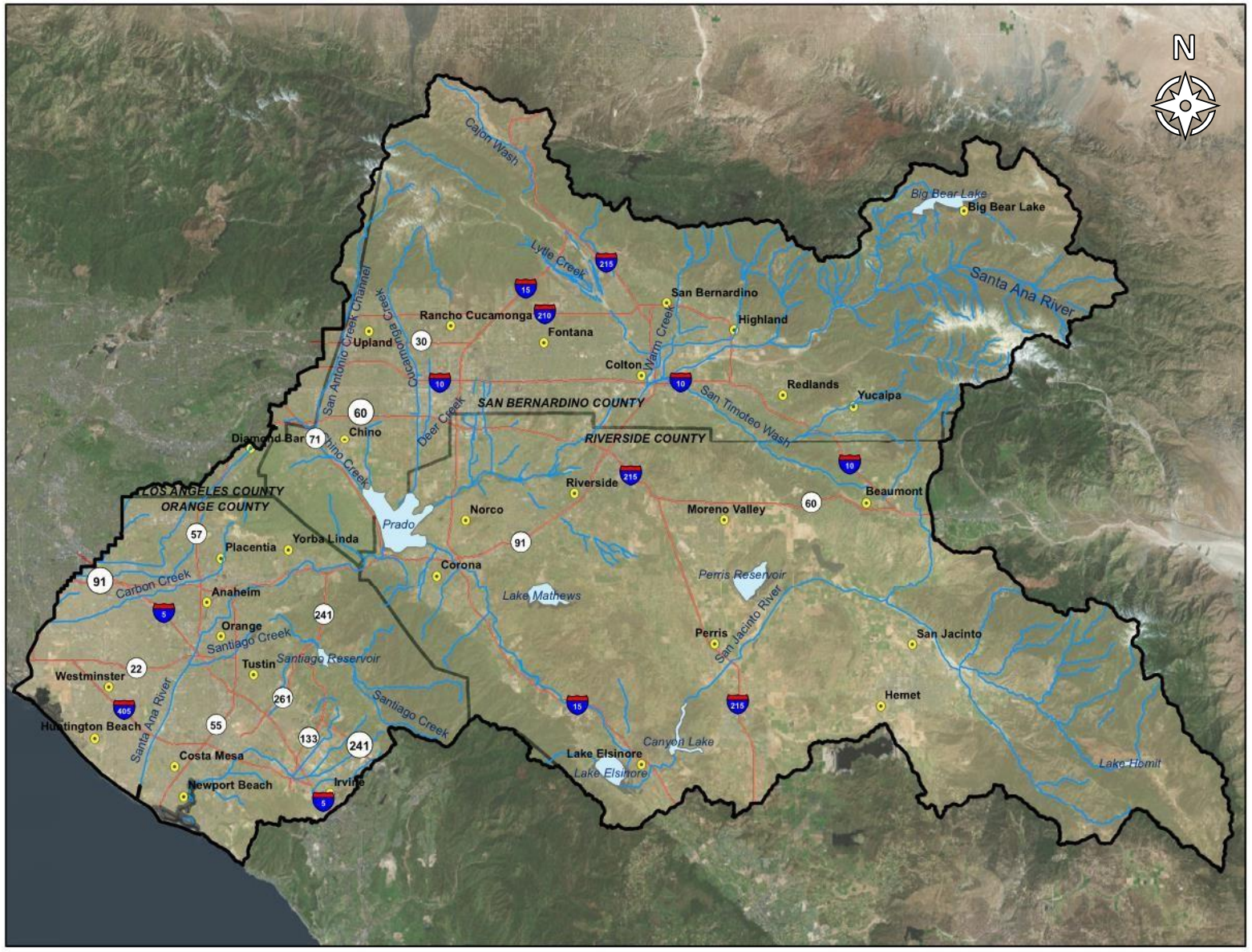


Figure 2.1. Santa Ana River Watershed and Location of Orange, Riverside, and San Bernardino Counties (Source: SAWPA)

Per the TMDL, the above compliance targets for fecal coliform become ineffective upon EPA approval of the BPA.[19]

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.[20] 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.[21] This TMDL monitoring program has been incorporated into the 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 AgSEP, respectively) were approved by the Santa Ana Water Board in 2008. These programs were incorporated into the Santa Ana River Watershed Bacteria Monitoring Program Monitoring Plan and QAPP.[22]

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.

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

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

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

[22] SAR 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 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).

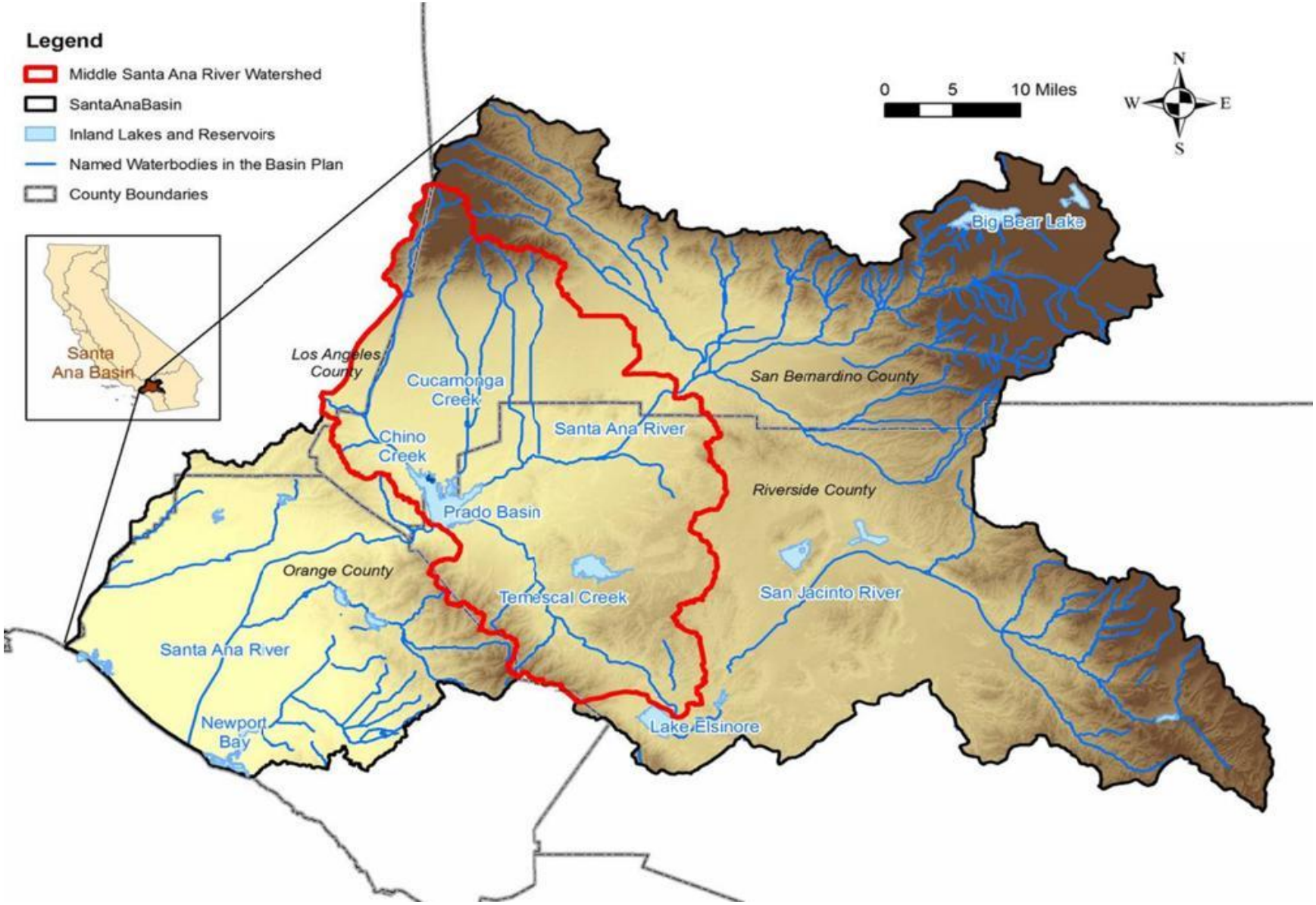


Figure 2.2. Middle Santa Ana River Watershed

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 Precipitation

Precipitation varies considerably across the watershed with highest average precipitation occurring in the upper mountain areas of the watershed (San Gabriel, San Bernardino, and San Jacinto mountains) (**Figure 2.3**). Historical average annual precipitation 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 precipitation ranges from approximately 11 to 19 inches.

2.1.4.1 Drought Conditions

Though the region has historically been in severe to exceptional drought during the past decade, the sampling period of this annual study from late spring 2023 to early 2024 has occurred during improving or non-drought period. **Figure 2.4** show the historical drought conditions for the Study Area counties (Orange, Riverside, and San Bernardino, respectively).[23] The U.S. Drought Monitor scale is as follows: Abnormally Dry (D0), Moderate Drought (D1), Severe Drought (D2). Extreme Drought (D3), and Exceptional Drought (D4).

[23] NOAA. NIDIS. National Integrated Drought Information System, 2024. https://www.drought.gov/states/California

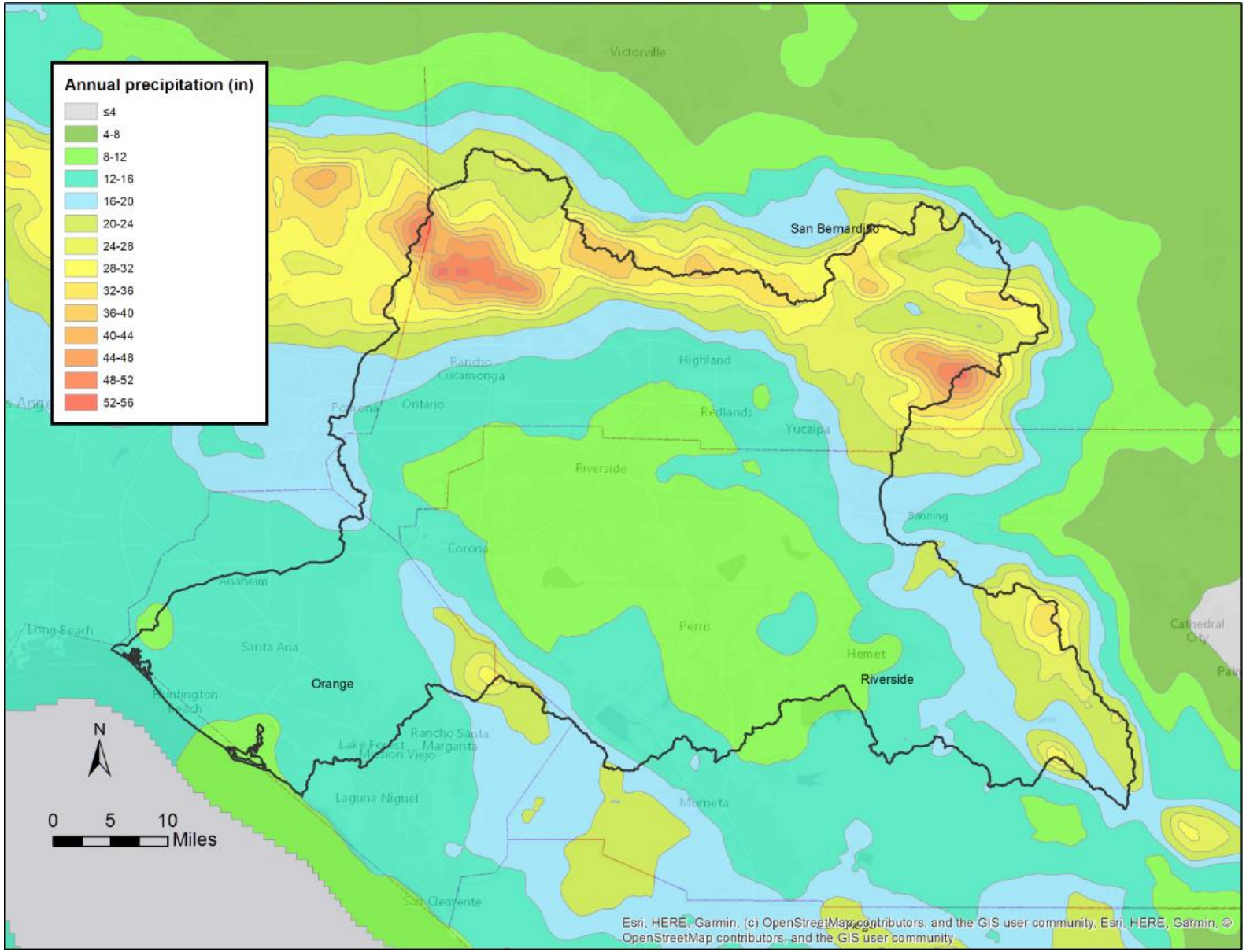


Figure 2.3. Historical Average Annual Precipitation in the Santa Ana River Watershed since 1980

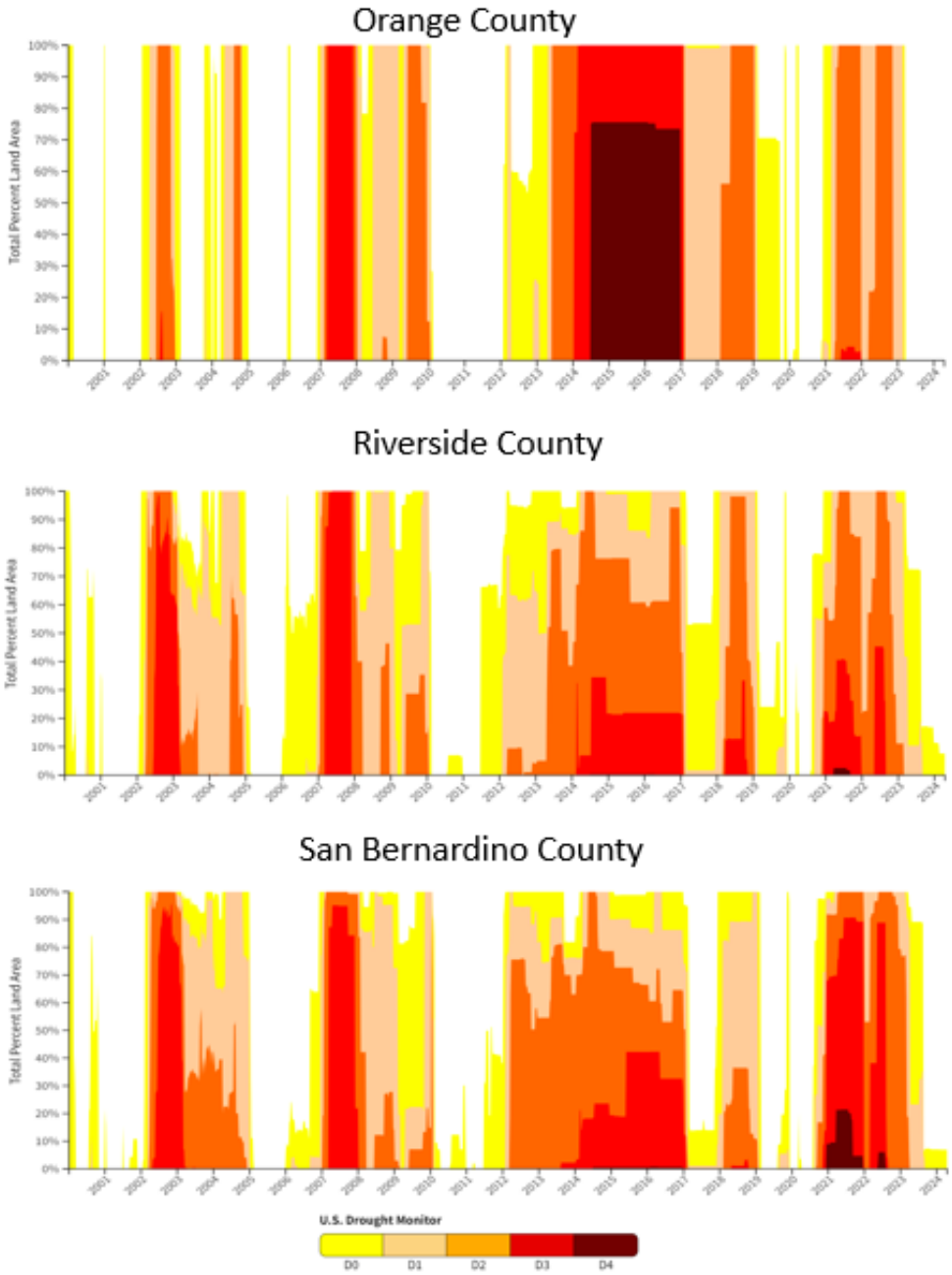


Figure 2.4. U.S. Drought Monitor (2000–present)

2.1.4.2 2023-2024 Precipitation

Key precipitation gages in the Santa Ana River watershed were identified and considered representative of the variability across the watershed (**Figure 2.5**). **Table 2.1** provides the locations of key precipitation gages in the Santa Ana River watershed[24] and **Table 2.2** summarizes the total monthly precipitation data from each location for the 2023-2024 monitoring year.

Table 2.1. Location of Key Precipitation 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

During the 2022 monitoring season, precipitation varied throughout the watershed. Heavier precipitation was recorded in the upper watershed and during winter months. Precipitation continued into the beginning months of 2023 and had a hydrologically significant impact on the area. Most 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 precipitation in the preceding 72-hour period. An exception occurred in August 2023 when the area experienced higher than normal precipitation due to a hurricane in the region. This precipitation event impacted the dry weather sampling that week. The hurricane likely changed sampling conditions in the months that followed the unusual precipitation event. The Santa Ana River likely experienced continuous flow from the mountains through the MSAR reaches due to runoff and increased shallow water baseflow. These conditions are atypical of late summer/early fall and further discussed with relation to results in Section 4 of this report.

[24] 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 Precipitation Totals (inches) During 2023 at Key Precipitation Gages

Station No.	Precipitation Gage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
178	Riverside North	4.29	2.11	5.38	0.13	0.42	0.05	0	2.03	0.22	0	0.28	1.04	4.29
179	Riverside South	3.80	2.42	4.45	0.13	0.59	0	0	2.24	0.06	0	0.17	0.83	3.80
35	Corona	7.56	2.50	7.64	0.17	1.02	0.02	0.01	2.09	0.05	0.09	0.20	0.84	7.56
131	Norco	4.90	2.02	5.72	0.09	0.57	0	0	2.50	0.01	0.11	0.22	0.95	4.90
67	Elsinore	4.18	2.31	4.80	0.02	0.26	0.31	0.02	2.09	0.02	0.02	0.25	0.72	4.18
90	Idyllwild	12.9	4.08	12.5	0	1.07	0	0.02	3.55	0.06	0.24	1.48	1.35	12.9
9022	Fawnskin													
2965	Lytle Creek Canyon													
2808	Highland Plunge Creek													
61	Tustin-Irvine Ranch													
169	Corona del Mar													
219	Costa Mesa Water District													
163	Yorba Reservoir													
5	Buena Park													

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

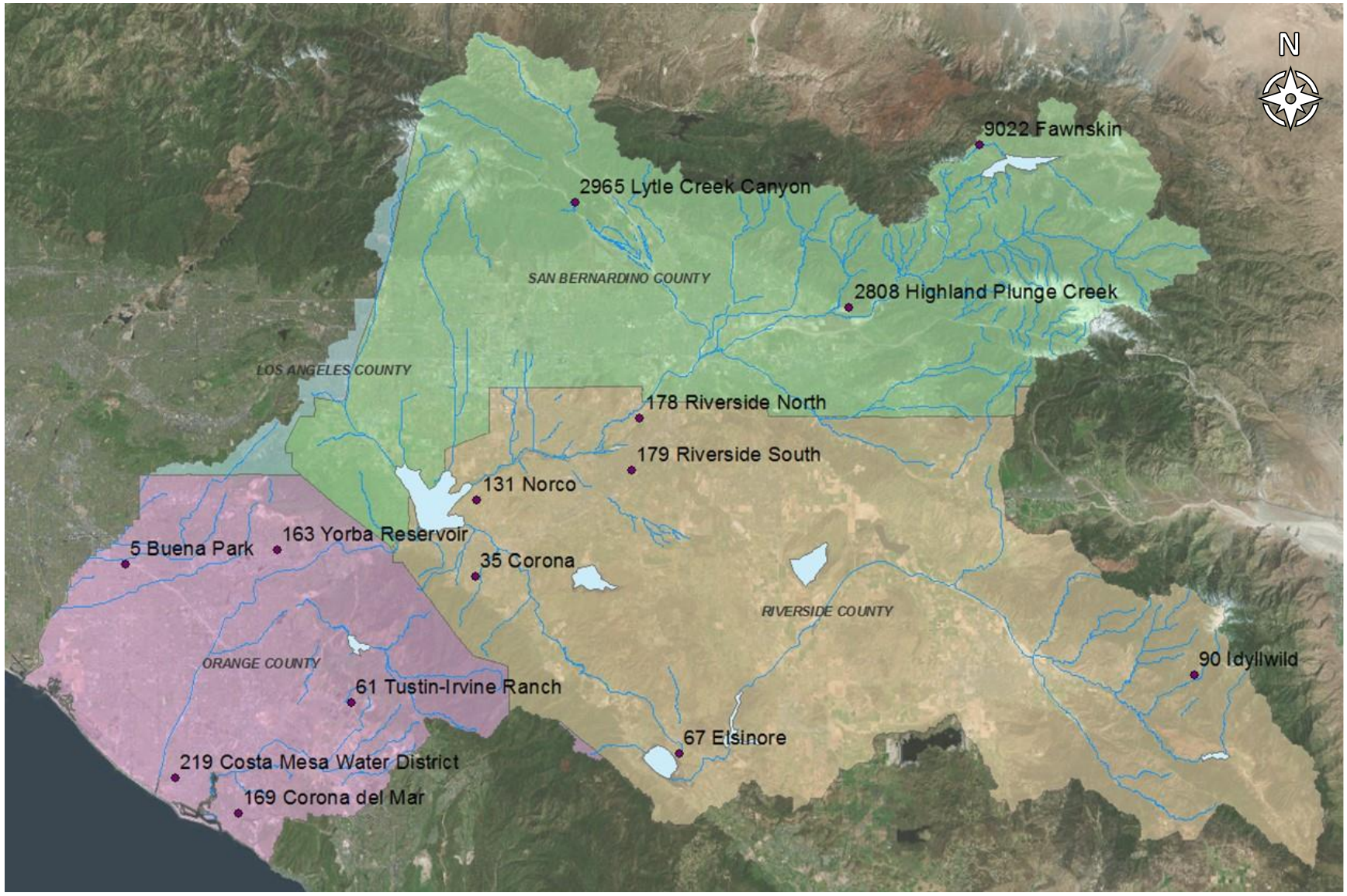


Figure 2.5. Key Precipitation Gages

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 2.6**).

