Hydrologic assessment of reference streams in the Los Angeles region

Raphael D. Mazor
Jeff Brown
Liesl Tiefenthaler
Adriana LeCompte Santiago
Garrett Keating

SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT

Technical Report 1412

Hydrologic assessment of reference streams in the Los Angeles region

Raphael D. Mazor, Jeff Brown, Liesl Tiefenthaler, Adriana LeCompte Santiago, Garrett Keating

Southern California Coastal Water Research Project

April 2025

Technical Report 1412

Acknowledgements

This research was funded by the California State Water Resources Control Board under Contract 19-078-270-3 (Task 4). Chad Loflen, Andrew Rehn, and John Olson provided assistance in reviewing data.

This report should be cited as:

Mazor, R., J. Brown, L. Tiefenthaler, A. LeCompte Santiago, and G. Keating. 2025. Hydrologic assessment of reference streams in the Los Angeles region. Technical Report 1412. Southern California Coastal Water Research Project. Costa Mesa, CA.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Executive Summary

As California considers the increased use of biointegrity indices in monitoring and management programs, questions arise about the interpretation of these indices in natural intermittent streams. The California Stream Condition Index (CSCI; Mazor et al. 2016) was developed with a reference data set believed at the time to be comprised of perennial streams, although subsequent evaluations in certain regions have shown that some of these reference sites were in fact intermittent. Natural flow intermittency could affect the biological composition of these streams in ways that could affect scores and lead to incorrect inferences about stream health. In order to address these questions, one can compare scores at perennial and intermittent reference sites (that is, minimally disturbed sites where the biological composition reflects natural conditions). If scores are similar, then the indices may be interpreted in similar ways in both perennial and intermittent streams; otherwise, an alternative interpretation (e.g., alternative thresholds) may be necessary to avoid making incorrect conclusions about the biological integrity of intermittent streams.

Although numerous reference sites have been sampled in the Los Angeles region (Ode et al. 2016), their streamflow duration was not known or documented in ways that allow such an analysis to occur. We attempted to classify streamflow duration at 66 reference sites, some of which were used to develop bioassessment indices. Hydrologic information was gathered through site visits at the end of the dry season (September through November in 2023 and 2024), deployment of water-presence loggers, review of historical aerial imagery, and other sources. We were able to classify 52 of these sites: 33 were perennial and 19 were intermittent. Index scores were nearly identical in the two types of streams, indicating that the CSCI and ASCIs may be interpreted similarly in perennial and intermittent streams. This finding is consistent with patterns seen in other parts of Southern California, but contrasts with patterns observed in northern California (Mazor et al. 2024), where intermittent streams had substantially lower CSCI scores than perennial streams.

INTRODUCTION

Streamflow duration has a strong influence on the composition of biological communities a stream can support (Bogan et al. 2013, Datry et al. 2017, Fritz et al. 2020). This influence can complicate the interpretation of bioassessment indices if they do not properly account for the different assemblages that occur in different types of streams (Mazor et al. 2014, Stubbington et al. 2018, Cid et al. 2020).

In California, two bioassessment indices are widely used to assess biological conditions: The California Stream Condition Index (CSCI, Mazor et al. 2016) for benthic macroinvertebrates, and the Algal Stream Condition Index for diatoms (ASCI_D, Theroux et al. 2020). Both indices were developed using the reference condition approach (Reynoldson et al. 1997, Hawkins et al. 2010), in which statistical models are developed to predict the biological composition of streams under natural, undisturbed (i.e., reference) conditions (Stoddard et al. 2006). These models are trained with reference sites, and applied to disturbed sites, and deviations from these predictions are interpreted as signs of ecological degradation. However, if natural intermittency alone can cause deviations from model predictions, then bioassessment indices could falsely characterize nonperennial streams as degraded.

Previous research focused primarily in the San Diego hydrologic region and adjacent desert mountains has shown that naturally intermittent reference streams do not have poor CSCI or ASCI_D scores that would falsely indicate degradation (Mazor et al. 2014, 2024, Rehn 2017, Loflen 2020). This conclusion is also true for ASCI_D scores in the Bay Area, although CSCI scores in that region were substantially lower at intermittent sites than perennial sties (Mazor et al. 2024). Although there are many reference sites between San Diego and the Bay Area, their streamflow duration status is not known (Figure 1), so it has thus far been difficult to pinpoint where or how this difference occurs. This study aims to fill an important gap by classifying reference sites in the Los Angeles region as perennial or intermittent. With these classifications, it will be possible to determine if the CSCI and ASCI_D can be applied equally well to intermittent and perennial streams in the Los Angeles region, or if naturally intermittent sites require a different interpretation to account for the influence of streamflow duration.

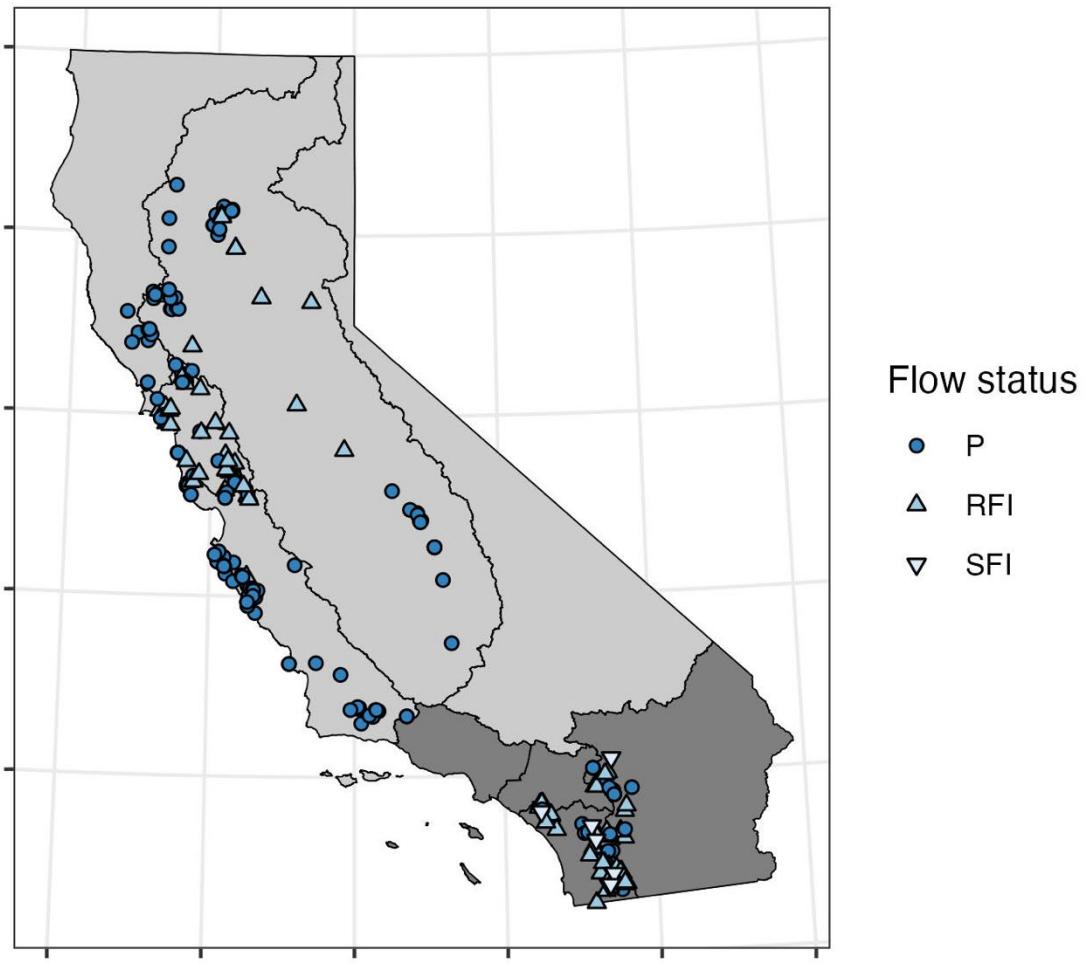


Figure 1. Location of intermittent and perennial reference sites in Southern California (dark gray) and Northern California regions (light gray). Reference sites in Regions 4, 6, and 8 and non-Chaparral portions of regions 1 and 5 are not shown. P: Perennial. RFI: Regularly flowing intermittent. SFI: Seldomly flowing intermittent. Reproduced from Mazor et al. (2024). Note: Only reference sites in xeric ecoregions are included in this study.

METHODS

For the purposes of this study, we define streamflow duration classes as follows:

- **Perennial stream reaches** flow year-round in years of typical rainfall. They may cease to flow during extreme droughts or due to diversions.
- **Intermittent stream reaches** flow for extended periods of years with typical rainfall (often longer than a month). Surface flows are typically sustained by groundwater, although other sources (e.g., snowmelt) may also sustain flows. Intermittent reaches

may or may not retain permanent pools during periods of low flows. In years with high precipitation, intermittent stream reaches may flow year-round, and in years with low precipitation, they may not flow at all.

- **Ephemeral stream reaches** only flow for short periods (typically less than a month), and only in direct response to precipitation events. In contrast to intermittent stream reaches, ephemeral stream reaches do not have flows sustained by groundwater.
- **Nonperennial stream reaches** include both intermittent and ephemeral stream reaches.

Intermittent stream reaches may be subdivided into regularly flowing intermittent (RFI) and seldomly flowing intermittent (SFI) reaches. RFI streams exhibit prolonged flows of several months in years with typical rainfall, whereas SFI reaches only exhibit prolonged flows in years with high rainfall. At this time, we do not have precise quantitative criteria to distinguish between the two types of streams other than to note that SFI streams are not sampled by most bioassessment efforts that do not deliberately target them.

Study area

The Los Angeles hydrologic region encompasses coastal watersheds in Los Angeles and Ventura Counties in southern California. Major watersheds include the Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek, the Los Angeles River, the San Gabriel River, and a number of small coastal streams draining into Santa Monica Bay. Much of the Los Angeles-San Gabriel basin is extensively urbanized, while the Santa Clara valley and Oxnard Plain support extensive agriculture. Natural areas are more common in the Santa Monica mountains as well as the San Gabriel mountains. At lower elevations, these natural areas are dominated by sage scrub, chaparral, and oak woodlands, while higher elevations support pine forests. The area experiences a mediterranean climate, with nearly all precipitation occurring in winter months as rain; however, snowfall is common and sometimes heavy in the highest elevations of the San Gabriel mountains.

Approach

We generated a list of 66 reference sites in the Los Angeles region (Figure 2; Appendix 1). Reference sites are defined as those with minimal levels of human activity that meet criteria specified in Ode et al. (2016). This list includes sites that were used to train the CSCI or ASCI models, as well as sites that were sampled after those indices were developed. 36 sites were

used to train the CSCI model[1], 12 were used to validate the model, and 18 were not used in CSCI development at all. For the ASCIs, 34 sites were used to train the model[1], 10 were used to validate the model, and 22 were not used in model development.

We gathered information on streamflow duration in several ways:

- Site visits at the end of the dry season (between August and November in 2023 or 2024)
- Deployment of water presence loggers (specifically, Stream Temperature, Intermittence, and Conductance [STIC] loggers; Chapin et al. 2014)
- Review of historical aerial imagery in Google Earth
- Consultation with local experts or field crews, or water reports for backpackers

Based on this information, we classified sites as perennial or nonperennial. We presumed that all nonperennial sites on this list were regularly flowing intermittent because they were sampled under programs that targeted perennial streams, and ephemeral or seldomly flowing intermittent streams can only be sampled in wet years with deliberate planning and coordination.

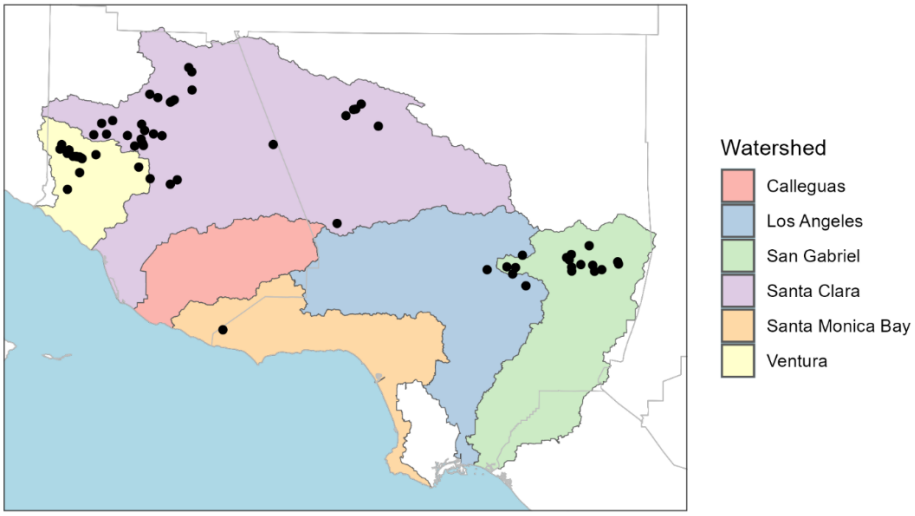


Figure 2. Candidate reference sites for hydrologic assessments in the Los Angeles region. No reference sites were located in the Calleguas Creek or Dominguez Gap watersheds. Major watersheds are indicated by color, and light gray lines indicate county boundaries.

[1] Site SMC05423 (34.28649, -119.30791), a non-reference perennial site on the lower mainstem of the Ventura River, was sampled in 2010, and submitted under the incorrect site code (SMC05243), which corresponds to a small reference site in the Santa Clara watershed. Data from this sampling event was used to train both the CSCI and ASCI models under the mistaken belief that it came from the Santa Clara reference site, SMC05243. Site SMC05243 has in fact never been sampled. This study evaluated the hydrology of SMC05243, not SMC05423.

Site visits

Forty-three candidate sites were visited in the Fall of 2024 to evaluate streamflow duration. Because of its mediterranean climate, intermittent streams in California exhibit a strong seasonal pattern, which can make it possible to distinguish intermittent from perennial streams through a single well-timed site-visit in the late summer or fall (Gasith and Resh 1999). An observation of flowing conditions in the late summer or early fall provides strong evidence that a stream is perennial, whereas an observation of dry conditions provides conclusive evidence that a stream is intermittent (provided that precipitation occurred with typical quantities and timing that year).

Ideally, site visits would occur in September or October, at which point most intermittent streams in the region would dry up (Figure 3). A handful of sites were also visited in August of 2023. These visits occurred earlier than the desired time period because Hurricane Hilary was forecast for August 20, 2023, and site-visits occurring after that date may not provide meaningful information about streamflow duration.

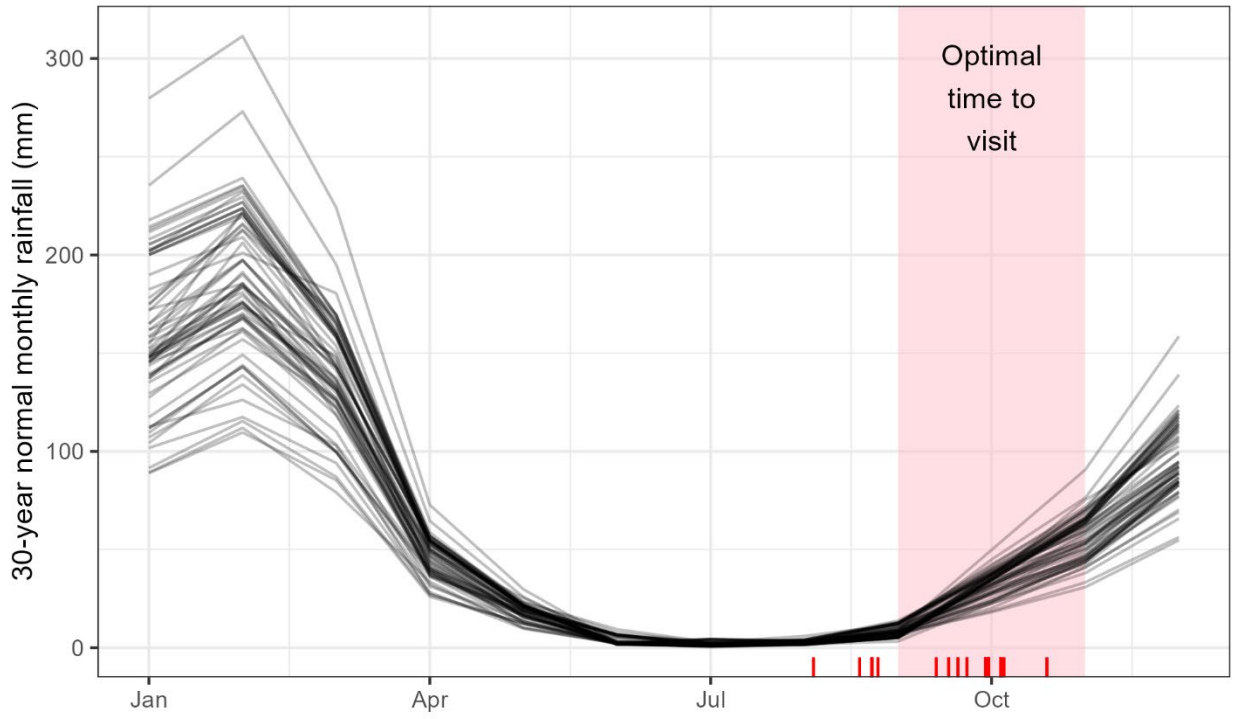


Figure 3. 30-year normal monthly rainfall at candidate reference sites in the Los Angeles region. Each site is represented by a different curve. The pink rectangle highlights the peak of the dry season, which is the optimal time for assessing the hydrology of sites. 30-year normal precipitation metrics were calculated using the prism package in R (Hart and Bell 2015). Red tick marks indicate the date of the most recent visit to each site.

