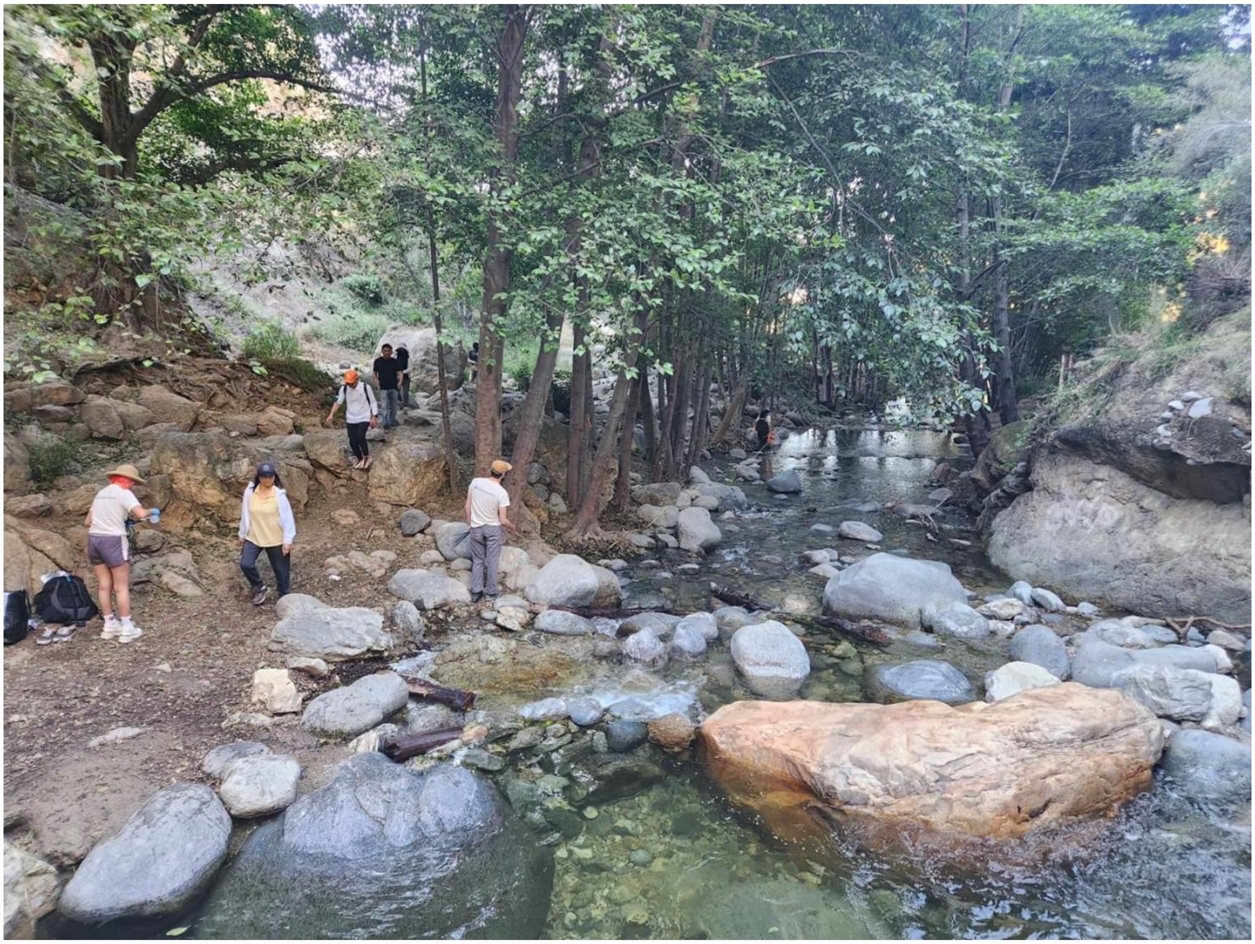
The 2023 State of the Los Angeles River Watershed Report



Principal Authors

Yareli Sanchez, Council for Watershed Health

Belle Zheng, Council for Watershed Health

Nate Sachs, Council for Watershed Health

Scott Johnson, Aquatic Bioassay Consulting

Karin Wisenbaker, Aquatic Bioassay Consulting

Thank you to the following Los Angeles River Watershed Monitoring Program Workgroup members who participated in the success of this program and report including:

Mas Dojiri, City of Los Angeles, LA Sanitation and Environment

Mahesh Pujari, City of Los Angeles, LA Sanitation and Environment

Jennifer Smolenksy, City of Los Angeles, LA Sanitation and Environment

Raphael Mazor, Southern California Coastal Water Research Project

Emiko Innes, Los Angeles County Flood Control District

Luke Ginger, Heal the Bay

Charlie Yu, City of Los Angeles, Watershed Protection Division

Scott Johnson, Aquatic Bioassay Consulting

Karin Wisenbaker, Aquatic Bioassay Consulting

Anthea Raymond, LA River Expeditions

Steve Appleton, LA River Kayak Safari

Land Acknowledgement

We acknowledge that the Los Angeles River and its watershed is the traditional and ancestral lands of the Fernandeño Tataviam, Gabrieleño Tongva, Ventureño Chumash, and Gabrielino Kizh Native Nations. We honor their Elders, past and present, and their descendants. We recognize a painful history of erasure on the unceded territory we now occupy. Local Tribes have stewarded this land since time immemorial and we acknowledge that the First Peoples of Los Angeles County are still here. We cannot achieve the sustainability and health of our watersheds without Tribal partnership. We are committed to uplifting the local Tribes in our work and ensuring meaningful Tribal engagement in all spheres of watershed management.

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1 Background

1.1 Environmental Setting:

The boundaries of the Los Angeles River Watershed encompass 834 square miles of land stretching from the San Gabriel Mountains on the northern end of the Los Angeles Basin to the Pacific Ocean. With straightening, through channelization, the river measures 51 miles. The first 32 miles are within the City of Los Angeles. The watershed is shaped roughly like a large comma, stretching from the western edge in the Santa Susana Mountains and Simi Hills and curving southward around the intrusion of the Santa Monica Mountains to discharge into the Pacific Ocean at Long Beach Harbor in San Pedro Bay (*Figure 1*).

Figure 1: Map of the Los Angeles River Watershed

The topography of the Los Angeles River Watershed is dramatic, dropping from 7,103 feet in the northwestern San Gabriel Mountains to sea level over a mere 51 miles. This corresponds to an average drop of 31 feet per mile. For comparison, the Mississippi River is 2,348 miles long and drops approximately 1 foot per mile. The deeply incised mountain slopes are as steep as 65-70% grade and are some of the steepest in the world.

1.1.1 Climate

The Los Angeles River watershed is situated in a Mediterranean climate zone, characterized by warm, dry summers and cool, wet winters. The seasonal variability in precipitation demonstrates characteristic Mediterranean climate conditions. It is this climate that is largely responsible for the settlement of Native Americans and later promoted westward migration and settlement in the Los Angeles region.

The spatial variation in local climate is largely a result of the topography of the region. Moisture-laden air from the ocean moves up the slopes of the San Gabriel Mountains, cooling as it rises and creating a barrier that traps moist ocean air against the mountain slopes and partially blocks summer heat from the desert and winter cold from the interior northeast. Rainfall increases with elevation. Altadena, nestled in the San Gabriel Mountain foothills at roughly 1,300 feet, receives the greatest amount of precipitation, compared to Downtown Los Angeles. Historically the San Gabriel Mountains have experienced high intensity record-breaking storms, during which heavy rainfall occurs over a relatively short period of time.

1.1.2 Regional Climate Change

In the 2023 State of the Watershed Report, building upon the groundwork laid by previous reports, we expand our discussion of the climate-related threats to the LA region. We recognize that due to these compounding threats, the Los Angeles (LA) region stands at a critical juncture in its response to climate challenges. The prosperity and well-being of the region are deeply intertwined with its ability to navigate the effects of a changing climate on human, natural, and economic systems.

1.1.2.1 Temperature

The trajectory of climate change in the LA region paints a picture of escalating temperatures. This trajectory is notable at long term monitoring stations in Los Angeles (Figure 2). Projections indicate that, by the middle of the century, average maximum temperatures could surge by 4-5°F, potentially reaching 5-8°F by the end of century (Hall et al., 2018). What is equally

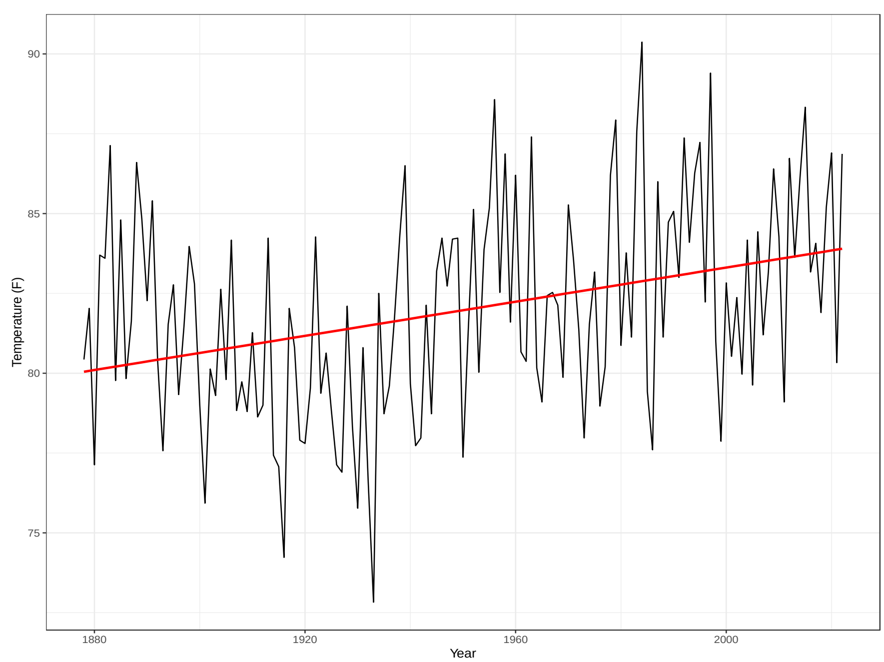


Figure 2: Monthly average temperature at long-term WRCC station at USC. (wrcc.dri.edu/)

disconcerting is the anticipated surge in extreme heat events, which could render the hottest days of the year up to 10°F warmer by the end of the century (Hall et al., 2018). This trend holds concerning implications due to its disproportionate impact on low-income communities and communities of color, which are already vulnerable and would likely bear the brunt of these extreme heat events (*LA County Climate Vulnerability Assessment*, 2021).

1.1.2.2 Drought

The natural occurrence of droughts in the American Southwest is an established natural phenomenon (MacDonald, 2007), but the recent droughts have been unprecedented in scale (Robeson, 2015)(Figure 3). The impact of global climate change amplifies the severity of these droughts and ushers in significant consequences. Projections based on climate simulations that utilize data from the record-breaking drought of 2012-2016 reveal a convergence of future droughts with factors like extreme heat days, diminished snowpack, soil desiccation, and forest die-offs (Ullrich et al., 2018). This web of factors wreaks havoc on human and natural systems alike, contributing to heightened wildfire risks and water shortages. A study in the Santa Clara River Watershed, for example, found increased riparian woodland mortality as a result of declining groundwater associated with the 2012-2019 drought period (Kibler et al., 2021).