Because the two Priority 1 Santa Ana River sites (MWD Crossing and Pedley Avenue) are also MSAR Bacteria TMDL compliance sites (**Table 2.4**), 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 at Elm Grove Beach	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 at 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

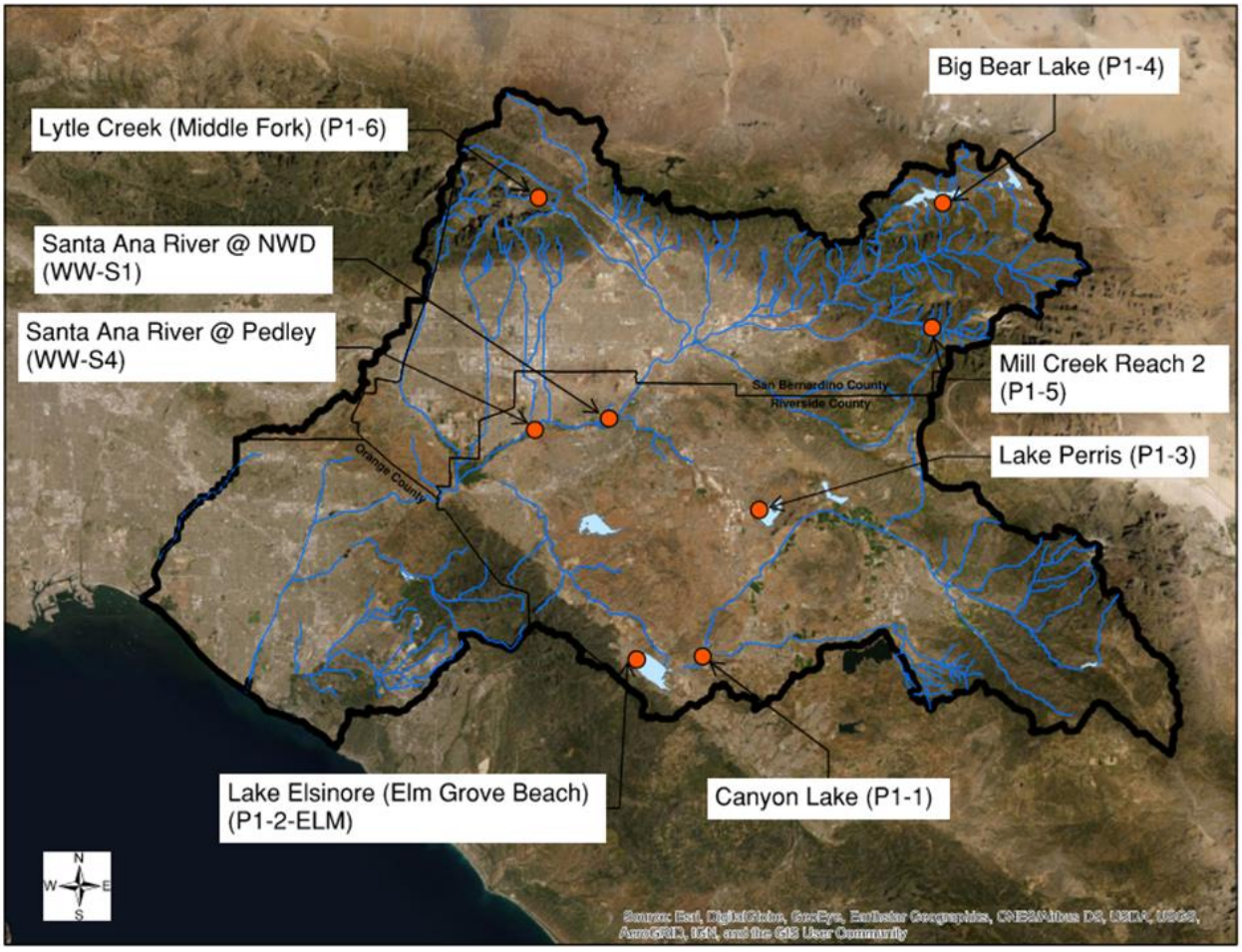


Figure 2.6. Priority 1 Monitoring Sites

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[25] (**Table 2.4**; **Figure 2.7**). 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.

[25] 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 2.7. Priority 2 Monitoring Sites

2.2.3 Priority 3

There are currently twenty-four waterbodies in the Santa Ana River watershed included on the 303(d) List as impaired for indicator bacteria for which no TMDL has been adopted. The number of waterbodies has increased from twenty-three to twenty-four with the additional of Perris Valley Channel which was

included in the final 2024 303(d) List.[26] Perris Valley Channel is not currently sampled through the RBMP and eight additional waterbodies were not included in the original RBMP for reasons described in Section 3.3.3.2 of the Monitoring Plan. Thus, there are fifteen Priority 3 monitoring sites listed in **Table 2.5** with their locations (shown on **Figure 2.8**). However, six of these were identified in the Priority 3 sampling plan modifications technical memorandum,[27] and samples and measurements were not collected. These sites are 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), and San Diego Creek Reach 2 (P3-OC9) 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, three are in Orange County, two are in Riverside County, and four are in San Bernardino County. Previous water quality data and the basis for listing these monitoring sites are described in the Monitoring Plan.

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[1]	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	Orange	33.5900	-117.8684
P3-OC5[1]	Los Trancos Creek at Crystal Cove State Park	Orange	33.5760	-117.8406
P3-OC6[1]	Morning Canyon Creek at Morning Canyon Beach	Orange	33.5876	-117.8658
P3-OC7[1]	Peters Canyon Wash downstream of Barranca Parkway	Orange	33.6908	-117.82404
P3-OC8[1]	San Diego Creek downstream of Campus Drive (Reach 1)	Orange	33.6553	-117.8454
P3-OC9[1]	San Diego Creek at Harvard Avenue (Reach 2)	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

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 Regional Board and City of Newport Beach.

[26] California Environmental Protection Agency. 2024 CALIFORNIA INTEGRATED REPORT: SURFACE WATER QUALITY ASSESSMENTS TO COMPLY WITH CLEAN WATER ACT SECTIONS 303(d) AND 305(b). Appendix A. March 2024.

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

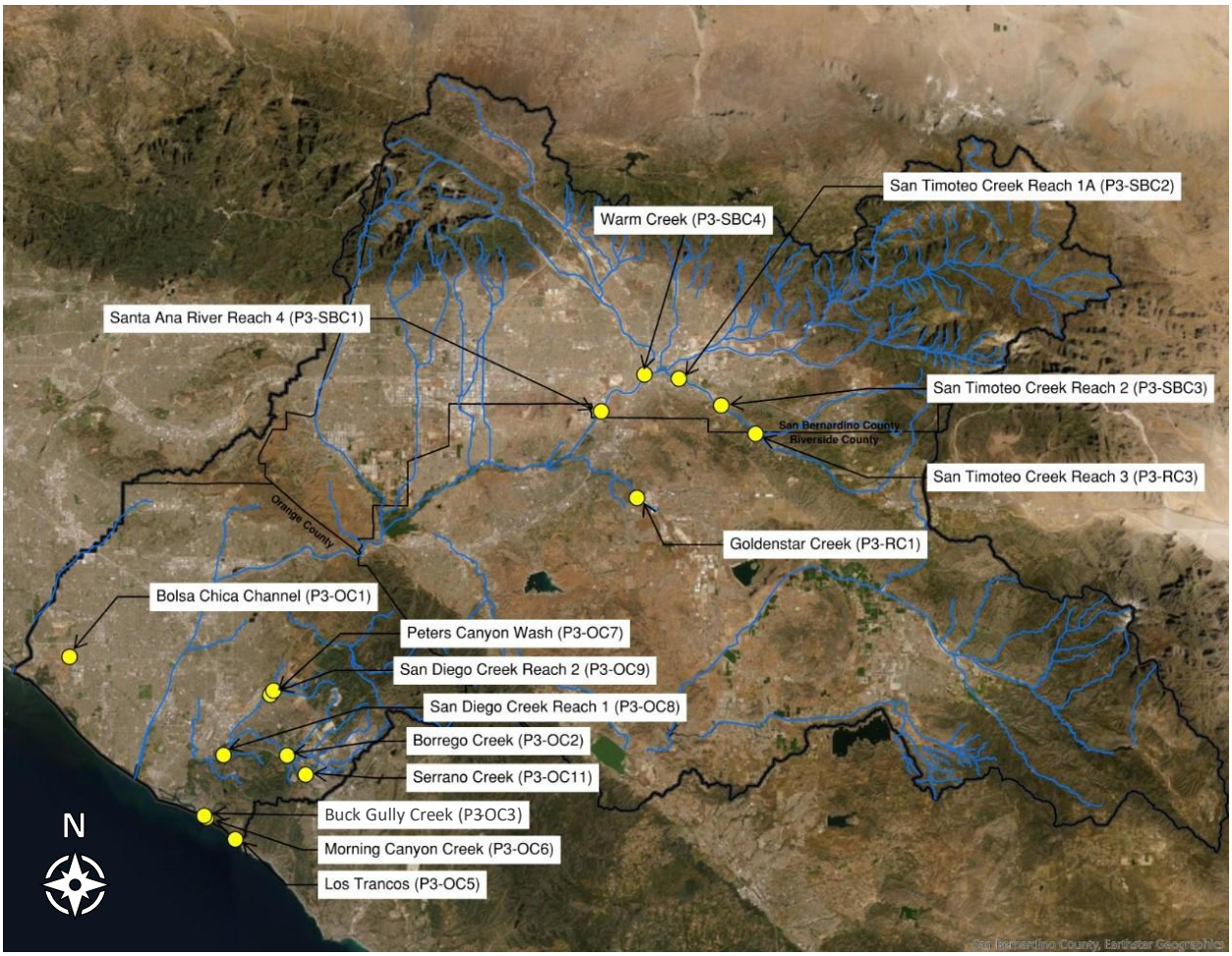


Figure 2.8. Priority 3 Monitoring Sites

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 2.9** and described as follows:

- *Santa Ana-Delhi Channel* – The Santa Ana-Delhi Channel has three reaches (Reaches 1 and 2, and 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

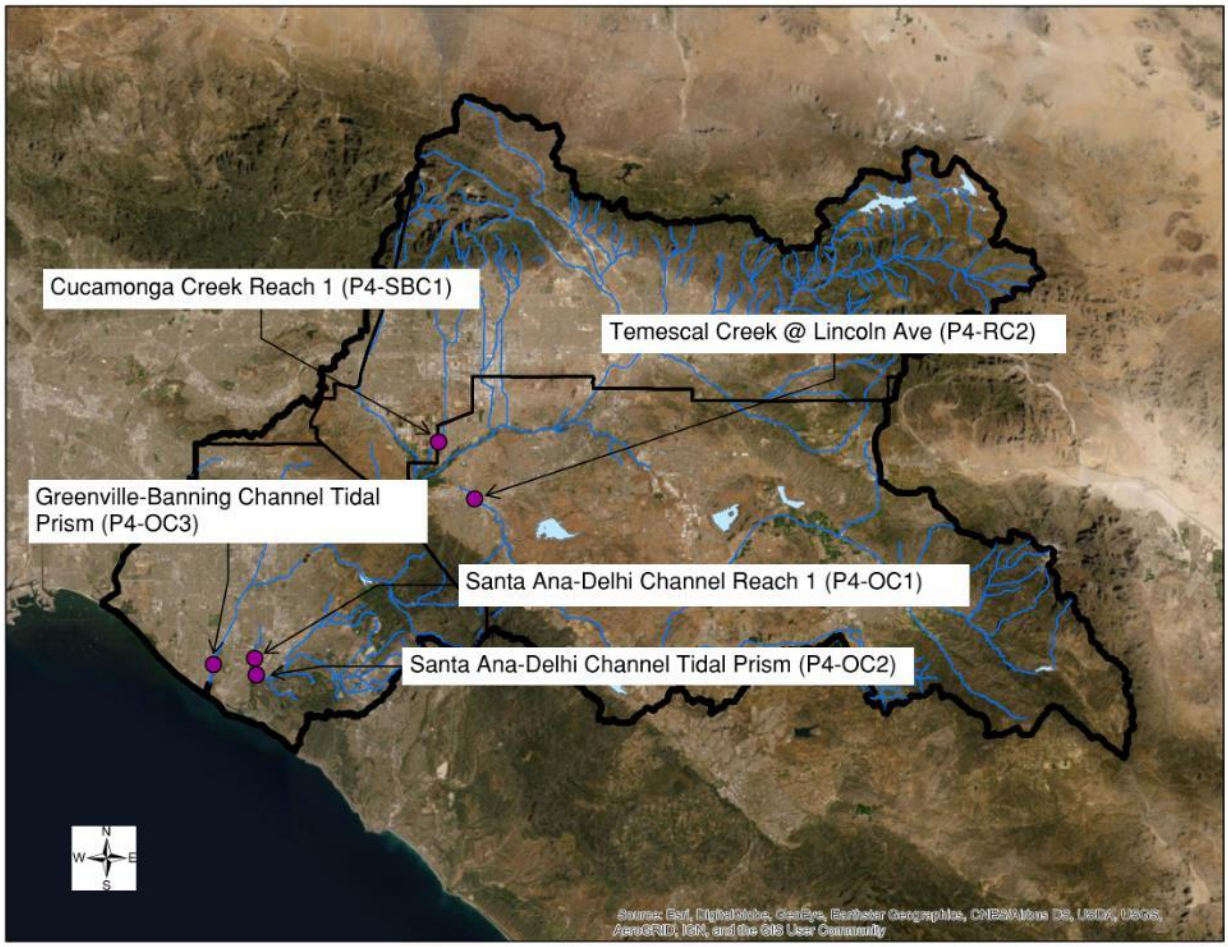


Figure 2.9. Priority 4 Monitoring Sites (top: Riverside County and San Bernardino County; bottom: Orange County)

3.0 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 all sites over a 20-week period from May 7 through September 25, 2023. The monitoring plan noted that the warm season monitoring would be complete by September 20, 2023; however, due to a rain event this was pushed back to September 25, 2023. Dry weather, cool season monitoring occurred over a five-week period from October 15 through November 22, 2023. Dry weather conditions are defined as no measurable precipitation 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 23rd and August 30th. Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) and Cucamonga Creek at Hellman Avenue (P4-SBC1) did not meet the site-specific antidegradation target in 2023 and required monthly follow-up samples. All other Priority 4 sites met their antidegradation targets in 2023 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 2023-2024 wet season, a precipitation event on February 20, 2024 was monitored with samples collected on February 20, 21, 22, and 23.

3.1.3 Summary of Sample Collection Effort

All samples prescribed by the 2023-2024 monitoring program were collected as shown in **Table 3.1**. Minor adjustments to dry weather collection dates and timing were made following precipitation to meet the dry weather monitoring requirements.

Table 3.1. Summary of Water Quality Sample Collection Activity

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

Note:

[1] Additional samples were collected at Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) and Cucamonga Creek at Hellman (P4-SBC1) 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 collecting 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:[28] 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).

[28] 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 (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 completeness 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.[29] Accordingly, prior to conducting statistical analyses, the bacterial indicator data were log transformed.

[29] 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

4.0 Results

This section summarizes the results of data analyses of the 2023-2024 dataset, which include the 2023 dry season (warm and cool) and the 2023-2024 wet season. Where appropriate and to provide context, data results are compared to water quality results previously reported for the same locations. **Appendix A** summarizes the monitoring results at each site for the sample period covered by this report.

E. coli and enterococci concentrations observed at each site were summarized and compliance was assessed using the appropriate water quality standards, antidegradation targets established by the BPA, or WLAs 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 dry (warm and cool) and wet seasons at Priority 1 sites (**Table 4.1**) are summarized in **Figure 4.1** through **Figure 4.7** with key observations described below.

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

- **pH** - The WQO for pH established in the Santa Ana Basin Plan allows pH to range between 6.5 and 8.5 standard units (S.U.). **Figure 4.1** shows that the lake sites (P1-1: Canyon Lake at Holiday Harbor, P1-2-ELM: Lake Elsinore at Elm Grove Beach, P1-3: Lake Perris, and P1-4: Big Bear Lake at Swim Beach) recorded pH values greater than 8.5 S.U. The highest exceedance percentage occurred at Lake Elsinore at Elm Grove Beach (P1-2-ELM) where 96 percent of the samples were greater than the allowable range. The highest values occurred at Lake Perris (P1-3) with pH reaching 9.3 S.U. for three consecutive weeks in June during 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 the allowable pH range.

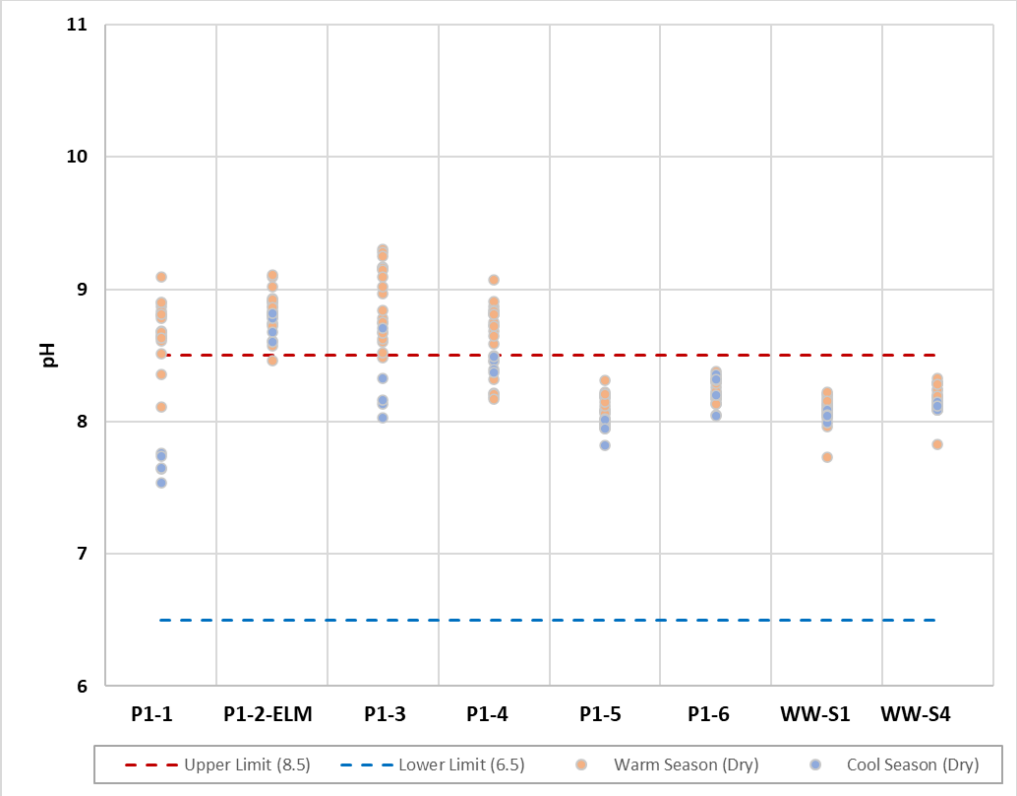


Figure 4.1. Distribution of pH Measurements at Priority 1 Sites

- **Water temperature** - **Figure 4.2** shows the 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 24°C) in lower elevations. Likewise, water temperature responds directly to the seasonal ambient temperatures of the warm and cool seasons.

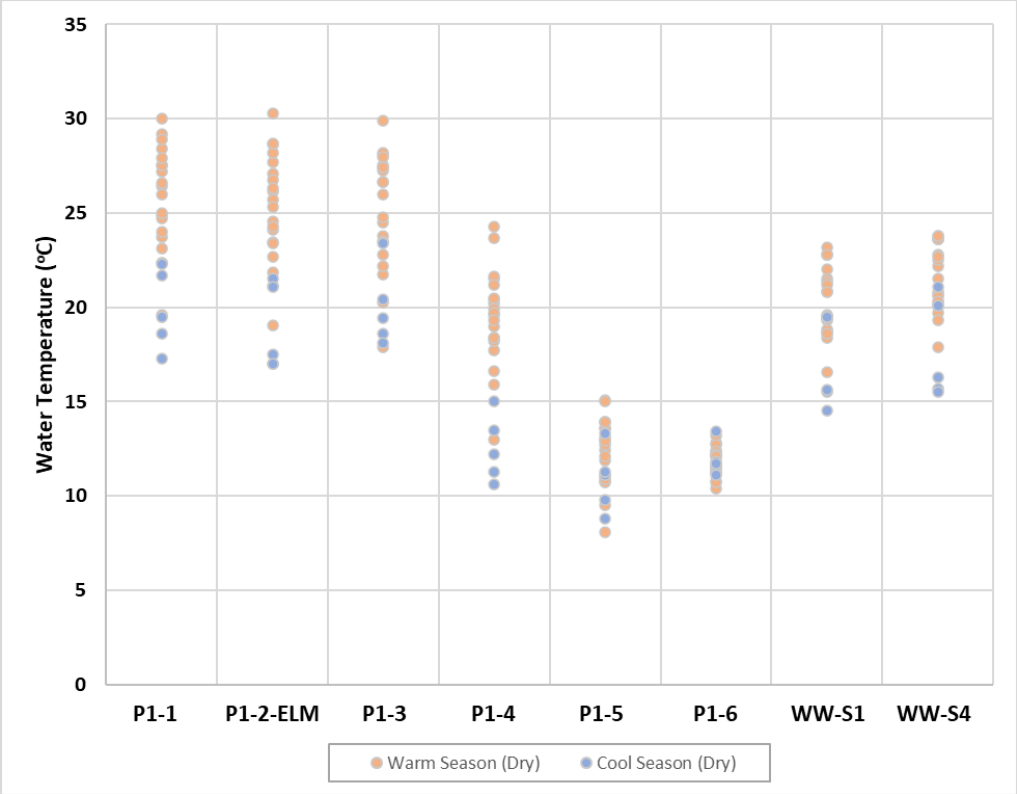


Figure 4.2. Distribution of Water Temperature Measurements at Priority 1 Sites

- **Dissolved oxygen** - **Figure 4.3** shows that the majority of DO concentrations at the Priority 1 sites range from 6 to 10 mg/L. WQOs for minimum DO concentrations for waterbodies with the WARM and COLD habitat beneficial use designations are 5 mg/L and 6 mg/L, respectively. These standards were met at all Priority 1 sites except for Canyon Lake (P1-1) where three of the five samples, or 60 percent of measurements taken during the cool, dry season fell below COLD habitat beneficial use. DO conditions in Canyon Lake are similar to results seen in previous years. Lake Elsinore (P1-2-ELM) also recorded a single DO sample at the minimum WQO of 5 mg/L.

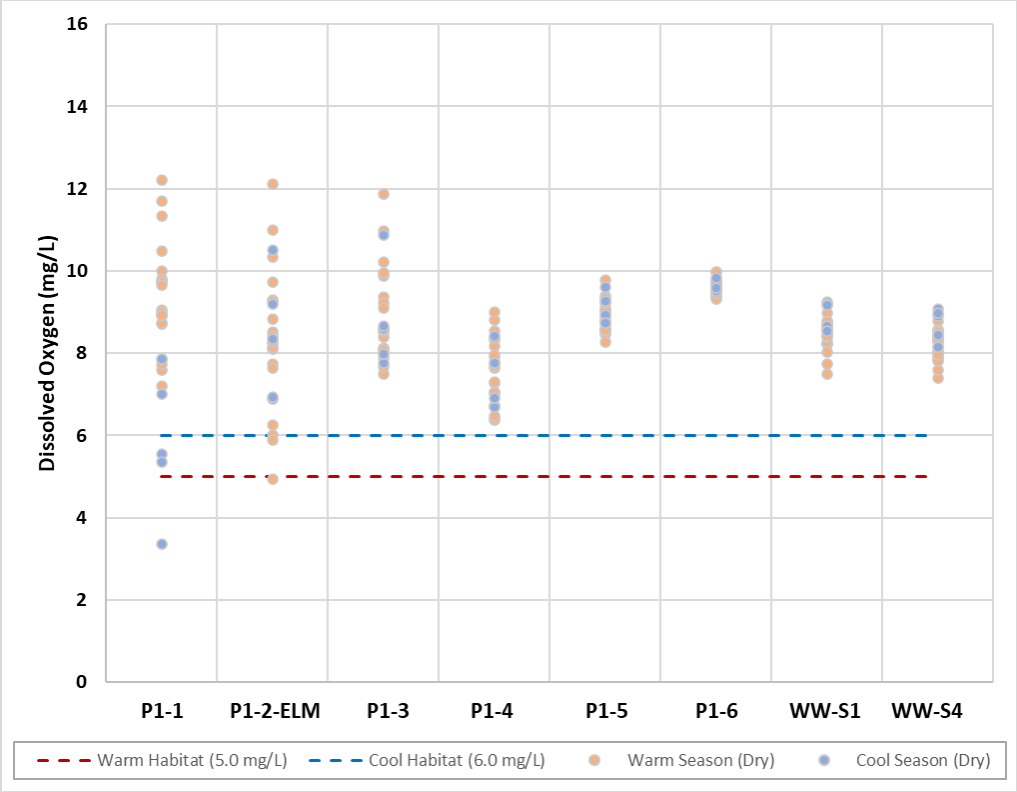


Figure 4.3. Distribution of Dissolved Oxygen Measurements at Priority 1 Sites

- **Conductivity** - **Figure 4.4** shows conductivity data, which appears to vary based on geography as sites located in the upper portions of the watershed (P1-5: Mill Creek Reach 2, P1-4: Big Bear Lake, and P1-6: Lytle Creek) have lower conductivity than sites located in the downstream portions of the watershed. Dry weather flow in waterbodies in the upper watershed generally consists of groundwater baseflow in dry conditions supplemented with snow melt; these flows generally have not accumulated many salts from geology, agricultural or urban runoff, or 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 continued to exhibit high conductivity in 2023-2024 (2,794 to 3,300 µS/cm). While the 2023-2024 range is still considered saline, salinity was reduced when compared to 2022-2023 data (about 3,000 to 4,400 µS/cm). High conductivity is not unusual for a terminal lake with ongoing evapo-concentration and water levels that are kept artificially high with the addition of treated effluent known to be high in TDS. Reductions seen in conductivity values during this sampling year could be a result of increased precipitation throughout the sampling season.