Logger deployment

STIC loggers were deployed at 9 sites to provide continuous information about streamflow duration. Continuous information is a useful complement to observations from a single site-visit because they can detect short-term drying events that may not otherwise be evident. Two loggers were deployed at each site at the crest of riffles (that is, the portion of the reach likely to experience drying first). Loggers were set to record water presence once per hour. Each logger was calibrated with distilled water following the protocol of Schumacher and Fritz (2019); this calibration provides benchmark conductance values above which loggers can be inferred to be submerged in stream water. Loggers were retrieved after a target period of 6 months.

Review of historical aerial imagery

Historical imagery in Google Earth was evaluated at all 66 candidate reference sites. . If water could be observed at or close to (up to 1 km) of the site, then the date was recorded as "flowing". If a dry streambed could be observed, the date was recorded as "dry". Most dates where the imagery was unclear or the conditions were ambiguous were not recorded; however, a few were flagged for secondary review of the data by outside experts; this review was performed by Chad Loflen (San Diego Regional Water Quality Control Board) and Emily Duncan (Los Angeles Regional Water Quality Control Board).

Comparison of bioassessment index scores at perennial and intermittent sites

Once sites were classified as perennial or intermittent, we compared bioassessment index scores by plotting raw scores. Welch's 2-sample t-test was used to evaluate the statistical significance of differences in mean values. Sites that could not be classified as perennial or intermittent were withheld from analysis.

Two indices were evaluated: The California Stream Condition Index (CSCI; Mazor et al. 2016) and the Algal Stream Condition Indices (ASCI-D for diatoms, ASCI-H for the hybrid index based on diatoms and soft-bodied algal taxa; Theroux et al. 2020). Any benthic macroinvertebrate samples with counts below 300 or more than 50% ambiguous taxa were excluded from analysis based on the criteria of Beck and Mazor (2020). If same-day replicates were available, only the higher score was used in analysis. If multiple sample dates were available, scores were averaged across dates. The use of the higher score for same-day replicates is justified because the higher score more accurately reflects the biological composition that the reach has the potential to support.

RESULTS

Determination of streamflow duration classes

Site visits

A total of 43 reference sites were visited, and 34 were observed to be flowing at the time of visitation, and 9 were observed to be dry or in the process of drying (Table 1, Figure 4). (One additional site was visited in April of 2024 in order to deploy a logger; however, this site was not accessible for a revisit, and thus no inferences about flow duration could be made). Four sites were visited in August of 2023 (prior to Hurricane Hillary), and all of them were revisited in 2024. Three of these sites were flowing in both years, but one (403S03452) was dry in 2023 and flowing in 2024. Visits to two of the sites were considered inconclusive because field crews suspected (but could not confirm) that they might dry within a few weeks of the last visit.

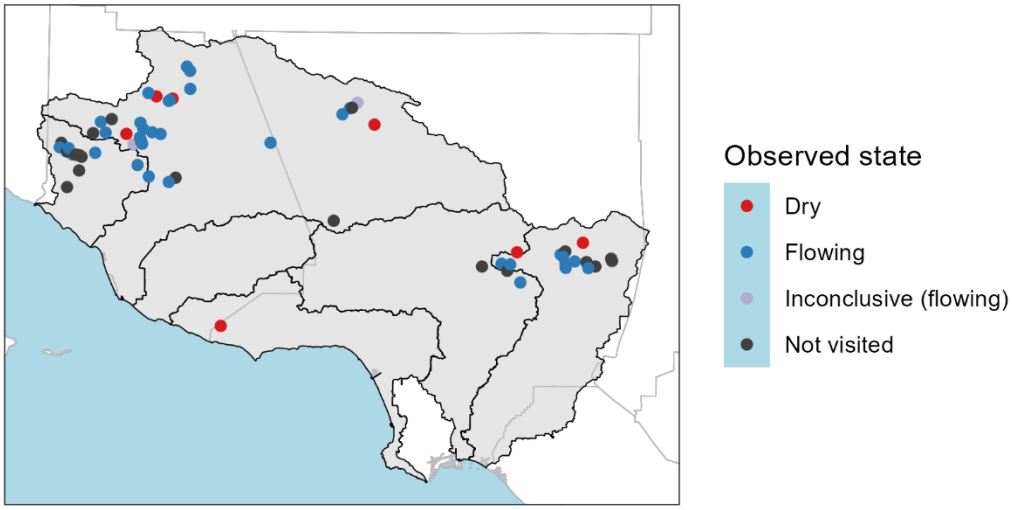


Figure 4. Hydrologic conditions observed at reference sites during Fall site-visits.

Table 1. Observed flow conditions at reference sites.

Station code	Date	Observed conditions	Comments
402BA0287	10/31/2024	Flowing	
402MTCUNF	10/31/2024	Flowing	
402WE0536	10/31/2024	Flowing	
403BA0015	9/25/2024	Flowing	Flow is very low. Inconclusive.
403BA0064	9/23/2024	Flowing	Five percent dry. Photos are hard to interpret. Inconclusive.
403BA0171	9/25/2024	Flowing	Ten percent dry
403BA0960	9/23/2024	Dry	
403LNCASC	10/30/2024	Dry	
403S00271	10/30/2024	Flowing	
403S01883	11/5/2024	Flowing	
403S02139	11/4/2024	Flowing	
403S03643	10/31/2024	Flowing	
403STC010	10/30/2024	Flowing	
403STC021	11/4/2024	Dry	Heavily vegetated streambed
403STC026	9/25/2024	Flowing	
403STC026	10/31/2024	Flowing	
403STC029	9/23/2024	Flowing	
403STC030	10/30/2024	Flowing	
403STC064	10/31/2024	Flowing	
403STC065	9/23/2024	Flowing	
403STC066	10/30/2024	Flowing	
403STC085	11/4/2024	Flowing	
403STC086	10/30/2024	Dry	
403WE0540	11/4/2024	Dry	Subsurface flow
403WE0683	9/25/2024	Flowing	Oil drilling nearby
403WE0795	11/4/2024	Flowing	
403WE0891	11/4/2024	Flowing	
403WE1027	11/5/2024	Flowing	
404ARRSEQ	11/21/2024	Dry	
405BRCAMS	10/21/2024	Flowing	
405BRCSGR	10/21/2024	Flowing	
405S02972	10/14/2024	Flowing	
405S03280	8/18/2023	Flowing	
405S03280	10/24/2024	Flowing	
405S03452	8/18/2023	Dry	Actual sampling reach likely flowing.
405S03452	10/24/2024	Flowing	
405WER318	10/21/2024	Flowing	

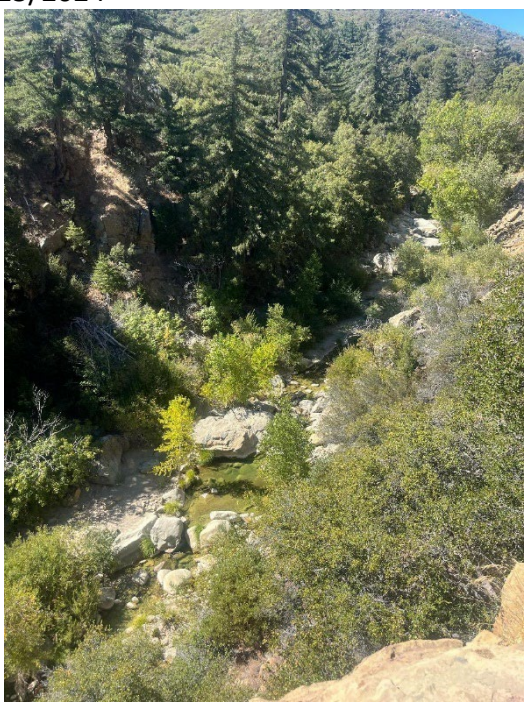
Station code	Date	Observed conditions	Comments
412S04204	10/18/2024	Flowing	
SGUT501	8/18/2023	Flowing	
SGUT501	10/24/2024	Flowing	
SMC00428	10/14/2024	Dry	Photos only show flow
SMC00911	9/4/2024	Flowing	
SMC01196	9/19/2024	Dry	
SMC01424	8/18/2023	Flowing	
SMC01424	10/18/2024	Flowing	
SMC01979	10/31/2024	Flowing	
SMC02591	9/4/2024	Flowing	
SMC04795	9/23/2024	Flowing	

Examples of flowing and dry conditions observed at these sites are shown in Figure 5.

A. 403LNCASC (Lion Creek) on 10/30/2024

B. 403BA0960 (Clearwater Canyon) on 9/23/2024

C. 403BA0171 (Santa Clara unnamed site) on 9/25/2024



D. 405WER318 (Bear Creek below West Fork San Gabriel) on 10/21/2024

Figure 5. Photos of sites in dry (A, B) and flowing (C, D) conditions

Logger deployment

At least one logger was retrieved at 4 of the 9 sites where they were deployed (a total of 6 loggers retrieved). One site, 403WE0501, was not accessible in the Fall due to a road closure and thus may still have loggers deployed. At many sites, loggers could not be located and are presumed lost due to either human interference or degradation of the logger casing. Among the 6 loggers that were retrieved, half had incomplete records due to premature stoppage or failure of the logger to record data (Table 2).

The three remaining loggers provided useful information for determining streamflow duration (Figure 6). At site 403BA0960, the logger indicated that the site dried sometime in July. The precise date could not be determined because the logger exhibited "ringing" behavior (i.e., dramatic fluctuations in measured intensity) during this period; however, there is a clear change between the submerged conditions (when conductance was recorded at ~10,000 lumens/ft^2) and dry conditions (when conductance was recorded as zero lumens/ft^2). Temperature fluctuations increase greatly (from 20-30°C to >50°C) during the dry period. At site 404ARRSEQ, conductance levels drop abruptly from ~15,000 lumens/ft^2 to zero lumens/ft^2 on 7/26/2024. At this site, temperatures briefly spiked to >50°C as well, but this site largely remained cooler than 403BA0960, perhaps reflecting the site's shadier conditions. At a third site, 405S03280, conductance levels remained close to ~6500 lumens/ft^2 throughout the entire deployment, indicating at least 180 continuous days of flow; temperatures remained between 15 and 20°C throughout most of this period.

Table 2. Results of logger deployment at 9 reference sites.

Station code	Logger number	Result
403BA0960	1	Dried in late July (exact date not discernible)
403BA0960	2	Logger submerged between deployment (4/9/24) until 4/24/24, when it stopped prematurely.
403STC026	1 and 2	Loggers lost
403WE0501	1 and 2	Site not accessible due to road closure
404ARRSEC	1	Dried on 7/26/2024
404ARRSEC	2	Logger stopped on 6/16/2024
405S03280	1	Logger lost
405S03280	2	Continuously submerged between 5/2/2024 and 10/28/2024 (180 days), when it was retrieved.
SGUT501	1 and 2	Loggers lost
SMC00911	1 and 2	Loggers lost
SMC01424	1	Logger stopped on day of deployment (4/17/2024)
SMC01424	2	Logger lost
SMC01979	1 and 2	Loggers lost

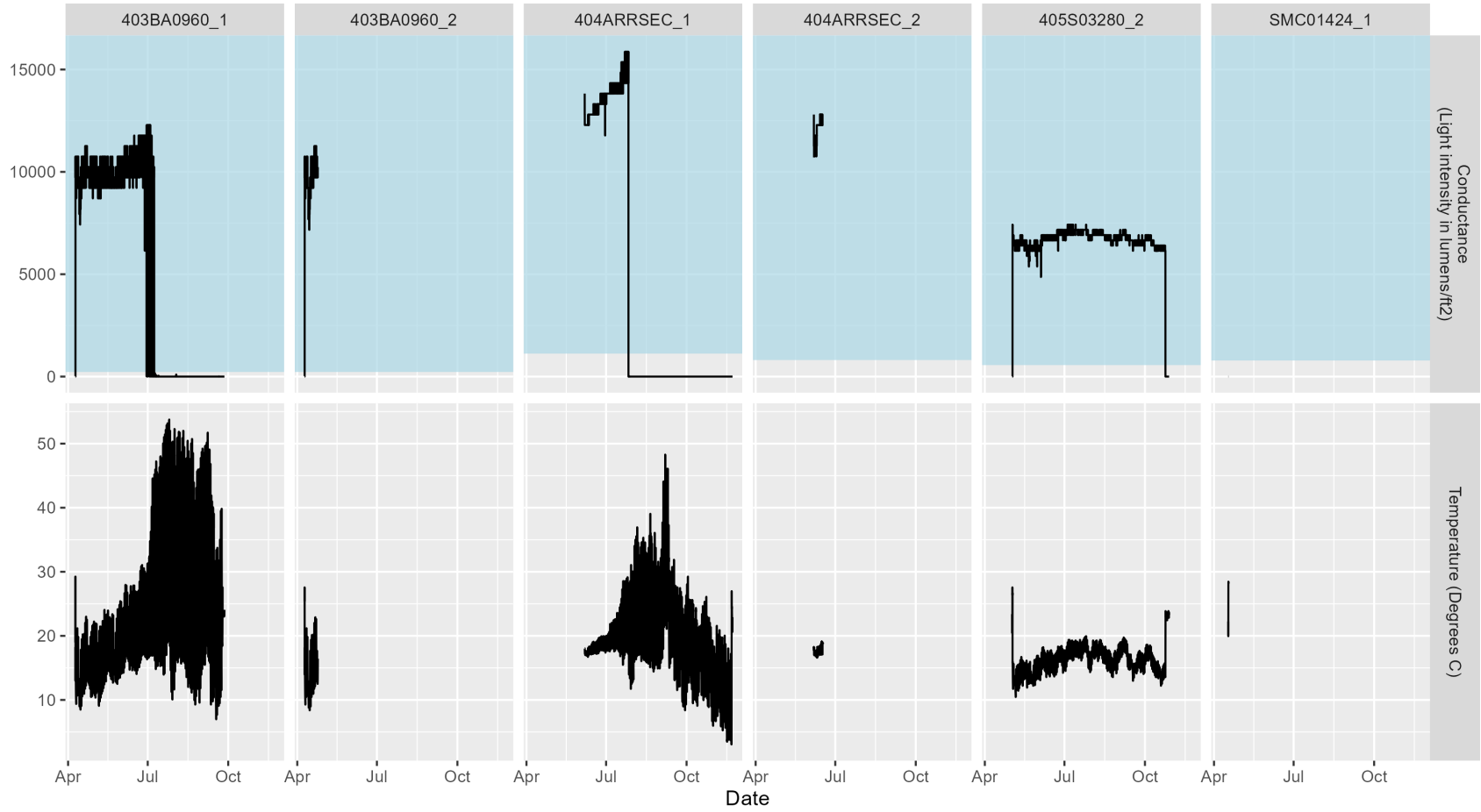


Figure 6. STIC logger recordings at 6 sites where loggers were retrieved. The top row shows conductance (measured as light intensity in lumens/ft^2) measured by the logger. Conductance levels within the area shaded in blue are interpreted as times when the logger is submerged. The bottom panel shows temperature in degrees Celsius.