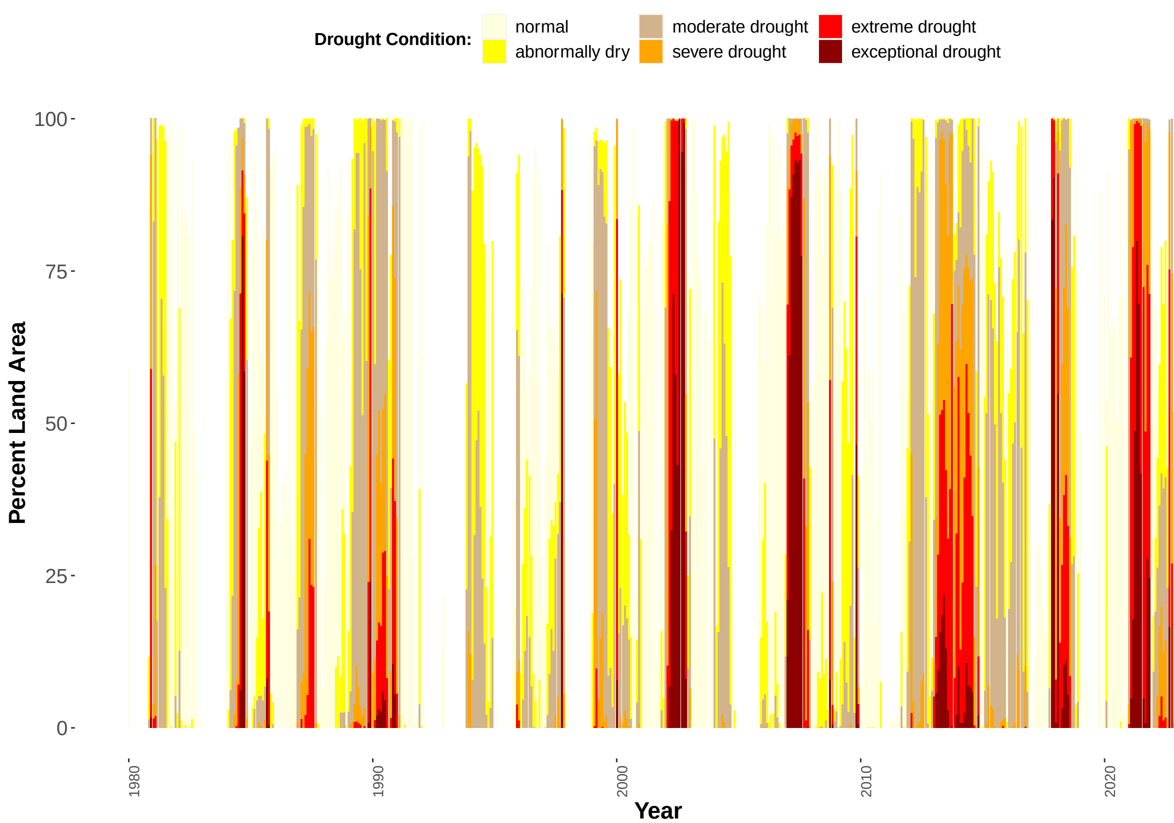


Figure 3: Percent of Los Angeles County land under several categories of drought condition based on monthly assessments. Data sourced from U.S. Drought Monitor. Note that abnormally dry conditions are not considered drought conditions.

1.1.2.3 Wildfire

The vulnerability of Southern California to wildfires is poised to intensify due to warming. Prolonged drought, extreme heat, and increased vapor pressure deficit has and will continue to increase the aridity of fuels and the frequency of large fires (Abatzoglou & Williams, 2016). Large wildfires (>400 HA) are already more frequent, of longer duration, and wildfire seasons are longer than in the mid-1980s in the American Southwest (Westerling et al., 2006). Projections suggest a potential annual increase of burned area by over 2000 hectares by the middle of the 21st century (Hall et al., 2018). Historically, wildfires were driven by natural forces such as lightning and Santa Ana Winds. However, a shift in human development patterns has resulted in two distinct patterns: more frequent fires due to increased ignitions or fire suppression and fuel build-up in forests and large open spaces, both of which deviate from historic fire regimes. Fire also denudes the landscape so as to exacerbate post-fire hazards such as flooding and debris flows (Figure 4). The cascading impacts of fire on ecosystems, air quality, and public health require heightened preparedness and mitigation.

Figure 4: Photograph near LARWMP site that burned in the 2020 Bobcat Fire

1.1.3 Precipitation

While the overall amount of precipitation in the LA region might not undergo substantial changes, the key climate impact lies in the heightened frequency and intensity of both dry and wet extremes (Dettinger, 2011; Payne et al., 2020). The late 21st century could see a notable 25-30% increase in precipitation during the wettest day of the year in specific regions. A repeat of the Great Flood of 1862 is 3 times more likely under global climate change (Huang & Swain, 2022; Swain et al., 2018). Paradoxically, the same timeframe could also usher in a doubling or more in extremely dry years, exacerbating the incidence of severe droughts. In recent years, Southern California experienced the record 2011-2017 drought and, in some areas, a record amount of rainfall in more than a decade in 2023 (Figure 5). This duality of intensified wet and dry extremes adds layers of complexity to the management of water resources in the region.

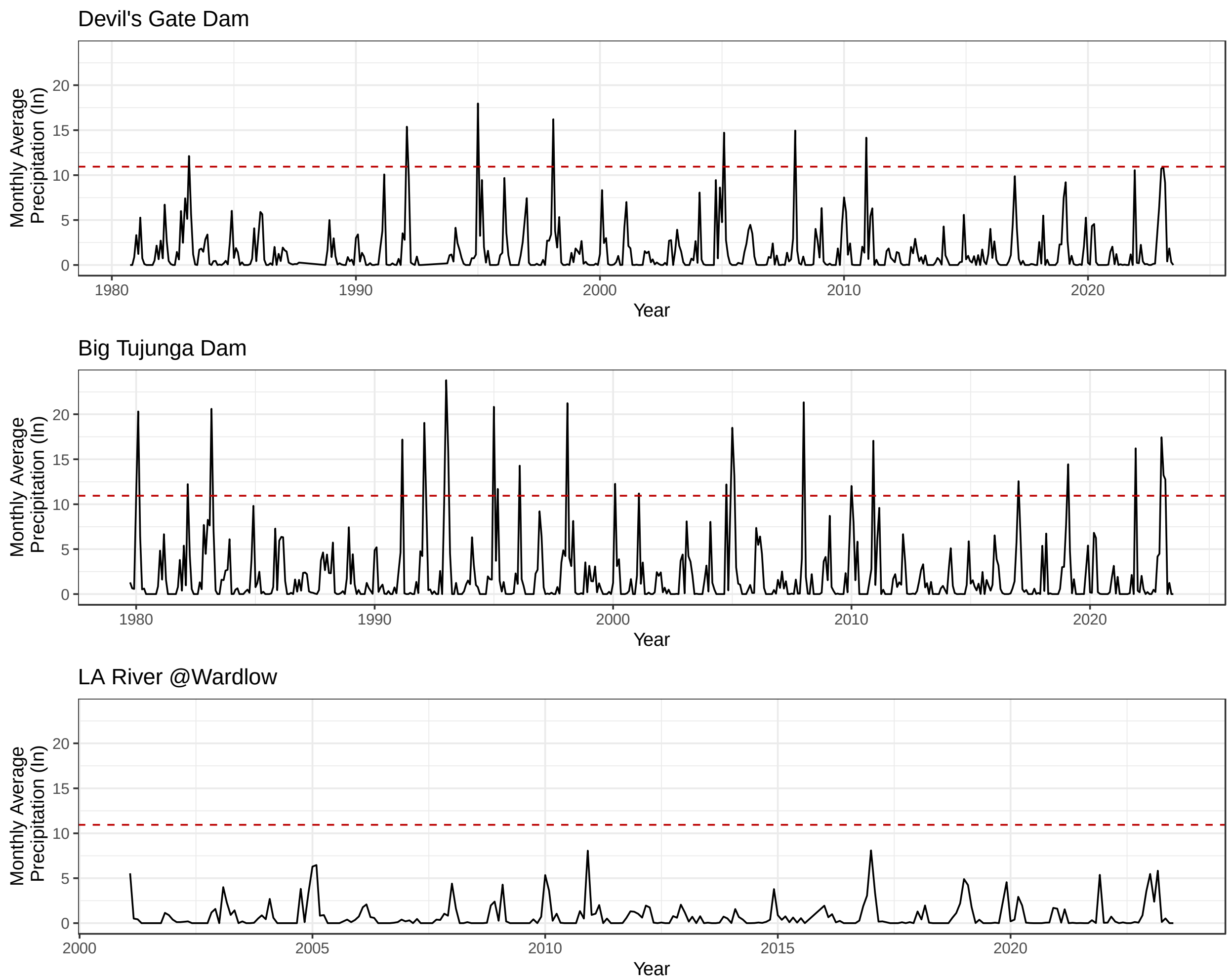


Figure 5: Monthly average precipitation in inches at 3 locations in Los Angeles River Watershed.

The red dotted line shows the value that captures 95% of the total monthly precipitation across the 3 sites. Data is sourced from Los Angeles County's rain gauges.

1.2 Demographics

The Los Angeles River Watershed is home to a large and diverse population. According to the Los Angeles River Masterplan, the river corridor alone is home to more than 1 million people. Communities living in the LA River corridor south of Canoga Park face pollution burdens that are higher than 90% of the communities across the state (*LA River Master Plan*, 2022). Communities between Downtown Los Angeles and Compton are larger (average of 4.1 people per household) and have lower median household incomes (about $65,000) than other parts of the River, which have 3-person households on average and median household incomes of $96,000. Many communities along the river corridor are also vulnerable to displacement or in advanced stages of displacement, such as the corridor communities of North East Los Angeles, in a county with considerable shortfall of affordable housing (*LA River Master Plan*, 2022). As such, the County has also experienced a steady rise in homelessness since 2012.

1.3 Art and Culture

The Los Angeles River has long been a source of cultural inspiration to the communities living near its banks. From the cats that decorate the storm drain covers of the River to the various graffiti artists that continue to reflect the culture and history of the river through the markings scribed on levee walls (Guanuna, 2015). More recently the art and culture of the Los Angeles River and neighboring communities have been formally celebrated and showcased at the annual SELA Arts Festival, which takes place annually in the Los Angeles River channel.