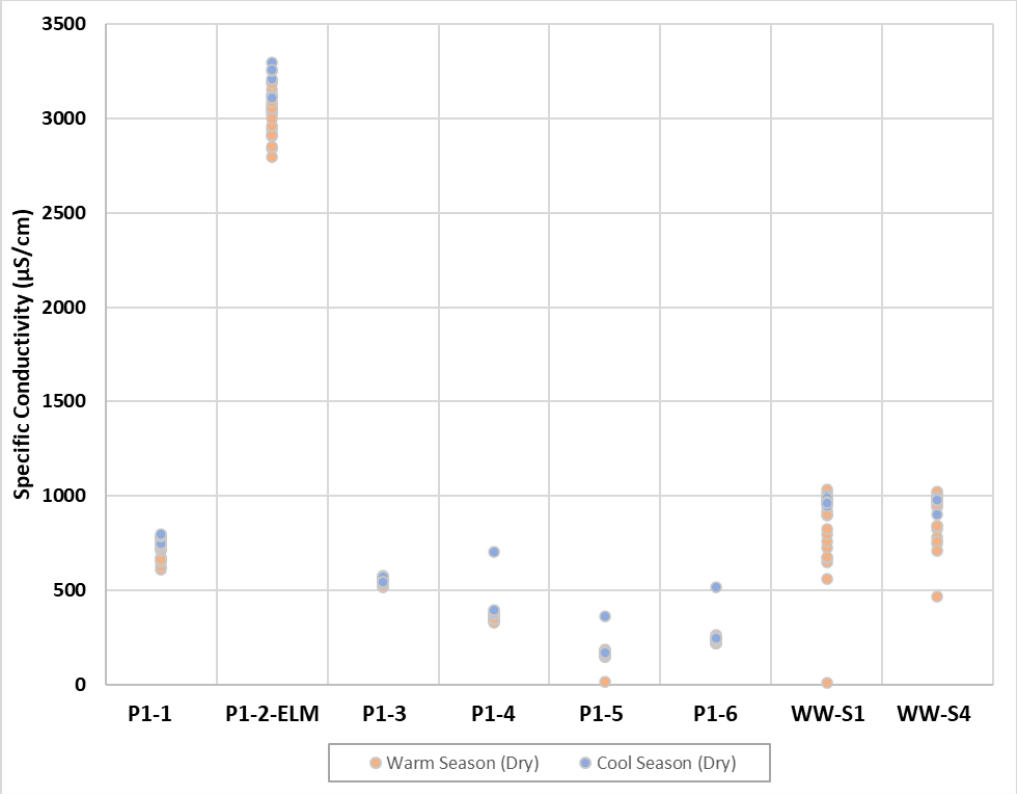


Figure 4.4. Distribution of Specific Conductivity Measurements at Priority 1 Sites

- **Turbidity and TSS** - **Figure 4.5** shows turbidity at six of the eight sites were generally low to moderate. Turbidity in Lake Elsinore (P1-2-ELM) during the 2023 dry season (maximum value of 47 NTU) was lower when compared to sample results from 2022 (high value of 338 NTU). Seasonal variability can be higher in the lake monitoring sites as the warm samples typically result in higher values corresponding to higher algal presence than the cool samples. As noted throughout the report, the 2023 dry season was generally cooler and wetter than previous monitoring seasons, which may account for the decrease in turbidity values and variability recorded at the Priority 1 sites.

  TSS concentrations at the eight sites (**Figure 4.6**) generally follow those of turbidity, with relatively low TSS values seen at the non-Santa Ana River Reach 3 Priority 1 sites. TSS values were also lower and less variable when compared to 2022 results.

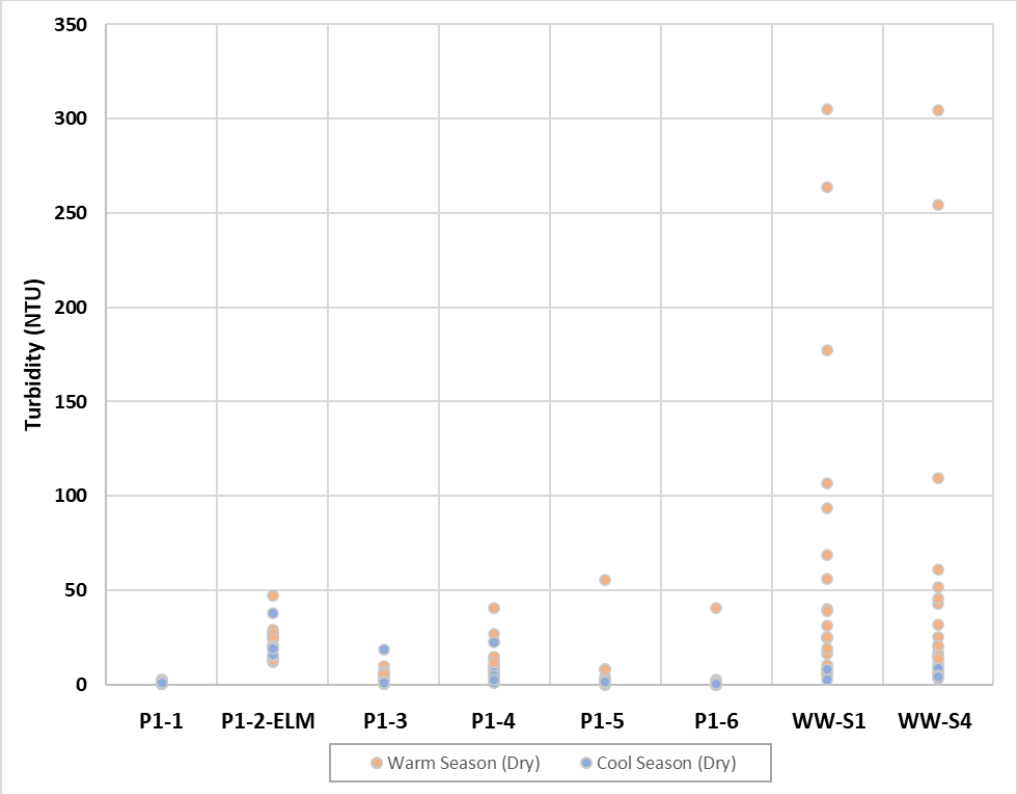


Figure 4.5. Distribution of Turbidity Measurements at Priority 1 Sites

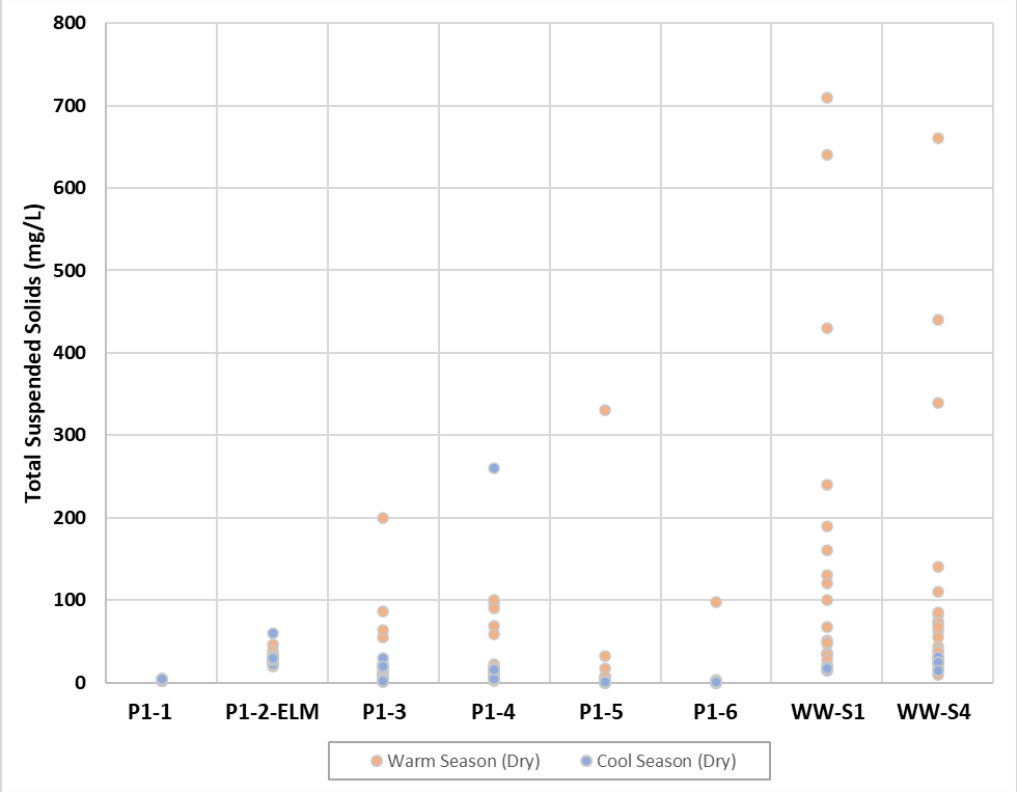
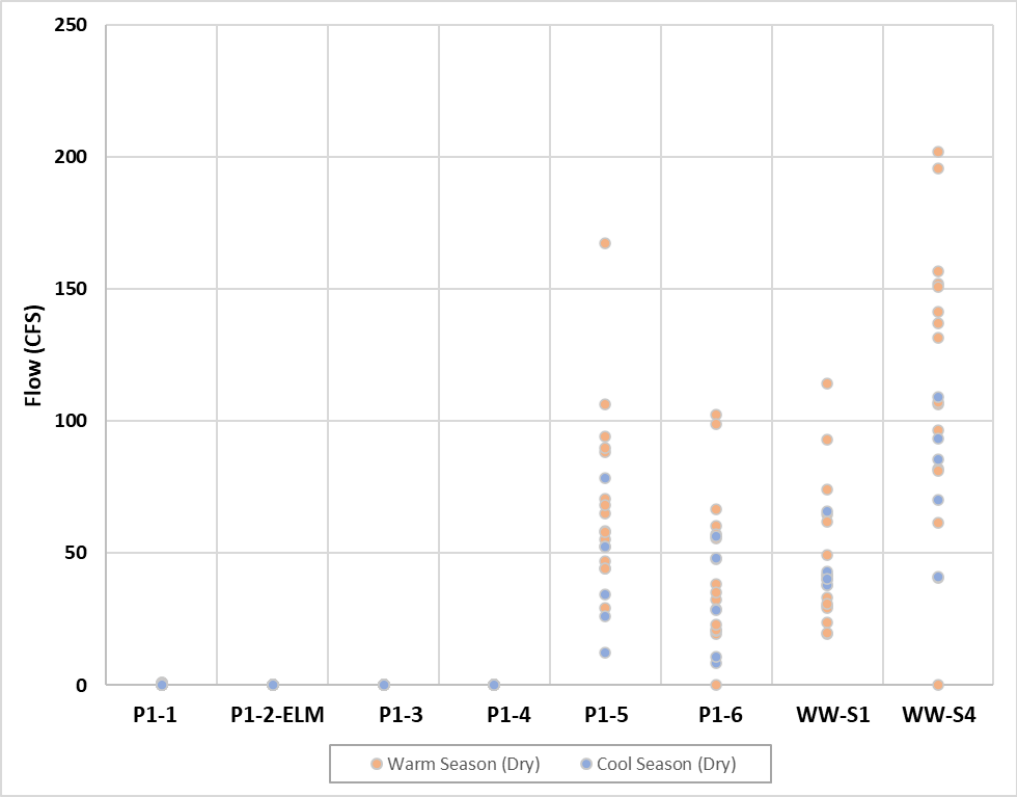


Figure 4.6. Distribution of TSS Measurements at Priority 1 Sites

- **Flow** - **Figure 4.7** provides the measured flow data from sampling dates at the stream sites only. Recorded instream flows were higher at all stream sites in 2023 as compared to 2022, with significant increases in the upstream sites. The range of flows recorded in Mill Creek: P1-5 rose from 1-11 cfs in 2022 to 12-167 cfs in 2023 while the range of flows recorded in Lytle Creek: P1-6 rose from 0-7 cfs in 2022 to 9-102 cfs in 2023. Flows consistently increase each year in the Santa Ana River sites (WW-S1 at MWD Crossing and WW-S4 at Pedley Avenue), which are fed by POTW effluent.



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

Figure 4.7. Distribution of Flow Measurements at Priority 1 Sites

4.1.2 Bacteria Characterization

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.

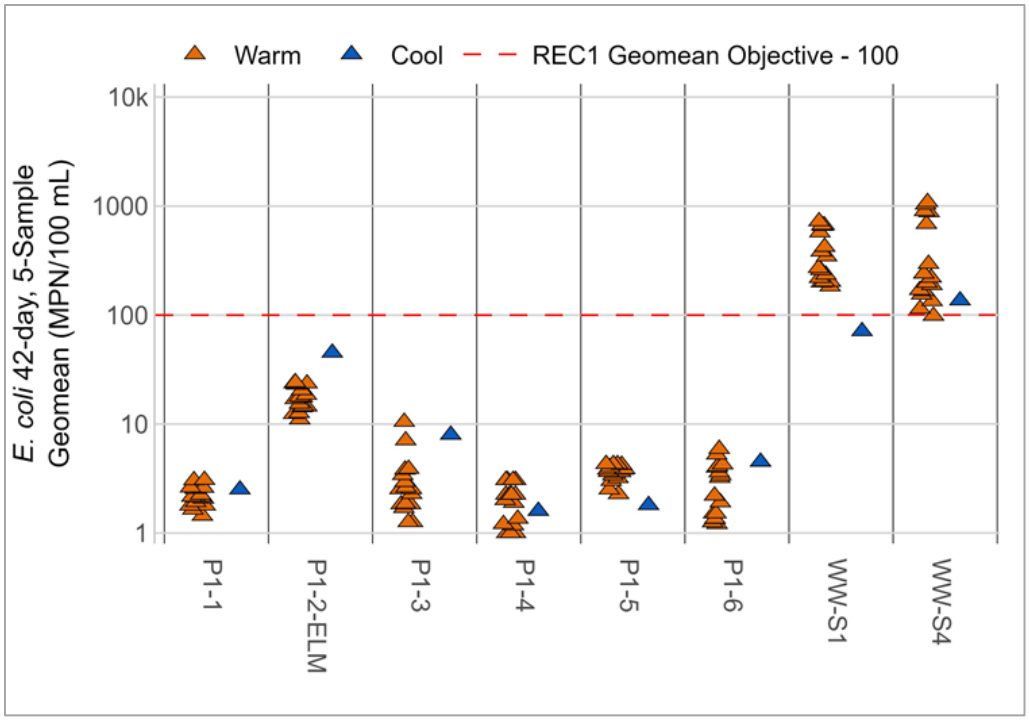


Figure 4.8. Distribution of *E. coli Geomean* Concentrations at Priority 1 Sites

Fecal bacteria conditions in Priority 1 waters during the 2023-2024 warm and cool dry sampling seasons were generally low and support recreational use, except at the two Santa Ana River sites (WW-S1: Santa Ana River Reach 3 at MWD Crossing and WW-S4: Santa Ana River Reach 3 at Pedley Avenue). Conditions at the non-Santa Ana River Priority 1 sites are improved from the previous year with notable reductions at Lake Elsinore (P1-2-ELM) and Lytle Creek (P1-6).

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 while **Figure 4.11** presents the individual and geomean enterococcus concentrations at Lake Elsinore.

All *E. coli* samples collected from Canyon Lake (P1-1), Lake Perris (P1-3), Big Bear Lake (P1-4), Mill Creek (P1-5), and Lytle Creek (P1-6) during the warm and cool dry season met WQOs. A number of single sample exceedances of enterococcus were documented at Lake Elsinore (P1-2-ELM) while geomean values decreased during the warm, dry season to meet the WQOs.

The previous (2022-2023) annual RMBP report[30] highlighted conditions of concern at Lytle Creek (P1-6) and Lake Elsinore (P1-2-ELM). Monitoring data from 2023 showed improved conditions at both locations (**Figure 4.10**, **Figure 4.11**, and **Figure 4.15**). A significant reduction in *E. coli* concentration was observed in 2023 relative to 2022 for Lytle Creek. The reduced concentrations over the 25 weekly samples are most likely due to a completely different baseflow regime in the creek in 2023 relative to 2022. Flowrates measured at the downstream Lytle Creek US Geographic Survey (USGS) gauge (Station

[30] https://sawpa.gov/wp-content/uploads/2023/09/FINAL-SAR-RMP-2022-2023-Annual-Report_Clean_WP_508.pdf

#11062000: Lytle Creek near Fontana, California) corresponding to sample dates ranged from 0.1 to 5.2 cubic feet per second (cfs) in 2022 and from 27 to 105 cfs in 2023.

WQOs were not met on Reach 3 of the Santa Ana River (WW-S1 at MWD Crossing and WW-S4 at Pedley Ave). This observation is consistent with previous years and these two Santa Ana River sites are being addressed through implementation of CBRPs in the MSAR TMDL (CDM 2011a, 2011b).[31],[32]

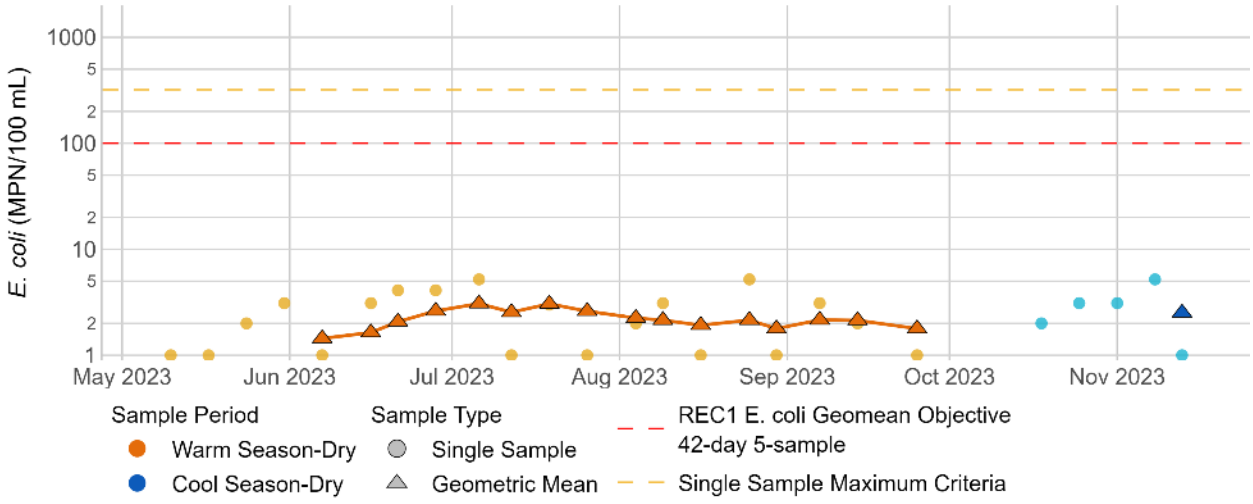


Figure 4.9. *E. coli* Concentrations and Geomeans at Canyon Lake at Holiday Harbor (P1-1)

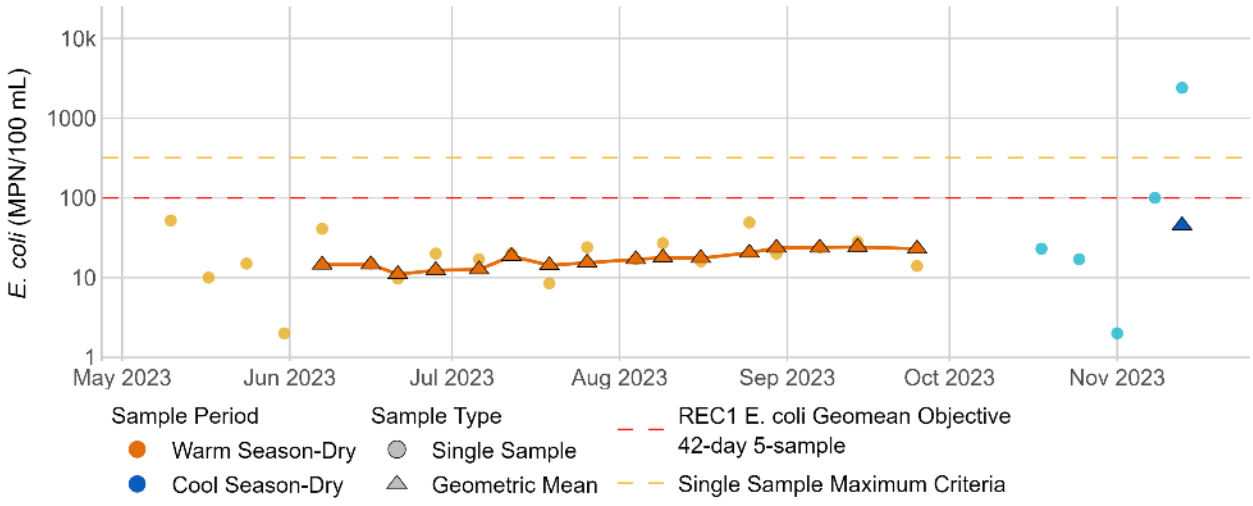


Figure 4.10. *E. coli* Concentrations and Geomeans at Lake Elsinore at Elm Grove Beach (P1-2-ELM)

[31] https://www.sawpa.gov/wp-content/uploads/2018/04/2011_CBRP_San-Bernardino-County-MS4-Program.pdf

[32] https://www.sawpa.gov/wp-content/uploads/2018/04/2011_CBRP_Riverside-County-MS4-Program.pdf