Review of historical aerial imagery

A total of 640 observations of historical aerial imagery were recorded (Table A 2). In 90% of these observations flowing or dry conditions could be determined, and 10% were flagged for secondary review. Flowing conditions were noted 467 times, and dry conditions were noted 109 times. Uninterpretable imagery was most common for streams in areas of steep topography or thick vegetation, such as the San Gabriel mountains.

Of the 66 sites that were evaluated, historical aerial imagery provided useful information for classifying streamflow duration at 43 of them, including 14 where site visits were not conducted or were inconclusive (Figure 7). Historical aerial imagery supported a perennial classification at 16 sites where flow was observed, but an intermittent classification at 9 sites where flow was observed (including the two sites where site-visits were considered inconclusive). Historical aerial imagery confirmed intermittent status at 6 sites where site visits revealed dry conditions. At the 23 sites where historical aerial imagery was inconclusive, 11 were flowing during site visits, and 2 were dry.

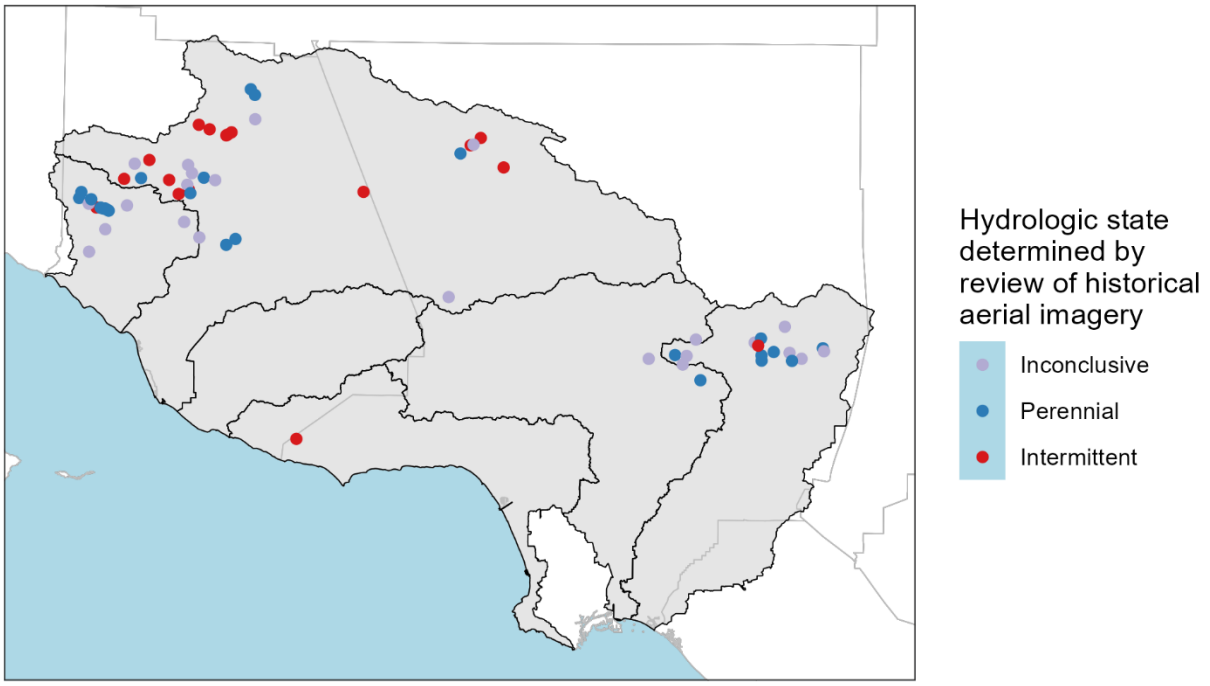


Figure 7. Hydrologic states of reference sites determined by a review of historical aerial imagery.

Other sources

Other sources of hydrologic information were attained for a handful of sites where possible.

Local expertise

Local experts confirmed an intermittent designation for 403S03643 (Chad Loflen, San Diego Regional Water Quality Control Board), 403STC010 (C. Loflen), 403STC026 (K. Hahs, Ventura County Watershed Protection District), and 404ARRSEQ (National Parks Service, https://www.nps.gov/places/arroyo-sequit.htm). A perennial designation was confirmed for SGUT501 (Karin Wisenbaker, Aquatic Bioassay Consulting [ABC]), 405S03452 (K. Wisenbaker), and 403STC066 (B. Karey, Ventura County Watershed Protection District). Experts were uncertain about SMC00144 (Karin Wisenbaker, ABC) and SMC01164 (Tim Miller, Mountains Recreation and Conservation Authority).

Campground water reports

Where practical, Los Padres campground water reports were consulted to gain information about historic flow conditions.

Site 403WE0501 is located on Agua Blanca Creek, a few km downstream of the Log Cabin campground and the Devil's Gateway. Water reports for the Log Cabin campground (https://www.hikelospadres.com/log-cabin-campground.html) indicate continuous late-season flow in most years, including a flowing observation on 10/26/2024 (Figure 8). There is one dry observation on 10/26/2022 (Figure 9). Flow duration in Devil's Gateway is likely longer than at the target site due to geologic confinement that increases discharge of groundwater into the stream. Review of aerial imagery in Google Earth supported this interpretation.

Figure 8. Flowing conditions at the Devil's Gateway on Agua Blanca creek, taken on 10/26/2024 by Alan Coles. Source: https://www.hikelospadres.com/agua-blanca-trail.html#prettyPhoto

Figure 9. Dry conditions in Agua Blanca Creek, taken by Alan Gonzalez on 10/26/2022. Source: https://www.hikelospadres.com/log-cabin-campground.html#prettyPhoto

403STC024 is located on Santa Paula creek between the Big Cone and Cross campgrounds. No dry conditions were reported at the Big Cone campground, although trickling conditions were noted by a ranger on 11/29/2015 (Figure 10). Flowing conditions were noted on most dates at the Cross campground, except for 7/8/2022, when dry conditions were noted by an anonymous surveyor (no photos were submitted).

Figure 10. Photo of trickling conditions of Santa Paula creek near the Big Cone campground, taken on 11/29/2015 by Ranger Heidi Anderson. The accompanying description reads: "Photo taken in November during an Ojai Ranger District trail project. Proof that the creek does dry up, as hard as that is to believe." Source: https://www.hikelospadres.com/big-cone-campground.html#prettyPhoto.

Synthesis

Synthesis of multiple sources of hydrologic data resulted in 32 perennial classifications and 21 intermittent classifications, with 13 sites retaining ambiguous classifications (Table 3, Figure 11).

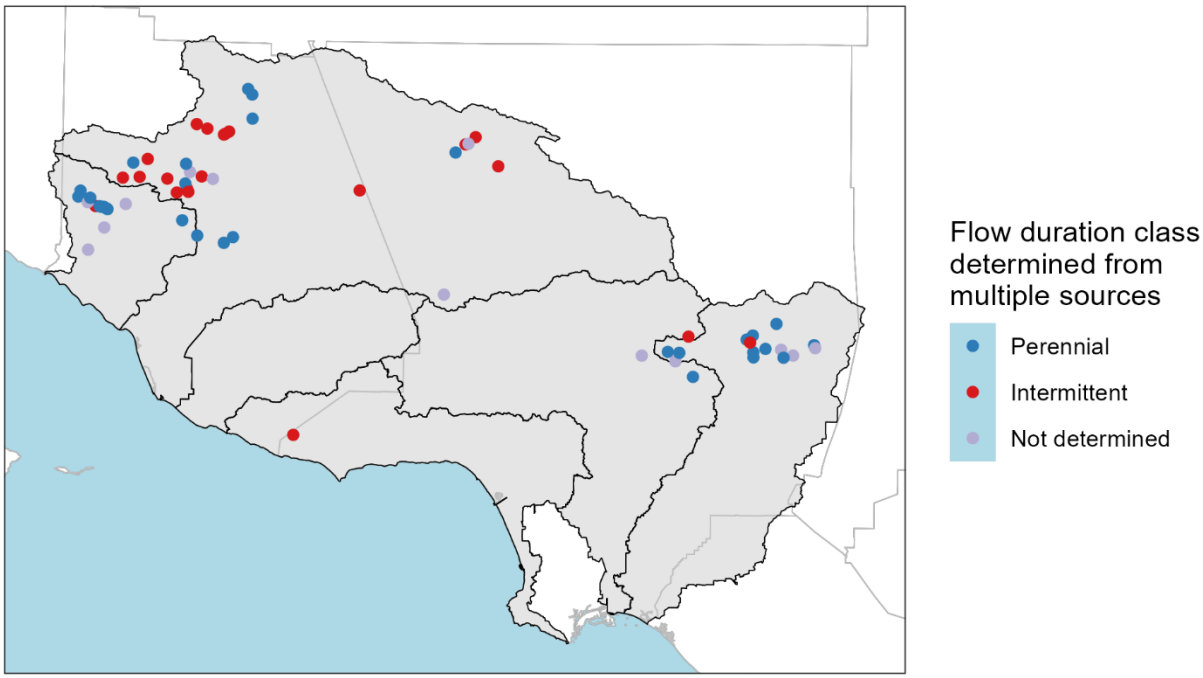


Figure 11. Flow duration classes reference sites determined by multiple sources.

Table 3. Final streamflow duration class determinations for all candidate reference sites in the Los Angeles region.

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
402BA0095	North Fork Santa Ana Creek Random Site 95	34.46328	-119.34566	Ventura	Ventura	Not determined	None
402BA0287	Matilija Creek Random Site 287	34.50284	-119.36644	Ventura	Ventura	Intermittent	Visit and imagery
402M00043	Matilija Creek below hot springs	34.50161	-119.34749	Ventura	Ventura	Perennial	Imagery
402MJCMHS	Matilija Creek nr. Res. nr. Matilija Hot Springs	34.50280	-119.35730	Ventura	Ventura	Perennial	Imagery
402MTCUNF	Matilija Creek, Upper NF ~0.7mi above conflence	34.51750	-119.37920	Ventura	Ventura	Perennial	Visit and imagery
402PS0048	Matilija Creek	34.53077	-119.40085	Ventura	Ventura	Perennial	Imagery
402S09503	Matilija creek ~1.6mi above Rattlesnake Cyn. Cr.	34.49757	-119.33913	Ventura	Ventura	Perennial	Imagery
402S13599	Matilija Creek	34.49898	-119.34187	Ventura	Ventura	Perennial	Imagery
402WE0536	Matilija Creek 1.7 miles upstream from Upper	34.51960	-119.40537	Ventura	Ventura	Perennial	Visit and imagery

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
	North Fork Matilija Creek.						
402WE0803	Coyote Creek Below Confluence of West Fork	34.42131	-119.38060	Ventura	Ventura	Not determined	None
403BA0015	Santa Clara Watershed Unknown River Random Site 15	34.53120	-119.18421	Ventura	Santa Clara	Intermittent	Imagery
403BA0064	Elizabeth Lake Canyon Random Site 64	34.64435	-118.51371	Los Angeles	Santa Clara	Intermittent	Imagery
403BA0171	Santa Clara Watershed Unknown River Random Site 191	34.58516	-119.28363	Ventura	Santa Clara	Perennial	Visit
403BA0960	Clearwater Canyon Random Site 960	34.59078	-118.46170	Los Angeles	Santa Clara	Intermittent	Visits, loggers, and imagery
403LNCASC	Lion Creek ~1.9mi above Sespe Cr.	34.53892	-119.16139	Ventura	Santa Clara	Intermittent	Visit and imagery
403S00271	Lion Creek near Middle Lion Fork Campground	34.54850	-119.16547	Ventura	Santa Clara	Perennial	Visit

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
403S00875	Tule Creek 875	34.55668	-119.30629	Ventura	Santa Clara	Intermittent	Imagery
403S01883	Lockwood Creek	34.71629	-119.01890	Ventura	Santa Clara	Perennial	Visit and imagery
403S02139	Alamo Creek above Mutau Cr.	34.67160	-119.01720	Ventura	Santa Clara	Perennial	Visit
403S03643	Sespe Creek 3643	34.56213	-119.12891	Ventura	Santa Clara	Intermittent	Visit, expertise, and imagery
403STC010	Random Site 10 - Lion Canyon	34.53306	-119.15833	Ventura	Santa Clara	Intermittent	Visit and imagery, local expertise and sample notes.
403STC021	Random Site 21 - Piru Creek - Forest Service Rd 7N13	34.64667	-119.06944	Ventura	Santa Clara	Intermittent	Visit and imagery
403STC024	Random Site 24 - Tributary to Santa Paula Creek near Big Cone Campsite	34.45056	-119.05583	Ventura	Santa Clara	Perennial	Imagery and campground reports
403STC026	Random Site 26 - Tule Creek	34.55889	-119.26861	Ventura	Santa Clara	Intermittent	Visit and imagery and local expertise.
403STC029	Random Site 29 - Elizabeth Canyon	34.61528	-118.55833	Los Angeles	Santa Clara	Perennial	Visit and imagery

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
403STC030	Random Site 30 - Piedra Blanca Creek	34.57000	-119.15556	Ventura	Santa Clara	Not determined	Visit
403STC064	Random Site 64 - Bear Canyon	34.55806	-119.10361	Ventura	Santa Clara	Not determined	Visit
403STC065	Random Site 65 - Elizabeth Canyon	34.63056	-118.53611	Los Angeles	Santa Clara	Intermittent	Visit and imagery
403STC066	Random Site 66 - Piedra Blanca Creek	34.58500	-119.16472	Ventura	Santa Clara	Perennial	Visit, local expertise (Bill Carey)
403STC085	Random Site 85 - Piru Creek	34.64250	-119.07750	Ventura	Santa Clara	Intermittent	Visit and imagery
403STC086	Random Site 86 - Rock Creek	34.55667	-119.20611	Ventura	Santa Clara	Intermittent	Visit and imagery
403WE0501	Agua Blanca Creek ~1mi Above Piru Creek	34.54172	-118.77286	Ventura	Santa Clara	Intermittent	Visit, imagery, and campground reports
403WE0540	Piru Creek ~1.9 miles upstream from Cedar Creek.	34.65136	-119.11845	Ventura	Santa Clara	Intermittent	Visit and imagery
403WE0683	Santa Paula Creek ~1.5mi N Hwy 150	34.43952	-119.07616	Ventura	Santa Clara	Perennial	Visit and imagery
403WE0795	Piru Creek ~1.7mi Below Cedar Creek	34.64080	-119.08094	Ventura	Santa Clara	Intermittent	Visit and imagery

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
403WE0891	Piru Creek Above Mutau Flat Road	34.65926	-119.14255	Ventura	Santa Clara	Intermittent	Visit and imagery
403WE1021	Elizabeth Canyon Creek Lake Hughes Rd. ~10mi E I5	34.63193	-118.52977	Los Angeles	Santa Clara	Not determined	None
403WE1027	Lockwood Creek at Lockwood Valley Campground	34.72654	-119.02842	Ventura	Santa Clara	Perennial	Visit and imagery
404ARRSEQ	Arroyo Sequit trib. ~0.5mi above confluence	34.08506	-118.91206	Los Angeles	Santa Monica Bay	Intermittent	Visits, loggers, imagery, and expertise
405BRCAMS	Bear Creek, WF ~0.5mi above mainstem	34.27380	-117.89900	Los Angeles	San Gabriel	Perennial	Visit
405BRCSGR	Bear Creek above San Gabriel River	34.25031	-117.88372	Los Angeles	San Gabriel	Perennial	Visit and imagery
405S02972	Trib to WF San Gabriel River	34.24958	-118.07550	Los Angeles	San Gabriel	Perennial	Visit and imagery
405S03280	San Gabriel, NF ~0.8mi below Bichota Cyn. Cr	34.25686	-117.85653	Los Angeles	San Gabriel	Perennial	Visits, loggers, imagery, and expertise
405S03452	Trib to Soldier Creek	34.30354	-117.83231	Los Angeles	San Gabriel	Perennial	Visit and expertise