Los Angeles-based arts organization Clockshop's collective history and cultural mapping project of the communities that surround the Los Angeles River, is a recent formal addition to the cultural tableau of the River. Titled *Take me to Your River: A Cultural Atlas of the LA River*, the ongoing three-year project aims to celebrate the experiences of those who call Northeast LA home — specifically the neighborhoods surrounding the Glendale Narrows section of the River such as Elysian Valley, Atwater Village, Cypress Park, and Glassell Park (ClockShop, n.d.). Given the rapid changes in these neighborhoods, *Take Me to Your River* serves to ensure these stories are not lost to gentrification. In addition to the project's interactive website, over the next three years, Clockshop will host a series of in-person public programs centering the artists as facilitators, organizers, and community historians (ClockShop, n.d.). To learn more about *Take Me to Your River* and view the stories visit takemetoyourriver.org.

Another ongoing formal art project along the Los Angeles River is LA River X. The bilingual (English/Spanish) public humanities project aims to showcase stories from along the river that might otherwise be lost. Curated by Tilly Hilton, Ph.D., LA River X offers the opportunity for everyday Angelenos to show what the river means to them through a variety of mediums including photography, artwork, writing, sound, and video (Hilton, n.d.). These guest hosts' work is then displayed on the project's Instagram accounts with the opportunity for their work to be kept forever in the digital Western Water Archives, at the Claremont Colleges Library. At the time of writing, LA River X has hosted over 60 Instagram takeovers and preserved more than 1700 works (LA River X, 2023). To view guest hosts' work visit the project's Instagram accounts (English: @lariverx, Spanish: @riodelosangelesx).

Figure 6: State of the LA River Watershed attendee viewing LARiverX photo archive prints.

1.4 Biodiversity

The Los Angeles River Watershed lies within the California Floristic Province, one of the world's biodiversity hotspots. Biodiversity hotspots are regions that support especially high numbers of endemic species, or species that occur naturally nowhere else on Earth. The concept was defined in 1988 by British ecologist Norman Myers to address the dilemma that conservationists face: identifying areas that are immediately important for conserving biodiversity. Destruction of habitat is the leading cause of biodiversity loss, but invasive species, pollution, overexploitation, and climate change pose major threats as well.

The biodiversity of the Los Angeles region has received increasing attention, strengthened by community science efforts, the City of Los Angeles' Biodiversity Motion, and strong local academic institutions and research-based organizations. The 2022 LA Biodiversity Index Baseline Report presented the LA City Biodiversity Index, a tool to support the no-net loss biodiversity target as described by Los Angeles' Green New Deal. The index includes 25 comprehensive metrics nestled within native species protection and enhancement, social equity, and governance and management themes. In the first baseline assessment, the City of Los Angeles received 37 out of 100 points performing the worst in the management of invasive species, off campus biodiversity educational visits, stream habitat quality, and for the lack of biodiversity vision/action plans or local initiatives (LA Sanitation and Environment, 2022).

Biodiversity Toolbox: Environmental DNA

Environmental DNA, known as eDNA, refers to organismal DNA found in environmental samples such as soil, water, sand, sediment, mud, ice, and air. As organisms move through and interact with the environment, their DNA is released into the surroundings. Unlike DNA, eDNA does not come directly from an intact organism. Rather, eDNA is derived from a variety of cellular material shed by organisms including feces, saliva, urine, shed skin or fur, leaves, pollen, mucus, and carcasses

(*CALeDNA*, 2023). This eDNA can be detected and analyzed through DNA sequencing methods, making eDNA a powerful tool in the research of biodiversity and the monitoring of ecosystems in a non-invasive and efficient manner.

California Environmental DNA (CALeDNA) is a community science monitoring initiative that is collecting baseline biodiversity data across the state (Meyer et al., 2021). Led by CALeDNA researchers, Environmental DNA method has been incorporated into monitoring in the Los Angeles River Watershed. From 2020-2022, a network of organizations co-designed and facilitated *POUR: Seasonal eDNA of the LA River* project. The organizations collected sediment from 12 locations within the Los Angeles River watershed. The eDNA taxonomic results can be viewed and explored on ednaexplorer.org.

Applications of eDNA + advantages

eDNA analysis offers a swift, cost-effective, and non-invasive method for collecting standardized biodiversity data. Conventional methods of species monitoring, particularly for endangered species, frequently involve invasive methods that can pose risks to the very species being safeguarded. Samples of eDNA are collected through a non-invasive method, as eDNA only requires DNA from the organism found in the soil, water, air, or snow of the environment. This allows for an accurate assessment of species in a certain environment without causing disturbance to the habitat and other organisms. eDNA approaches for studying biodiversity excel in their ability to detect even small populations of specific species, allowing for the improvement of biodiversity richness assessments (US Geological Survey, n.d.). eDNA is a valuable approach in detecting invasive species, as it allows for the efficient and timely identification of these organisms without direct contact, aiding in the preservation of native ecosystems.

How does it work?

Each organism possesses a unique DNA barcode, also referred to as a molecular barcode, which is a distinctive DNA sequence used for species identification and classification. Researchers can identify the species that left their traces in the environmental sample by utilizing the extracted DNA, a technique called metabarcoding in high throughput sequencing. However, the minuscule amount of DNA extracted from a soil or sediment sample makes it impractical to sequence or identify accurately due to its limited quantity (US Geological Survey, n.d.). eDNA methods often use a laboratory technique called a polymerase chain reaction (PCR) for the amplification of DNA samples. Essentially, a PCR reaction rapidly and exponentially increases very low concentrations of DNA to make sufficient amounts for analysis (Kelly et al., 2019).

1.5 Programs and Plans

As the Los Angeles region plans for a sustainable and more water resilient future, the Los Angeles River and its streams will play an integral role in enhancing these objectives. Our connection to its history, its ecology, and our region's thirst for water will again define it. Below we briefly describe programs and plans that are shaping the River and its watershed.

1.5.1 LA River Improvement Plans

The Lower Los Angeles River Revitalization Plan (LLARRP) and Working Group. Completed in 2017, the LLARRP prioritizes maintaining flood control functions of the River while identifying opportunities to restore natural features, create recreational opportunities, and address issues related to economics, health, equity, safety, accessibility, and connectivity. The Working Group has continued to guide the implementation of the LLARRP through Implementation Advisory Group Meetings, which provide a venue for discussion of proposed projects, ensure all proposed projects are consistent with goals and objectives, and maximize multi-use opportunities and community benefits.

The Los Angeles River Master Plan. Los Angeles County's LA River Master Plan builds on two decades of work to offer a vision for the River's future that unifies community, technical, planning, and policy expertise and seeks to provide multiple benefits to communities along the river. The research and project database at the core of the plan encompasses over 140 planning efforts along the LA River channel, the LA River watershed, and the region. These efforts are guided by a vision that integrates water, people, and environment in planning and implementation.

The Los Angeles County Water Plan draft plan was released in 2023. The plans strategies for water resilience include mitigating the impact of wildfire on water supply, sediment management, invasive species management, and facilitating the infiltration of precipitation. Together the outlined strategies will increase drought preparedness, water capture, green neighborhoods and parks, and improve the management of water supplies.

One Water LA is focused on creating an integrated framework for the management of watersheds, water facilities, and water resources to improve, among other objectives, climate resilience, the reliability of local water, and the health of local watersheds. Since the release of the 2018 plan, One Water LA has taken action in a number of target areas including Education and Sustainability, Integration, Stormwater and Urban Runoff, and Recycled Water/Wastewater. Accomplishments of note include the creation of the "One Water LA" curriculum for LAUSD, the development of facilities plans in the areas of Stormwater and Urban Runoff and Recycled Water/Wastewater, which seek to increase recycled water availability towards the goal of improving local water supply.

1.5.2 Programs

Since the last 2018 State of the Watershed, Los Angeles County voters passed Measure W. The voter approved parcel tax on the impermeable area on private property generates local funding to improve water quality, protect public health, and increase local water supply. To date about 51 acres of impervious area have been removed, sixty-one-thousand-acre feet of stormwater captured, and 353 projects and studies supported using Safe Clean Water Program Funding. Funded projects have addressed priority pollutants in local watersheds and have benefits that include reducing heat island, providing recreational opportunities, improving flood protection, increasing shade, and enhancing habitat and park space, among others (Safe Clean Water Program, n.d.).

1.6 Flows in the Los Angeles River

Flows in the Los Angeles River have steadily increased since the 1940s as impervious cover has increased. Today annual stream flows in the Los Angeles River reflect flood management practices, the discharges of publicly owned treatment works (POTW), a Mediterranean climate, water use in urban communities, and water conservation practices. The average stream flow at the Wardlow gauge highlights the volume of flow that moves through the mouth of the River as well as seasonal variability, of which the most recent spike in flow reflects the strongest storm season in more than a decade (Figure 7). This seasonal variability includes a typical dry-weather period from May through September, characterized by little or no rainfall and steady flows that are sustained by treated effluents from three publicly-owned treatment works (POTWs): the City of Los Angeles' Glendale Water Reclamation Plant (WRP) and Donald C. Tillman WRP, and the City of Burbank WRP. Urban runoff is also a source of dry-season flow in many of the tributaries and channels of the lower watershed. Approximately 100 million gallons of runoff from landscape irrigation, car washing, and other inadvertent sources flows through the Los Angeles County storm drain system daily and into the flood control channels, including the Los Angeles River and its tributaries (Sheng & Wilson, 2009). The typical wet weather period for this region spans October through April, with typical storms ranging in duration from one to three days and resultant flows ranging from below 1 CFS, in urban tributaries, to 2,109 CFS at the Wardlow gage (Sheng & Wilson, 2009). The 2023 storm events has daily average flows of 20,000 CFS.

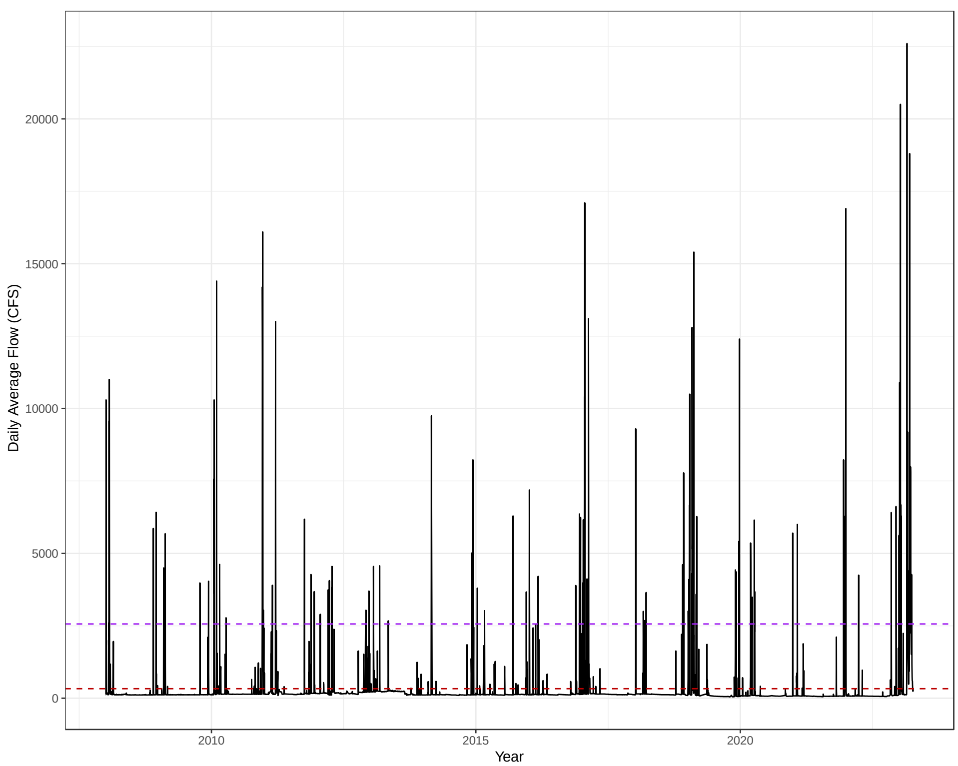


Figure 7: Flows in the Los Angeles River at the Wardlow gauge.