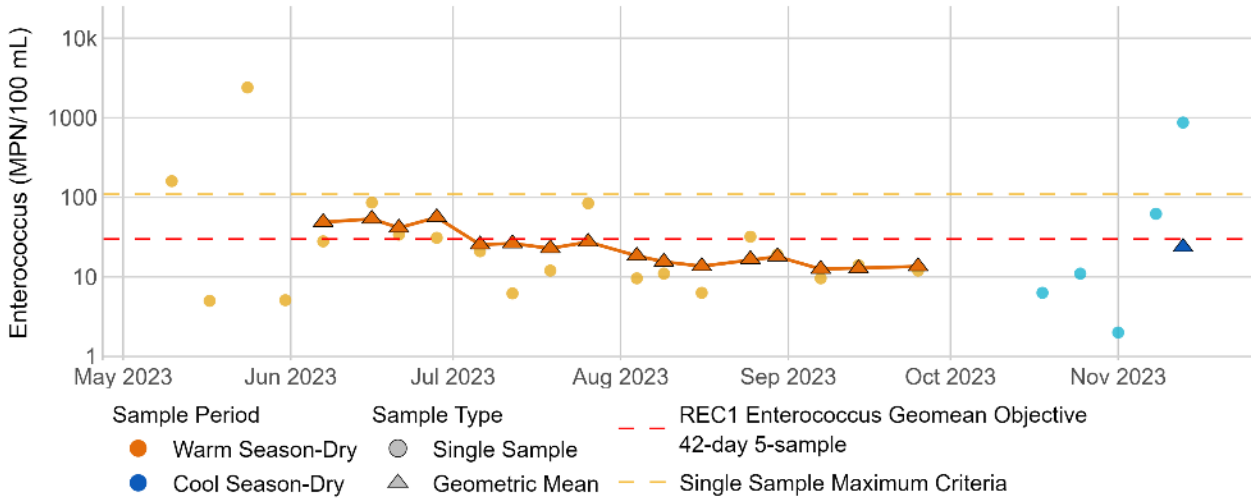


Figure 4.11. Enterococcus Concentrations and Geomeans at Lake Elsinore at Elm Grove Beach (P1-2-ELM)

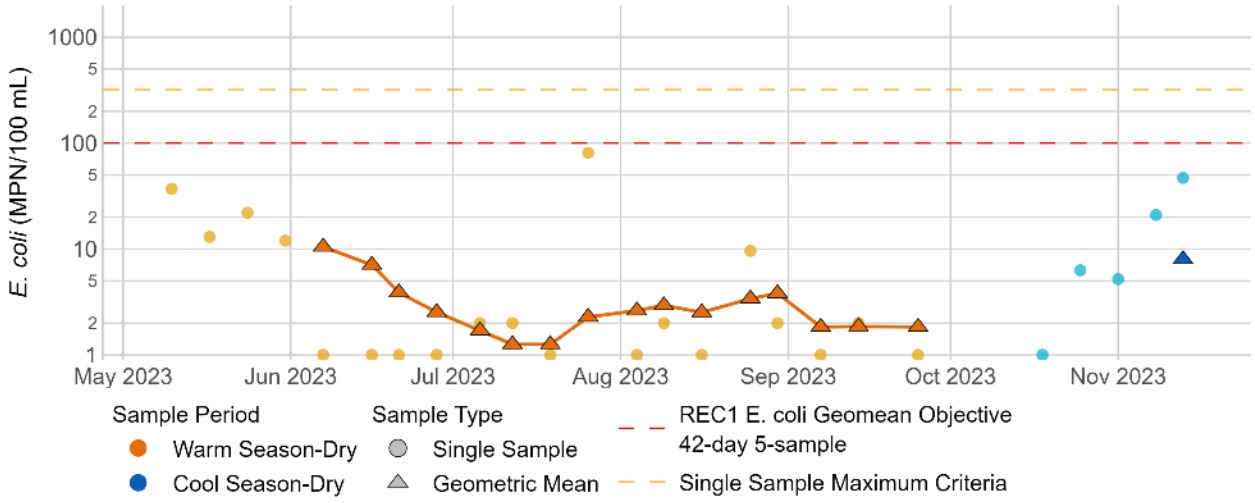


Figure 4.12. *E. coli* Concentrations and Geomeans at Lake Perris (P1-3)

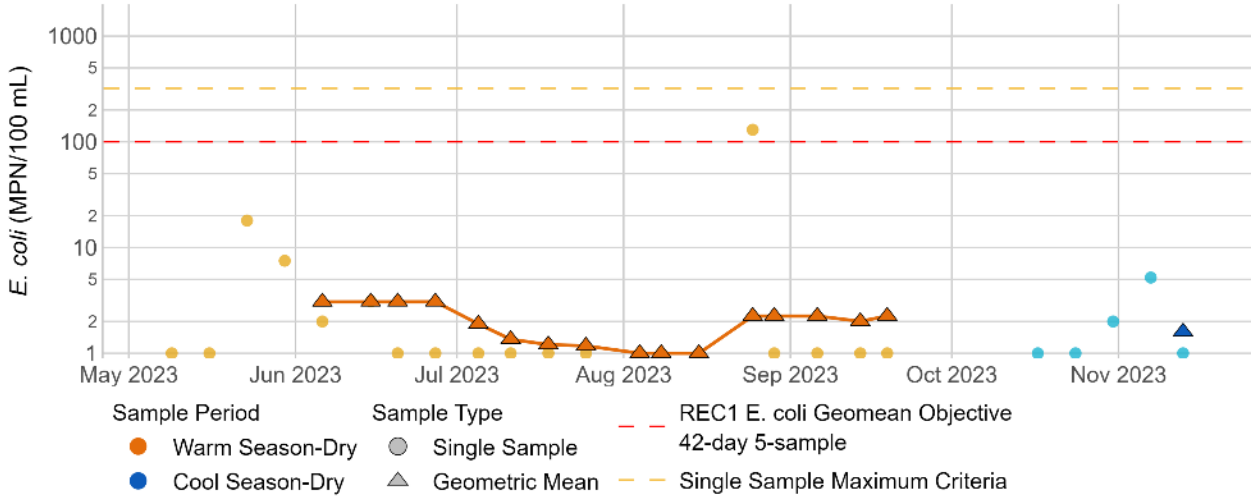


Figure 4.13. *E. coli* Concentrations and Geomeans at Big Bear Lake (P1-4)

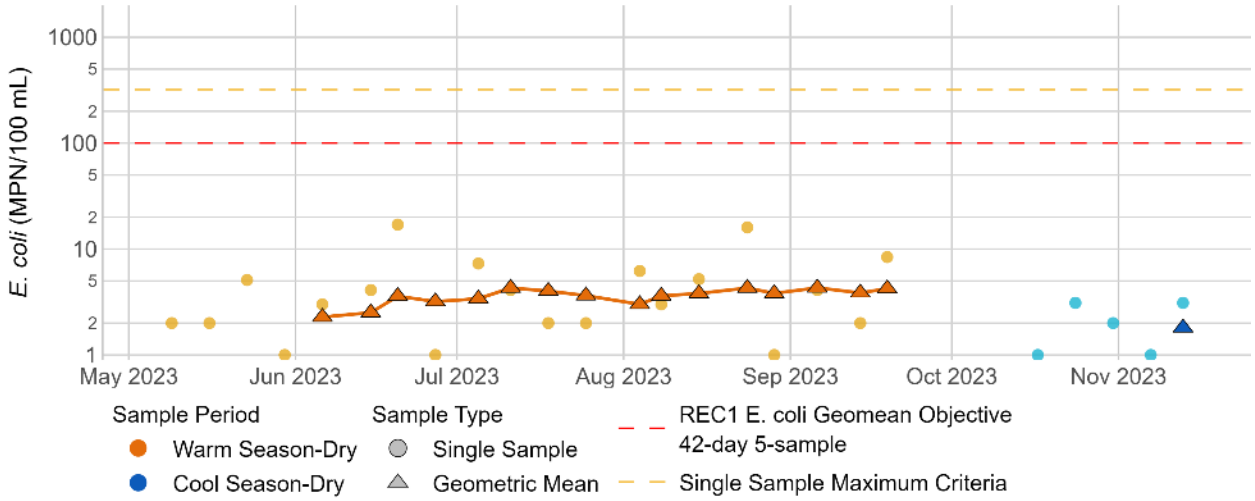


Figure 4.14. *E. coli* Concentrations and Geomeans at Mill Creek Reach 2 (P1-5)

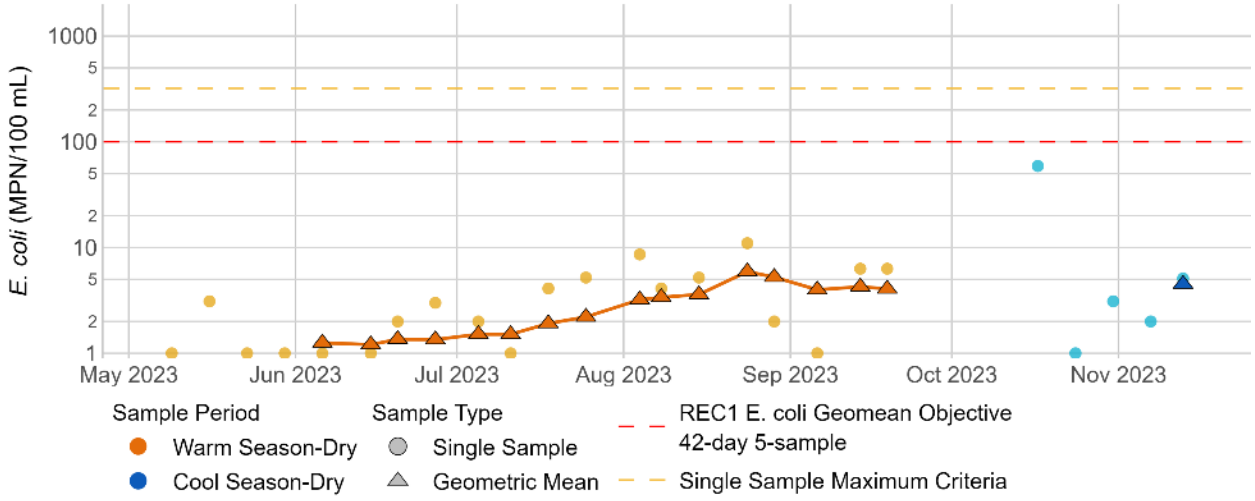


Figure 4.15. *E. coli* Concentrations and Geomeans at Lytle Creek (P1-6)

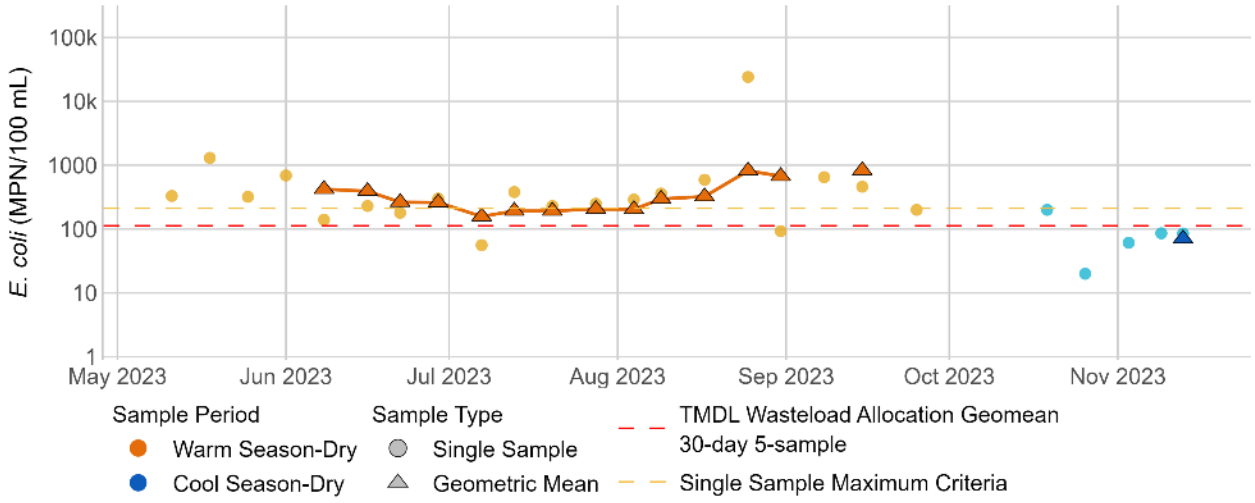


Figure 4.16. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

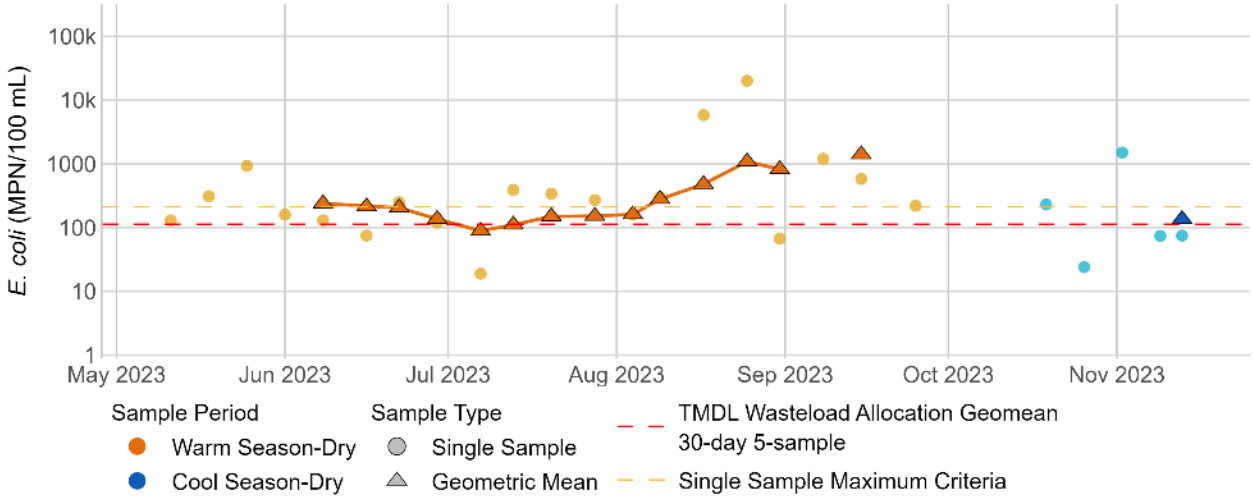


Figure 4.17. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

4.1.3 Bacteria Compliance Analysis

The compliance analysis compares 2023 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 part per thousand (ppth), 95 percent or more of the time, a six-week rolling geometric mean not to exceed 100 cfu/100 mL, calculated weekly, and 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.

Table 4.2 presents the monitoring season frequency of exceedance with the applicable Statewide Bacteria Provision for REC-1 waters.

Table 4.2. 2023-2024 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 Objectives During the Dry Weather Monitoring

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]	24	12
P1-3	Lake Perris	0	0
P1-4	Big Bear Lake	0	0
P1-5	Mill Creek Reach 2	0	0

Site ID	Site	Geometric Mean Criterion Exceedance Frequency (%)	STV Criterion Exceedance Frequency (%)
P1-6	Lytle Creek (Middle Fork)	0	0
WW-S1	Santa Ana River Reach 3 at MWD Crossing	94	60
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	94	56

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

Three Priority 1 sites exceeded the geomean and STV WQOs: 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). Geomean exceedance frequencies at Lake Elsinore are reduced when compared to 2022 (100% in 2022 versus 24% in 2023) and similar when compared to 2022 at the Santa Ana River sites (100% in 2022 versus 94% in 2023). STV exceedance frequencies increased at WW-S4: Santa Ana River at Pedley Avenue (17% in 2022 versus 56% in 2023). Both geomean and STV exceedance frequencies improved to 0% at P1-6: Lytle Creek (Middle Fork).

The percentage of samples exceeding the STV per month at the Santa Ana River Priority 1 sites is shown in **Table 4.3**. More STV exceedances were observed throughout the season at Pedley Avenue when compared to 2022.

Table 4.3. Monthly Frequency of Exceedance of STV (320 MPN/100 mL) Water Quality Objective During the 2023 Dry Weather Monitoring for the Santa Ana River Sites

Month	Number of Samples Collected	STV Criterion Exceedance Frequency (%)	
		SAR @ MWD Crossing	SAR @ Pedley Avenue
May	3	100	50
June	5	50	25
July	4	75	75
August	4	75	60
September	4	67	100
October	3	0	50
November	2	0	33

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** with key observation noted below.

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

Site ID	Site Description	County
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

- **pH** - **Figure 4.18** shows that all the pH measurements were within the allowable limits (6.5 – 8.5 S.U.) at all Priority 2 sites except Prado Park Lake (WW-C3). Prado Park Lake had 21 samples (84% of the total number of samples) recorded above the maximum pH threshold. Prado Park Lake had similar pH values during the 2022 monitoring season.

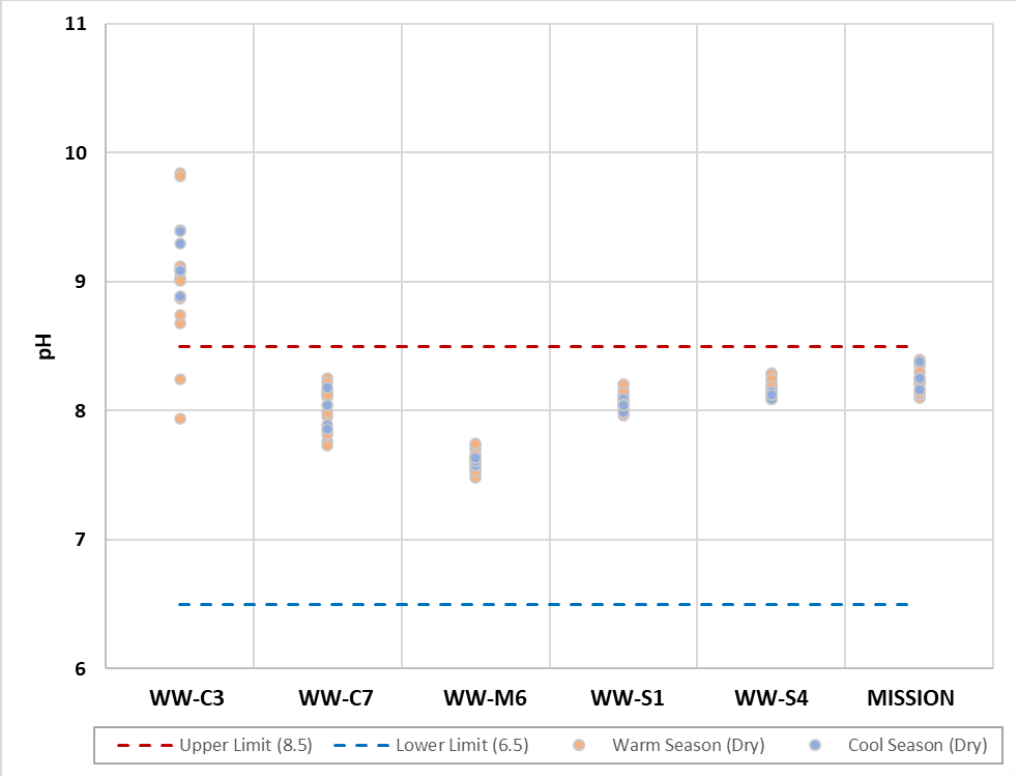


Figure 4.18. Distribution of pH Measurements at Priority 2 Sites

- **Water temperature** - Water temperatures were generally similar in 2023 to those recorded in 2022 (**Figure 4.19**) with slight increases in temperature seen at Prado Park Lake (WW-C3) during the 2023 dry season. On average, temperatures are higher in the upstream mainstem Santa Ana River (MISSION) and decrease as flow continues downstream (WW-S4 and WW-S1).

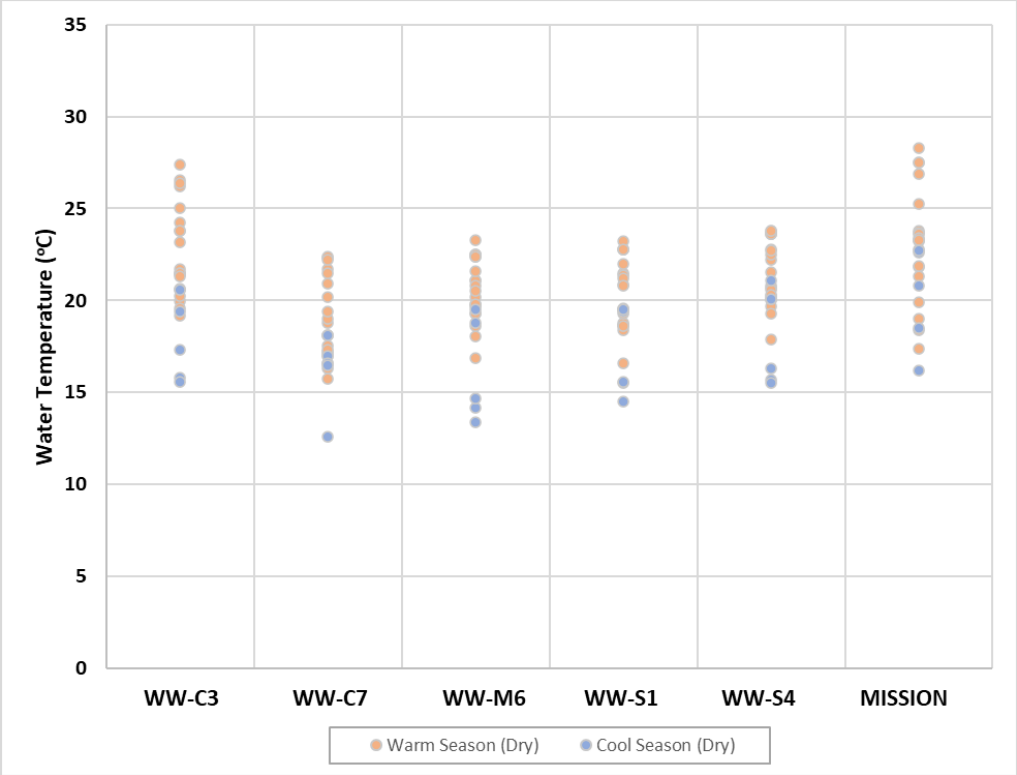


Figure 4.19. Distribution of Water Temperature Measurements at Priority 2 Sites

- **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 (MISSION, WW-S1, and WW-S4) and Prado Park Lake (WW-C3) are greater than 5 mg/L (**Figure 4.20**). One sample from Chino Creek (WW-C7) and four samples from Mill Cucamonga Creek (WW-M6) were below 5 mg/L. Low DO levels at Chino Creek and Mill Cucamonga Creek are typical of those seen in previous years.

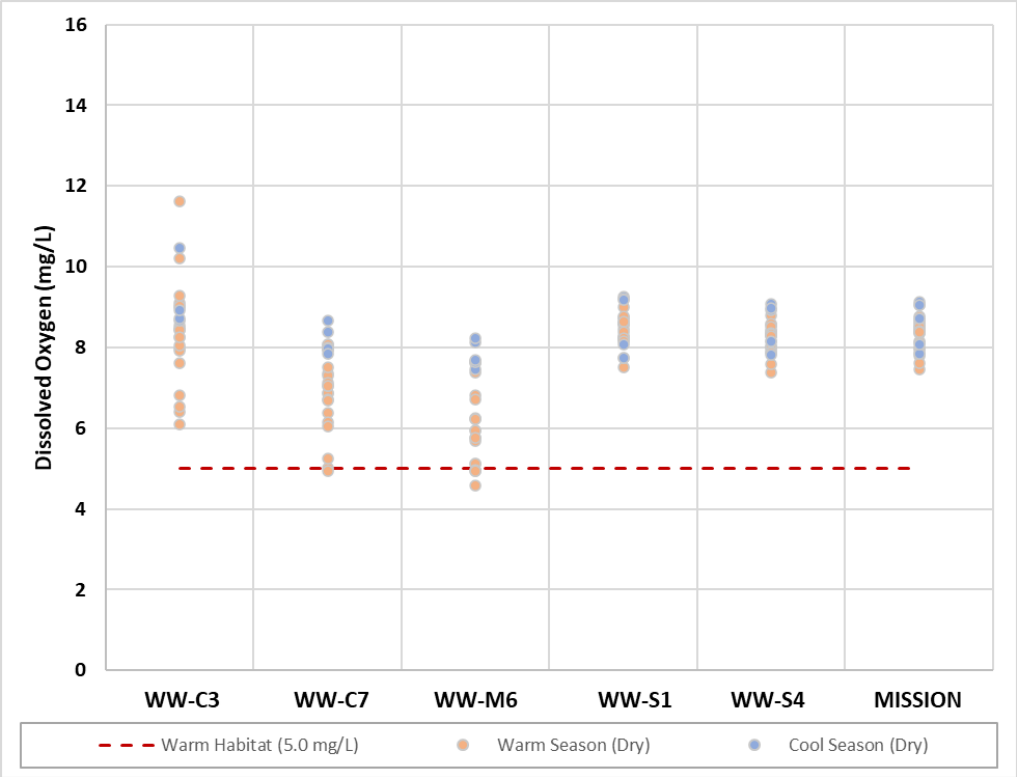


Figure 4.20. Distribution of Dissolved Oxygen Measurements at Priority 2 Sites

- **Specific conductivity** - **Figure 4.21** shows that specific conductivity is generally similar at the three Santa Ana River sites, generally increasing as flow continues downstream, ranging from 468 µS/cm to 1032 µS/cm. Specific conductivity in Prado Park Lake, Chino Creek, and Mill Cucamonga Creek was also similar to values recorded in 2022. Peak values were recorded at all sites during summer months when temperatures were also highest.