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
405SGB003	San Gabriel Random Site 3	34.28157	-117.88508	Los Angeles	San Gabriel	Perennial	Imagery
405SGB006	San Gabriel Random Site 6	34.25553	-117.82139	Los Angeles	San Gabriel	Not determined	None
405SGRAAG	San Gabriel River, EF above Allison Gulch	34.26448	-117.74751	Los Angeles	San Gabriel	Perennial	Imagery
405WER318	Bear Creek below West Fork	34.26833	-117.89111	Los Angeles	San Gabriel	Intermittent	Visit and imagery
412S04204	SANTA ANITA CANYON ~0.3mi above Winter Cr.	34.20360	-118.01850	Los Angeles	Los Angeles	Perennial	Visit and imagery
SGUR103	Rush Creek	34.23218	-118.05822	Los Angeles	San Gabriel	Not determined	None
SGUT501	WF SG Below confluence of Bear creek	34.24080	-117.88330	Los Angeles	San Gabriel	Perennial	Visit, expertise, and imagery
SMC00144	Graveyard Canyon	34.24481	-117.79459	Los Angeles	San Gabriel	Not determined	None
SMC00428	West Fork San Gabriel River below confluence with Rush Creek	34.24810	-118.04976	Los Angeles	San Gabriel	Perennial	Visit
SMC00476	Bear Canyon	34.24209	-118.13381	Los Angeles	Los Angeles	Not determined	None

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
SMC00911	Wheeler Springs 250 m upstream of NF Matilija	34.50797	-119.29854	Ventura	Ventura	Not determined	Visit
SMC01164	Unnamed tributary to the SF Santa Clara River	34.35078	-118.57968	Los Angeles	Santa Clara	Not determined	None
SMC01196	Big Tujunga Creek 185m downstream of Upper Big Tujunga Canyon Rd	34.27835	-118.02952	Los Angeles	Los Angeles	Intermittent	Visit
SMC01248	Tributary of the San Gabriel River	34.25895	-117.74499	Los Angeles	San Gabriel	Not determined	None
SMC01424	Susanna Canyon	34.24075	-117.81585	Los Angeles	San Gabriel	Perennial	Visit and imagery
SMC01567	Upper North Fork Matilija Creek 50m upstream of confluence with Matilija Creek	34.50959	-119.38373	Ventura	Ventura	Not determined	None
SMC01979	Sisar Canyon 160 m south of hairpin in Sisar Canyon Road	34.45205	-119.13624	Ventura	Santa Clara	Perennial	Visit
SMC02591	Upper North Fork Matilija	34.51783	-119.37846	Ventura	Ventura	Perennial	Visit and imagery

Station code	Stream name	Latitude	Longitude	County	Watershed	Flow duration class	Sources
	Creek approx 200 m north of Matilija Campground						
SMC04383	Matilija Creek ~ 4km upstream of Hwy 33	34.50224	-119.35602	Ventura	Ventura	Perennial	Imagery
SMC04795	Thacher Creek	34.47989	-119.17067	Ventura	Ventura	Perennial	Visit
SMC05243	Unnamed trib, 1 km upstream of confluence with Derrydale Creek	34.59250	-119.25122	Ventura	Santa Clara	Intermittent	Imagery
SMC05407	Matilija Creek ~ 5km upstream of Hwy 33	34.50124	-119.35043	Ventura	Ventura	Perennial	Imagery

Comparison of bioassessment index scores at perennial and intermittent reference sites

Index scores were very similar at perennial and intermittent reference sites (Figure 12). Mean scores were very close to each other, and close to values expected at reference sites (i.e., 1; Table 4). Differences were not statistically significant (Table 5). The average CSCI score was 0.023 higher at perennial sites than intermittent sites, and average ASCI_D score was 0.012 lower at perennial sites than intermittent sites; the average ASCI_H score was 0.058 lower at perennial sites than intermittent sites.

Table 4. Mean and standard deviation of index scores at perennial and intermittent reference sites in the Los Angeles region.

Flow duration class	Index	# sites	Mean score	Standard deviation	Earliest sample	Most recent sample
Perennial	ASCI_D	27	0.96	0.11	2008	2023
Perennial	ASCI_H	26	0.96	0.12	2008	2021
Perennial	CSCI	32	0.99	0.11	2000	2023
Intermittent	ASCI_D	15	0.97	0.11	2008	2023
Intermittent	ASCI_H	15	1.02	0.12	2008	2017
Intermittent	CSCI	20	0.97	0.12	2000	2023

Table 5. Welch's two-sample t-test comparing mean index scores at perennial and intermittent reference sites in the Los Angeles region.

Index	Mean at perennial reference sites	Mean at intermittent reference sites	Degrees of freedom	t	p
CSCI	0.99	0.97	39.7	0.70	0.49
ASCI_D	0.96	0.97	29.4	-0.33	0.75
ASCI_H	0.96	1.02	28.3	-1.47	0.15

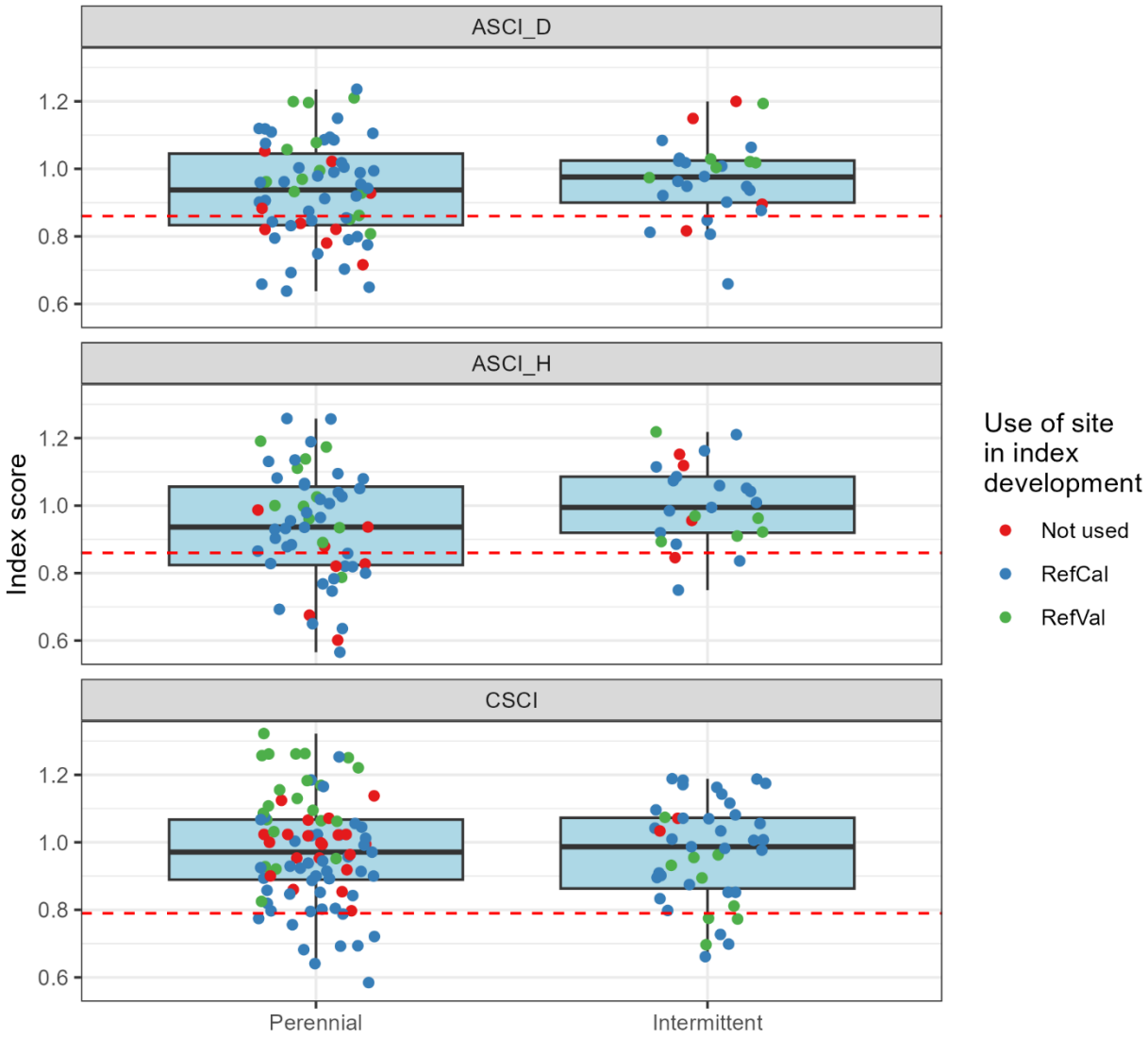


Figure 12. Bioassessment index scores at perennial and intermittent reference sites in the Los Angeles region. Each point represents a single sample. The red dashed lines represent assessment thresholds based on the 10th percentile of scores at reference sites used in index development (CSCI: Mazor et al. 2016; ASCIs: Theroux et al. 2020). RefCal: Site used to train the CSCI or ASCI models. RefVal: Site used to validate the CSCI or ASCI models. Not used: Site not used in index development.

CONCLUSION

The bioassessment indices evaluated in this study can provide meaningful measures of biointegrity in both perennial and naturally intermittent streams in the Los Angeles region. There is no indication that scores in this region vary based on streamflow duration. This finding is consistent with other studies of intermittent streams in southern California (Mazor et al. 2014, 2024, Rehn 2017), and contrasts with studies of northern California intermittent streams (Lunde et al. 2013, Mazor et al. 2024), at least for the CSCI. This study fills a crucial geographic gap between southern and northern California streams and should provide watershed managers in this region with greater confidence in incorporating biointegrity measures into their monitoring and management programs.

Although at one time, all the reference sites evaluated in the study were presumed to be perennial, we have determined that 40% of them are, in fact, intermittent. A review of reference sites in the San Diego region found a much higher proportion of intermittent sites (i.e., 85%). This higher proportion of perennial streams in Los Angeles compared to San Diego is consistent with both the climatic, topographic, and geologic gradients that drive streamflow duration (Mazor 2015, Fritz et al. 2020).

This study demonstrates the value in using pre-existing bioassessment data to address questions of index applicability. Although previous studies have recognized that the Los Angeles region contains a large number of reference sites that have been extensively sampled (Mazor et al. 2016, Ode et al. 2016), the lack of associated hydrologic data prevented a comprehensive analysis of the impacts of flow duration on index interpretation. Through a number of well-timed site visits and review of historical aerial imagery, we were able to classify 80% of candidate reference sites as perennial or intermittent. A similar approach could expand the scope of this study to adjacent regions where few intermittent reference sites are known at present (e.g., the Central and North Coast). Given the high rates of loss and equipment failure, we do not recommend the continued use of loggers in regions where site visits are practical and can be timed in accordance with climatic patterns. However, in regions where such visits are impractical, loggers may continue to provide useful information provided they can be securely deployed (e.g., Fritz et al. 2020, Mazor et al. 2021). Wildlife cameras may also provide useful information at suitable sites.

Although it is possible to add more reference sites in the Los Angeles region to this study through new data collection or hydrologic assessment of additional sites, future reanalysis with a larger data set is unlikely to change the very small differences in scores that were observed (<0.05 for all three indices), or lead to different conclusions about the interpretation of bioassessment indices in intermittent streams in this region.

REFERENCES

Beck, M. W., and R. D. Mazor. 2020. A decision framework for evaluating bioassessment samples and landscape models. 1115, Southern California Coastal Water Research Project, Costa Mesa, CA. (Available from: https://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1115_CSCIDecisionFramework.pdf)

Bogan, M. T., K. S. Boersma, and D. A. Lytle. 2013. Flow intermittency alters longitudinal patterns of invertebrate diversity and assemblage composition in an arid-land stream network: *Intermittent flow alters longitudinal patterns*. Freshwater Biology 58:1016–1028.

Chapin, T. P., A. S. Todd, and M. P. Zeigler. 2014. Robust, low-cost data loggers for stream temperature, flow intermittency, and relative conductivity monitoring. Water Resources Research 50:6542–6548.

Cid, N., N. Bonada, J. Heino, M. Cañedo-Argüelles, J. Crabot, R. Sarremejane, J. Soininen, R. Stubbington, and T. Datry. 2020. A Metacommunity Approach to Improve Biological Assessments in Highly Dynamic Freshwater Ecosystems. BioScience 70:427–438.

Datry, T., N. Bonada, and A. J. Boulton (Eds.). 2017. Intermittent rivers and ephemeral streams: Ecology and management. Academic Press, an imprint of Elsevier, London ; San Diego, CA.

Fritz, K. M., T.-L. Nadeau, J. E. Kelso, W. S. Beck, R. D. Mazor, R. A. Harrington, and B. J. Topping. 2020. Classifying Streamflow Duration: The Scientific Basis and an Operational Framework for Method Development. Water 12:2545.

Gasith, A., and V. H. Resh. 1999. Streams in Mediterranean Climate Regions: Abiotic Influences and Biotic Responses to Predictable Seasonal Events. Annual Review of Ecology and Systematics 30:51–81.

Hart, E., and K. Bell. 2015, November 12. Prism: Access Data From The Oregon State Prism Climate Project.

Hawkins, C. P., J. R. Olson, and R. A. Hill. 2010. The reference condition: Predicting benchmarks for ecological and water-quality assessments. Journal of the North American Benthological Society 29:312–343.

Loflen, C. 2020. Biological Objectives for the San Diego Region. Final Staff Report. San Diego Regional Water Quality Control Board, San Diego, CA. (Available from: https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/bio_objectives/doc/Final_Staff_Report.pdf)

Lunde, K. B., M. R. Cover, R. D. Mazor, C. A. Sommers, and V. H. Resh. 2013. Identifying Reference Conditions and Quantifying Biological Variability Within Benthic Macroinvertebrate

Communities in Perennial and Non-perennial Northern California Streams. Environmental Management 51:1262–1273.

Mazor, R. D. 2015. 2015 Report on the SMC Regional Stream Survey. Technical Report 963, Southern California Coastal Water Research Project, Costa Mesa, CA. (Available from: http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/963_2015_SMC_Report_EnginChannels.pdf)

Mazor, R. D., A. C. Rehn, N. Lombardo, and M. A. Sutula. 2024. A technical foundation for biointegrity and biostimulatory indicators and thresholds for modified channels, intermittent streams, and streams on the Central Valley floor. SCCWRP Technical Report TR #1367, Southern California Coastal Water Research Project, Costa Mesa, CA.

Mazor, R. D., A. C. Rehn, P. R. Ode, M. Engeln, K. C. Schiff, E. D. Stein, D. J. Gillett, D. B. Herbst, and C. P. Hawkins. 2016. Bioassessment in complex environments: Designing an index for consistent meaning in different settings. Freshwater Science 35:249–271.

Mazor, R. D., E. D. Stein, P. R. Ode, and K. Schiff. 2014. Integrating intermittent streams into watershed assessments: Applicability of an index of biotic integrity. Freshwater Science 33:459–474.

Mazor, R. D., B. J. Topping, T.-L. Nadeau, K. M. Fritz, J. E. Kelso, R. A. Harrington, W. S. Beck, K. S. McCune, A. O. Allen, R. Leidy, J. T. Robb, and G. C. L. David. 2021. Implementing an Operational Framework to Develop a Streamflow Duration Assessment Method: A Case Study from the Arid West United States. Water 13:3310.

Ode, P. R., A. C. Rehn, R. D. Mazor, K. C. Schiff, E. D. Stein, J. T. May, L. R. Brown, D. B. Herbst, D. Gillett, K. Lunde, and C. P. Hawkins. 2016. Evaluating the adequacy of a reference-site pool for ecological assessments in environmentally complex regions. Freshwater Science 35:237–248.

Rehn, A. C. 2017. Biological condition of non-perennial streams and spring-fed oases. Colorado River Basin Region. SWAMP-MR-RB7_2017-0001, State Water Resources Control Board, Sacramento, CA. (Available from: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/r7_nonperennial_report_final.pdf)

Reynoldson, T. B., R. H. Norris, V. H. Resh, K. E. Day, and D. M. Rosenberg. 1997. The Reference Condition: A Comparison of Multimetric and Multivariate Approaches to Assess Water-Quality Impairment Using Benthic Macroinvertebrates. Journal of the North American Benthological Society 16:833–852.

Schumacher, C., and K. M. Fritz. 2019. Standard Operating Procedure: Verifying/Calibrating, Deploying, Retrieving Stream Temperature, Intermittency, and Conductivity (STIC) Data Loggers, and Downloading and Converting Data. EPA Report D-WQD-ECB-024-SOP-02. Environmental Protection Agency, Washington, D.C.