The red dotted line represents average flows while the purple dotted line captures 95th percentile flows.

The treated wastewater that is released into the Los Angeles River supports several beneficial uses, including habitat and recreation. The Water Boards are promoting water reuse and recycling to conserve the state's water resources, which will result in the reduction of instream flow. A key step in obtaining the approval from the State Water Board to reduce in stream flows for reuse and recycling is demonstrating that the reduced discharge will largely not affect fish, wildlife, or other public trust resources (such as recreation). A study team that includes the Southern California Coastal Water Research Program and the Colorado School of Mines developed a hydrologic model to understand how flow reductions would impact ecology and recreation in the Los Angeles River. Sensitivity curves were developed to relate reduced discharges to functional changes in flow. The study team also developed analysis tools that support management decisions (Southern California Coastal Water Research Program, n.d.). Wolfland et al. (2022) found that there were greater opportunities for wastewater recycling during the wet season and that a 4% reduction of dry season flows would potentially impact habitat for select indicator species.

1.7 Water Quality

1.7.1 Beneficial Uses

The Los Angeles Regional Water Quality Control Board, through the Basin Plan, regulates the protection of surface water and groundwater quality in the Los Angeles River Watershed for the Coastal Watersheds of Los Angeles and Ventura Counties. The Basin Plan identifies surface and groundwater bodies, designates applicable beneficial use classifications to each water body (Table 1), establishes general and water body-specific WQOs, and suggests an implementation plan for maintaining or restoring the WQOs. Each stream segment may have multiple beneficial use designations. The table below lists all the beneficial use classifications in the watershed. Since the 2018 State of the Watershed Report, the Los Angeles Regional Board is engaging Tribal governments in the establishment of Tribal beneficial uses, which include the Tribal Tradition and Culture and Tribal Subsistence Fishing use. Once waterbodies are designated for Tribal beneficial uses, associated water quality objectives may be amended or established (State Water Resources Control Board, 2023).

Table 1: Beneficial uses of water bodies in the Los Angeles River Watershed.

Use category	Estuary	Above Estuary
Population Uses		Municipal and domestic supply (MUN)
		Industrial process supply (PROC)
	Industrial service supply	Industrial service supply (IND)
		Groundwater recharge (GWR)
	Navigation (NAV)	Navigation (NAV)
Recreation and Commercial Uses	Water contact recreation	Water contact recreation (REC-1)
	Non-contact water recreation (REC-2)	Non-contact water recreation (REC-2)
	Commercial and sport fishing (COMM)	
		Warm freshwater habitat (WARM)

Use category	Estuary	Above Estuary
Habitat-Related Uses		Cold freshwater habitat (COLD)
	Estuarine habitat (EST)	
	Wetland habitat (WET)	Wetland habitat (WET)
	Marine habitat (MAR)	
	Wildlife habitat	Wildlife habitat (WILD)
	Rare, threatened, or endangered species	Rare, threatened, or endangered species (RARE)
	Migration of aquatic organisms (MIGR)	
	Spawning, reproduction, and/or early development	Spawning, reproduction, and/or early development (SPWN)

1.7.2 Water Quality Objectives

Under the Porter Cologne and Clean Water Act (CWA), all regulated water bodies have a designated beneficial use and corresponding water quality objectives based on those uses. Water quality objectives (WQOs) are either numeric concentrations or narrative characteristics (for example, water shall not contain taste or odors that cause nuisance) that are protective of a given beneficial use. WQOs are meant to be protective of public health, welfare, and to protect water quality. The Los Angeles Basin Plan contains WQOs for a variety of constituents such as: bacteria, dissolved oxygen, temperature, turbidity, pH, and nutrients. Under the CWA, the discharge of waste into a body of water requires a permit and discharge limits are established so as to not impair a designated beneficial use (Los Angeles Regional Water Quality Control Board, 2016).

1.7.3 Permitted Discharges

The Los Angeles Regional Water Quality Control Board controls pollution in the Los Angeles River and some of its tributaries by issuing permits to point source dischargers. The Los Angeles Water Board utilizes National Pollution Discharge Elimination System (NPDES) permits and waste discharge requirements to limit the discharge of contaminants and protect surface water quality and ground water quality. NPDES general permits are issued to multiple point source dischargers within specific categories, based on similarity of operations, discharges, required effluent limitations, monitoring requirements, and other factors. This allows a large number of facilities to be covered under a single permit. Individual permits are tailored to the activity, discharge, and receiving water quality of a facility. The three water reclamation plants in the Watershed hold individual NPDES permits. Of the 68 entities that hold active NPDES discharge permits, 52 are covered under general permits and 16 hold individual permits (Los Angeles Regional Water Quality Control Board, n.d.). Other minor general permits cover miscellaneous wastes such as ground water dewatering, recreational lake overflow, swimming pool wastes, and ground water seepage. Other permits are for discharge of treated contaminated ground water, non-contact cooling water, and storm water. A majority of NPDES permittees discharge directly into the Los Angeles River. A small number discharge into Burbank Western Channel, Compton Creek, Arroyo Seco, Bull Creek, and Rio Hondo. The largest numbers of general industrial storm water permits occur in the cities of Los Angeles (many within the community of Sun Valley), Vernon, N. Hollywood, South Gate, Long Beach, Compton, and Pacoima. Metal plating, transit, trucking and warehousing, and wholesale trade are a large component of these businesses. The Los Angeles River Watershed has about twice the number of industrial storm water dischargers than the San Gabriel River Watershed and the most in Los Angeles County and Ventura County watersheds.

1.7.4 Water Quality Impairments

The Clean Water Act (CWA) requires each State to assess the status of water quality in the State (Section 305(b)) and provide a list of impaired water bodies (Section 303(d)) to the U.S. Environmental Protection Agency (USEPA) every two years. The majority of the Los Angeles River is considered impaired by a variety of point and nonpoint sources. The 2020-2022 303(d) list identifies pH, ammonia, a number of metals, coliform, trash, odor, algae, oil, DDT as well as other pesticides, and volatile organics for a total of 81 individual impairments (reach/constituent combinations). Some of these constituents are of concern throughout the length of the river while others are of concern only in certain reaches (

Table 2). Impairment may be a result of water column exceedances, excessive pollutant levels in sediments, or bioaccumulation of pollutants. The beneficial uses most often threatened or impaired by degraded water quality are aquatic life, recreation, groundwater recharge, and municipal water supply.

The CWA requires a Total Maximum Daily Load (TMDL) be developed to restore impaired water bodies to their full beneficial uses by allocating allowable loadings from point sources and nonpoint sources. TMDLs have been established for trash (2001), and bacteria (2012) for the Los Angeles River, for nitrogen compounds and related effects for the Los Angeles River (2004), for metals for the Los Angeles River and its tributaries (2006), and for nitrogen, phosphorus, trash, organochlorine pesticides, and polychlorinated biphenyl for Los Angeles Area Lakes (2012).

Table 2: Water Quality Impairments (303(d) list) for select reaches of the Los Angeles River Watershed (California State Water Resources Control Board, n.d.).

Water Body Name	Size Affected (acre/miles)	Pollutant
Alhambra Wash	6.9	Ammonia
Aliso Canyon Wash	10.1	Selenium, Indicator Bacteria, Copper
Arroyo Seco reach 1 (LA River to West Hollywood Ave.)	5.2	Indicator Bacteria, Trash
Arroyo Seco reach 2 (West Hollywood Ave to Devils Gate Dam)	4.4	Indicator Bacteria, Trash
Bell Creek	8.9	Indicator Bacteria
Bull Creek	6.5	Toxicity, Indicator Bacteria, Ammonia
Burbank Western Channel	13.2	Indicator Bacteria, Cyanide, Selenium, Copper, Lead, Trash
Colorado Lagoon	13.2	PCBs, Toxicity, DDT, Zinc, Chlordane , Dieldrin, PAHs, Indicator Bacteria, Lead
Compton Creek	8.5	Copper, Lead, pH, Indicator Bacteria, Trash, Zinc, Benthic Community Effects
Dry Canyon Creek	3.9	Indicator Bacteria, Selenium total)
Echo Park lake	13.0	Trash, PCBs, Algae, Eutrophic
Lake Balboa	27.0	Ammonia, Dissolved Oxygen, Toxicity
Legg Lake	24.8	Odor, Ammonia, pH, Trash, PCB, DDT
Lincoln Park Lake (Carson to Figueroa Street)	3.8	PCBs, Ammonia, Eutrophic, Odor, Organic Enrichment/Low Dissolved Oxygen, trash
Los Angeles River Estuary (Queensway Bay)	207.0	PCBs, Chlordane, DDT, Toxicity, trash
Los Angeles River Reach 1 (Estuary to Carson Street)	3.4	Indicator Bacteria, Cyanide, Ammonia, Cadmium, Dissolved Copper, Lead, Nutrients (Algae), Trash, Dissolved Zinc, pH
Los Angeles River Reach 2	18.8	Indicator Bacteria, Oil, Ammonia, Copper, Lead, Nutrients (Algae), Trash
Los Angeles River Reach 3 (Figueroa St. to Riverside Dr.)	7.9	Ammonia, Copper, Toxicity, indicator Bacteria, Nutrients (Algae), Trash
Los Angeles River Reach 4 (Sepulveda Dr. to Sepulveda Dam)	11.1	Toxicity, Indicator Bacteria, Nutrients (algae), Trash
Los Angeles River Reach 5 (within Sepulveda Basin)	1.9	Ammonia, Copper, Lead, Benthic Community Effects, Toxicity, Oil, Nutrients (Algae), Trash
Los Angeles River Reach 6 (Above Sepulveda Flood Control Basin)	6.9	Selenium, Indicator Bacteria, Toxicity, Copper
Machado Lake	45.0	Trash, Ammonia, Nutrients, Copper, Lead, Indicator Bacteria, Oil
McCoy Canyon Creek	4.0	Indicator Bacteria, Nitrogen, Nitrate, Total Selenium
Monrovia Canyon Creek	3.4	Lead
Peck Road Park Lake	103.2	Chlordane (tissue), DDT (tissue), Odor, Organic Enrichment/Low Dissolved Oxygen, Trash
Rio Hondo Reach 1 (Confluence LA River to Santa Ana Fwy)	4.6	Indicator Bacteria, Toxicity, Copper, Lead, Trash, Zinc, pH
Rio Hondo Reach 2 (At spreading grounds)	4.9	Coliform Bacteria, Cyanide
Rio Hondo Reach 3 (Above Spreading Grounds)	8.1	Indicator Bacteria, Iron, Dissolved Oxygen
Tujunga Wash (LA River to Hansen Dam)	9.7	Indicator Bacteria, Ammonia, Copper, Trash
Verdugo Wash Reach 1 (LA River to Verdugo Rd.)	2.0	Copper, Indicator Bacteria, Trash
Verdugo Wash Reach 2 (Above Verdugo Rd.)	7.6	Trash, Indicator bacteria

1.7.4.1 Contaminants of Emerging Concern

Thousands of new chemical substances are manufactured every year and it is not feasible to monitor them all in the environment. Once chemicals of emerging concern, chemicals that are largely unregulated and poorly monitored in the environment, enter the environment they can affect aquatic organisms, wildlife, and humans. The lack of information about many CECs complicates risk assessment necessary to inform monitoring and management. The State Water Resources Control Board convened a panel of scientific experts to develop screening framework to identify CECs for monitoring and reconvened experts in 2020 to provide recommendations for the development of a monitoring program (Drewes et al., 2023; Sutton et al., 2022). As monitoring is implemented, the results of these may inform monitoring priorities in the Los Angeles River watershed over the next decade. We briefly discuss two CECs that have received considerable media attention in the past few years below.