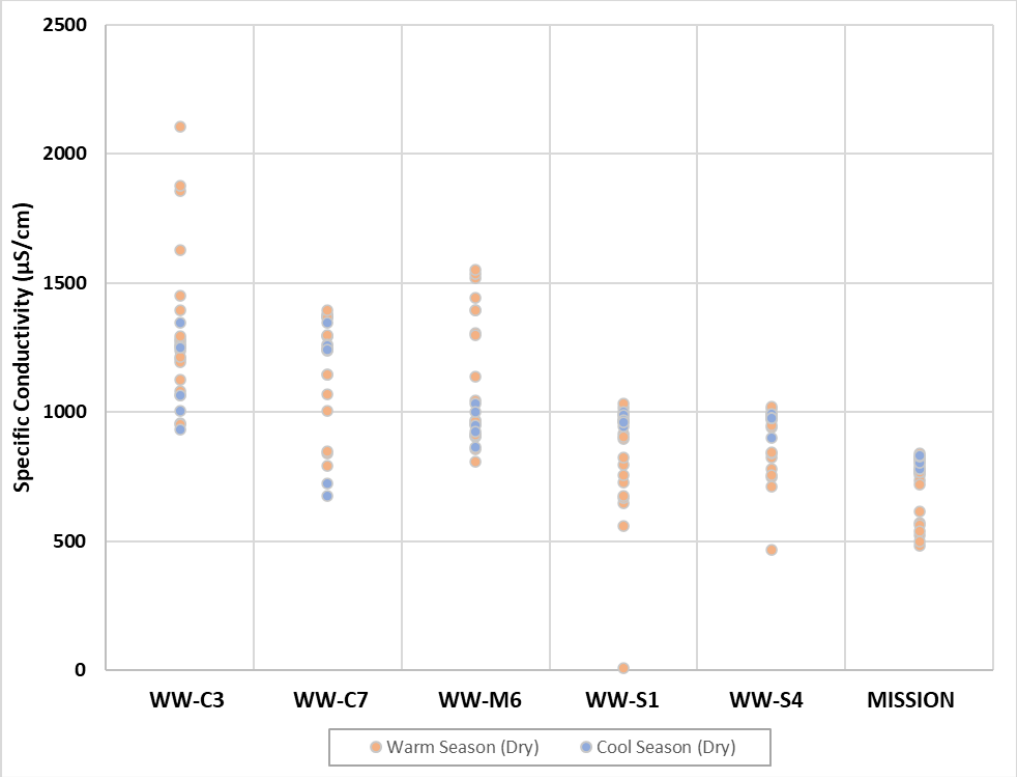


Figure 4.21. Distribution of Specific Conductivity Measurements at Priority 2 Sites

- **Turbidity and TSS** - **Figure 4.22** and **Figure 4.23** show that turbidity and TSS are low to moderate in Prado Park Lake (WW-C3), Chino Creek (WW-C7), and Mill Cucamonga Creek (WW-M6). The Santa Ana River sites had variable ranges of turbidity and TSS during the warm dry season with lower values recorded during the cool dry season.

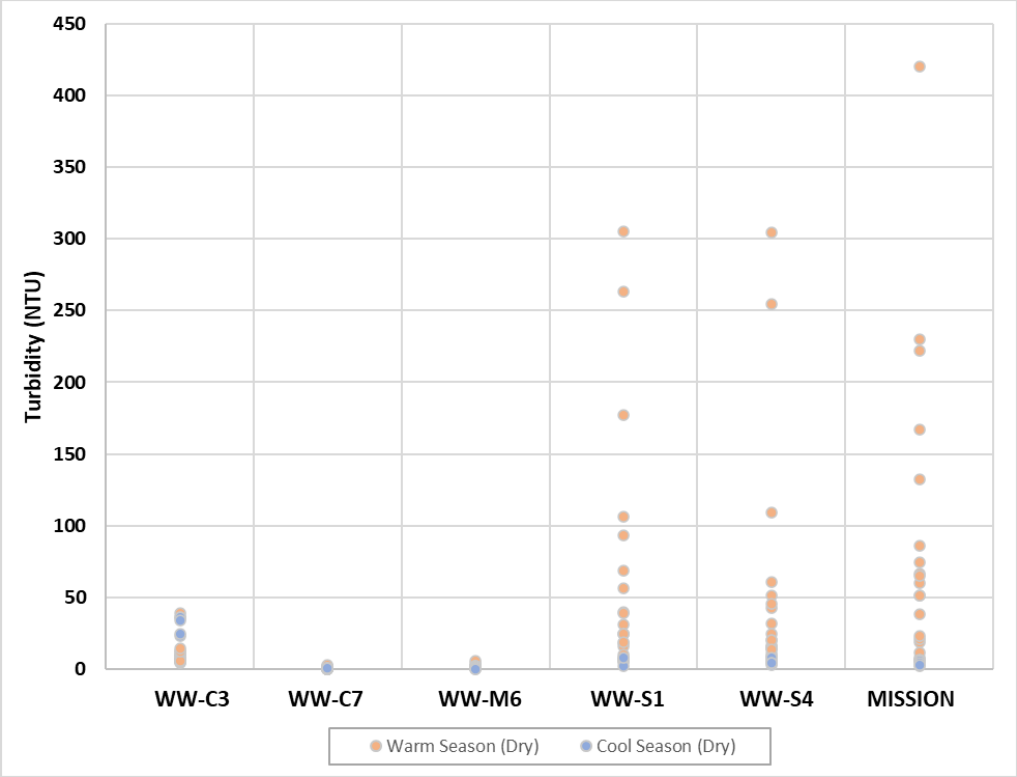


Figure 4.22. Distribution of Turbidity Measurements at Priority 2 Sites

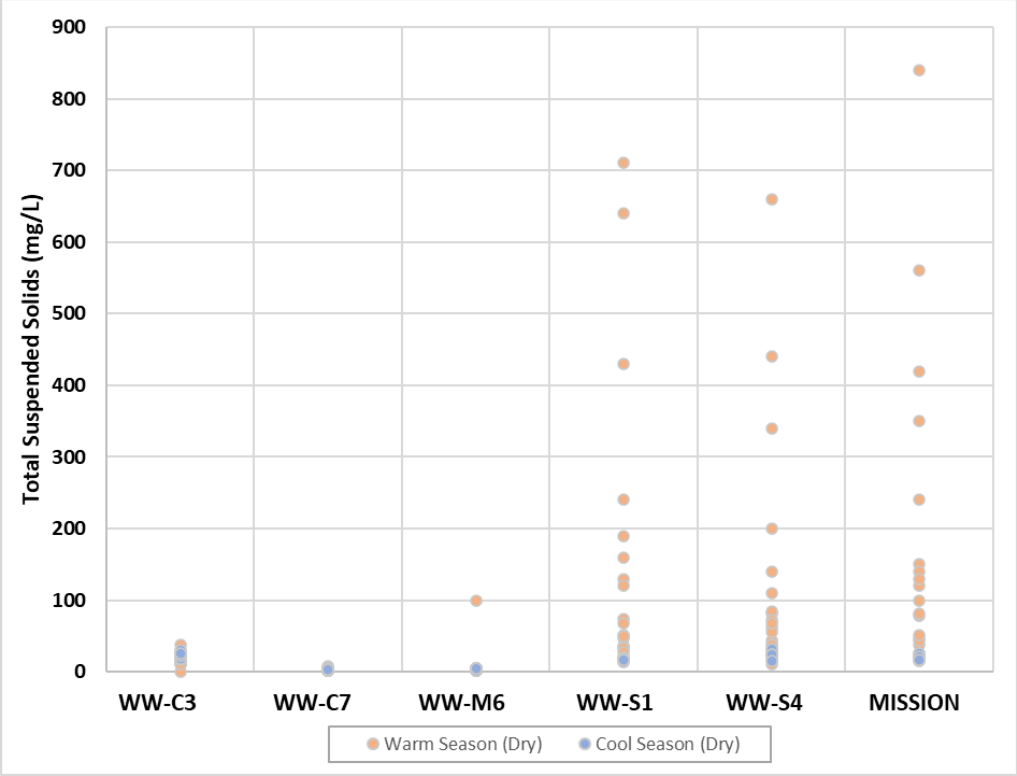


Figure 4.23. Distribution of TSS Measurements at Priority 2 Sites

- **Flow** - **Figure 4.24** shows that measured flow is lowest below Prado Park Lake (WW-C3) with rates ranging from 0.2 to 8.1 cfs. Chino and Mill-Cucamonga Creeks (WW-C7 and WW-M6, respectively) had slightly higher but similar ranges of flow (6.4 to 54.5 cfs and 2.0 to 59.2 cfs, respectively). Flow is higher in the Santa Ana River and highest at the most downstream site: Santa Ana River at Pedley Avenue (WW-S4). Maximum flow at Santa Ana River at Pedley Avenue (202.0 cfs) is approximately 77 percent higher than the maximum flow at Santa Ana River at MWD Crossing (114.2 cfs) due to effluent discharge from Riverside Water Quality Control Plant (WQCP).

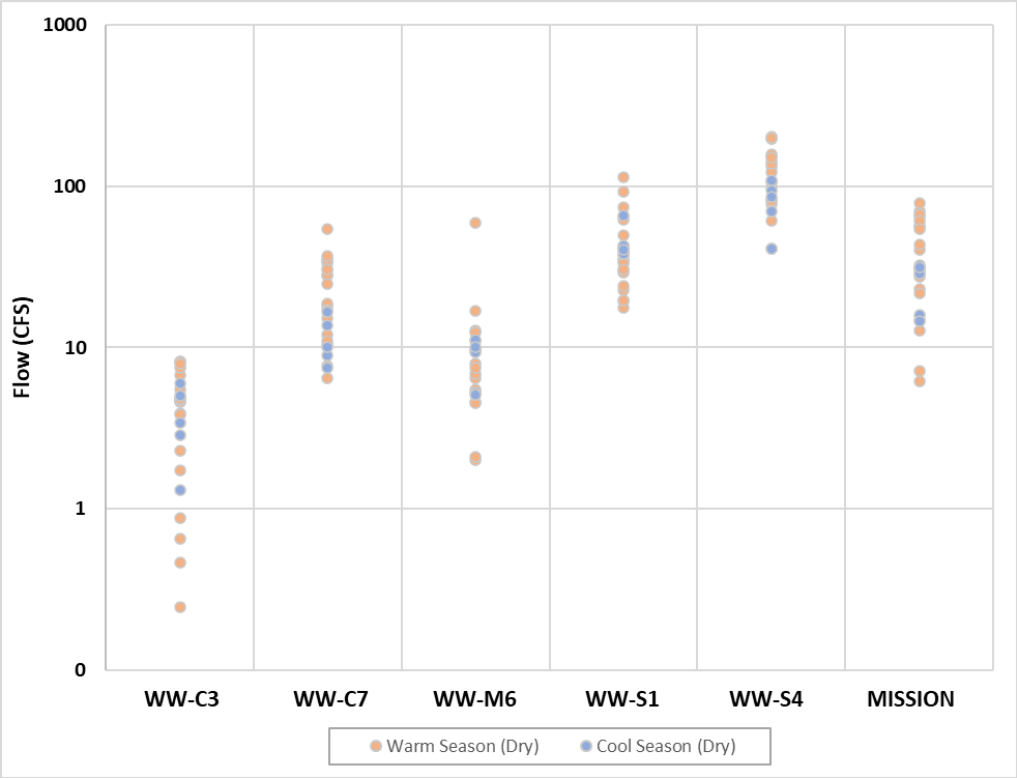


Figure 4.24. Distribution of Flow Measurements at Priority 2 Sites

4.2.2 Bacteria Characterization

Geomeans for Priority 2 sites were calculated using a five-sample minimum, 30-day geomean per the 2005 TMDL requirements.

4.2.2.1 Dry Weather

Figure 4.25 summarizes the distribution of the geomeans of *E. coli* concentrations observed at Priority 2 sites during the warm, and cool, dry seasons. Note that the Santa Ana River at Mission Blvd Bridge site (WW-MISSION) is included with Priority 2 monitoring summaries, however, the site is not used to assess TMDL compliance. Instead, this site provides an understanding of load from upstream sources, comprised of non-MS4 flows during typical dry weather conditions; however, in the 2023-2024 sampling season there was a hurricane in the middle of the dry season, which resulted in higher flows for weeks after the hurricane. During this time, it appears likely there was connectivity along the river systems in places that are typically dry during the dry season (e.g. in Reach 3 upstream of the wastewater

treatment plant discharge). Therefore, there may be contributions from MS4 sources in the MSAR study area.

In 2023, no Priority 2 site was in attainment with the TMDL WLAs during the warm, dry season. Geomeans from Chino Creek (WW-C7) and Santa Ana River at Pedley Avenue (WW-S4) also exceeded the TMDL WLA during the cool, dry season. Cool, dry season geomeans were lower at the remaining sites when compared to 2022 data which generally did not attain the WLA. Although single value sample results for bacteria spiked following the hurricane event in August, the geomean responses were more muted.

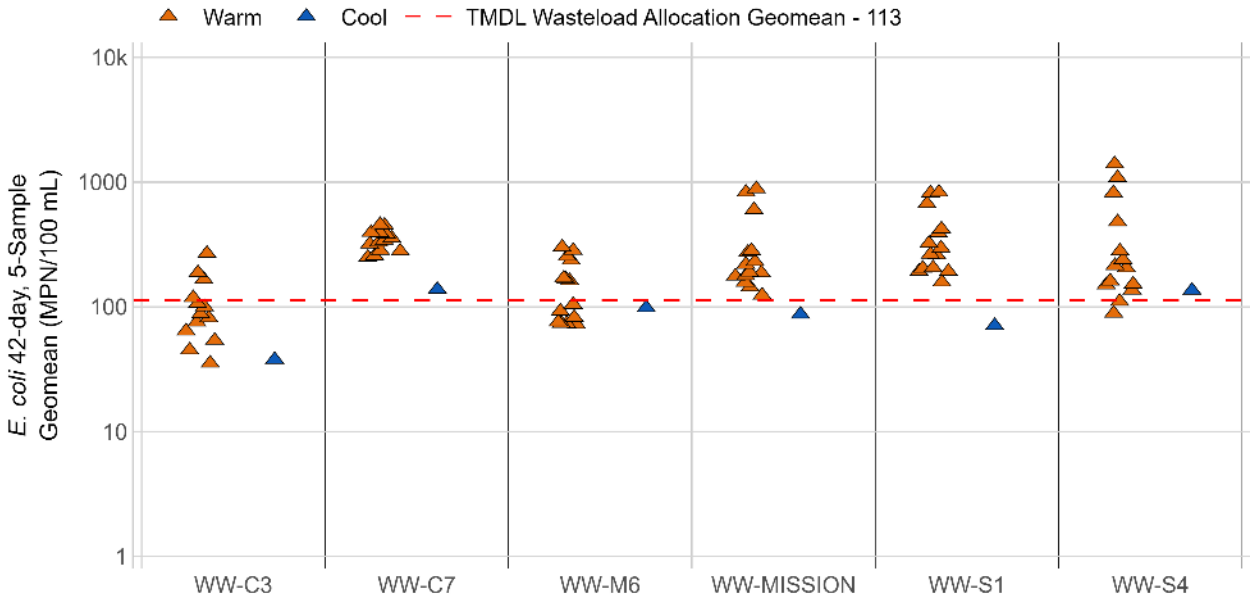


Figure 4.25. Distribution of *E. coli* Concentrations at Priority 2 Sites

Figure 4.26 through **Figure 4.31** show the individual and rolling geomean *E. coli* concentrations during the 2023-2024 monitoring period.

E. coli concentrations at Prado Park Lake (WW-C3) ranged from 6 to 2,400 MPN/100 mL (**Figure 4.26**). This range is more variable with a higher maximum than was observed in 2022 (5 to 280 MPN/100 mL). Data from both 2022 and 2023 showed that the bacteria concentrations in the lake began to increase mid-summer. Bacteria levels remained relatively high throughout the remainer of the dry season in 2022 with the geomean exceeding the TMDL threshold whereas 2023 values steadily decreased and came into compliance in the fall.

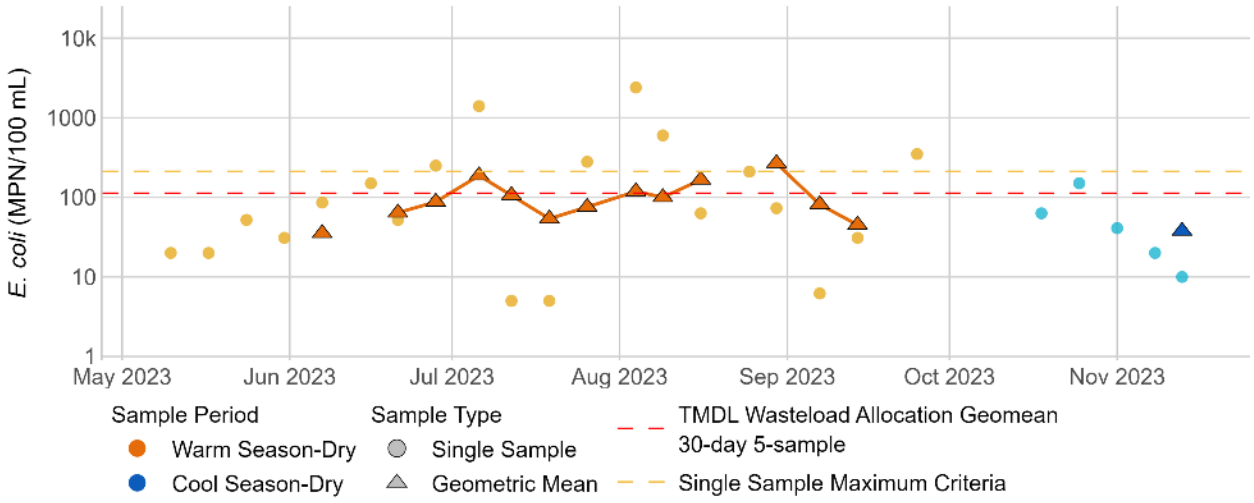


Figure 4.26. *E. coli* Concentrations and Geomeans at Prado Park Lake (WW-C3)

Figure 4.27 shows that bacteria data at Chino Creek (WW-C7) consistently saw geomean values above the TMDL threshold. Bacteria levels rose following the August 20, 2023 hurricane event (610 and 2,300 MPN/100 mL during the weeks of August 20 and August 27, respectively). Levels dropped dramatically the third week after the event (22 MPN/100 mL during the week of September 3). Bacteria levels returned to more typical values one month post-event with a slight decline seen during the cool, dry season. Note that the cool, dry season geomean value remained above the TMDL WLA.

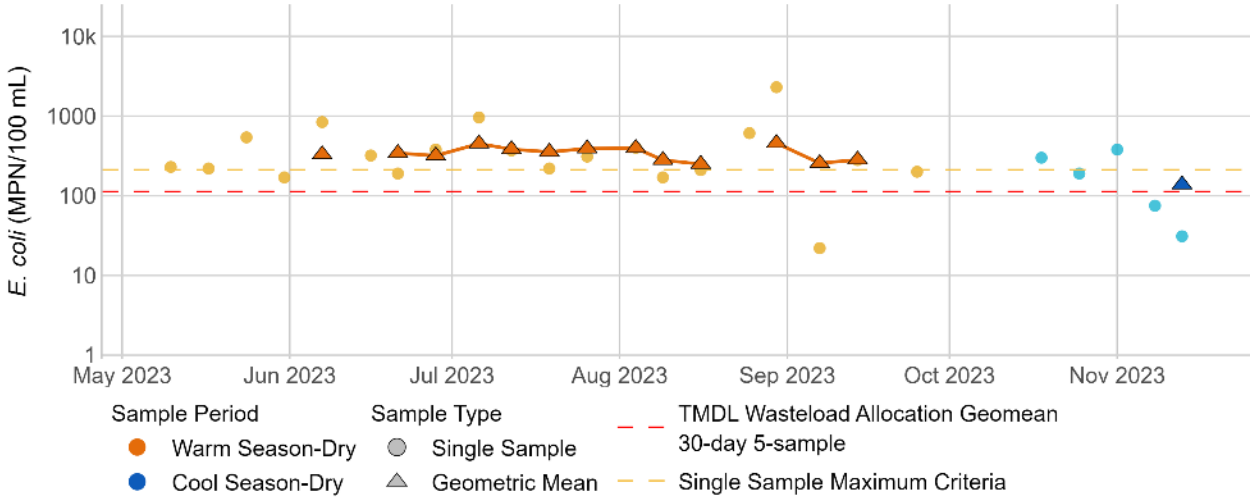


Figure 4.27. *E. coli* Concentrations and Geomeans at Chino Creek at Central Avenue (WW-C7)

Geomean values at Mill-Cucamonga Creek; WW-M6 (**Figure 4.28**) were slightly above the TMDL threshold and then dipped below the threshold for portions of July and August before rising again following the hurricane. The cool, dry geomean was below the threshold. Conditions in Mill-Cucamonga Creek (WW-M6) have improved 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* (more details on the 10-week synoptic surveys used to estimate this reduced loading are provided in the 2023 Triennial TMDL Report).

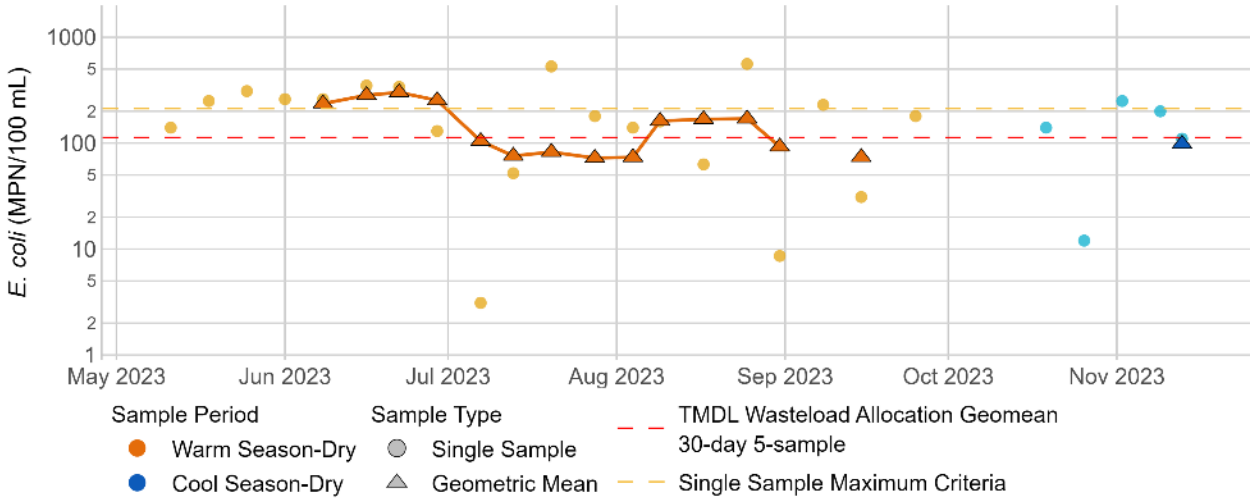


Figure 4.28. *E. coli* Concentrations and Geomeans at Mill-Cucamonga Creek Below Wetlands (WW-M6)

For the Santa Ana River monitoring sites (**Figure 4.29** through **Figure 4.31**), *E. coli* geomeans consistently exceeded the TMDL WLA (30-day rolling geomeans ranged from 133 to 895 MPN/100 mL) prior to the August hurricane. All sites show a similar pattern that saw geomeans above the threshold at the beginning of the season followed by slight decreases through early summer with large spikes in single samples and corresponding geomeans following the August hurricane. Samples from the week of August 20, 2023 were seasonal maximums of 24,000; 20,000; and 24,000 MPN/100 mL at MWD Crossing, Pedley Avenue, and Mission Avenue, respectively). Bacteria levels in the Santa Ana River sites declined dramatically the following week before resuming more typical levels into fall. Note that the cool, dry season geomeans at MWD Crossing (WW-S1) and Mission Avenue (MISSION) were in compliance with the TMDL WLA. None of the Santa Ana River sites were below this threshold during the cool, dry season in 2022.