Stoddard, J. L., D. P. Larsen, C. P. Hawkins, R. K. Johnson, and R. H. Norris. 2006. SETTING EXPECTATIONS FOR THE ECOLOGICAL CONDITION OF STREAMS: THE CONCEPT OF REFERENCE CONDITION. Ecological Applications 16:1267–1276.

Stubbington, R., R. Chadd, N. Cid, Z. Csabai, M. Miliša, M. Morais, A. Munné, P. Pařil, V. Pešić, I. Tziortzis, R. C. M. Verdonschot, and T. Datry. 2018. Biomonitoring of intermittent rivers and ephemeral streams in Europe: Current practice and priorities to enhance ecological status assessments. Science of The Total Environment 618:1096–1113.

Theroux, S., R. D. Mazor, M. W. Beck, P. R. Ode, E. D. Stein, and M. Sutula. 2020. Predictive biological indices for algae populations in diverse stream environments. Ecological Indicators 119:106421.

APPENDIX 1. CANDIDATE REFERENCE SITES FOR HYDROLOGIC ASSESSMENT IN THE LOS ANGELES REGION

Sixty six reference sites were identified as candidates for hydrologic assessment in the Los Angeles Region. An additional 6 sites previously identified (in deliverable 4.5.i) were removed from consideration when 4 were discovered to be non-reference, and 2 were identified as aliases of other sites on this list. The four non-reference sites were located below either Bouquet or San Gabriel dams, which are not represented in the National Inventory of Dams database and therefore passed reference screens inappropriately.

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
402BA0095	North Fork Santa Ana Creek Random Site 95	34.46328	-119.34566	Ventura	Ventura	RefCal	RefVal
402BA0287	Matilija Creek Random Site 287	34.50284	-119.36644	Ventura	Ventura	RefCal	RefCal
402M00043	Matilija Creek below hot springs	34.50161	-119.34749	Ventura	Ventura	Not used	Not used
402MJCMHS	Matilija Creek nr. Res. nr. Matilija Hot Springs	34.50280	-119.35730	Ventura	Ventura	Not used	Not used
402MTCUNF	Matilija Creek, Upper NF ~0.7mi above confluence	34.51750	-119.37920	Ventura	Ventura	Not used	RefCal
402PS0048	Matilija Creek	34.53077	-119.40085	Ventura	Ventura	Not used	RefVal
402S09503	Matilija creek ~1.6mi above Rattlesnake Cyn. Cr.	34.49757	-119.33913	Ventura	Ventura	Not used	RefVal
402S13599	Matilija Creek	34.49898	-119.34187	Ventura	Ventura	Not used	RefCal
402WE0536	Matilija Creek 1.7 miles	34.51960	-119.40537	Ventura	Ventura	RefCal	Not used

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
	upstream from Upper North Fork Matilija Creek.						
402WE0803	Coyote Creek Below Confluence of West Fork	34.42131	-119.38060	Ventura	Ventura	RefCal	Not used
403BA0015	Santa Clara Watershed Unknown River Random Site 15	34.53120	-119.18421	Ventura	Santa Clara	RefCal	RefCal
403BA0064	Elizabeth Lake Canyon Random Site 64	34.64435	-118.51371	Los Angeles	Santa Clara	RefVal	RefCal
403BA0171	Santa Clara Watershed Unknown River Random Site 191	34.58516	-119.28363	Ventura	Santa Clara	RefCal	RefVal
403BA0960	Clearwater Canyon Random Site 960	34.59078	-118.46170	Los Angeles	Santa Clara	RefCal	RefCal
403LNCASC	Lion Creek ~1.9mi above Sespe Cr.	34.53892	-119.16139	Ventura	Santa Clara	Not used	RefCal
403S00271	Lion Creek near Middle Lion Fork Campground	34.54850	-119.16547	Ventura	Santa Clara	RefCal	RefVal
403S00875	Tule Creek 875	34.55668	-119.30629	Ventura	Santa Clara	RefVal	RefCal
403S01883	Lockwood Creek	34.71629	-119.01890	Ventura	Santa Clara	RefCal	RefCal
403S02139	Alamo Creek above Mutau Cr.	34.67160	-119.01720	Ventura	Santa Clara	Not used	RefCal
403S03643	Sespe Creek 3643	34.56213	-119.12891	Ventura	Santa Clara	RefCal	RefCal
403STC010	Random Site 10 - Lion Canyon	34.53306	-119.15833	Ventura	Santa Clara	RefVal	Not used

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
403STC021	Random Site 21 - Piru Creek - Forest Service Rd 7N13	34.64667	-119.06944	Ventura	Santa Clara	RefCal	Not used
403STC024	Random Site 24 - Tributary to Santa Paula Creek near Big Cone Campsite	34.45056	-119.05583	Ventura	Santa Clara	RefVal	Not used
403STC026	Random Site 26 - Tule Creek	34.55889	-119.26861	Ventura	Santa Clara	RefCal	Not used
403STC029	Random Site 29 - Elizabeth Canyon	34.61528	-118.55833	Los Angeles	Santa Clara	RefCal	Not used
403STC030	Random Site 30 - Piedra Blanca Creek	34.57000	-119.15556	Ventura	Santa Clara	RefCal	Not used
403STC064	Random Site 64 - Bear Canyon	34.55806	-119.10361	Ventura	Santa Clara	RefCal	RefCal
403STC065	Random Site 65 - Elizabeth Canyon	34.63056	-118.53611	Los Angeles	Santa Clara	RefCal	Not used
403STC066	Random Site 66 - Piedra Blanca Creek	34.58500	-119.16472	Ventura	Santa Clara	RefVal	Not used
403STC085	Random Site 85 - Piru Creek	34.64250	-119.07750	Ventura	Santa Clara	RefCal	Not used
403STC086	Random Site 86 - Rock Creek	34.55667	-119.20611	Ventura	Santa Clara	RefCal	RefVal
403WE0501	Agua Blanca Creek ~1mi Above Piru Creek	34.54172	-118.77286	Ventura	Santa Clara	RefCal	RefCal
403WE0540	Piru Creek ~1.9 miles upstream from Cedar Creek.	34.65136	-119.11845	Ventura	Santa Clara	RefCal	RefCal

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
403WE0683	Santa Paula Creek ~1.5mi N Hwy 150	34.43952	-119.07616	Ventura	Santa Clara	RefVal	RefCal
403WE0795	Piru Creek ~1.7mi Below Cedar Creek	34.64080	-119.08094	Ventura	Santa Clara	RefCal	Not used
403WE0891	Piru Creek Above Mutau Flat Road	34.65926	-119.14255	Ventura	Santa Clara	RefVal	Not used
403WE1021	Elizabeth Canyon Creek Lake Hughes Rd. ~10mi E I5	34.63193	-118.52977	Los Angeles	Santa Clara	Not used	Not used
403WE1027	Lockwood Creek at Lockwood Valley Campground	34.72654	-119.02842	Ventura	Santa Clara	RefCal	RefCal
404ARRSEQ	Arroyo Sequit trib. ~0.5mi above confluence	34.08506	-118.91206	Los Angeles	Santa Monica Bay	Not used	Not used
405BRCAMS	Bear Creek, WF ~0.5mi above mainstem	34.27380	-117.89900	Los Angeles	San Gabriel	RefCal	RefCal
405BRCSGR	Bear Creek above San Gabriel River	34.25031	-117.88372	Los Angeles	San Gabriel	Not used	RefVal
405S02972	Trib to WF San Gabriel River	34.24958	-118.07550	Los Angeles	San Gabriel	Not used	RefCal
405S03280	San Gabriel, NF ~0.8mi below Bichota Cyn. Cr	34.25686	-117.85653	Los Angeles	San Gabriel	RefVal	RefCal
405S03452	Trib to Soldier Creek	34.30354	-117.83231	Los Angeles	San Gabriel	Not used	RefCal
405SGB003	San Gabriel Random Site 3	34.28157	-117.88508	Los Angeles	San Gabriel	Not used	Not used

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
405SGB006	San Gabriel Random Site 6	34.25553	-117.82139	Los Angeles	San Gabriel	Not used	Not used
405SGRAAG	San Gabriel River, EF above Allison Gulch	34.26448	-117.74751	Los Angeles	San Gabriel	Not used	RefCal
405WER318	Bear Creek below West Fork	34.26833	-117.89111	Los Angeles	San Gabriel	RefCal	RefVal
412S04204	SANTA ANITA CANYON ~0.3mi above Winter Cr.	34.20360	-118.01850	Los Angeles	Los Angeles	Not used	RefCal
SGUR103	Rush Creek	34.23218	-118.05822	Los Angeles	San Gabriel	RefCal	RefCal
SGUT501	WF SG Below confluence of Bear creek	34.24080	-117.88330	Los Angeles	San Gabriel	RefVal	Not used
SMC00144	Graveyard Canyon	34.24481	-117.79459	Los Angeles	San Gabriel	Not used	Not used
SMC00428	West Fork San Gabriel River below confluence with Rush Creek	34.24810	-118.04976	Los Angeles	San Gabriel	RefCal	RefCal
SMC00476	Bear Canyon	34.24209	-118.13381	Los Angeles	Los Angeles	RefVal	RefCal
SMC00911	Wheeler Springs 250 m upstream of NF Matilija	34.50797	-119.29854	Ventura	Ventura	RefVal	RefVal
SMC01164	Unnamed tributary to the SF Santa Clara River	34.35078	-118.57968	Los Angeles	Santa Clara	RefCal	Not used
SMC01196	Big Tujunga Creek 185m downstream of Upper Big Tujunga Canyon Rd	34.27835	-118.02952	Los Angeles	Los Angeles	RefCal	RefCal

Station code	Stream name	Latitude	Longitude	County	Watershed	CSCI	ASCI
SMC01248	Tributary of the San Gabriel River	34.25895	-117.74499	Los Angeles	San Gabriel	RefCal	RefCal
SMC01424	Susanna Canyon	34.24075	-117.81585	Los Angeles	San Gabriel	RefCal	RefCal
SMC01567	Upper North Fork Matilija Creek 50m upstream of confluence with Matilija Creek	34.50959	-119.38373	Ventura	Ventura	RefVal	RefCal
SMC01979	Sisar Canyon 160 m south of hairpin in Sisar Canyon Road	34.45205	-119.13624	Ventura	Santa Clara	RefCal	RefCal
SMC02591	Upper North Fork Matilija Creek approx 200 m north of Matilija Campground	34.51783	-119.37846	Ventura	Ventura	RefCal	RefVal
SMC04383	Matilija Creek ~ 4km upstream of Hwy 33	34.50224	-119.35602	Ventura	Ventura	RefCal	RefCal
SMC04795	Thacher Creek	34.47989	-119.17067	Ventura	Ventura	RefCal	RefCal
SMC05243	Unnamed trib, 1 km upstream of confluence with Derrydale Creek	34.59250	-119.25122	Ventura	Ventura	RefCal*	RefCal*
SMC05407	Matilija Creek ~ 5km upstream of Hwy 33	34.50124	-119.35043	Ventura	Ventura	RefCal	RefCal

Table A 1. Candidate reference sites for hydrologic assessment in the Los Angeles region. RefCal: Reference site used to train the CSCI or ASCI models. RefVal: Reference site used to validate the CSCI or ASCI models. Not used: Reference site not used to train or validate the CSCI or ASCI models.

*Site SMC05423 (34.28649, -119.30791), a non-reference perennial site on the lower mainstem of the Ventura River, was sampled in 2010, and submitted under the incorrect site code (SMC05243), which corresponds to a small reference site in the Santa Clara watershed. Data from this sampling event was used to train both the CSCI and ASCI models under the mistaken belief that it came from the Santa Clara reference site, SMC05243. Site SMC05243 has in fact never been sampled. This study evaluated the hydrology of SMC05243, not SMC05423.

APPENDIX 2. HISTORICAL AERIAL IMAGERY OBSERVATIONS

Historical aerial imagery for all 66 sites listed in Appendix 1 was investigated using Google Earth's time slider. At least 15 years (from 2004 to 2024) were evaluated. If water could be observed at or close to (within 1 km) of the site, then the date was recorded as "flowing". If a dry streambed could be observed, the date was recorded as "dry". Most dates where the imagery was unclear or the conditions were ambiguous were not recorded; however, a few were flagged for secondary review of the data by additional experts; this review was performed by Chad Loflen and Emily Duncan.