Microplastics

Microplastics (MPs) are tiny pieces of plastic particles, typically between 1 micrometers and 5,000 micrometers in size, or about the size of a grain of sand (SWCRB, 2020). Over the last decade, MPs have become a growing area of focus for environmental regulators and public health agencies due to their potential impacts on both environmental and human health.

Plastic is a category that encompasses a wide range of materials composed of either semi-synthetic or synthetic polymers. These materials are lightweight, durable, flexible, and inexpensive. As a result, plastics have been used in a variety of applications and are ubiquitous in the modern era. A large source of environmental MPs is from industrial materials, personal care products, and cleaning products, where they are used as mild abrasives, polishing agents, or glitter for aesthetic purposes. In addition, large plastic waste (aka macroplastics) can also degrade and fragment into ever smaller pieces when exposed to the elements, such as sunlight, heat, or oxidation (Guo & Wang, 2019; Kasmuri et al., 2022).

MPs have infiltrated nearly every part of the environment and have been found in the atmosphere, soil, food, and both freshwater and marine ecosystems (Wright et al., 2020). MPs can enter humans and organisms through inhalation, direct contact, and ingestion. While little is still known about the long-term impacts of MPs on human health, there is increasing evidence that MPs may be detrimental to human health (Prata et al., 2020). Early research indicates that exposure to MPs can result in cellular damage (Danopoulos et al., 2022). Furthermore, MPs may trigger inflammation that lead to immune disorders. Additionally, microplastics have the potential to interact with other contaminants such as heavy metals, which can lead to unanticipated consequences. Further research will be needed to fully understand the environmental and human health effects of MPs.

Within the State there has been legislation to address drinking water and marine ecosystem concerns related to MPs. SB 1422, enacted in 2018, mandated the State Water Board to define microplastics in drinking water by July 1, 2020. By July 1, 2021, they were required to establish a standardized testing method for microplastics and a four-year testing and reporting plan, including that includes public disclosure of the information. This legislation addresses the concerns of with microplastics in drinking water and promotes transparency in monitoring and reporting these contaminants (State Water Resources Control Board, 2022). In addition, SB 1263, enacted in 2018, required the Ocean Protection Council to adopt and implement a Statewide Microplastics Strategy related to MPs that pose a threat to marine health. The Statewide Microplastics Strategy coalesces a comprehensive research plan that facilitates marine risk assessment, method standardization, characterization of ambient concentrations of microplastics, and a path for investigating sources and pathways that relate to environmental impacts, among other strategy components.

PFAS

Per- and polyfluoroalkyl substances (PFAS) – also called "forever chemicals" and previously known as perfluorinated chemicals (PFC) – are a family of man-made chemicals. PFAS are incredibly persistent in the environment due to their highly stable chemical structure and studies estimate PFAS can persist in the environment for thousands of years. PFAS' special chemical properties have made them useful in a wide range of consumer and industrial products.

Some of the more prominent historical and current uses of PFAS include, but are not limited to: aqueous film forming foams (AFFF) used in firefighting; waterproofing and anti-staining coatings for textiles, carpet, upholstery, apparel, non-stick pan coatings (Teflon), automotive lubricants, oil and grease repellent food packaging, and anti-weather coatings, paints, and varnishes (ATSDR, 2022).

The extent of PFAS impact on human and environmental health are still not fully known. Based on current understandings, USEPA states that prolonged exposure to PFAS may lead to negative health effects in pregnant people and developing babies, weakened immune response, and increased risks of certain cancers (Environmental Protection Agency, 2021). Likewise, the persistence of PFAS in the environment makes it possible for fish to bioaccumulate these chemicals at levels exceeding concentrations in the surrounding water but further research is still needed to identify changes in fish tissue concentrations at different sites (urban, recreational sites, etc.) (Drewes et al., 2018).

The Environmental Protection Agency released the PFAS RoadMap in 2021 with the goals of: investing in research and development to understand PFAS exposure, toxicity, human and ecological effects, and interventions; preventing PFAS from entering land, air, and water at dangerous levels; and broadening and accelerating the remediation of PFAS (USEPA, 2021). Most recent action by USEPA requires persons that manufactured PFAS since 2011 to report uses, production volumes, byproducts, disposal, and exposure (State Water Resources Control Board, N.D.).

1.8 References

Abatzoglou, J. T., & Williams, A. P. (2016). Impact of anthropogenic climate change on wildfire across western US forests. Proceedings of the National Academy of Sciences, 113(42), 11770–11775.

ATSDR. (2022, November 1). PFAS chemicals overview. Agency for Toxic Substances and Disease Registry. https://www.atsdr.cdc.gov/pfas/health-effects/overview.html

CALeDNA. (2023, June 1). CALeDNA. https://ucedna.com

California State Water Resources Control Board. (n.d.). California 2020-2022 Integrated Report. Retrieved September 23, 2023, from https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=6cca2a3a1815465599201266373cbb7b

State Water Resources Control Board. (2022). *Microplastics Drinking Water*. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html

ClockShop. (n.d.). About the Project. Take Me To Your River. Retrieved October 2, 2023, from https://takemetoyourriver.org/about/

Danopoulos, E., Twiddy, M., West, R., & Rotchell, J. M. (2022). A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells. Journal of Hazardous Materials, 427, 127861. https://doi.org/10.1016/j.jhazmat.2021.127861

Dettinger, M. (2011). Climate Change, Atmospheric Rivers, and Floods in California – A Multimodel Analysis of Storm Frequency and Magnitude Changes1. JAWRA Journal of the American Water Resources Association, 47(3), 514–523. https://doi.org/10.1111/j.1752-1688.2011.00546.x

Drewes, J. E., Anderson, P., Denslow, N., Jakubowski, W., Olivieri, A., Schlenk, D., & Snyder, S. (2018). Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water (1032; SCCWRP Technical Reports, p. 176). https://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1032_CECMonitoringInRecycledWater.pdf

Drewes, J. E., Anderson, P., Denslow, N., Muir, D., Olivieri, A., Schlenk, D., & Snyder, S. (2023). Monitoring Strategies for Constituents of Emerging Concern (CECs) in California's Aquatic Ecosystems: Recommendations of a Science Advisory Panel.

Guanuna, L. (2015, September 17). Getting Up, Staying Up: History of Graffiti in the L.A. River. PBS SoCal. https://www.pbssocal.org/shows/earth-focus/getting-up-staying-up-history-of-graffiti-in-the-l-a-river

Guo, X., & Wang, J. (2019). The chemical behaviors of microplastics in marine environment: A review. Marine Pollution Bulletin, 142, 1–14. https://doi.org/10.1016/j.marpolbul.2019.03.019

Hall, A., Berg, N., & Reich, K. (2018). Los Angeles Region Report [Summary Report].

Hilton, T. (n.d.). LA River X. Retrieved October 2, 2023, from https://www.lariverx.net/home

Huang, X., & Swain, D. L. (2022). Climate change is increasing the risk of a California megaflood. Science Advances, 8(32), eabq0995. https://doi.org/10.1126/sciadv.abq0995

Kasmuri, N., Tarmizi, N. A. A., & Mojiri, A. (2022). Occurrence, impact, toxicity, and degradation methods of microplastics in environment—A review. Environmental Science and Pollution Research, 29(21), 30820–30836. https://doi.org/10.1007/s11356-021-18268-7

Kelly, R. P., Shelton, A. O., & Gallego, R. (2019). Understanding PCR processes to draw meaningful conclusions from environmental DNA studies. Scientific Reports, 9(1), 12133.

Kibler, C. L., Schmidth, C. E., Roberts, D. A., Stella, J. C., Kui, L., Lambert, A. M., & Singer, M. B. (2021). A brown wave of riparian woodland mortality following groundwater declines during the 2012–2019 California drought -. Environmental Research, 16(8). https://iopscience.iop.org/article/10.1088/1748-9326/ac1377

LA County Climate Vulnerability Assessment. (2021). https://ceo.lacounty.gov/wp-content/uploads/2021/10/LA-County-Climate-Vulnerability-Assessment-1.pdf

LA River Master Plan. (2022). Los Angeles County. https://pw.lacounty.gov/uploads/swp/LARiverMasterPlan-FINAL-DIGITAL-COMPRESSED.pdf

LA Sanitation and Environment. (2022). LA Biodiversity Index Baseline Report. https://www.lacitysan.org/cs/groups/public/documents/document/y250/mdc2/~edisp/cnt076756.pdf

Los Angeles Regional Water Quality Control Board. (n.d.). Adopted Orders/Permits. Retrieved September 22, 2023, from https://www.waterboards.ca.gov/losangeles/board_decisions/adopted_orders/search.php?go

MacDonald, G. M. (2007). Severe and sustained drought in southern California and the West: Present conditions and insights from the past on causes and impacts. Quaternary International, 173–174, 87–100. https://doi.org/10.1016/j.quaint.2007.03.012

Meyer, R., Ramos, M., Lin, M., Schweizer, T., Gold, Z., Ramos, D., Shirazi, S., Kandlikar, G., Kwan, W., Curd, E., Freise, A., Parker, J., Sexton, J., Wetzer, R., Pentcheff, N., Wall, A., Pipes, L., Garcia-Vedrenne, A., Mejia, M., … Wayne, R. (2021). The CALeDNA program: Citizen scientists and researchers inventory California's biodiversity. California Agriculture, 75(1), 20–32.