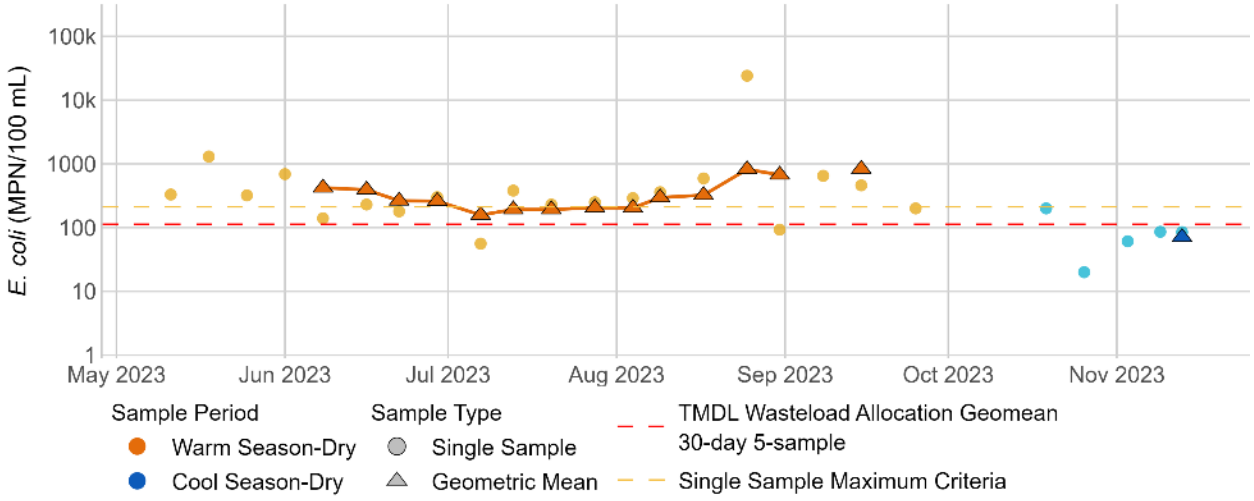


Figure 4.29. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

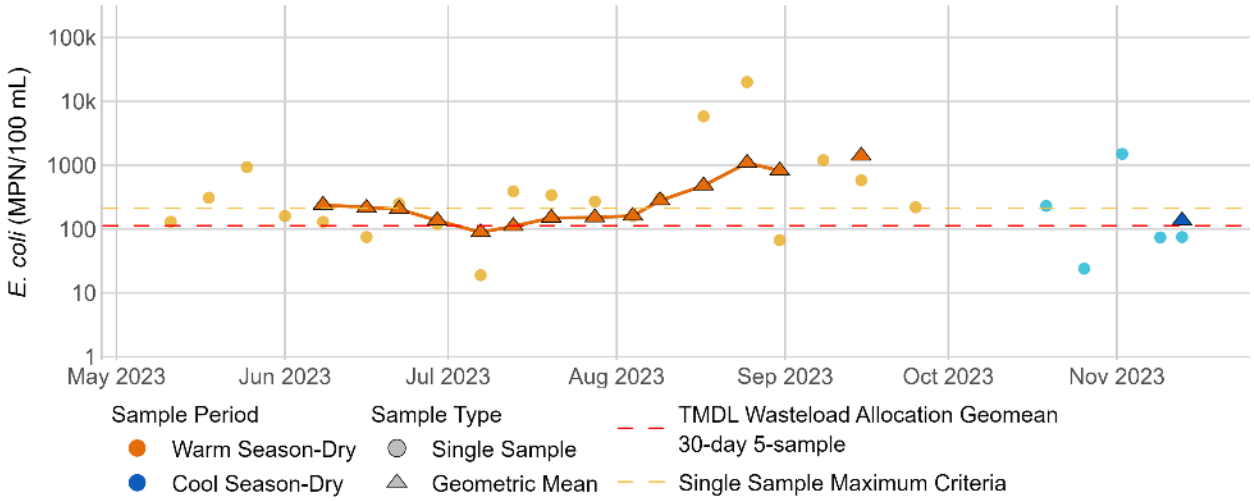


Figure 4.30. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

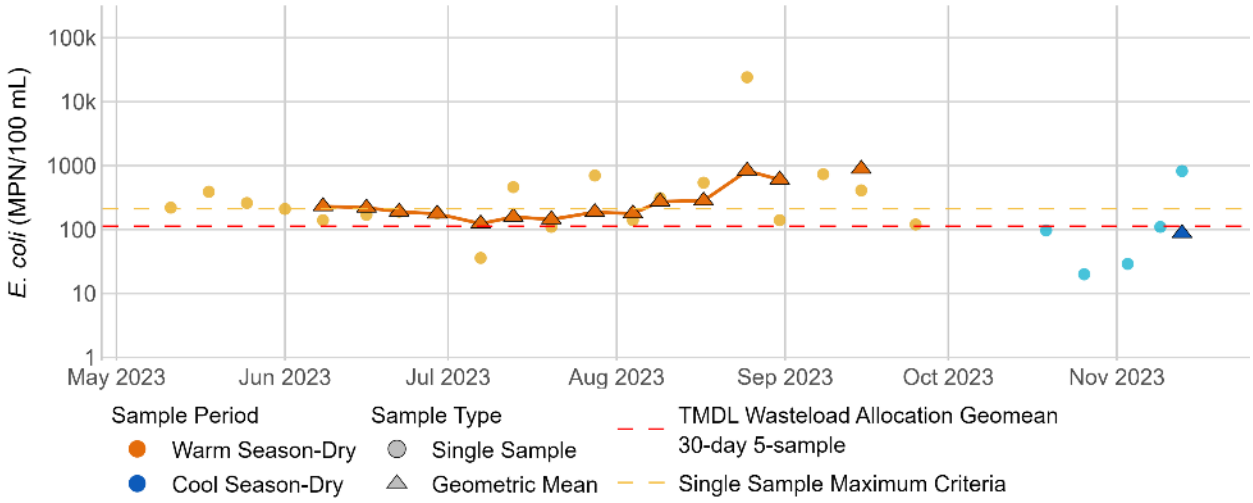


Figure 4.31. *E. coli* Concentrations and Geomeans at Santa Ana River at Mission Avenue (MISSION)

4.2.2.2 Wet Weather 2023-2024 Event

A number of wet weather events occurred in early 2024 that were not targeted for monitoring due to safety concerns associated with the amount of precipitation and/or storm timing that impacted the sampling crew's ability to deliver samples to the receiving laboratory during regular business hours. Wet weather samples were collected following a precipitation event beginning February 20, 2024. Precipitation records from the Ontario International Airport[33] show that the area received the following rainfall during the targeted storm event:

- 0.38 inches on February 19, 2024
- 2.04 inches on February 20, 2024
- 0.76 inches of February 21, 2024

Samples collected during the storm event are summarized in **Table 4.5**.

[33] National Weather Service. NOAA Online Weather Data. Climatological Data for Ontario International Airport, California. February 2024.

Table 4.5. *E. coli* Concentrations (MPN/100 mL) Observed During the 2023-2024 Storm Event

Site	2/20/2024 During Storm	2/21/2024 24 hours after storm start	2/22/2024 48 hours after storm start	2/23/2024 72 hours after storm start
Prado Park Lake (WW-C3)	20,000	24,000	11,000	24,000
Chino Creek at Central Avenue (WW-C7)	3,200	10,000	1,300	6,700
Mill-Cucamonga Creek below Wetlands (WW-M6)	12,000	3,900	750	220
SAR Reach 3 at MWD Crossing (WW-S1)	14,000	5,800	930	360
SAR Reach 3 at Pedley Avenue (WW-S4)	16,000	14,000	1,500	270

Figure 4.32 and **Figure 4.33** display changing E. *coli* concentrations at two stations (Chino Creek: WW-C7 and Mill-Cucamonga Creek: WW-M6) over the sampling period. Discharge data from USGS gauges located upstream of the compliance monitoring sites on Chino Creek (11073495) and Cucamonga Creek (11073360) are also shown on the figures. As shown in **Figure 4.32**, the initial sample collected at Chino Creek was before the peak flow was experienced at the site. It is possible that the upper reaches of the drainage area had not yet drained resulting in the lower initial sample result.

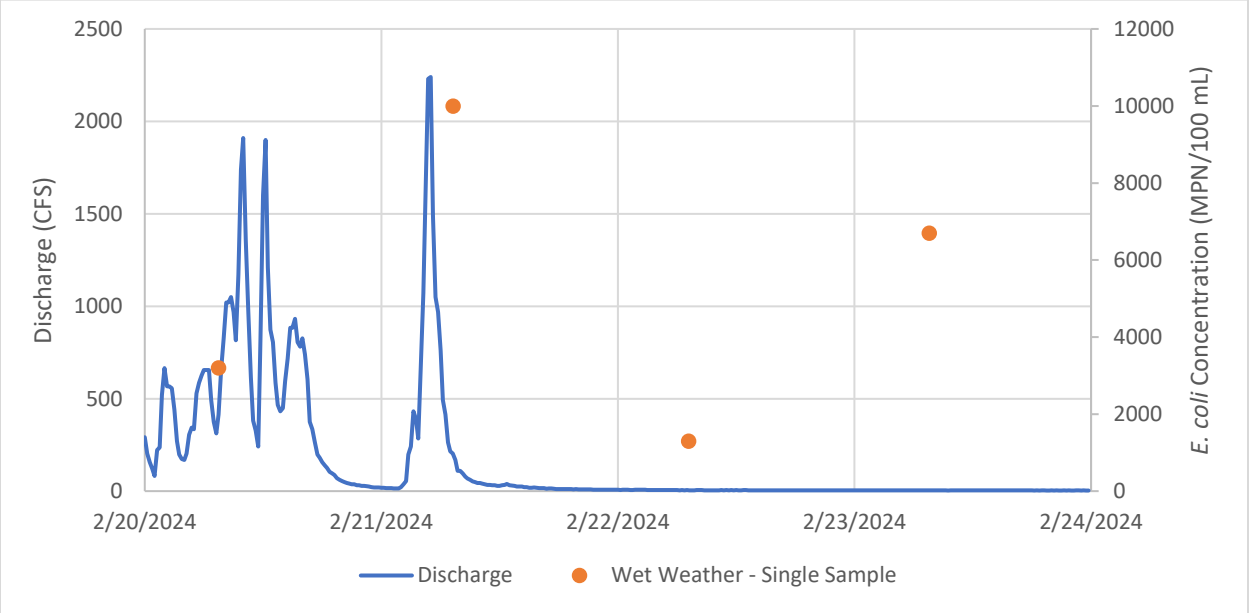


Figure 4.32. *E. coli* Concentrations Observed at Chino Creek During and After the February 20, 2024 Storm Event

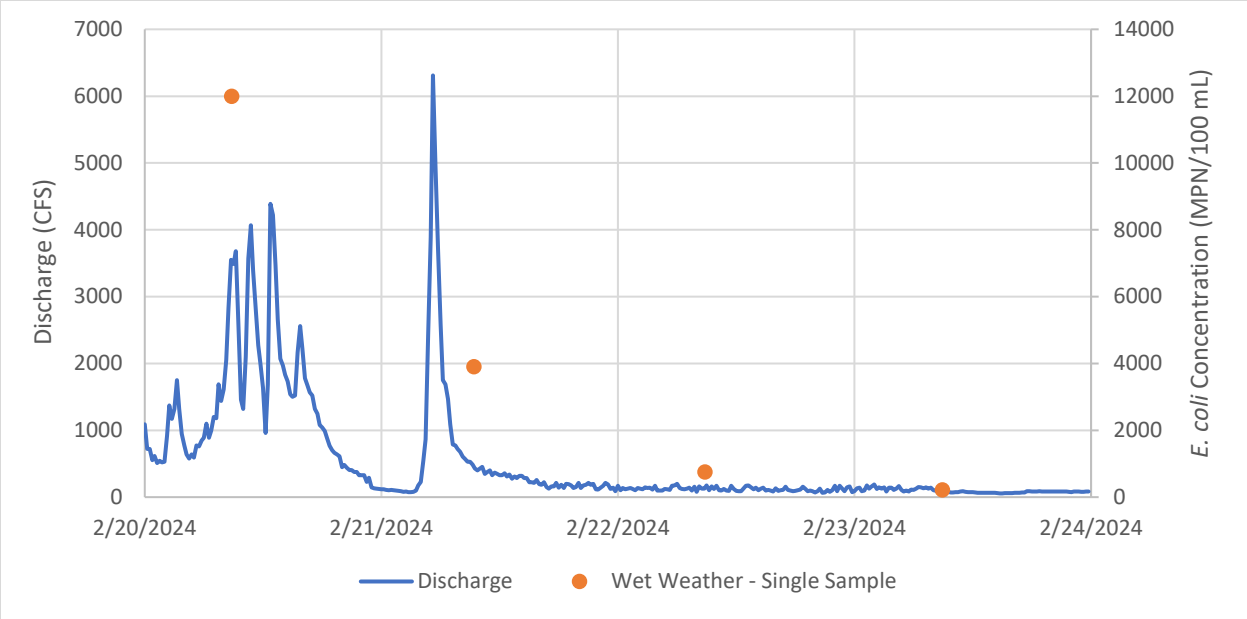


Figure 4.33. *E. coli* Concentrations Observed at Mill-Cucamonga Creek During and After the February 20, 2024 Storm Event

Figure 4.34 shows a hydrograph analysis that was conducted for all storm events sampled by the MSAR Task Force since 2007 to determine which follow-up samples were collected during active wet weather or post-storm, that is, whether or not flow had returned to pre-wet weather event conditions. Analysis of the full set of post-storm samples shows that *E. coli* concentrations decline most sharply within the first 24 hours following a return to a pre-event flow condition for all the impaired waters. Thus, it is possible that controls implemented to address dry weather *E. coli* loads may also provide significant protection to potential swimmers 24 hours post-storm.

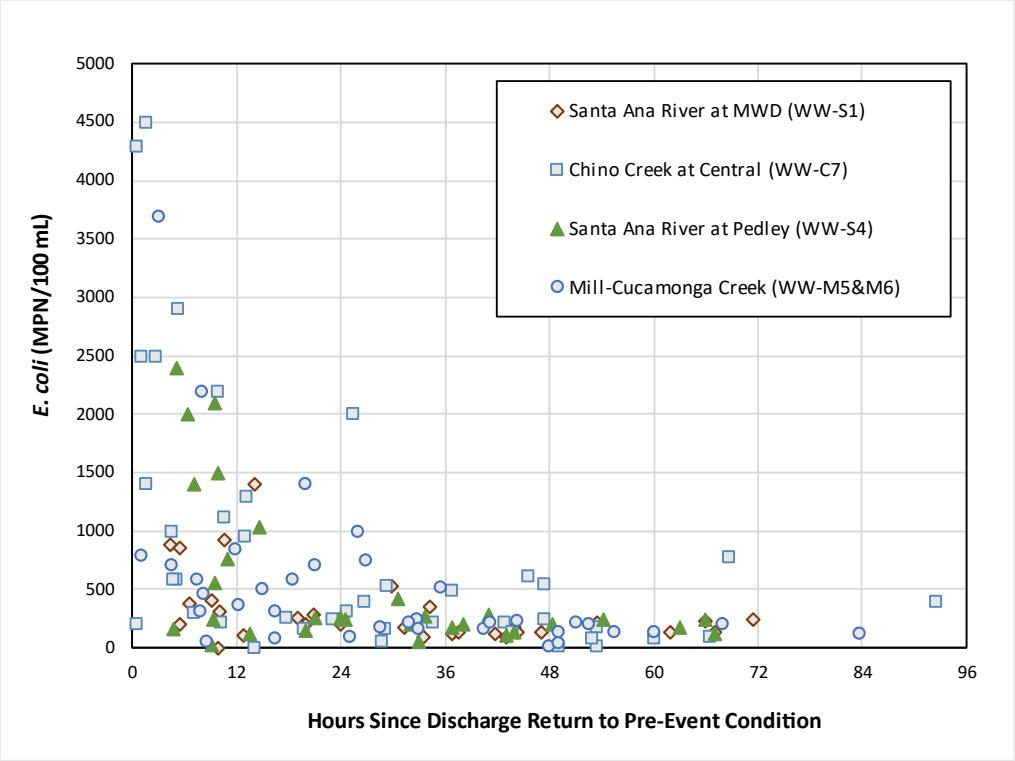


Figure 4.34. *E. coli* Concentrations for All Post-storm Samples Based on the Time Since the Return of Pre-Wet Weather Event Flow Conditions (2007-2023)

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 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.

Table 4.6 and **Table 4.7** show the geomean and STV exceedance frequencies. Exceedances occurred during most months at several sites. Many of the Priority 2 geomeans exceeded the MSAR TMDL WLAs/LAs (**Table 4.6**), including all geomeans calculated at Chino Creek at Central Avenue (WW-C7) in both the warm and cool portions of the dry season, all warm, dry season geomeans at MWD Crossing (WW-S1) and the cool, dry geomean at Pedley Avenue (WW-S4).

Table 4.6. Frequency of Exceedance with MSAR TMDL WLAs/LAs for *E. coli* (113 MPN/100 mL) for the 2023 Dry Weather Samples

Site ID	Site	Warm, Dry Season Geomean WLA/LA Exceedance Frequency (%)	Cool, Dry Season Geomean WLA/LA Exceedance Frequency (%) (n=1)
WW-C3	Prado Park Lake	31%[1]	0%
WW-C7	Chino Creek at Central Avenue	100%[1]	100%
WW-M6	Mill-Cucamonga Creek	50%[2]	0%
WW-S1	Santa Ana River at MWD Crossing	100%[2]	0%
WW-S4	Santa Ana River at Pedley Avenue	86%[2]	100%

Notes:

[1] Prado Park Lake and Chino Creek at Central Avenue were calculated out of 13 geomean calculations due to the fifth samples being collected outside of 30-day geomean calculation period.

[2] Mill-Cucamonga Creek, SAR at MWD Crossing, and SAR at Pedley Avenue were calculated out of 14 geomean calculations due to the 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 2023 Dry Weather Samples for the Santa Ana River Sites

Month	Number of Samples Collected	STV Criterion Exceedance Frequency (%)				
		Prado Park Lake (WW-C3)	Chino Creek at Central Avenue (WW-C7)	Mill-Cucamonga Creek (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
May	4	0%	75%	75%[1]	100%[1]	50%[1]
June	4	25%	75%	75%	50%	25%
July	4	50%	100%	25%	75%	75%
August	5	40%	60%	25%	75%	60%
September	3	33%	33%	33%	67%	100%
October	2	0%	50%	0%	0%	50%
November	3	0%	0%	33%	0%	33%

Note:

[1] The sample taken on June 1st included in May total to match sampling of other sites which were taken May 31st.

Figure 4.35 provides 2023 geometric means of *E. coli* during the warm, dry season compared with long-term site geomeans. Changes in 2023 could be attributed to construction activity within the river bottom prior to the 2023 dry season that involved homeless encampment cleanups, reworking the sediment of the riverbed, and rerouting of the low flow channel away from levees. Details of the construction and zones of work within the river bottom were reported by RCFC&WCD in April 2023.[34] A significant increase in 2023 *E. coli* levels was observed at Priority 3 site P3-SBC1 (Santa Ana River Reach 4 above S. Riverside Avenue Bridge) relative to historical levels within Reach 4 prior to the transition to Reach 3 at Mission Avenue. This could be associated with movement of an in-stream source (e.g., wildlife, homeless encampments, swimmers, etc.) away from the construction in the vicinity of the

[34] https://sawpa.gov/wp-content/uploads/2023/04/4.17.2023-Riverside-Levees-Presentation.pdf

Mission Avenue Bridge. The 2023 MSAR TMDL Triennial Report[35] provides more in-depth analysis of the segment of the Santa Ana River upstream from Mission Avenue, including recommendations for further study to either identify a controllable source to be eliminated or to determine the portion of upstream loading that may be associated with uncontrollable[36] sources.

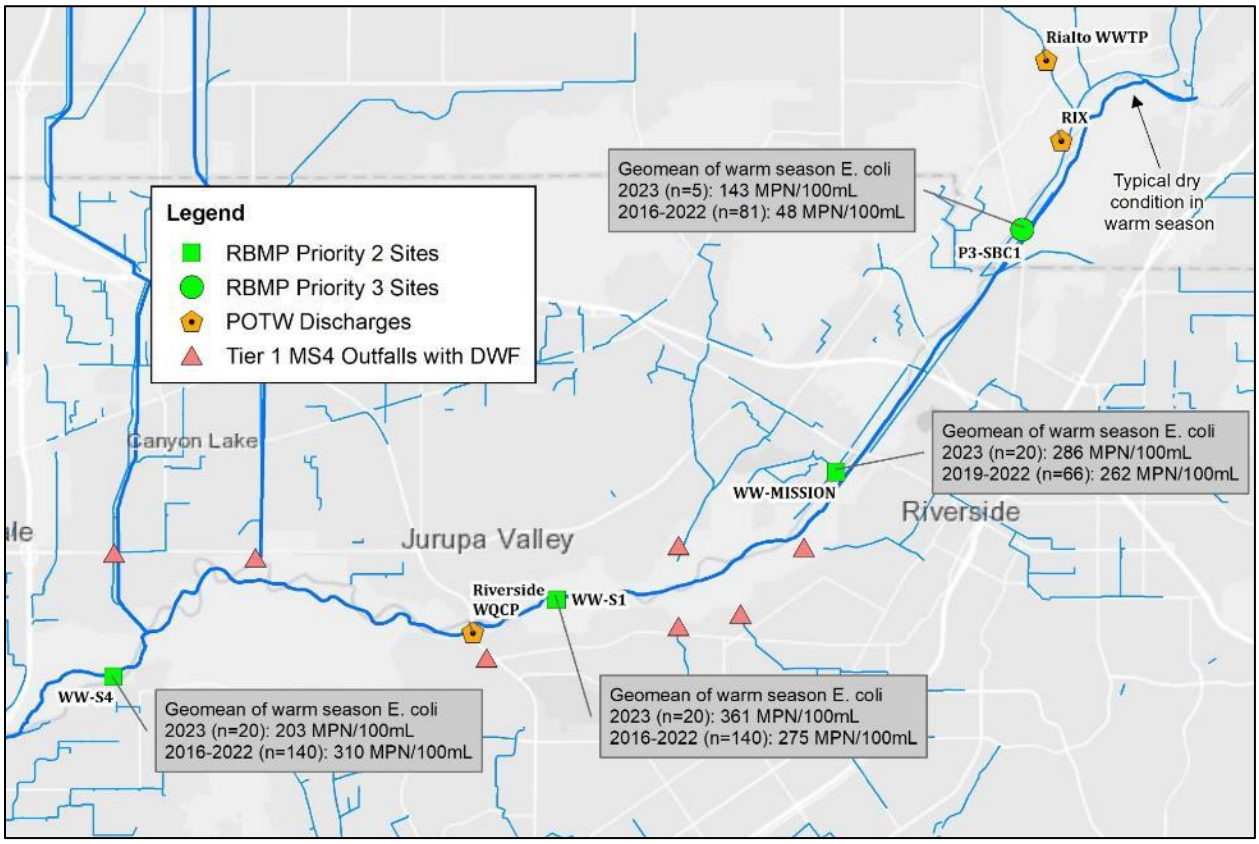


Figure 4.35. Warm Season, Dry Weather *E. coli* Geomean Concentrations at RBMP Sites in Santa Ana River from POTW Discharges into Typically Dry Streambed Downstream to TMDL Compliance Monitoring Locations

4.3 Priority 3

4.3.1 Water Quality Observations

Water quality parameters measured in the field at Priority 3 sites (**Table 4.8**) are summarized in **Figure 4.36** through **Figure 4.42** with key observation noted below. Sites where no samples were collected during the 2023-2024 dry season (noted in **Table 4.8** and discussed further in Section 2.2.3) are not included on the figures. **Table 4.8** also includes information on the 5-week sampling period for each site as this affects field observations as seen in **Figure 4.36** through **Figure 4.42**.