Station code	Latitude	Longitude	Date	Flow conditions	Comments
402BA0287	34.50284	-119.36644	9/11/2023	Flowing	Clear
402BA0287	34.50284	-119.36644	6/24/2022	Dry	Clear
402BA0287	34.50284	-119.36644	3/1/2021	Flowing	Clear
402BA0287	34.50284	-119.36644	11/10/2019	Flowing	Clear
402BA0287	34.50284	-119.36644	4/12/2018	Flowing	Clear
402BA0287	34.50284	-119.36644	1/12/2018	Flowing	Clear
402BA0287	34.50284	-119.36644	8/8/2017	Dry	Wet portions just upstream
402BA0287	34.50284	-119.36644	4/14/2017	Flowing	Clear
402BA0287	34.50284	-119.36644	11/2/2016	Dry	Clear
402BA0287	34.50284	-119.36644	8/28/2016	Dry	Clear
402BA0287	34.50284	-119.36644	7/2/2016	Dry	Clear
402BA0287	34.50284	-119.36644	12/31/2014	Flowing	Clear
402BA0287	34.50284	-119.36644	1/19/2014	Dry	Clear
402BA0287	34.50284	-119.36644	4/17/2013	Dry	Clear
402BA0287	34.50284	-119.36644	8/31/2007	Dry	Clear
402BA0287	34.50284	-119.36644	8/12/2006	Flowing	Clear
402M00043	34.50161	-119.34749	9/11/2023	Flowing	Clear
402M00043	34.50161	-119.34749	6/24/2022	Unclear	Probably flowing but not clear enough
402M00043	34.50161	-119.34749	3/1/2021	Flowing	Clear
402M00043	34.50161	-119.34749	11/10/2019	Flowing	Clear
402M00043	34.50161	-119.34749	4/12/2018	Flowing	Clear
402M00043	34.50161	-119.34749	1/12/2018	Flowing	Clear
402M00043	34.50161	-119.34749	8/8/2017	Flowing	Less clear
402M00043	34.50161	-119.34749	4/14/2017	Flowing	Less clear
402M00043	34.50161	-119.34749	12/31/2014	Flowing	Clear
402M00043	34.50161	-119.34749	1/22/2014	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
402M00043	34.50161	-119.34749	4/17/2013	Flowing	Clear
402MJCMHS	34.50280	-119.35730	9/11/2023	Flowing	Clear
402MJCMHS	34.50280	-119.35730	6/24/2022	Dry???	Not so clear but clearly dry further upstream
402MJCMHS	34.50280	-119.35730	3/1/2021	Flowing	Clear
402MJCMHS	34.50280	-119.35730	11/10/2019	Flowing	Clear
402MJCMHS	34.50280	-119.35730	4/12/2018	Flowing	Clear
402MJCMHS	34.50280	-119.35730	1/12/2018	Flowing	Clear
402MJCMHS	34.50280	-119.35730	8/8/2017	Flowing	Not so clear but clearly dry further upstream
402MJCMHS	34.50280	-119.35730	4/14/2017	Flowing	Clear
402MJCMHS	34.50280	-119.35730	8/28/2016	Unclear	
402MJCMHS	34.50280	-119.35730	12/31/2014	Flowing	Clear
402MJCMHS	34.50280	-119.35730	1/19/2014	Flowing	Clear
402MJCMHS	34.50280	-119.35730	4/17/2013	Flowing	Clear
402MJCMHS	34.50280	-119.35730	5/24/2009	Flowing	Clear
402MTCUNF	34.51750	-119.37920	9/11/2023	Flowing	Clear
402MTCUNF	34.51750	-119.37920	6/24/2022	Flowing	
402MTCUNF	34.51750	-119.37920	3/1/2021	Flowing	Clear
402MTCUNF	34.51750	-119.37920	11/10/2019	Flowing	Clear
402MTCUNF	34.51750	-119.37920	4/12/2018	Flowing	Clear
402MTCUNF	34.51750	-119.37920	8/8/2017	Flowing	Mostly obscured by vegetation
402MTCUNF	34.51750	-119.37920	4/14/2017	Flowing	Mostly obscured by vegetation
402MTCUNF	34.51750	-119.37920	12/31/2014	Flowing	Mostly obscured by vegetation
402PS0048	34.53077	-119.40085	6/24/2022	Unclear	Poor visibility, might be dry
402PS0048	34.53077	-119.40085	3/1/2021	Flowing	Clear
402PS0048	34.53077	-119.40085	11/10/2019	Flowing	Clear
402PS0048	34.53077	-119.40085	1/9/2018	Flowing	Poor visibility
402PS0048	34.53077	-119.40085	8/8/2017	Flowing	
402PS0048	34.53077	-119.40085	4/14/2017	Flowing	
402PS0048	34.53077	-119.40085	12/31/2014	Flowing	
402PS0048	34.53077	-119.40085	1/19/2014	Unclear	Poor visibility, might be flowing
402PS0048	34.53077	-119.40085	4/17/2013	Flowing	Mostly obscured by vegetation
402PS0048	34.53077	-119.40085	9/11/2011	Flowing	Clear
402PS0048	34.53077	-119.40085	8/12/2006	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
402S09503	34.49757	-119.33913	6/24/2022	Flowing	Hard to see at site but water evident both upstream and downstream
402S09503	34.49757	-119.33913	3/1/2021	Flowing	Clear
402S09503	34.49757	-119.33913	11/10/2019	Flowing	Clear
402S09503	34.49757	-119.33913	4/12/2018	Flowing	Clear
402S09503	34.49757	-119.33913	1/12/2018	Flowing	Clear
402S09503	34.49757	-119.33913	8/8/2017	Flowing	Clear
402S09503	34.49757	-119.33913	4/14/2017	Flowing	Clear
402S09503	34.49757	-119.33913	8/8/2016	Unclear	Hard to see. No water evident downstream or upstream
402S09503	34.49757	-119.33913	7/2/2016	Unclear	Hard to see. No water evident downstream or upstream
402S09503	34.49757	-119.33913	12/31/2014	Flowing	Clear
402S09503	34.49757	-119.33913	1/22/2014	Flowing	Clear
402S09503	34.49757	-119.33913	4/17/2013	Flowing	Clear
402S09503	34.49757	-119.33913	9/11/2011	Flowing	Clear
402S09503	34.49757	-119.33913	8/31/2007	Flowing	Clear
402S13599	34.49757	-119.33913	6/24/2022	Flowing	Hard to see at site but water evident both upstream and downstream
402S13599	34.49757	-119.33913	3/1/2021	Flowing	Clear
402S13599	34.49757	-119.33913	11/10/2019	Flowing	Clear
402S13599	34.49757	-119.33913	4/12/2018	Flowing	Clear
402S13599	34.49757	-119.33913	1/12/2018	Flowing	Clear
402S13599	34.49757	-119.33913	8/8/2017	Flowing	Clear
402S13599	34.49757	-119.33913	4/14/2017	Flowing	Clear
402S13599	34.49757	-119.33913	8/8/2016	Unclear	Hard to see. No water evident downstream or upstream
402S13599	34.49757	-119.33913	7/2/2016	Unclear	Hard to see. No water evident downstream or upstream
402S13599	34.49757	-119.33913	12/31/2014	Flowing	Clear
402S13599	34.49757	-119.33913	1/22/2014	Flowing	Clear
402S13599	34.49757	-119.33913	4/17/2013	Flowing	Clear
402S13599	34.49757	-119.33913	9/11/2011	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
402S13599	34.49757	-119.33913	8/31/2007	Flowing	Clear
402WE0536	34.51960	-119.40537	5/2/2024	Flowing	Clear
402WE0536	34.51960	-119.40537	9/11/2023	Flowing	Clear
402WE0536	34.51960	-119.40537	3/1/2022	Flowing	Clear
402WE0536	34.51960	-119.40537	11/10/2019	Flowing	Clear
402WE0536	34.51960	-119.40537	4/12/2018	Flowing	Clear
402WE0536	34.51960	-119.40537	1/9/2018	Flowing	Clear
402WE0536	34.51960	-119.40537	8/8/2017	Flowing	Clear
402WE0536	34.51960	-119.40537	4/14/2017	Flowing	Clear
402WE0536	34.51960	-119.40537	4/17/2013	Flowing	Hard to see
402WE0803	34.42131	-119.38060	7/8/2023	Flowing	Good visibility. Lots of algae
402WE0803	34.42131	-119.38060	3/1/2021	Flowing	OK visibility
402WE0803	34.42131	-119.38060	4/12/2018	Flowing	OK visibility
403BA0015	34.53120	-119.18421	12/27/2023	Flowing	Easier to seee at road crossing
403BA0015	34.53120	-119.18421	3/1/2021	Flowing	Easier to seee at road crossing
403BA0015	34.53120	-119.18421	11/10/2019	Dry	
403BA0015	34.53120	-119.18421	11/4/2018	Dry	
403BA0015	34.53120	-119.18421	4/12/2018	Flowing	
403BA0015	34.53120	-119.18421	1/9/2018	Unclear	
403BA0015	34.53120	-119.18421	12/30/2017	Unclear	Possibly flowing
403BA0015	34.53120	-119.18421	12/9/2017	Unclear	Possibly flowing
403BA0015	34.53120	-119.18421	11/29/2017	Unclear	
403BA0015	34.53120	-119.18421	8/31/2017	Dry	
403BA0015	34.53120	-119.18421	8/8/2017	Dry	Very clear at road crossing
403BA0015	34.53120	-119.18421	4/1/2017	Flowing	Easier to seee at road crossing
403BA0015	34.53120	-119.18421	8/28/2016	Dry	
403BA0015	34.53120	-119.18421	7/2/2016	Dry	
403BA0015	34.53120	-119.18421	12/31/2014	Unclear	Additional review needed.
403BA0015	34.53120	-119.18421	1/22/2014	Unclear	Possibly dry
403BA0015	34.53120	-119.18421	4/17/2013	Dry	Very clear at road crossing
403BA0015	34.53120	-119.18421	5/24/2009	Unclear	Bad imagery
403BA0015	34.53120	-119.18421	7/7/2006	Flowing	
403BA0015	34.53120	-119.18421	4/26/2006	Flowing	
403BA0015	34.53120	-119.18421	12/31/2004	Unclear	Bad imagery
403BA0064	34.64435	-118.51371	6/15/2023	Flowing	
403BA0064	34.64435	-118.51371	1/25/2023	Flowing	

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403BA0064	34.64435	-118.51371	9/23/2020	Dry???	Additional review needed.
403BA0064	34.64435	-118.51371	2/15/2020	Flowing	
403BA0064	34.64435	-118.51371	10/21/2018	Dry	
403BA0064	34.64435	-118.51371	12/8/2017	Unclear	Blurry
403BA0064	34.64435	-118.51371	4/29/2017	Flowing	
403BA0064	34.64435	-118.51371	7/8/2016	Dry	
403BA0064	34.64435	-118.51371	4/4/2016	Dry???	2nd opinion. Clearly wet just downstream.
403BA0064	34.64435	-118.51371	4/11/2015	Dry???	2nd opinion. Clearly wet just downstream.
403BA0064	34.64435	-118.51371	12/10/2013	Flowing?	Second opinion?
403BA0064	34.64435	-118.51371	5/24/2013	Flowing?	Second opinion?
403BA0064	34.64435	-118.51371	7/15/2011	Flowing	Clear
403BA0064	34.64435	-118.51371	11/14/2009	Unclear	
403BA0064	34.64435	-118.51371	5/24/2009	Unclear	
403BA0064	34.64435	-118.51371	1/8/2008	Flowing	Clear
403BA0064	34.64435	-118.51371	3/15/2006	Flowing	Clear
403BA0064	34.64435	-118.51371	11/2/2005	Flowing	Clear
403BA0064	34.64435	-118.51371	12/31/2004	Unclear	
403BA0171	34.58516	-119.28363	9/11/2023	Flowing	Poor visibility
403BA0171	34.58516	-119.28363	6/24/2022	Dry	Poor visibility
403BA0171	34.58516	-119.28363	3/1/2021	Flowing	Poor visibility
403BA0171	34.58516	-119.28363	4/12/2018	Flowing	Poor visibility
403BA0171	34.58516	-119.28363	8/8/2017	Flowing	Poor visibility
403BA0171	34.58516	-119.28363	4/4/2017	Flowing	Poor visibility
403BA0171	34.58516	-119.28363	8/28/2016	Unclear	Possibly dry
403BA0171	34.58516	-119.28363	7/2/2016	Unclear	Possibly dry
403BA0171	34.58516	-119.28363	4/17/2013	Flowing	Poor visibility
403BA0960	34.59078	-118.46170	5/22/2023	Flowing	Clear
403BA0960	34.59078	-118.46170	9/23/2020	Flowing	Thin trickle
403BA0960	34.59078	-118.46170	2/15/2020	Flowing	Thin trickle
403BA0960	34.59078	-118.46170	10/21/2018	Dry	Poor visibility
403BA0960	34.59078	-118.46170	12/8/2017	Dry	
403BA0960	34.59078	-118.46170	7/27/2017	Dry	Clear
403BA0960	34.59078	-118.46170	4/29/2017	Flowing	Clear
403BA0960	34.59078	-118.46170	7/8/2016	Dry	Clear
403BA0960	34.59078	-118.46170	4/4/2016	Dry	Clear
403BA0960	34.59078	-118.46170	4/11/2015	Dry	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403BA0960	34.59078	-118.46170	5/24/2013	Unclear	Massive change in valley morphology
403BA0960	34.59078	-118.46170	7/15/2011	Flowing	Clear
403LNCASC	34.53892	-119.16139	12/27/2023	Flowing	Clear
403LNCASC	34.53892	-119.16139	3/1/2021	Dry	Possibly some pools
403LNCASC	34.53892	-119.16139	11/10/2019	Dry	Possibly some pools
403LNCASC	34.53892	-119.16139	11/4/2018	Dry	
403LNCASC	34.53892	-119.16139	4/12/2018	Flowing	Clear
403LNCASC	34.53892	-119.16139	1/9/2018	Flowing	Clear
403LNCASC	34.53892	-119.16139	12/30/2017	Dry	Poor imagery
403LNCASC	34.53892	-119.16139	12/6/2017	Dry	
403LNCASC	34.53892	-119.16139	11/29/2017	Dry	
403LNCASC	34.53892	-119.16139	8/8/2017	Dry	Clear
403LNCASC	34.53892	-119.16139	4/14/2017	Flowing	Clear
403LNCASC	34.53892	-119.16139	7/2/2016	Dry	
403LNCASC	34.53892	-119.16139	12/31/2014	Dry	
403LNCASC	34.53892	-119.16139	4/17/2013	Dry	Clear
403LNCASC	34.53892	-119.16139	8/31/2007	Dry	
403LNCASC	34.53892	-119.16139	7/7/2006	Flowing	Clear
403S00271	34.54850	-119.16547	12/27/2023	Flowing	
403S00271	34.54850	-119.16547	3/1/2021	Flowing	Clear
403S00271	34.54850	-119.16547	4/12/2018	Flowing	
403S00271	34.54850	-119.16547	4/14/2017	Flowing	
403S00875	34.55668	-119.30629	9/11/2023	Flowing	
403S00875	34.55668	-119.30629	6/24/2022	Dry	Not great imagery
403S00875	34.55668	-119.30629	3/1/2021	Flowing	
403S00875	34.55668	-119.30629	11/10/2019	Dry	Not great imagery
403S00875	34.55668	-119.30629	4/12/2018	Flowing	
403S00875	34.55668	-119.30629	1/9/2018	Flowing	Poor imagery but flow evident up and downstream
403S00875	34.55668	-119.30629	12/12/2017	Flowing	Poor imagery but flow evident up and downstream
403S00875	34.55668	-119.30629	8/8/2017	Dry	Clear
403S00875	34.55668	-119.30629	4/14/2017	Flowing	Dry just downstream of site
403S00875	34.55668	-119.30629	8/28/2016	Dry	Not great imagery
403S00875	34.55668	-119.30629	7/2/2016	Dry	
403S00875	34.55668	-119.30629	12/31/2014	Flowing	

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403S00875	34.55668	-119.30629	4/17/2013	Unclear	Probably flowing but not clear enough
403S00875	34.55668	-119.30629	8/31/2007	Dry	
403S01883	34.71629	-119.01890	8/1/2023	Flowing	
403S01883	34.71629	-119.01890	3/1/2021	Flowing	Clear
403S01883	34.71629	-119.01890	11/10/2019	Flowing	Clear
403S01883	34.71629	-119.01890	10/22/2018	Flowing	
403S01883	34.71629	-119.01890	4/12/2018	Flowing	Clear
403S01883	34.71629	-119.01890	12/11/2017	Flowing	
403S01883	34.71629	-119.01890	11/29/2017	Flowing	
403S01883	34.71629	-119.01890	8/8/2017	Flowing	
403S01883	34.71629	-119.01890	4/14/2017	Flowing	
403S01883	34.71629	-119.01890	12/31/2014	Flowing	
403S01883	34.71629	-119.01890	4/17/2013	Flowing	
403S01883	34.71629	-119.01890	5/24/2009	Flowing	
403S01883	34.71629	-119.01890	8/31/2007	Flowing	
403S02139	34.67160	-119.01720	3/1/2021	Flowing	Also Alamo
403S02139	34.67160	-119.01720	4/12/2018	Flowing	Also Alamo
403S02139	34.67160	-119.01720	8/8/2017	Unclear	Alamo is possibly dry
403S02139	34.67160	-119.01720	4/14/2017	Flowing	Also Alamo
403S02139	34.67160	-119.01720	4/17/2013	Flowing	Also Alamo
403S03643	34.56213	-119.12891	8/1/2023	Flowing	Clear
403S03643	34.56213	-119.12891	3/1/2021	Flowing	Clear
403S03643	34.56213	-119.12891	11/10/2019	Unclear	Large pools are obvious but can't tell if they are isolated
403S03643	34.56213	-119.12891	11/4/2018	Dry	Large pools are visible
403S03643	34.56213	-119.12891	4/12/2018	Flowing	Clear
403S03643	34.56213	-119.12891	1/9/2018	Flowing	Clear
403S03643	34.56213	-119.12891	12/30/2017	Unclear	Large pools are obvious but can't tell if they are isolated
403S03643	34.56213	-119.12891	12/11/2017	Unclear	Large pools are obvious but can't tell if they are isolated
403S03643	34.56213	-119.12891	11/29/2017	Dry	Large pools are visible
403S03643	34.56213	-119.12891	8/8/2017	Unclear	Large pools are obvious but can't