Payne, A. E., Demory, M.-E., Leung, L. R., Ramos, A. M., Shields, C. A., Rutz, J. J., Siler, N., Villarini, G., Hall, A., & Ralph, F. M. (2020). Responses and impacts of atmospheric rivers to climate change. Nature Reviews Earth & Environment, 1(3), Article 3. https://doi.org/10.1038/s43017-020-0030-5

Prata, J. C., da Costa, J. P., Lopes, I., Duarte, A. C., & Rocha-Santos, T. (2020). Environmental exposure to microplastics: An overview on possible human health effects. Science of The Total Environment, 702, 134455. https://doi.org/10.1016/j.scitotenv.2019.134455

Robeson, S. M. (2015). Revisiting the recent California drought as an extreme value. Geophysical Research Letter. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015GL064593

Safe Clean Water Program. (n.d.). Program Overview. Retrieved October 2, 2023, from https://portal.safecleanwaterla.org/scw-reporting/dashboard

Sheng, J., & Wilson, J. P. (2009). Hydrology and Water Quality Modeling of the Los Angeles River Watershed (22; The Green Visions Plan for 21st Century Southern California). University of Southern California.

Southern California Coastal Water Research Program. (n.d.). Los Angeles River Environmental Flows Project Analysis Tool. Retrieved October 1, 2023, from https://la-river-eflows-study-2021-sccwrp.hub.arcgis.com/

State Water Resources Control Board. (2023, September 23). Regional Water Board Progress Updates on Tribal Beneficial Uses | California State Water Resources Control Board. https://waterboards.ca.gov/tribal_affairs/regional_tbu_updates.html

State Water Resources Control Board. (n.d.). *CA PFAS Timeline*. Per- and Polyfluoroalkyl Substances. Retrieved September 20, 2023, from https://www.waterboards.ca.gov/pfas/ca_pfas_timeline.html

Sutton, R., Miller, E., Wong, A., Mendez, M., & Lin, D. (2022). CECs in California's Ambient Aquatic Ecosystems: Occurrence and Risk Screening of Key Classes.

Swain, D. L., Langenbrunner, B., Neelin, J. D., & Hall, A. (2018). Increasing precipitation volatility in twenty-first-century California. Nature Climate Change, 8(5), Article 5. https://doi.org/10.1038/s41558-018-0140-y

SWCRB. (2020). RESOLUTION NO. 2020-0021: ADOPTION OF DEFINITION OF 'MICROPLASTICS IN DRINKING WATER.' STATE WATER RESOURCES CONTROL BOARD. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2020/rs2020_0021.pdf

Ullrich, P. A., Xu, Z., Rhoades, A. m., Dettinger, M. d., Mount, J. f., Jones, A. d., & Vahmani, P. (2018). California's Drought of the Future: A Midcentury Recreation of the Exceptional Conditions of 2012–2017. Earth's Future, 6(11), 1568–1587. https://doi.org/10.1029/2018EF001007

US Environmental Protection Agency. (2021). PFAS Strategic Roadmap: EPA's Commitments to Action 2021–2024 (PFAS Strategic Roadmap, p. 26). https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf

US Geological Survey. (n.d.). Environmental DNA. Retrieved October 2, 2023, from https://www.usgs.gov/special-topics/water-science-school/science/environmental-dna-edna

Westerling, A. L., Hidalgo, H. G., Cayan, D. R., & Swetnam, T. W. (2006). Warming and earlier spring increase western US forest wildfire activity. Science, 313(5789), 940–943.

Wolfand, J. M., Taniguchi-Quan, K. T., Abdi, R., Gallo, E., Irving, K., Philippus, D., Rogers, J. B., Stein, E. D., & Hogue, T. S. (2022). Balancing water reuse and ecological support goals in an effluent dominated river. Journal of Hydrology X, 15, 100124. https://doi.org/10.1016/j.hydroa.2022.100124

Wright, S. L., Ulke, J., Font, A., Chan, K. L. A., & Kelly, F. J. (2020). Atmospheric microplastic deposition in an urban environment and an evaluation of transport. Environment International, 136, 105411. https://doi.org/10.1016/j.envint.2019.105411

2 What are the conditions of the streams in the Los Angeles River Watershed?

2.1 Background

The goal of the LARWMP is to assess the condition of streams throughout the Los Angeles River Watershed to inform watershed management decisions. In the past century the physical, biological, and chemical conditions of streams in the urbanized lower watershed of the Los Angeles River have been dramatically altered due to development. In contrast, streams in the more remote areas of the upper watershed maintain some pre-urbanization integrity, providing an opportunity to assess a gradient of conditions across the watershed. We provide a summary and assessment of the current condition of streams over 14 years of monitoring from 2008 through 2022. This information serves as a comprehensive baseline for assessing future management actions.

2.2 Monitoring Methods

To determine the condition of perennial streams in the Los Angeles River Watershed, a total of ninety-eight sites were sampled from 2008 through 2022. These sites were randomly selected and stratified to ensure that the three watershed subregions were adequately sampled and include the natural portions of the upper watershed, the effluent-dominated reaches of the mainstem channel, and the urban tributaries of the lower watershed (Figure 8). In 2014, the LARWMP program began to revisit previously sampled random sites to better detect changing conditions in the watershed.

Figure 8: Subregions sampled by the LARWMP. Natural sites are found in natural portions of the upper watershed. Urban sites are located along the urban tributaries. Effluent sites are found along the mainstem of the Los Angeles River.

The monitoring design of LARWMP is consistent with regional and statewide Perennial Streams Assessment (PSA) programs that in turn are built upon earlier programs, namely USEPA's

Environmental Monitoring and Assessment Program (EMAP) and California's Monitoring and Assessment Program (CMAP). Sampling is conducted during the dry weather (March through September). While perennial streams (flowing year-round) are targeted for sampling, seasonal variation in flow due to annual rainfall amounts make sampling at non-perennial streams inevitable.

Bioassessment using resident aquatic biota as indicators of the biological integrity of streams is the key component of the monitoring program. The biological condition of streams is assessed using two biological indicators: algae and benthic macroinvertebrates. The California Stream Condition Index (CSCI) is a statewide biological scoring tool that translates complex data about benthic macroinvertebrates (BMI) found living in a stream into an overall measure of stream health (Mazor, 2015). Streams in reference condition are expected to have a CSCI score ≥0.79 (Ode, 2016). Similarly, the Algal Stream Condition Index (ASCI) uses a multiple line of evidence approach to understand stream condition. Algae are useful indicators of stream condition because they are sensitive to water quality conditions, particularly nutrients, and can respond to management actions in locations where BMI are less useful (e.g. engineered channels) (Theroux et al., 2020). Streams in reference condition are expected to have an ASCI score ≥0.86. Bioassessment is combined with chemical and physical habitat characteristics that provide a multiple lines of evidence approach for assessing stream condition.

Riparian wetland condition was assessed using the California Rapid Assessment Method (CRAM) (Collins et al., 2008). The method was developed to allow evaluation of statewide investments in restoring, protecting, and managing wetlands. Briefly, the CRAM method assesses four attributes of wetland condition: buffer and landscape, hydrologic connectivity, physical structure, and biotic structure. Each of these attributes is comprised of several metrics and sub-metrics that are evaluated in the field for a prescribed assessment area. The CRAM metrics are ecologically meaningful and reflect the relationship between stress and the high priority functions and ecological services of wetlands. The greater the CRAM score, the better the biotic, physical, hydrologic, and buffer zone condition of the habitat. Streams in reference condition are expected to have a CRAM score ≥72 (Mazor, 2015).

Trash assessments began in 2018 at random sites using the riverine quantitative tally method as reviewed in the trash monitoring playbook (Moore et al., 2020). Briefly, trash items are tallied under trash categories (e.g. paper, plastic, cloth and fabric) and into more detailed trash types (e.g. foam pieces, plastic bag pieces). A 30-meter stretch of each random site is visually assessed. The assessment area spans the thalweg to the bank full width. The assessment also makes note of storm drain and homeless encampments within the assessment area (Moore et al., 2020).

In 2014, the Technical Stakeholder Group (TSG) agreed to modify the LARWMP sampling design based on design changes made by the Southern California Stormwater Monitoring Coalitions (SMC) Regional Monitoring Program. This design modification was made to help improve our ability to detect changing conditions not only in the Los Angeles watershed, but in the Southern California region as a whole. The design incorporates site revisits at random sites previously sampled by the SMC program. In addition, the program began to re-visit sites previously sampled through the

LARWMP program, contributing more information that can help us detect changing conditions in the Los Angeles River watershed.

Assessing Biological Condition in California's Streams

One of the ways the LARWMP determines the health of our rivers and streams is by taking a closer look at the organisms that live there. Benthic macroinvertebrates (BMI) are bottom-dwelling organisms that are visible to the naked eye. BMI exist year-round in streams in either their adult or juvenile forms. These include insects (such as the Psychodidae shown below in Figure 9), aquatic worms, and snails, that can be sensitive to pollution, changes to physical habitat condition, and other types of stress. Many BMI respond to stress in ways we can predict. By observing and collecting data about the BMI at a specific site, we can learn about the health of that stream. Measurements about BMI communities is used to calculate the **California Stream Condition Index (CSCI) score**, which helps quantify site conditions by comparing our sites to healthy or "reference sites."

The CSCI was developed using a state-wide dataset to establish site-specific expectations of "reference condition." It is therefore applicable throughout the state. The index has two components: a measure of the number of species observed at a site compared to what is expected (O/E), and a multi-metric index, which measures community structure.

Figure 9: Benthic macro-invertebrate taxa, Psychodidae, captured in LARWMP stream site. Source: Aquatic Bioassay Consulting.

Algae are another biological indicator that work well in urbanized environments because algae are generally more closely related to water quality than habitat features (Fetscher & McLaughlin, 2008). The LARWMP uses measurements of both diatoms and soft-body algae as indicators using the hybrid Algal Stream Condition Index. Algae are a good indicator because they have short generation times, are responsive to a variety of environmental stressors, and are pervasive across stream substratum.

2.3 Results

2.3.1 Biological, Physical, and Chemical Condition of Streams in the Watershed

The LARWMP found that the majority of sites in the watershed are altered, i.e. in the lower "altered" or "very likely altered" conditions based on comparisons to reference conditions established by CSCI and ASCI indicators (Table 3). Additionally, the distribution of sites in healthy or reference condition, i.e. "likely intact" and "possible altered" categories, is largely concentrated around the natural sub-regions of the Los Angeles River Watershed (Figure 11, Figure 10). In the 14 years of monitoring, there are only a small percentage (4.5%) of effluent sites that have CSCI scores in reference condition. CSCI scores in the urban subregion somewhat resembles the score profile of effluent-dominated sites, with the exception of having no sites in reference condition (Figure 11; Figure 10). ASCI scores profiles reflect a different distribution. There are a smaller proportion of sites in reference condition overall, including in natural areas. Based on ASCI scores, there are no sites in reference condition in the effluent sub-region and a small percentage (11%) of sites in reference condition in the urban sub-region.

Table 3: Percentage of sampled stream sites across the watershed in likely intact, possibly altered, likely altered, and very likely altered categories based on CSCI, ASCI, and CRAM indicator scores.