[35] GEI Consultants, Inc. and CDM Smith Inc. February 2023. Final Report: Middle Santa Ana River Bacterial Indicator TMDLs: 2023 Triennial Review. Prepared for the Santa Ana Watershed Project Authority.

[36] Includes the following as expressed in the Basin Plan: wildlife activity and waste, bacterial regrowth within sediment or biofilm, resuspension from disturbed sediment, marine vegetation (wrack) along high tide line, concentrations (flocks) of semi-wild waterfowl, and shedding during swimming.

Table 4.8. Priority 3 Monitoring Sites

Site ID	Site Description	County	Sampled in 2023-2024 by RMBP Program	First Week of 5-week Monitoring Period
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	Orange	Yes	7/2/2023
P3-OC2	Borrego Creek upstream of Barranca Parkway	Orange	Yes	7/23/2023
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	7/23/2023
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	Riverside	Yes	7/2/2023
P3-RC3	San Timoteo Creek Reach 3	Riverside	Yes	5/14/2023
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	San Bernardino	Yes	7/2/2023
P3-SBC2	San Timoteo Creek Reach 1A at Anderson St.	San Bernardino	Yes	5/14/2023
P3-SBC3	San Timoteo Creek Reach 2 at San Timoteo Canyon Road	San Bernardino	Yes	5/14/2023
P3-SBC4	Warm Creek below Fairway Drive	San Bernardino	Yes	5/14/2023

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 Regional Board and City of Newport Beach.

- **pH** - **Figure 4.36** presents pH measurements collected at Priority 3 sites. During the dry, warm sampling period, most sites experienced pH values above the maximum allowable range (6.5 S.U. to 8.5 S.U.). San Timoteo Creek Reach 3 (P3-RC3) and Santa Ana River Reach 4 (P3-SBC1) were within the allowable range. Priority 3 sites in Orange County consistently had the highest pH values. Serrano Creek (P3-OC11) saw the highest pH levels (ranging from 9 to 10.63) with all five samples exceeding the upper pH limit. Note that the Orange County sites were sampled midsummer whereas a number of other Priority 3 sites were sampled in May (San Timoteo Creek Reach 3: P3-RC3, San Timoteo Creek Reach 1A: PS-SBC2, San Timoteo Creek Reach 2: P3-SBC3, and Warm Creek: P3-SBC4).

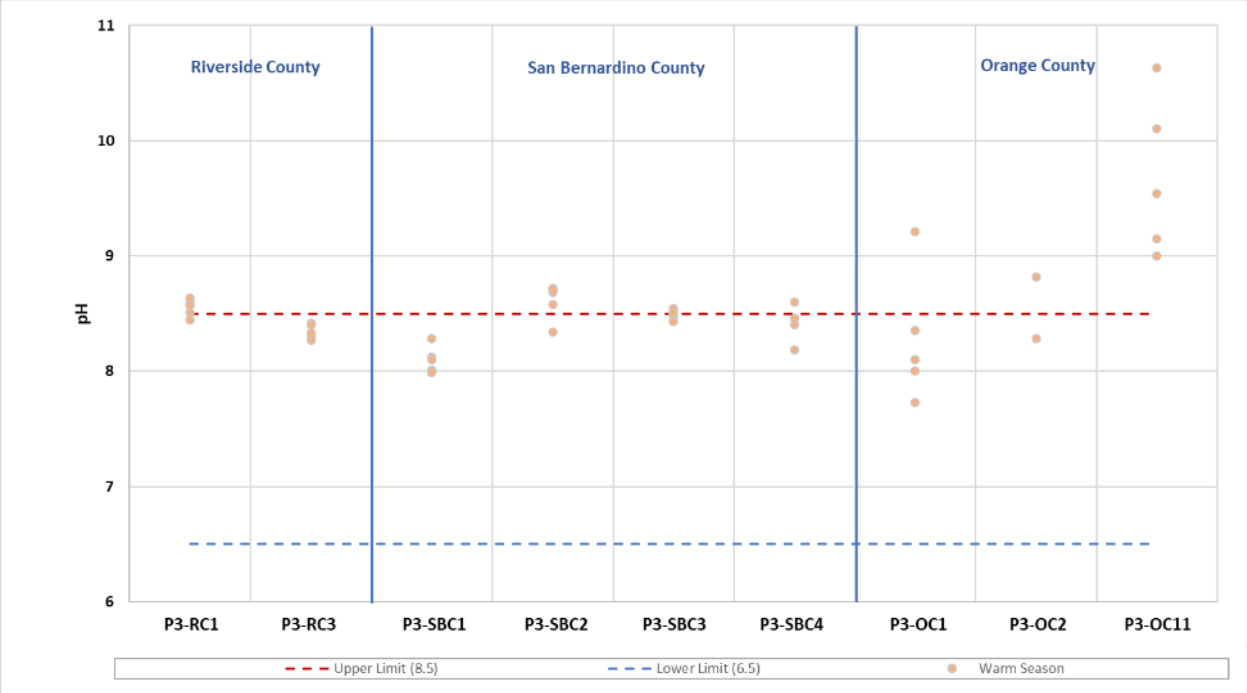


Figure 4.36. Distribution of pH Measurements at Priority 3 Sites

- **Water temperature** - **Figure 4.37** shows water temperatures at the time each Priority 3 site was sampled. Again, note that the site with higher temperatures were sampled in July and/or August while the sites with lower recorded stream temperatures were sampled in May.

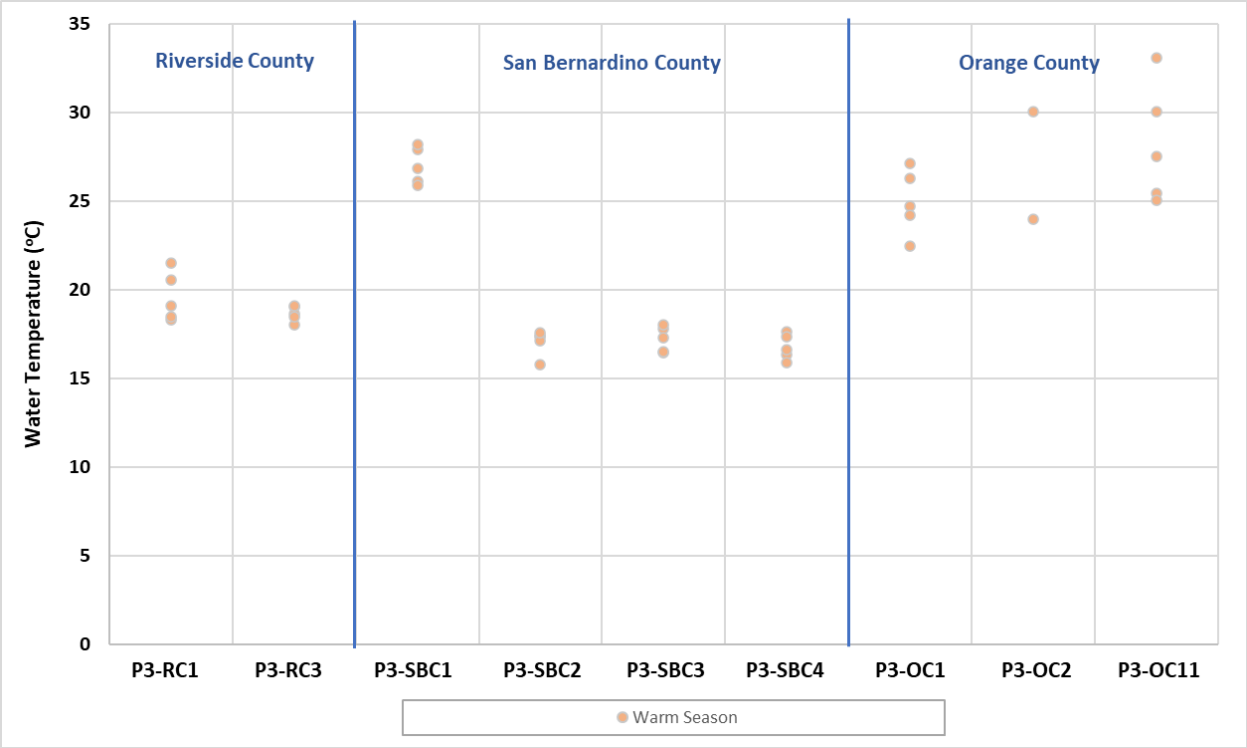


Figure 4.37. Distribution of Water Temperature Measurements at Priority 3 Sites

- **Dissolved oxygen** - **Figure 4.38** shows that DO levels at all sites except for a single sample at P3-OC1 met the WQO of a minimum of 5 mg/L for warm habitat during the warm season.

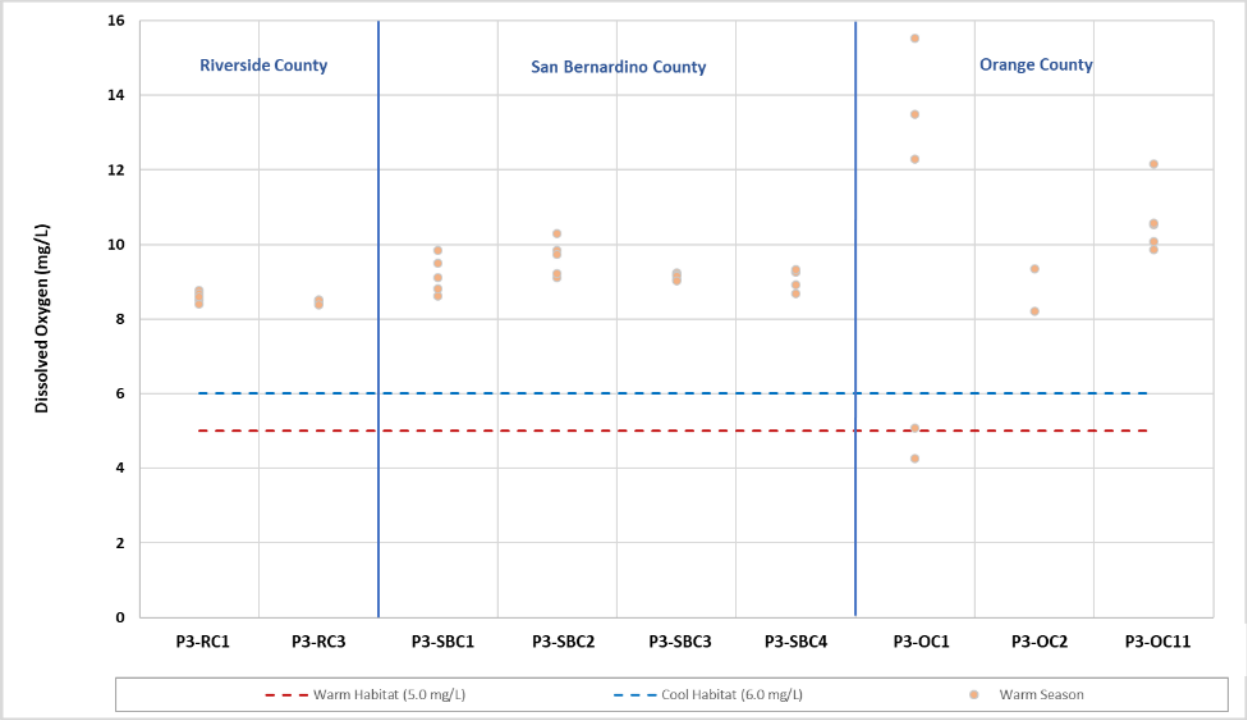


Figure 4.38. Distribution of Dissolved Oxygen Measurements at Priority 3 Sites

- **Conductivity** - Specific conductivity followed the trends seen for other parameters with higher values at the sites that were sampled later in the summer when flows were lowest and temperatures were highest (**Figure 4.39**).

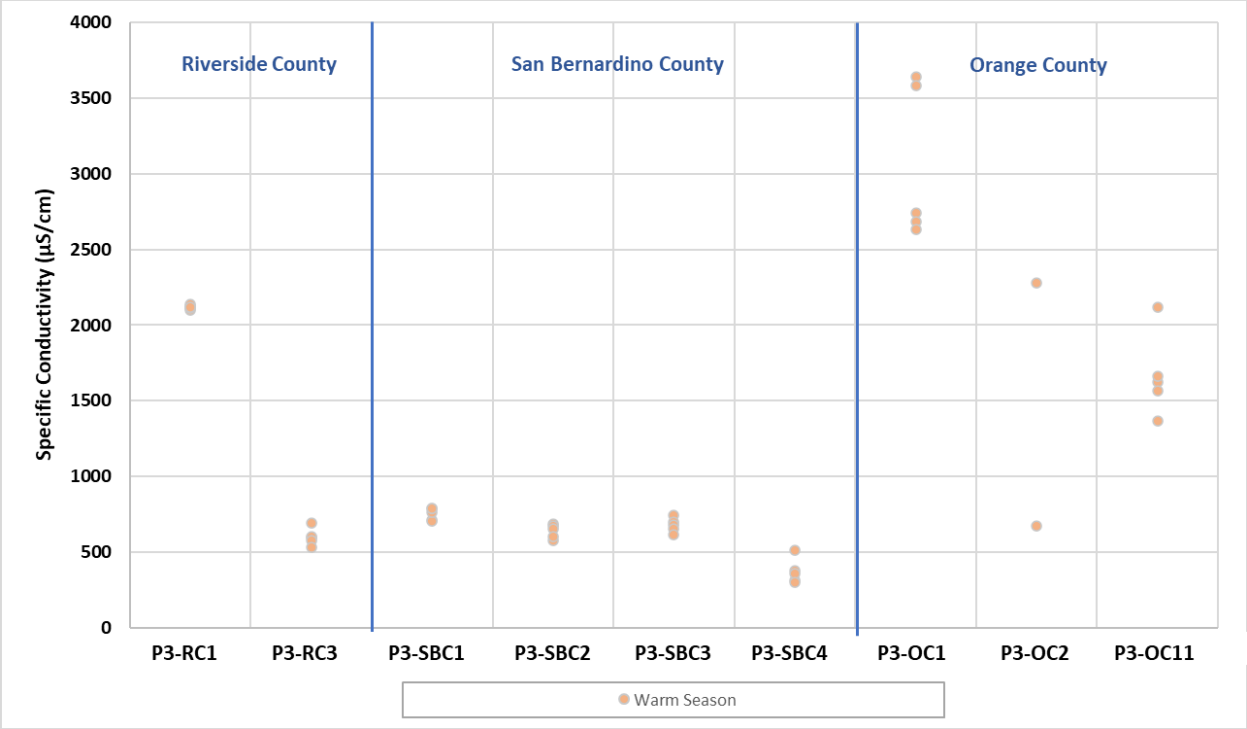


Figure 4.39. Distribution of Specific Conductivity Measurements at Priority 3 Sites

- **Turbidity and TSS** - **Figure 4.40** shows that turbidity levels were variable with a particularly high result at San Timoteo Creek Reach 1A (P3-SBC2) and four samples at Warm Creek (P3-SBC4) being greater than 600 NTU. The high values correspond to increases in flows recorded during the second week of sample collection in May.

  Figure 4.41 shows that TSS reflects similar variability seen in the turbidity results with a high vale at San Timoteo Creek Reach 1A (P3-SBC2) and three samples at Warm Creek (P3-SBC4) greater than 2,000 mg/L. Field notes indicated that the elevated turbidity and TSS results for Borrego Creek: P3-OC2 observed on 8/24/23 were due to a discharge upstream.

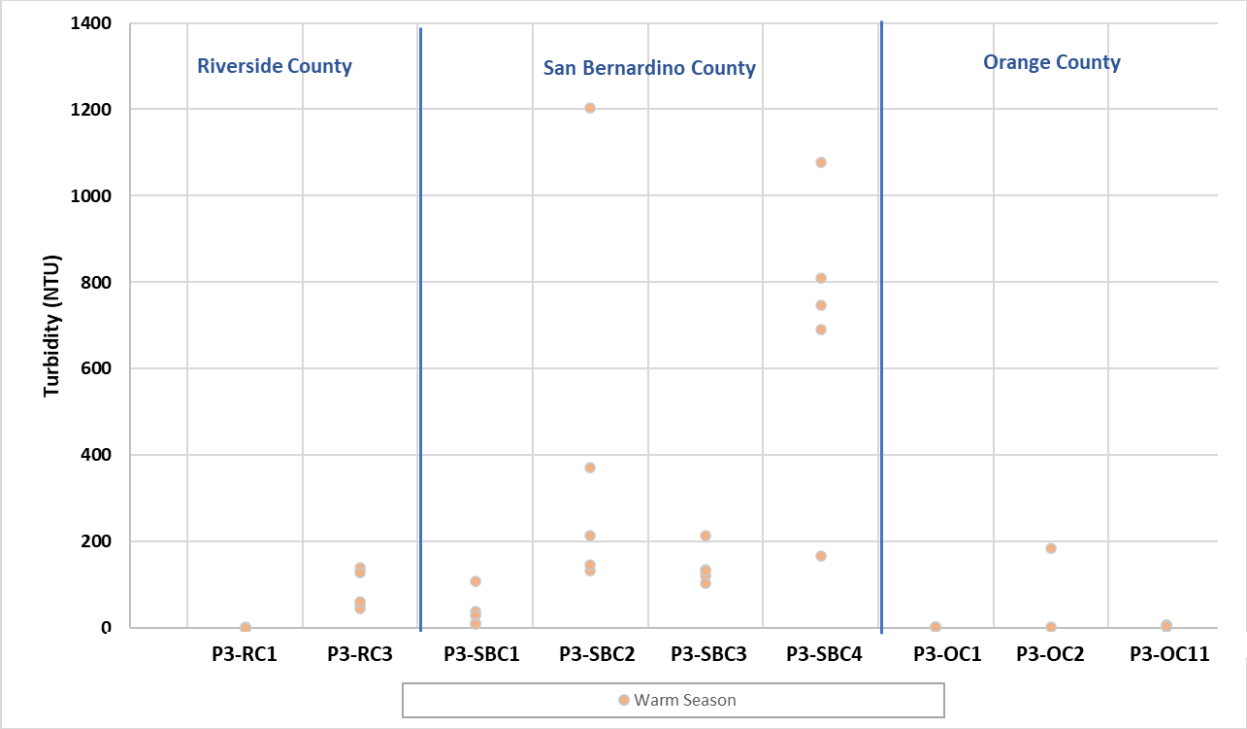


Figure 4.40. Distribution of Turbidity Measurements at Priority 3 Sites

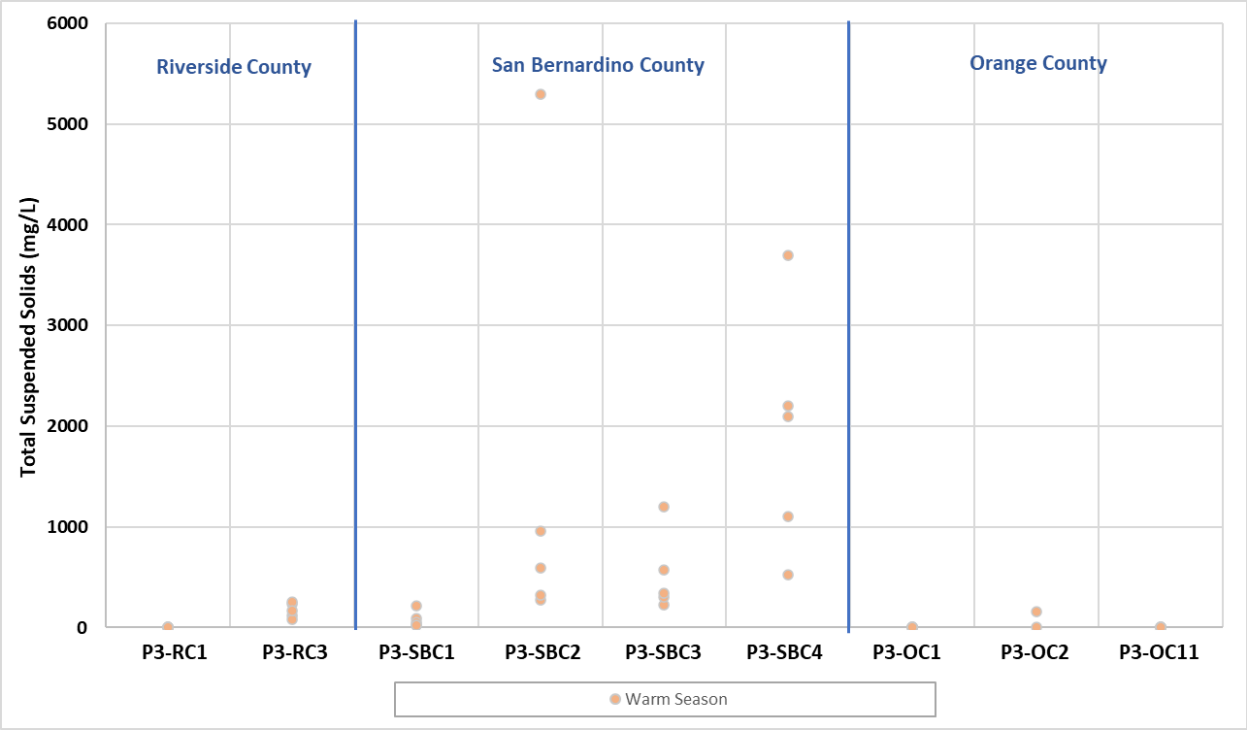


Figure 4.41. Distribution of TSS Measurements at Priority 3 Sites

- **Flow** - **Figure 4.42** shows flows recorded during Priority 3 sample collection. San Timoteo Creek Reach 3: P3-RC3 had the highest average flow (49 cfs) while flows at the Orange County sites averaged 1.2 cfs.