Station code	Latitude	Longitude	Date	Flow conditions	Comments
					tell if they are isolated
403S03643	34.56213	-119.12891	4/14/2017	Flowing	Clear
403S03643	34.56213	-119.12891	12/31/2014	Flowing	Clear
403S03643	34.56213	-119.12891	4/17/2013	Flowing	Clear
403S03643	34.56213	-119.12891	5/24/2009	Flowing	
403S03643	34.56213	-119.12891	8/31/2007	Unclear	Large pools are obvious but can't tell if they are isolated
403S03643	34.56213	-119.12891	7/7/2006	Flowing	Clear
403STC010	34.53306	-119.15833	12/27/2023	Flowing	Clear
403STC010	34.53306	-119.15833	3/1/2021	Flowing	Clear
403STC010	34.53306	-119.15833	11/10/2019	Flowing	Clear
403STC010	34.53306	-119.15833	4/12/2018	Flowing	Clear
403STC010	34.53306	-119.15833	12/30/2017	Flowing	Clear
403STC010	34.53306	-119.15833	8/8/2017	Flowing	Barely evident in a few spots under veg
403STC010	34.53306	-119.15833	4/14/2017	Flowing	Clear
403STC010	34.53306	-119.15833	12/31/2014	Flowing	Clear
403STC010	34.53306	-119.15833	4/17/2013	Flowing	Clear
403STC010	34.53306	-119.15833	7/7/2006	Flowing	Clear
403STC021	34.64667	-119.06944	8/1/2023	Flowing	Clear
403STC021	34.64667	-119.06944	3/1/2021	Flowing	Clear
403STC021	34.64667	-119.06944	2/15/2020	Flowing	Clear
403STC021	34.64667	-119.06944	2/15/2020	Dry	Clear
403STC021	34.64667	-119.06944	11/10/2019	Dry?	Flowing downstream but it looks like it's dry upstream
403STC021	34.64667	-119.06944	11/4/2018	Dry	Possible pooling downstream
403STC021	34.64667	-119.06944	10/22/2018	Dry	Possible pooling downstream
403STC021	34.64667	-119.06944	4/12/2018	Flowing	Clear
403STC021	34.64667	-119.06944	1/9/2018	Flowing	Clear
403STC021	34.64667	-119.06944	12/11/2017	Dry	Possible pooling downstream
403STC021	34.64667	-119.06944	11/29/2017	Dry	Possible pooling downstream
403STC021	34.64667	-119.06944	8/8/2017	Dry	Pooling downstream
403STC021	34.64667	-119.06944	4/14/2017	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403STC021	34.64667	-119.06944	12/31/2014	Flowing	Possibly snow
403STC021	34.64667	-119.06944	4/17/2013	Flowing	Clear
403STC021	34.64667	-119.06944	5/24/2009	Flowing	Clear
403STC021	34.64667	-119.06944	8/31/2007	Dry	
403STC021	34.64667	-119.06944	12/31/2004	Flowing	Clear
403STC024	34.45056	-119.05583	5/11/2023	Flowing	Clear
403STC024	34.45056	-119.05583	3/1/2021	Flowing	Hard to see
403STC024	34.45056	-119.05583	4/12/2018	Flowing	Hard to see
403STC024	34.45056	-119.05583	12/31/2017	Flowing	Hard to see
403STC024	34.45056	-119.05583	4/14/2017	Flowing	Hard to see
403STC024	34.45056	-119.05583	8/27/2014	Flowing	Hard to see
403STC026	34.55889	-119.26861	4/17/2023	Flowing	Possibly isolated pools
403STC026	34.55889	-119.26861	3/1/2021	Flowing	Clear
403STC026	34.55889	-119.26861	4/12/2018	Flowing	Clear
403STC026	34.55889	-119.26861	8/8/2017	Dry	
403STC026	34.55889	-119.26861	4/14/2017	Flowing	Clear
403STC026	34.55889	-119.26861	7/7/2006	Flowing	Clear
403STC026	34.55889	-119.26861	4/26/2006	Flowing	Clear
403STC029	34.61528	-118.55833	1/25/2023	Flowing	Clear
403STC029	34.61528	-118.55833	2/17/2022	Flowing	Clear
403STC029	34.61528	-118.55833	2/15/2020	Flowing	
403STC029	34.61528	-118.55833	8/19/2019	Flowing	Mostly clear
403STC029	34.61528	-118.55833	12/31/2017	Flowing	
403STC029	34.61528	-118.55833	4/29/2017	Flowing	Mostly clear
403STC029	34.61528	-118.55833	10/2/2016	Flowing	Not great imagery
403STC029	34.61528	-118.55833	2/8/2016	Flowing	
403STC029	34.61528	-118.55833	8/26/2012	Unclear	Probably flowing but not clear enough
403STC029	34.61528	-118.55833	4/26/2011	Flowing	
403STC030	34.57000	-119.15556	3/1/2021	Flowing	
403STC030	34.57000	-119.15556	4/12/2018	Flowing	
403STC030	34.57000	-119.15556	12/30/2017	Flowing	
403STC030	34.57000	-119.15556	8/8/2017	Unclear	downstream pool looks dry
403STC030	34.57000	-119.15556	4/14/2017	Flowing	
403STC064	34.55806	-119.10361	3/1/2021	Flowing	
403STC064	34.55806	-119.10361	4/12/2018	Flowing	
403STC064	34.55806	-119.10361	8/8/2017	Dry	
403STC064	34.55806	-119.10361	4/14/2017	Flowing	
403STC064	34.55806	-119.10361	4/17/2013	Dry	
403STC065	34.63056	-118.53611	6/15/2023	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403STC065	34.63056	-118.53611	1/25/2023	Flowing	Clear
403STC065	34.63056	-118.53611	2/17/2022	Flowing	Clear
403STC065	34.63056	-118.53611	2/28/2021	Flowing	Clear
403STC065	34.63056	-118.53611	2/15/2020	Flowing	Clear
403STC065	34.63056	-118.53611	8/19/2019	Flowing	Clear
403STC065	34.63056	-118.53611	11/19/2018	Unclear	Probably flowing but not clear enough
403STC065	34.63056	-118.53611	10/21/2018	Unclear	Probably flowing but not clear enough
403STC065	34.63056	-118.53611	8/12/2018	Unclear	Probably flowing but not clear enough
403STC065	34.63056	-118.53611	12/31/2017	Flowing	Clear
403STC065	34.63056	-118.53611	12/5/2017	Flowing	Clear
403STC065	34.63056	-118.53611	4/29/2017	Flowing	Clear
403STC065	34.63056	-118.53611	10/2/2016	Dry	Not clear
403STC065	34.63056	-118.53611	4/4/2016	Flowing	Clear
403STC065	34.63056	-118.53611	2/8/2016	Flowing	Clear
403STC065	34.63056	-118.53611	5/1/2015	Flowing	Clear
403STC065	34.63056	-118.53611	4/11/2015	Flowing	Clear
403STC065	34.63056	-118.53611	8/27/2014	Dry	
403STC065	34.63056	-118.53611	12/10/2013	Flowing	
403STC065	34.63056	-118.53611	7/15/2011	Flowing	
403STC066	34.58500	-119.16472	12/27/2023	Flowing	
403STC066	34.58500	-119.16472	3/1/2021	Flowing	Clear
403STC066	34.58500	-119.16472	11/10/2019	Flowing	
403STC066	34.58500	-119.16472	11/4/2018	Unclear	Possibly dry
403STC066	34.58500	-119.16472	4/12/2018	Flowing	
403STC066	34.58500	-119.16472	8/8/2017	Dry	Hard to see
403STC066	34.58500	-119.16472	4/14/2017	Flowing	Clear
403STC066	34.58500	-119.16472	4/17/2013	Flowing	
403STC066	34.58500	-119.16472	8/31/2007	Unclear	Possible flow?
403STC066	34.58500	-119.16472	7/7/2006	Flowing	Clear
403STC085	34.64250	-119.07750	8/1/2023	Flowing	Clear
403STC085	34.64250	-119.07750	3/1/2021	Flowing	Clear
403STC085	34.64250	-119.07750	2/15/2020	Flowing	Clear
403STC085	34.64250	-119.07750	11/10/2019	Dry	Pools, possibly disconnected
403STC085	34.64250	-119.07750	11/4/2018	Dry	
403STC085	34.64250	-119.07750	10/22/2018	Dry	
403STC085	34.64250	-119.07750	4/12/2018	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403STC085	34.64250	-119.07750	1/9/2018	Flowing	Possibly discontinuous
403STC085	34.64250	-119.07750	12/11/2017	Dry	
403STC085	34.64250	-119.07750	11/29/2017	Dry	
403STC085	34.64250	-119.07750	8/8/2017	Dry	
403STC085	34.64250	-119.07750	4/14/2017	Flowing	Clear
403STC085	34.64250	-119.07750	12/31/2014	Flowing	Clear
403STC085	34.64250	-119.07750	4/17/2013	Flowing	Clear
403STC085	34.64250	-119.07750	5/24/2009	Flowing	Clear
403STC085	34.64250	-119.07750	8/31/2007	Dry	
403STC086	34.55667	-119.20611	12/27/2023	Flowing	Clear
403STC086	34.55667	-119.20611	3/1/2021	Flowing	Clear
403STC086	34.55667	-119.20611	11/10/2019	Dry	Clear
403STC086	34.55667	-119.20611	4/12/2018	Flowing	Clear
403STC086	34.55667	-119.20611	1/9/2018	Flowing	
403STC086	34.55667	-119.20611	12/30/2017	Dry	
403STC086	34.55667	-119.20611	12/6/2017	Dry	
403STC086	34.55667	-119.20611	11/29/2017	Dry	
403STC086	34.55667	-119.20611	8/8/2017	Dry	
403STC086	34.55667	-119.20611	4/14/2017	Flowing	
403STC086	34.55667	-119.20611	8/28/2016	Dry	
403STC086	34.55667	-119.20611	12/31/2014	Flowing	Clear
403STC086	34.55667	-119.20611	1/22/2014	Dry	
403STC086	34.55667	-119.20611	4/17/2013	Flowing	Clear
403STC086	34.55667	-119.20611	8/31/2007	Dry	
403STC086	34.55667	-119.20611	7/7/2006	Flowing	Clear
403WE0501	34.54172	-118.77286	8/29/2023	Flowing	Clear
403WE0501	34.54172	-118.77286	3/1/2021	Flowing	Clear
403WE0501	34.54172	-118.77286	10/22/2018	Dry	Clear
403WE0501	34.54172	-118.77286	4/12/2018	Flowing	Clear
403WE0501	34.54172	-118.77286	8/8/2017	Dry	Clear
403WE0501	34.54172	-118.77286	4/14/2017	Flowing	Clear
403WE0501	34.54172	-118.77286	2/8/2016	Flowing	Clear
403WE0501	34.54172	-118.77286	12/31/2014	Flowing	Clear
403WE0501	34.54172	-118.77286	7/23/2014	Dry	Clear
403WE0501	34.54172	-118.77286	4/17/2013	Flowing	Clear
403WE0501	34.54172	-118.77286	8/31/2007	Flowing	
403WE0501	34.54172	-118.77286	3/15/2006	Flowing	Clear
403WE0540	34.65136	-119.11845	8/1/2023	Flowing	Clear
403WE0540	34.65136	-119.11845	3/1/2021	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403WE0540	34.65136	-119.11845	11/10/2019	Dry	Possibly misinterpretting muddy water?
403WE0540	34.65136	-119.11845	11/4/2018	Dry	Clear
403WE0540	34.65136	-119.11845	4/12/2018	Flowing	Clear
403WE0540	34.65136	-119.11845	1/9/2018	Flowing	
403WE0540	34.65136	-119.11845	12/30/2017	Dry	
403WE0540	34.65136	-119.11845	12/11/2017	Dry	
403WE0540	34.65136	-119.11845	11/29/2017	Dry	
403WE0540	34.65136	-119.11845	8/8/2017	Flowing	Clear
403WE0540	34.65136	-119.11845	4/14/2017	Flowing	Clear
403WE0540	34.65136	-119.11845	12/31/2014	Flowing	
403WE0540	34.65136	-119.11845	4/17/2013	Flowing	Clear
403WE0540	34.65136	-119.11845	5/24/2009	Flowing	Clear
403WE0540	34.65136	-119.11845	8/31/2007	Dry	
403WE0540	34.65136	-119.11845	4/26/2006	Flowing	Clear
403WE0540	34.65136	-119.11845	11/20/2005	Flowing	Clear
403WE0540	34.65136	-119.11845	12/31/2004	Flowing	Clear
403WE0683	34.43952	-119.07616	10/22/20118	Flowing	Visible downstream. Upstream obscured by veg
403WE0683	34.43952	-119.07616	5/11/2023	Flowing	Clear
403WE0683	34.43952	-119.07616	3/1/2021	Flowing	Visible upstream and downstream
403WE0683	34.43952	-119.07616	1/25/2021	Flowing	Visible upstream and downstream
403WE0683	34.43952	-119.07616	8/19/2019	Flowing	
403WE0683	34.43952	-119.07616	11/19/2018	Flowing	Visible downstream. Upstream obscured by veg
403WE0683	34.43952	-119.07616	8/12/2018	Flowing	
403WE0683	34.43952	-119.07616	4/12/2018	Unclear	Flowing downstream but possibly dry at bend. Upstream not visible through veg.
403WE0683	34.43952	-119.07616	12/31/2017	Flowing	
403WE0683	34.43952	-119.07616	8/8/2017	Unclear	Trail has a puddle on it but that isn't the streambed

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403WE0683	34.43952	-119.07616	4/14/2017	Unclear	Flowing downstream but possibly dry at bend. Upstream not visible through veg.
403WE0683	34.43952	-119.07616	10/2/2016	Unclear	Dry downstream
403WE0683	34.43952	-119.07616	8/26/2012	Flowing	Clear
403WE0683	34.43952	-119.07616	4/26/2011	Flowing	Clear
403WE0683	34.43952	-119.07616	8/31/2007	Flowing	Clear
403WE0683	34.43952	-119.07616	4/17/2003	Flowing	Clear
403WE0795	34.64080	-119.08094	8/1/2023	Flowing	Clear
403WE0795	34.64080	-119.08094	3/1/2021	Flowing	Clear
403WE0795	34.64080	-119.08094	2/15/2020	Flowing	Clear
403WE0795	34.64080	-119.08094	11/10/2019	Dry	Pools, possibly disconnected
403WE0795	34.64080	-119.08094	11/4/2018	Dry	
403WE0795	34.64080	-119.08094	10/22/2018	Dry	
403WE0795	34.64080	-119.08094	4/12/2018	Flowing	Clear
403WE0795	34.64080	-119.08094	1/9/2018	Flowing	Possibly discontinuous
403WE0795	34.64080	-119.08094	12/11/2017	Dry	
403WE0795	34.64080	-119.08094	11/29/2017	Dry	
403WE0795	34.64080	-119.08094	8/8/2017	Dry	
403WE0795	34.64080	-119.08094	4/14/2017	Flowing	Clear
403WE0795	34.64080	-119.08094	12/31/2014	Flowing	Clear
403WE0795	34.64080	-119.08094	4/17/2013	Flowing	Clear
403WE0795	34.64080	-119.08094	5/24/2009	Flowing	Clear
403WE0795	34.64080	-119.08094	8/31/2007	Dry	
403WE0891	34.65926	-119.14255	6/15/2024	Flowing	Clear
403WE0891	34.65926	-119.14255	8/1/2023	Flowing	Clear
403WE0891	34.65926	-119.14255	3/1/2021	Flowing	Clear
403WE0891	34.65926	-119.14255	11/10/2019	Flowing	Clear
403WE0891	34.65926	-119.14255	11/4/2018	Dry	Not great imagery
403WE0891	34.65926	-119.14255	4/12/2018	Flowing	Clear
403WE0891	34.65926	-119.14255	1/9/2018	Flowing	Not great imagery
403WE0891	34.65926	-119.14255	12/30/2017	Dry	Not great imagery
403WE0891	34.65926	-119.14255	12/11/2017	Dry	Not great imagery
403WE0891	34.65926	-119.14255	11/29/2017	Dry	Not great imagery
403WE0891	34.65926	-119.14255	8/8/2017	Flowing	Thin ribbon
403WE0891	34.65926	-119.14255	4/14/2017	Flowing	Clear
403WE0891	34.65926	-119.14255	12/31/2014	Flowing	Snow
403WE0891	34.65926	-119.14255	4/17/2013	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
403WE0891	34.65926	-119.14255	5/24/2009	Flowing	Not great imagery
403WE0891	34.65926	-119.14255	8/31/2007	Dry	Not great imagery
403WE0891	34.65926	-119.14255	7/7/2006	Flowing	Clear
403WE1021	34.63193	-118.52977	6/15/2023	Flowing	Clear
403WE1021	34.63193	-118.52977	1/25/2023	Flowing	Clear
403WE1021	34.63193	-118.52977	2/17/2022	Flowing	Clear
403WE1021	34.63193	-118.52977	2/28/2021	Flowing	
403WE1021	34.63193	-118.52977	2/15/2020	Flowing	
403WE1021	34.63193	-118.52977	8/19/2019	Flowing	Flow visible downstream
403WE1021	34.63193	-118.52977	11/19/2018	Flowing	Flow visible downstream
403WE1021	34.63193	-118.52977	8/12/2018	Unclear	Possibly flow downstream
403WE1021	34.63193	-118.52977	12/31/2017	Flowing	
403WE1021	34.63193	-118.52977	12/5/2017	Flowing	Clear
403WE1021	34.63193	-118.52977	4/29/2017	Flowing	Clear
403WE1021	34.63193	-118.52977	10/2/2016	Dry	Based on downstream visibility
403WE1021	34.63193	-118.52977	4/4/2016	Flowing	
403WE1021	34.63193	-118.52977	2/8/2016	Flowing	
403WE1021	34.63193	-118.52977	5/1/2015	Flowing	
403WE1021	34.63193	-118.52977	4/11/2015	Flowing	
403WE1021	34.63193	-118.52977	8/26/2012	Dry	Based on downstream visibility
403WE1021	34.63193	-118.52977	7/15/2011	Flowing	
403WE1021	34.63193	-118.52977	4/26/2011	Flowing	
403WE1021	34.63193	-118.52977	1/8/2008	Flowing	
403WE1021	34.63193	-118.52977	11/2/2005	Flowing	
403WE1027	34.72654	-119.02842	3/1/2021	Flowing	
403WE1027	34.72654	-119.02842	11/10/2019	Unclear	Flowing upstream
403WE1027	34.72654	-119.02842	4/12/2018	Flowing	
403WE1027	34.72654	-119.02842	4/14/2017	Flowing	
403WE1027	34.72654	-119.02842	12/31/2014	Flowing	
403WE1027	34.72654	-119.02842	4/17/2013	Flowing	
403WE1027	34.72654	-119.02842	8/31/2007	Flowing	
404ARRSEQ	34.08506	-118.91206	4/21/2023	Flowing	
404ARRSEQ	34.08506	-118.91206	2/17/2022	Flowing	
404ARRSEQ	34.08506	-118.91206	2/28/2021	Dry	
404ARRSEQ	34.08506	-118.91206	8/19/2019	Dry	
404ARRSEQ	34.08506	-118.91206	1/3/2019	Dry	Pool visible
404ARRSEQ	34.08506	-118.91206	11/19/2018	Dry	