	Likely Intact	Possibly Altered	Likely Altered	Very Likely Altered
CSCI	21%	10%	25%	44%
ASCI	11%	8%	19%	62%
CRAM	20%	8%	8%	64%

The variables that had the strongest relationship with biological condition were related to water chemistry and physical habitat. High CSCI scores were strongly associated with complex physical habitat such as improved riparian habitat condition (CRAM), epifaunal substrate, cobble/gravel, reduced channel alteration, and increased canopy cover, conditions most frequently found in the natural sub-regions (Figure 12). Hybrid ASCI scores were associated with both water chemistry and physical habitat variables (Figure 13). High ASCI scores were associated with improved riparian habitat condition (CRAM), higher scores for epifaunal substrate, reduced channel alteration, increased canopy cover, and lower concentrations of nitrate, often found in the natural sub-region. However, overall stressor associations are stronger for BMI communities than algal communities.

Much like biological condition, urban and effluent regions of the lower watershed had significantly poorer riparian habitat condition than the upper watershed (Figure 14). Development in the lower watershed has nearly eliminated natural streambed habitat and riparian buffers, while sites in natural regions have wide buffer zones, improved hydrological connectivity, and dense, native vegetative canopy. Given the strong relationship between biological communities and physical habitat condition, as described above, it is not surprising that CSCI and CRAM scores mirror each other. Benthic macroinvertebrate communities require complex in-stream and riparian cover and a wide and undisturbed riparian buffer zone.

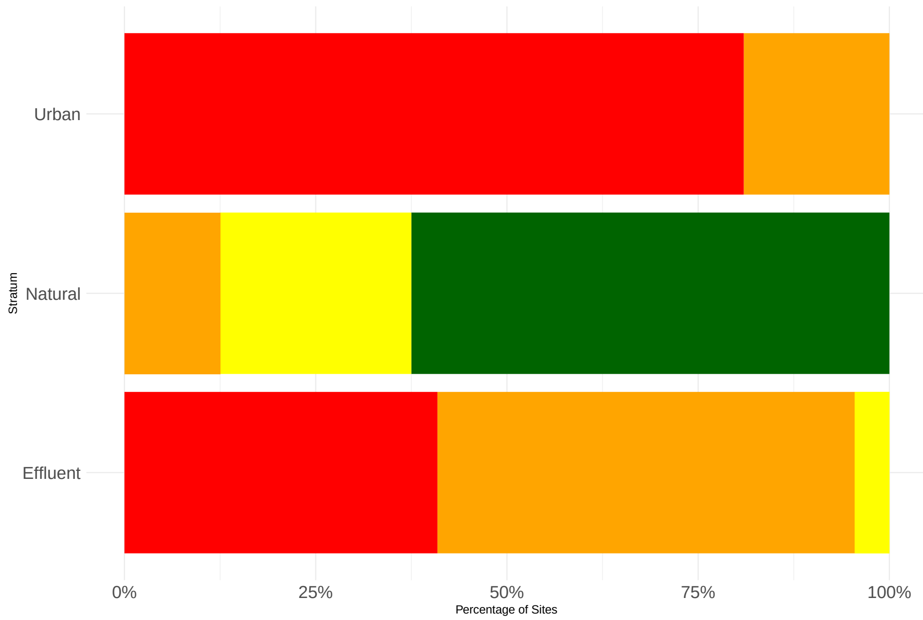


Figure 11: Proportion of sites in reference condition based on benthic macro-invertebrates (CSCI scores) for each water watershed subregion from 2008-2022.

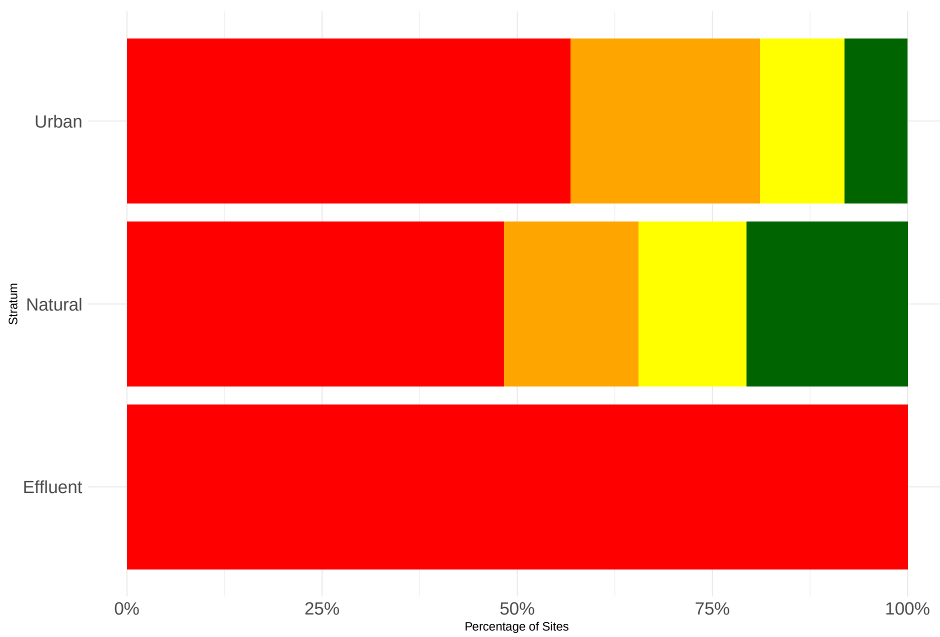


Figure 10: Proportion of sites in reference condition based on ASCI scores for each watershed subregion from 2009-2022.

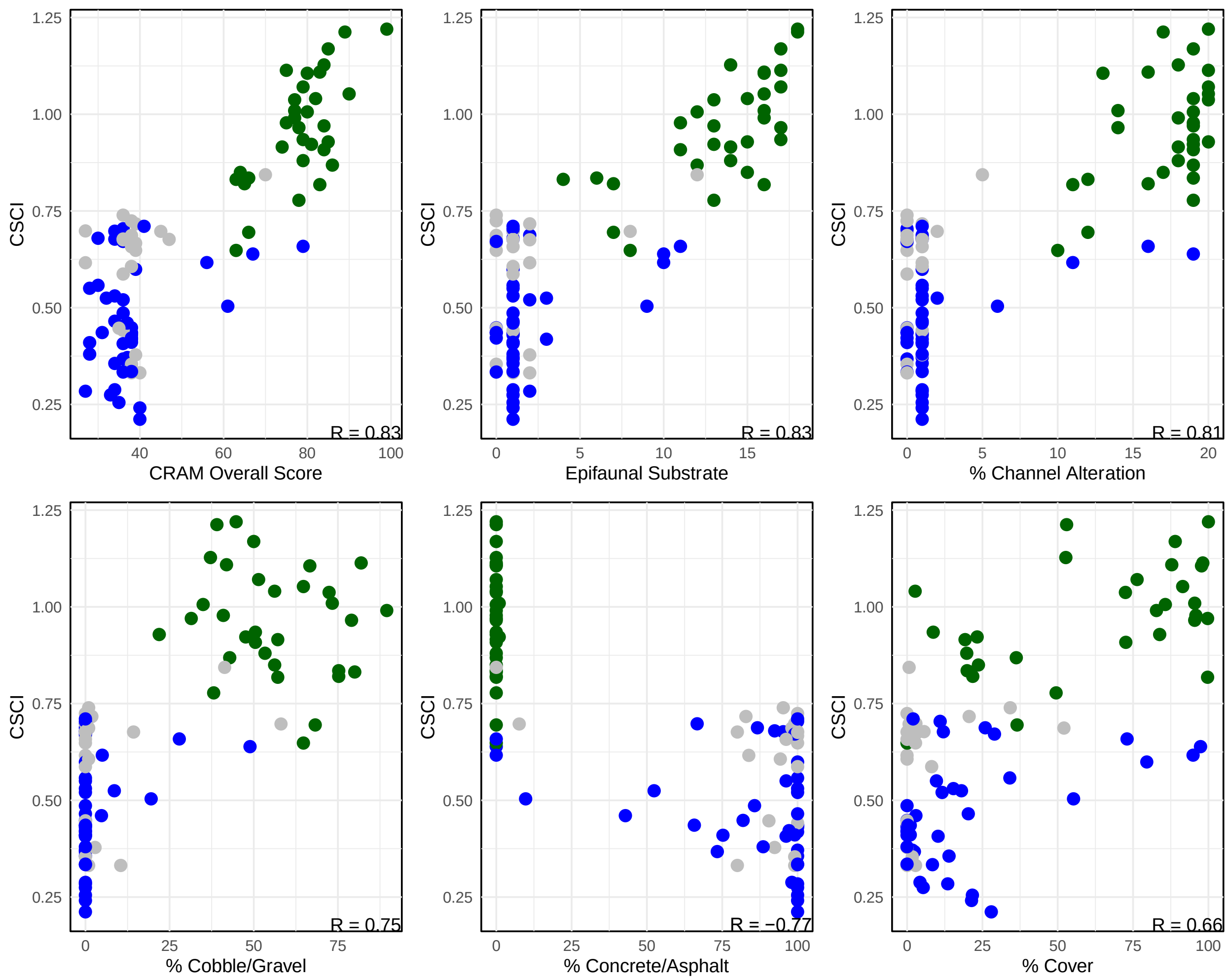


Figure 12: Select correlation plots that show variables most strongly associated with CSCI scores. Points are color coded by sub-region and green=natural, blue = urban, and gray = effluent.