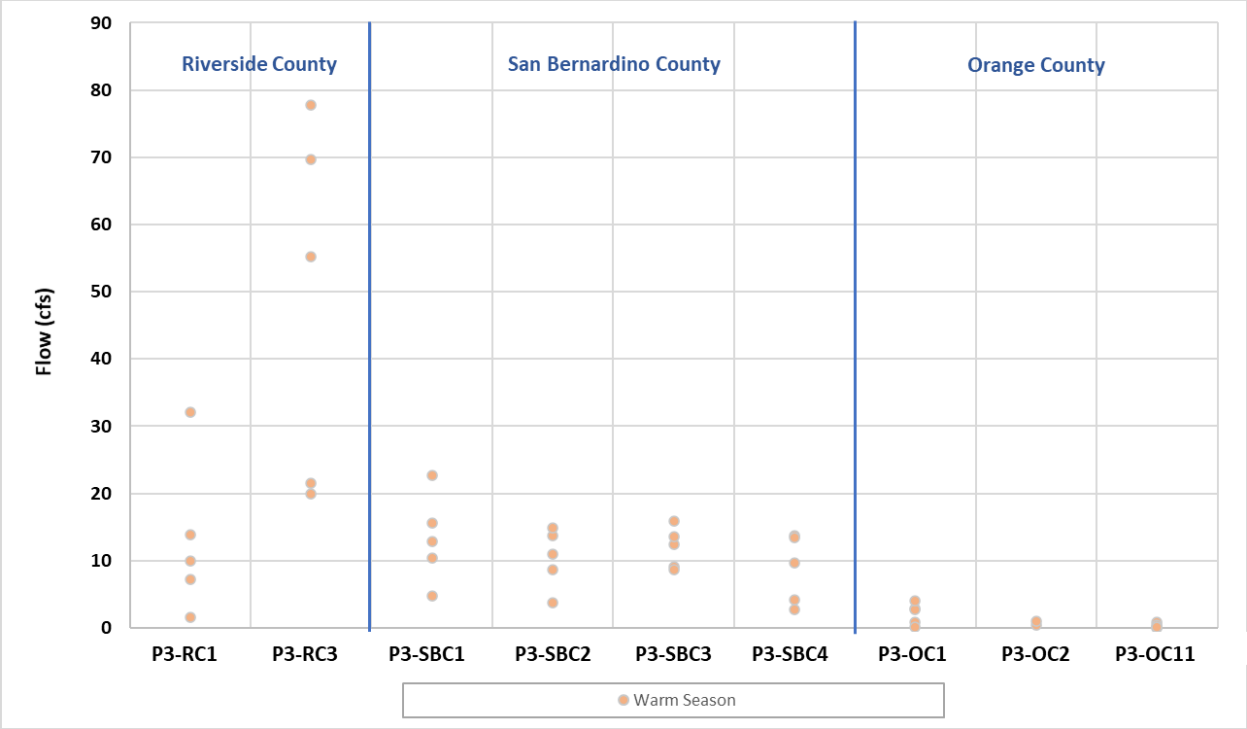


Figure 4.42. Distribution of Flow Measurements at Priority 3 Sites

4.3.2 Bacteria Characterization

The Task Force has collaborated with the Regional Board to collect five consecutive-week samples each warm, 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 about 20 years ago and new monitoring data collected through this RBMP has provided updated information. **Figure 4.43** displays the 2023 5-week geomeans and individual *E. coli* concentrations at Priority 3 sites during dry weather.

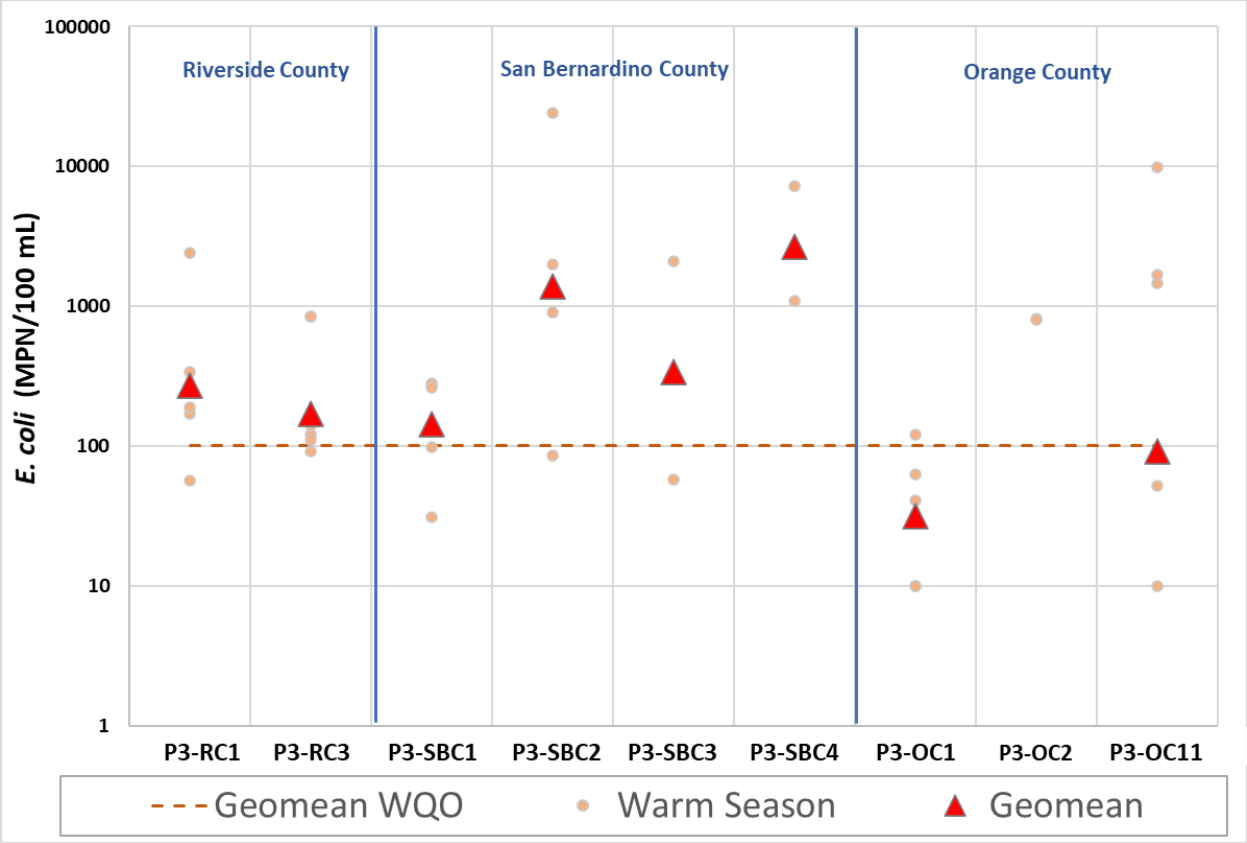


Figure 4.43. Distribution of *E. coli* Concentration Measurements at Priority 3 Sites

The geometric mean of *E. coli* concentrations at Goldenstar Creek (P3-RC1) met WQOs in the 2022 dry season but data from 2023 results shows this may not be a long-term trend and continued monitoring for this site is recommended. Bolsa Chica Channel (P3-OC1) met the geomean WQO for *E. coli* in 2023 as was also demonstrated in previous years. Monitoring within Reach 4 of the Santa Ana River near the San Bernardino/Riverside County boundary is discussed under the Priority 2 sites in the context of RBMP program-wide sampling within the Santa Ana River (refer back to **Figure 4.35**). Lastly, monitoring from three sites along San Timoteo Creek began in the 2020 warm season following their addition to the 303(d) list of impaired waters for fecal bacteria. Results show an increase in *E. coli* concentration from upstream (P3-RC3 on Reach 2 within Riverside County) to downstream segments (P3-SB3 and then P3-SB2 in San Bernardino County) (**Figure 4.44**).

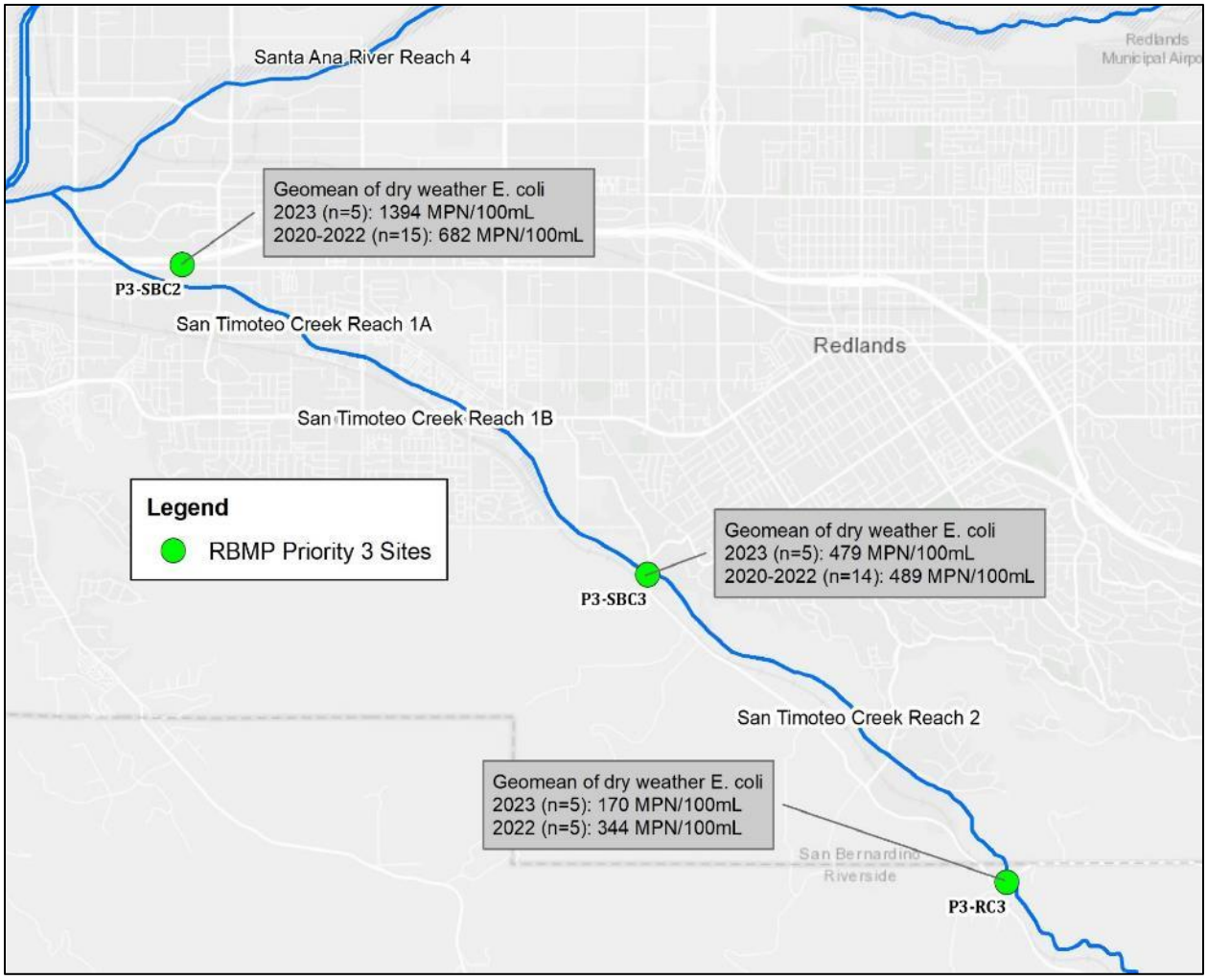


Figure 4.44. Current (2023) and Long-term *E. Coli* Geomean Concentrations during Warm Season, Dry Weather at Priority 3 Sites on San Timoteo Creek

4.4 Priority 4

The Basin Plan Amendment 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.[37] 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 3 of 4 samples in data collected after the BPA must fall below these values to infer no degradation.

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

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 2023.

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	8/30/2023	8/30/2023	8/30/2023	6/23/2023	6/23/2023
pH	7.94	7.49	8.22	9.13	9
Water Temperature (°C)	26.4	26.0	25.0	20.6	18.6
Dissolved Oxygen (mg/L)	14.35	8.85	4.86	6.89	12.8
Conductivity (µS/cm)	2,587	21,078	47,651	1,388	595
Turbidity (NTU)	2.65	5.90	4.86	5.55	2.49
TSS (mg/L)	8.9	11	13	13	20
Flow (cfs)	N/A	N/A	N/A	4.34	8.19

4.4.2 Bacteria Characterization

Priority 4 water quality sample results were compared to site-specific single sample antidegradation targets (**Table 4.11**, **Figure 4.44**). Santa Ana-Delhi Channel in Tidal Prism (P4-OC2), and Cucamonga Creek at Hellman Avenue (P4-SBC1) exceeded their antidegradation targets of 464 and 1,385 MPN/100mL, respectively. The other three Priority 4 sites met their antidegradation targets.

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	Santa Ana-Delhi Channel Upstream of Irvine Avenue	1067	238		8/30/2023
P4-OC2[1]	Santa Ana-Delhi Channel in Tidal Prism	464		1125	8/30/2023, Monthly
P4-OC3	Greenville-Banning Channel in Tidal Prism	64		41	8/30/2023
P4-RC2	Temescal Creek at Lincoln Avenue	725	260		6/23/2023
P4-SBC1[2]	Cucamonga Creek at Hellman Avenue	1,385	3800		6/23/2023, Monthly

Notes:
[1] Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) exceeded the antidegradation target and Orange County is continuing to collect monthly samples.
[2] Cucamonga Creek at Hellman Avenue (P4-SBC1) exceeded the antidegradation target and additional samples were collected.

In the 2023-2024 monitoring period, exceedances of antidegradation threshold values occurred in Cucamonga Creek 1 at Hellman Avenue (P4-SBC1) and Santa Ana Delhi Channel in Tidal Prism (P4-OC2) stations. Results from follow-up sampling at each site is shown in **Table 4.12** and **Table 4.13**.

Table 4.12. Monthly Follow-Up Sampling at Santa Ana-Delhi Channel in Tidal Prism (P4-OC2)

Sample Requirement	Sample Date	*E. coli* Concentration (MPN/100 mL)
2023 Annual Sample	8/30/2023	1125[1]
Required Monthly Follow-up Samples[2]	11/28/2023	1296[1]
	12/28/2023	960[1]
	2/26/2024	74
	3/28/2024	96

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

The antidegradation threshold of 464 MPN/100 mL enterococcus was exceeded at Santa Ana Delhi Channel in Tidal Prism (P4-OC2) on August 30, 2023, which triggered follow-up sampling. Follow-up sampling over three events conducted by Orange County Public Works (OCPW) did not reduce the antidegradation threshold exceedance frequency to less than 75 percent (2 of 4 samples exceeded 464 MPN/100 mL). The Santa Ana Delhi Channel is a key focus area within the Newport Bay Source Investigation program, which will continue to collect data to guide pollution prevention plans to reduce bacteria loading to Newport Bay, including via the REC2 Only segment of Santa Ana Delhi Channel. More detailed information on source investigations is provided in the Task 3B deliverable for the Newport Bay Fecal Coliform TSO R8-2019-0050, amended R8-2023-0063 (OCPW, 2023).[38]

[38] OCPW. Newport Bay Fecal Coliform TMDL Pollution Prevention Plan; Appendix A: Source Investigation Final Report, August 2023.

Table 4.13. Monthly Follow-Up Sampling at Cucamonga Creek at Hellman Avenue (P4-SBC1)

Sample Requirement	Sample Date	*Enterococcus* Concentration (MPN/100 mL)
2023 Annual Sample	6/23/2023	3800[1]
Required Monthly Follow-up Samples[2]	7/20/2023	400
	7/27/2023	2420[1]
	8/3/23	1100
	8/9/23	210
	8/17/23	580
	8/24/23	110
	8/31/23	1400[1]
	9/7/23	1600[1]
	9/14/23	1700[1]
	9/21/23	1100
	9/28/23	490

Notes:

[1] This sample exceeded the antidegradation target for Cucamonga Creek at Hellman Avenue of 1,385 MPN/100 mL.

[2] San Bernardino County collected follow-up samples that were insufficient to show that degradation is not occurring in Cucamonga Creek at Hellman Avenue.

The antidegradation threshold of 1,385 MPN/100 mL *E. coli* was exceeded at Cucamonga Creek at Hellman Avenue (P4-SBC1) on June 23, 2023, which triggered follow-up sampling. Follow-up sampling included one RBMP sample on July 20 and 10 samples from synoptic surveys that occurred weekly from July 27 through September 28. Results from the follow-up sampling did not reduce the antidegradation threshold exceedance frequency to less than 75 percent. As discussed above, 2023 was a unique hydrologic year with atypical, elevated flow conditions throughout the watershed during the warm season (e.g. Hurricane Hilary occurred between weeks 4 and 5 of the 10-week synoptic survey. The 10-week synoptic surveys involve flow and water quality sampling along a longitudinal profile within Cucamonga Creek and comprise the source investigation element of the dry weather CBRP. Data summaries and interpretation for bacteria source tracking and elimination as well as outfall prioritization from annual 10-week synoptic surveys in 2017 through 2022 are reported in detail in the 2023 Triennial Report. The MSAR TMDL Task Force will coordinate with its member, SBCFCD, to obtain data and re-evaluate conditions within the REC2 Only segment of Cucamonga Creek following the 2024 10-week synoptic survey.

4.5 Related Activities and Study Results

Limited additional activities and studies were completed during the 2023-2024 monitoring season. The following section includes details on previous efforts undertaken within the Study Area and will be updated annually as additional, relevant information is available.

Riverside Levees Rehabilitation Project - Flooding in in December 2011 through January 2012 resulted in damage to the Riverside levees and Riverside County Flood Control & Water Conservation District (RCFC&WCD or the District) 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 4.45**. 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. Details of the construction and zones of work within the river bottom were reported by Riverside County Flood Control and Water Conservation District (RCFC&WCD) in April 2023.[39] A significant increase in 2023 *E. coli* levels was observed at P3-SBC1 (Santa Ana River Reach 4 above S. Riverside Avenue Bridge) relative to historical levels within Reach 4 prior to the transition to Reach 3 at Mission Avenue; this could be associated with movement of an in-stream source (e.g., wildlife, homeless encampments, swimmers, etc.) away from the construction in the vicinity of the Mission Avenue Bridge. The 2023 MSAR TMDL Triennial Report[40] provides more in-depth analysis of the segment of the Santa Ana River upstream from Mission Avenue, including recommendations for further study to either identify a controllable source to be eliminated or to determine the portion of upstream loading that may be associated with uncontrollable[41] sources.

Review of monitoring results in future sampling years should be viewed in the context of project progress and potential effects.

[39] https://sawpa.gov/wp-content/uploads/2023/04/4.17.2023-Riverside-Levees-Presentation.pdf

[40] GEI Consultants, Inc. and CDM Smith Inc. February 2023. Final Report: Middle Santa Ana River Bacterial Indicator TMDLs: 2023 Triennial Review. Prepared for the Santa Ana Watershed Project Authority.

[41] Includes the following as expressed in the Basin Plan: wildlife activity and waste, bacterial regrowth within sediment or biofilm, resuspension from disturbed sediment, marine vegetation (wrack) along high tide line, concentrations (flocks) of semi-wild waterfowl, and shedding during swimming.

Figure 4.45. 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. Limited discussions were held in 2023 with the Task Force on potential additional analyses that could be performed on archived samples collected during the Pig Marker Study to assess other potential animal sources. No additional efforts were completed during the 2023-2024 monitoring season.

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. The results of the Chris Basin study are provided in the 2023 MSAR Triennial Report.

Newport Bay Source Investigation Study - 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 future years. The bacteria source identification work in Newport Bay is ongoing.

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.

Sampling on Lake Elsinore for enterococcus was conducted at Launch Pointe (P1-2) for the 2019-2020 and 2020-2021 monitoring periods. Since then, the Task Force supported moving the Lake Elsinore site to Elm Grove Beach as part of an effort to consolidate general assessment monitoring by Riverside County Health Department and this RBMP. Historically, the Health Department monitored multiple beach sites around the lake with a less frequent sampling schedule than provided by the RBMP. As of

this report, three years of data collection at Elm Grove Beach have been completed with a total sample size of 75 grab samples (60 during warm season and 15 during cool season). During this period, an increase in fecal bacteria was observed in fall of 2021 and extended through the 2022 monitoring period. Source investigation in February 2022 observed that the condition was isolated to Elm Grove Beach and not indicative of widespread bacterial contamination in the lake. A population of unhoused persons in the abandoned Elsinore Valley Municipal Water District (EVMWD) effluent channel was suspected as an important source of fecal bacteria and cleanup activities were completed in June 2023. Review of enterococcus results from 2023 sampling shows that conditions have improved (**Figure 4.46**). Though **Figure 4.46** shows annual geomeans, the 2023 fecal bacteria levels meet the REC1 6-week geomean WQOs. Monitoring for the upcoming season is recommended to return to Launch Point, which is the Regional Board approved Priority 1 monitoring site for Lake Elsinore.

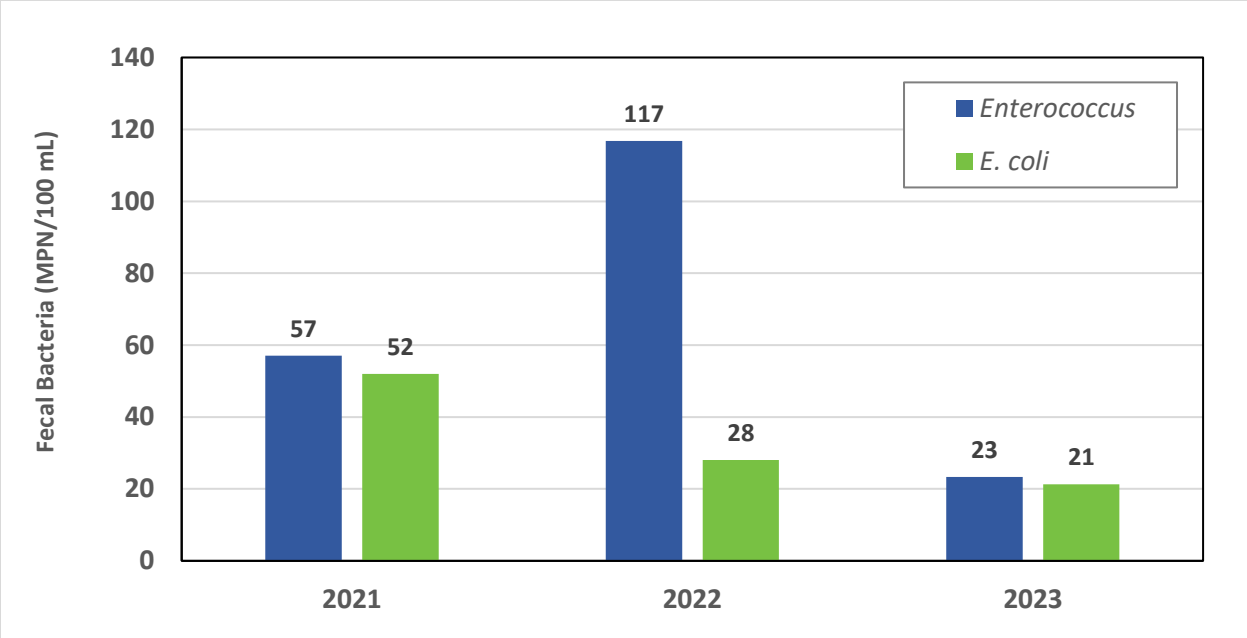


Figure 4.46. Annual Geomeans for Enterococcus and *E. Coli* Concentration at Elm Grove Beach in Lake Elsinore

5.0 Recommendations for 2024-2025 Monitoring Program Season

This section describes recommended updates to the RBMP Monitoring Plan for the 2024-2025 monitoring year.

- Monitoring on Lake Elsinore for the upcoming season is recommended to return to Launch Point (P1-2) from the current location at Elm Grove Beach (P1-2ELM).
- Continued follow-up monitoring is needed at the Priority 4 sites that did not meet the antidegradation targets during the 2023 dry monitoring season: Santa Ana-Delhi Channel in Tidal Prism (P4-OC2) and Cucamonga Creek at Hellman Avenue (P4-SBC1).
- 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.

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