Station code	Latitude	Longitude	Date	Flow conditions	Comments
404ARRSEQ	34.08506	-118.91206	10/22/2018	Dry	
404ARRSEQ	34.08506	-118.91206	8/12/2018	Dry	
404ARRSEQ	34.08506	-118.91206	12/31/2017	Dry	
405BRCSGR	34.25031	-117.88372	5/19/2023	Flowing	
405BRCSGR	34.25031	-117.88372	6/18/2022	Flowing	
405BRCSGR	34.25031	-117.88372	4/24/2022	Flowing	
405BRCSGR	34.25031	-117.88372	1/13/2022	Flowing	
405BRCSGR	34.25031	-117.88372	4/10/2015	Flowing	
405BRCSGR	34.25031	-117.88372	7/15/2011	Flowing	
405S02972	34.24958	-118.07550	6/19/2023	Flowing	Visible downstream and upstream
405S02972	34.24958	-118.07550	5/16/2023	Flowing	Visible downstream and upstream
405S03280	34.25686	-117.85653	5/19/2023	Flowing	Barely visible through veg
405S03280	34.25686	-117.85653	6/23/2016	Flowing	Barely visible through veg
405S03280	34.25686	-117.85653	3/15/2006	Flowing	
405S03280	34.25686	-117.85653	2/13/2006	Flowing	
405S03280	34.25686	-117.85653	12/31/2004	Flowing	
405SGB003	34.28157	-117.88508	10/25/2023	Flowing	
405SGB003	34.28157	-117.88508	6/18/2022	Flowing	
405SGB003	34.28157	-117.88508	4/24/2022	Flowing	
405SGB003	34.28157	-117.88508	1/13/2022	Flowing	
405SGB003	34.28157	-117.88508	5/24/2020	Flowing	
405SGB003	34.28157	-117.88508	9/25/2018	Unclear	Most visible spot looks dry
405SGB003	34.28157	-117.88508	8/19/2018	Unclear	Most visible spot looks dry
405SGB003	34.28157	-117.88508	4/28/2017	Flowing	
405SGB003	34.28157	-117.88508	3/15/2006	Flowing	
405SGB006	34.25553	-117.82139	5/19/2023	Flowing	Based on downstream waterfall
405SGB006	34.25553	-117.82139	5/24/2020	Flowing	Based on downstream waterfall
405SGB006	34.25553	-117.82139	4/28/2017	Flowing	Based on downstream waterfall
405SGB006	34.25553	-117.82139	7/15/2011	Flowing	Based on downstream waterfall
405SGRAAG	34.26448	-117.74751	11/4/2023	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
405SGRAAG	34.26448	-117.74751	7/2/2022	Flowing	Clear
405SGRAAG	34.26448	-117.74751	6/18/2022	Flowing	
405SGRAAG	34.26448	-117.74751	1/13/2022	Flowing	
405SGRAAG	34.26448	-117.74751	1/1/2021	Flowing	
405SGRAAG	34.26448	-117.74751	9/25/2020	Flowing	
405SGRAAG	34.26448	-117.74751	6/12/2020	Flowing	
405SGRAAG	34.26448	-117.74751	4/28/2017	Unclear	Not sure if dry streambed or water
405SGRAAG	34.26448	-117.74751	4/10/2015	Flowing	
405SGRAAG	34.26448	-117.74751	2/23/2014	Flowing	
405SGRAAG	34.26448	-117.74751	5/24/2013	Flowing	
405SGRAAG	34.26448	-117.74751	5/9/2013	Flowing	
405SGRAAG	34.26448	-117.74751	7/15/2011	Flowing	Turbid water is ard to distinguish from floodplain
405SGRAAG	34.26448	-117.74751	1/8/2008	Flowing	
405SGRAAG	34.26448	-117.74751	6/17/2007	Flowing	
405WER318	34.26833	-117.89111	10/25/2023	Flowing	
405WER318	34.26833	-117.89111	6/18/2022	Flowing	Bad imagery
405WER318	34.26833	-117.89111	4/24/2022	Flowing	
405WER318	34.26833	-117.89111	4/24/2022	Flowing	
405WER318	34.26833	-117.89111	1/13/2022	Flowing	
405WER318	34.26833	-117.89111	9/25/2020	Flowing	
405WER318	34.26833	-117.89111	9/14/2020	Flowing	
405WER318	34.26833	-117.89111	5/24/2020	Flowing	
405WER318	34.26833	-117.89111	9/25/2018	Dry	Review
405WER318	34.26833	-117.89111	8/19/2018	Dry	Review
405WER318	34.26833	-117.89111	4/28/2017	Flowing	
405WER318	34.26833	-117.89111	4/11/2015	Flowing	
405WER318	34.26833	-117.89111	4/10/2015	Flowing	
405WER318	34.26833	-117.89111	7/15/2011	Flowing	
412S04204	34.20360	-118.01850	6/19/2023	Flowing	
412S04204	34.20360	-118.01850	4/24/2022	Flowing	
412S04204	34.20360	-118.01850	9/27/2020	Flowing	
412S04204	34.20360	-118.01850	5/2/2019	Flowing	
412S04204	34.20360	-118.01850	2/10/2019	Flowing	
412S04204	34.20360	-118.01850	4/28/2017	Flowing	
SGUR103	34.23218	-118.05822	6/19/2023	Flowing	
SGUT501	34.24080	-117.88330	5/19/2023	Flowing	Clear
SGUT501	34.24080	-117.88330	6/18/2022	Flowing	Clear
SGUT501	34.24080	-117.88330	4/24/2022	Flowing	Clear
SGUT501	34.24080	-117.88330	1/13/2022	Flowing	

Station code	Latitude	Longitude	Date	Flow conditions	Comments
SGUT501	34.24080	-117.88330	5/24/2020	Flowing	
SGUT501	34.24080	-117.88330	4/28/2017	Flowing	
SGUT501	34.24080	-117.88330	4/11/2015	Flowing	Clear
SGUT501	34.24080	-117.88330	4/10/2015	Flowing	Clear
SGUT501	34.24080	-117.88330	5/24/2013	Flowing	Clear
SGUT501	34.24080	-117.88330	7/15/2011	Flowing	Clear
SGUT501	34.24080	-117.88330	5/24/2009	Flowing	
SGUT501	34.24080	-117.88330	1/8/2008	Flowing	Clear
SGUT501	34.24080	-117.88330	3/15/2006	Flowing	Clear
SGUT501	34.24080	-117.88330	2/13/2006	Flowing	Clear
SMC00144	34.24481	-117.79459	5/16/2023	Flowing	Barely visible through veg
SMC00144	34.24481	-117.79459	6/12/2020	Flowing	Barely visible through veg
SMC00144	34.24481	-117.79459	5/24/2020	Flowing	
SMC00144	34.24481	-117.79459	9/25/2018	Unclear	Possibly dry. Decent visibility. Review.
SMC00144	34.24481	-117.79459	4/28/2017	Flowing	Clear
SMC00144	34.24481	-117.79459	4/10/2015	Flowing	Clear
SMC00144	34.24481	-117.79459	2/23/2014	Flowing	
SMC00144	34.24481	-117.79459	5/24/2013	Flowing	
SMC00144	34.24481	-117.79459	5/9/2013	Flowing	
SMC00144	34.24481	-117.79459	7/15/2011	Flowing	Barely visible through veg
SMC00144	34.24481	-117.79459	8/18/2005	Unclear	I think flow might be visible. Review
SMC00428	34.24556	-118.04759	2/27/2024	Flowing	
SMC00428	34.24556	-118.04759	6/19/2023	Flowing	Clear
SMC00911	34.50797	-119.29854	9/11/2023	Flowing	
SMC00911	34.50797	-119.29854	6/24/2022	Unclear	Possibly dry. Decent visibility. Review.
SMC00911	34.50797	-119.29854	3/1/2021	Unclear	Might be dry
SMC00911	34.50797	-119.29854	11/10/2019	Unclear	Might be dry
SMC00911	34.50797	-119.29854	4/12/2018	Unclear	Might be dry
SMC00911	34.50797	-119.29854	8/8/2017	Unclear	Might be dry
SMC00911	34.50797	-119.29854	4/14/2017	Flowing	Evident downstream
SMC01164	34.35078	-118.57968	2/14/2024	Flowing	
SMC01164	34.35078	-118.57968	6/27/2023	Flowing	Clear
SMC01164	34.35078	-118.57968	2/17/2022	Flowing	
SMC01164	34.35078	-118.57968	2/28/2021	Flowing	

Station code	Latitude	Longitude	Date	Flow conditions	Comments
SMC01164	34.35078	-118.57968	8/19/2019	Unclear	Might be dry, Dry downstream
SMC01164	34.35078	-118.57968	8/12/2018	Unclear	Might be dry, Dry downstream
SMC01164	34.35078	-118.57968	2/8/2016	Flowing	
SMC01164	34.35078	-118.57968	8/27/2014	Unclear	Might be dry, Dry downstream
SMC01164	34.35078	-118.57968	8/26/2012	Unclear	Probably dry
SMC01164	34.35078	-118.57968	4/26/2011	Flowing	Clear
SMC01164	34.35078	-118.57968	1/8/2008	Flowing	
SMC01196	34.27835	-118.02952	4/28/2017	Flowing	Clear
SMC01196	34.27835	-118.02952	4/11/2015	Flowing	Clear
SMC01196	34.27835	-118.02952	4/10/2015	Flowing	Clear
SMC01196	34.27835	-118.02952	5/24/2013	Flowing	Clear
SMC01196	34.27835	-118.02952	7/15/2011	Flowing	
SMC01424	34.24075	-117.81585	5/16/2023	Flowing	Evident downstream
SMC01424	34.24075	-117.81585	5/24/2020	Flowing	
SMC01424	34.24075	-117.81585	4/28/2017	Flowing	
SMC01424	34.24075	-117.81585	5/24/2013	Unclear	Possibly dry downstream. Looks like there's no connection to the mainstem
SMC01424	34.24075	-117.81585	3/15/2006	Flowing	
SMC01567	34.50959	-119.38373	9/11/2023	Flowing	Clear
SMC01567	34.50959	-119.38373	6/24/2022	Unclear	Mainstem is dry above and below confluence
SMC01567	34.50959	-119.38373	3/1/2021	Flowing	Clear
SMC01567	34.50959	-119.38373	11/10/2019	Flowing	
SMC01567	34.50959	-119.38373	4/12/2018	Flowing	Clear
SMC01567	34.50959	-119.38373	1/9/2018	Unclear	
SMC01567	34.50959	-119.38373	8/8/2017	Flowing	Flow goes south rather than east but clearly from NF
SMC01567	34.50959	-119.38373	4/14/2017	Flowing	Clear
SMC01567	34.50959	-119.38373	11/2/2016	Unclear	No flow downstream
SMC01567	34.50959	-119.38373	8/28/2016	Unclear	No flow downstream
SMC01567	34.50959	-119.38373	12/31/2014	Flowing	Clear
SMC01567	34.50959	-119.38373	4/17/2013	Flowing	Flow barely entering mainstem

Station code	Latitude	Longitude	Date	Flow conditions	Comments
SMC01567	34.50959	-119.38373	8/31/2007	Unclear	Disconnected pool evident
SMC01567	34.50959	-119.38373	8/12/2006	Flowing	Clear
SMC01979	34.45205	-119.13624	3/19/2024	Flowing	
SMC01979	34.45205	-119.13624	5/11/2023	Flowing	Clear
SMC01979	34.45205	-119.13624	3/1/2021	Flowing	Clear
SMC01979	34.45205	-119.13624	8/19/2019	Flowing	Clear
SMC01979	34.45205	-119.13624	8/12/2018	Flowing	Clear
SMC01979	34.45205	-119.13624	4/12/2018	Flowing	Clear
SMC02591	34.51783	-119.37846	9/11/2023	Flowing	Clear
SMC02591	34.51783	-119.37846	6/24/2022	Flowing	
SMC02591	34.51783	-119.37846	3/1/2021	Flowing	Clear
SMC02591	34.51783	-119.37846	11/10/2019	Flowing	Clear
SMC02591	34.51783	-119.37846	4/12/2018	Flowing	Clear
SMC02591	34.51783	-119.37846	8/8/2017	Flowing	Mostly obscured by vegetation
SMC02591	34.51783	-119.37846	4/14/2017	Flowing	Mostly obscured by vegetation
SMC02591	34.51783	-119.37846	12/31/2014	Flowing	Mostly obscured by vegetation
SMC04383	34.50224	-119.35602	9/11/2023	Flowing	Clear
SMC04383	34.50224	-119.35602	6/24/2022	Dry???	Not so clear but clearly dry further upstream
SMC04383	34.50224	-119.35602	3/1/2021	Flowing	Clear
SMC04383	34.50224	-119.35602	11/10/2019	Flowing	Clear
SMC04383	34.50224	-119.35602	4/12/2018	Flowing	Clear
SMC04383	34.50224	-119.35602	1/12/2018	Flowing	Clear
SMC04383	34.50224	-119.35602	8/8/2017	Flowing	Not so clear but clearly dry further upstream
SMC04383	34.50224	-119.35602	4/14/2017	Flowing	Clear
SMC04383	34.50224	-119.35602	8/28/2016	Unclear	
SMC04383	34.50224	-119.35602	12/31/2014	Flowing	Clear
SMC04383	34.50224	-119.35602	1/19/2014	Flowing	Clear
SMC04383	34.50224	-119.35602	4/17/2013	Flowing	Clear
SMC04383	34.50224	-119.35602	5/24/2009	Flowing	Clear
SMC04795	34.47989	-119.17067	6/19/2023	Flowing	Clear
SMC04795	34.47989	-119.17067	8/19/2019	Flowing	Not great imagery
SMC05407	34.50124	-119.35043	9/11/2023	Flowing	Clear
SMC05407	34.50124	-119.35043	6/24/2022	Flowing	Much less water evident
SMC05407	34.50124	-119.35043	3/1/2021	Flowing	Clear

Station code	Latitude	Longitude	Date	Flow conditions	Comments
SMC05407	34.50124	-119.35043	11/10/2019	Flowing	Clear
SMC05407	34.50124	-119.35043	4/12/2018	Flowing	Clear
SMC05407	34.50124	-119.35043	1/12/2018	Flowing	Clear
SMC05407	34.50124	-119.35043	8/8/2017	Flowing	Clear
SMC05407	34.50124	-119.35043	4/14/2017	Flowing	Clear
SMC05407	34.50124	-119.35043	12/31/2014	Flowing	Clear
SMC05407	34.50124	-119.35043	4/17/2013	Flowing	Clear
SMC05407	34.50124	-119.35043	5/24/2009	Flowing	Clear
SMC05407	34.50124	-119.35043	8/31/2007	Flowing	Clear
SMC05407	34.50124	-119.35043	8/12/2006	Flowing	Clear

Table A 2. Historical aerial imagery observations