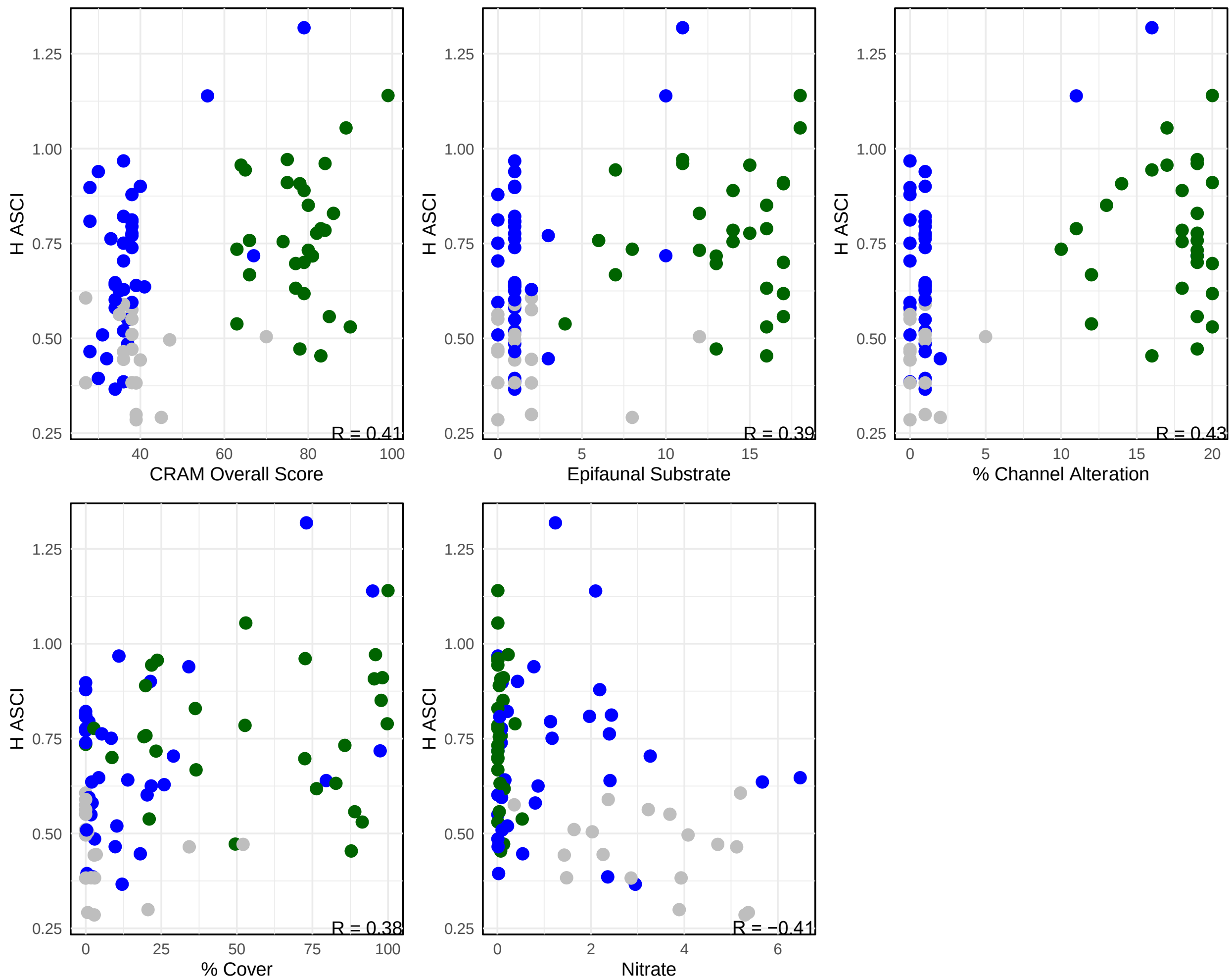


Figure 13: Select correlation plots that show variables most strongly associated with Hybrid ASCI scores. The points are color coded by sub-region and are green = natural, blue = urban, and gray = effluent.

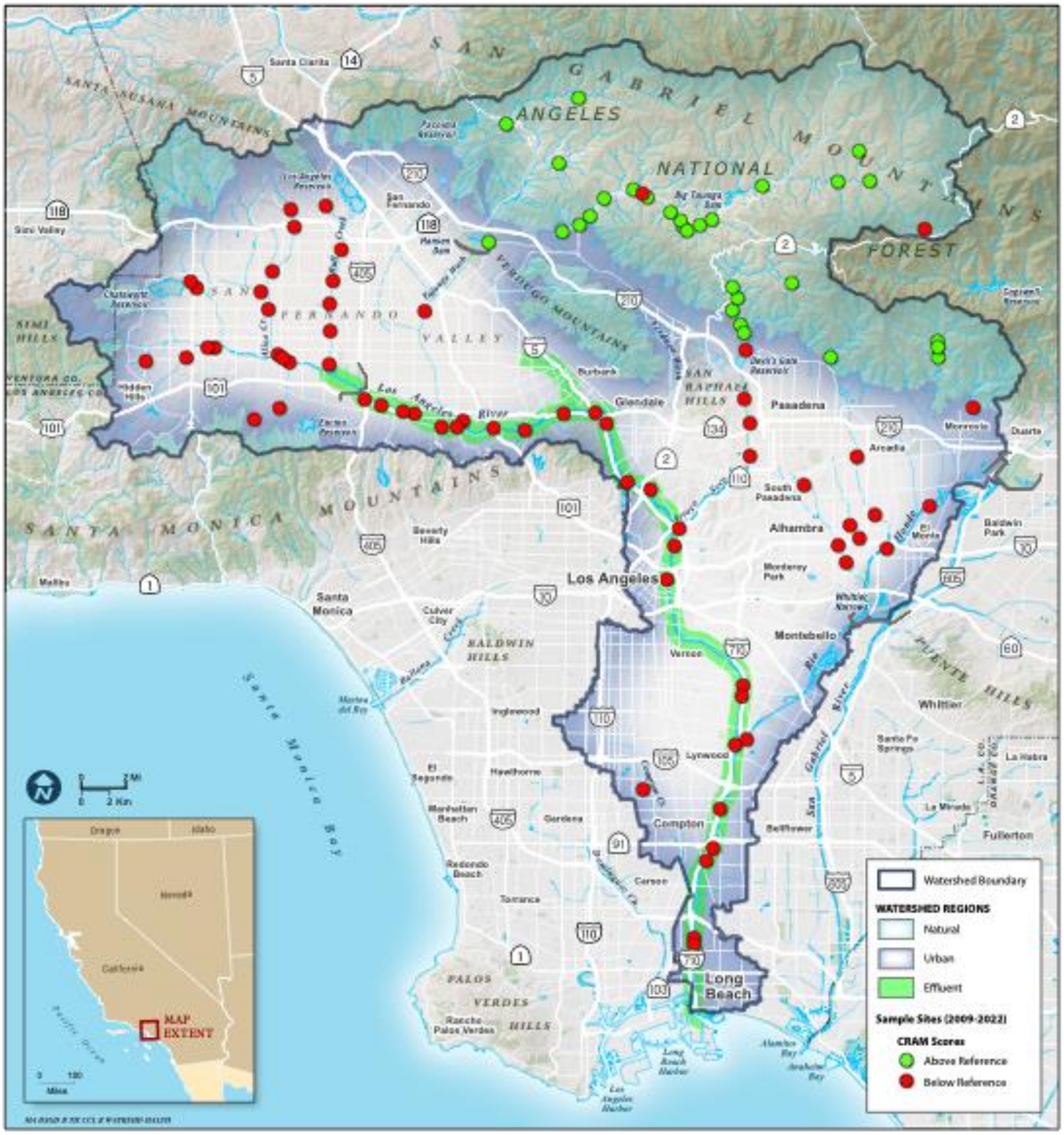


Figure 14: Map of CRAM scores for random sites sampled from 2008-2022.

Using revisit sites that have 2 or more data points, we assessed changes in the watershed using a Bayesian random effects regression analysis applied to CSCI and ASCI scores over time (Figure 15). We find that individual sites in the watershed are stable and conditions are not getting better or worse over time. Scores within each sub-region are also stable over time. However, we did find that ASCI scores across the watershed are decreasing over time, suggesting degrading water quality conditions.

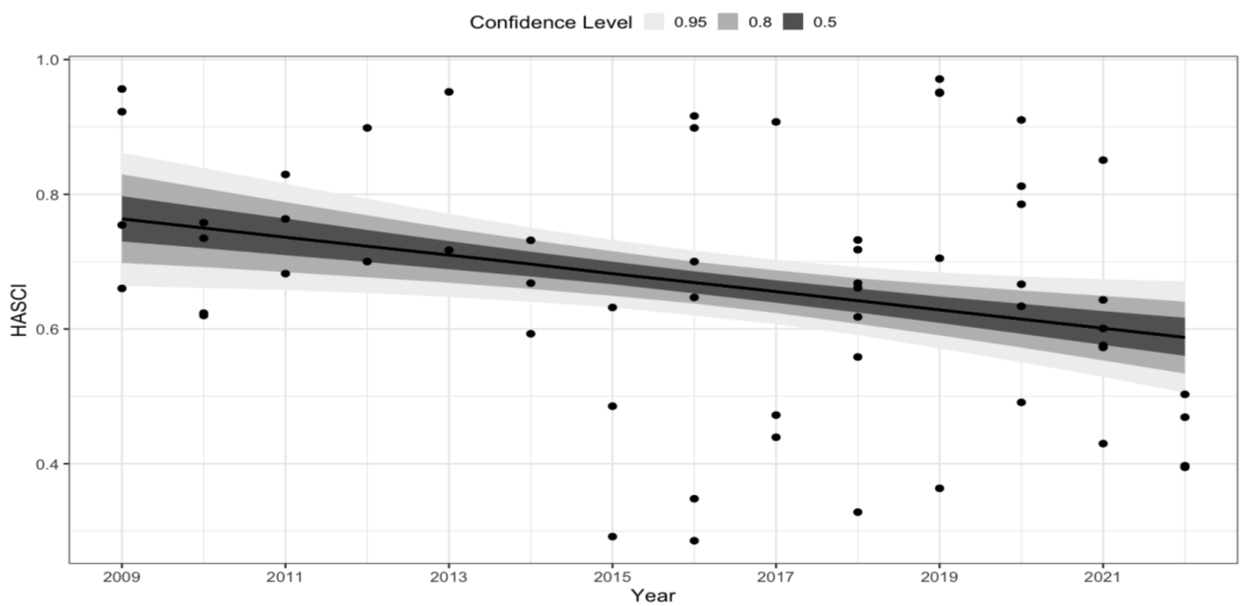


Figure 15: Hybrid ASCI trend analysis using a Bayesian random effects regression model for the watershed. Slope is significant over time.

A comparison of water quality, nutrients, and physical habitat parameters among the three watershed subregions from 2008 thru 2022 demonstrates the average condition of streams in effluent, urban and natural sub-regions (Table 4). We have found that conditions in the natural sub-region are distinct from the urban tributaries and the mainstem for many physical habitat, water chemistry, and nutrient related variables.

Table 4: Average physical habitat, general chemistry, and nutrient related variables for each subregion of the LA River for the period 2008-2022.

Measured Variables	Effluent	Urban	Natural
Physical Habitat			
Eroded (%)	0.21	1.2	8.22
Stable (%)	97.52	89.5	27.3
Vulnerable (%)	2.27	9.3	64.47
FastWater (%)	76.86	41.24	53.12
SlowWater (%)	23.07	58.5	45.95
Concrete/asphalt (%)	86.97	82.98	0.06
Cobble gravel (%)	5.34	2.82	52.85
Wetted Width (m)	38.29	5.25	3.84
Mean Slope (%)	0.65	1.11	2.68
Cover (%)	6.47	17.19	67.26
ChannelAlteration	1	2.12	17.19
Epifaunal Substrate	1.82	2.1	13.34
Sediment Deposition	17.55	16.43	12.88
General Chemistry			
Alkalinity (mg/L)	141.23	281.86	205.19
DO (mg/L)	10.57	10.43	8.27
pH	8.44	8.79	7.94
Specific Conductivity (us/cm)	1045.82	1228.33	460.44
Temperature (C)	22.68	24.47	17.08
CPOM (mg/L)	4.39	12.81	22.76
Nutrients (mg/L)			
Ammonia	0.12	0.32	0.05
DOC	6.94	10.74	3.12
Nitrate Nitrite N	3.3	1	0.07
Nitrate	3.4	1.02	0.07
Nitrite	0.08	0.03	0.01
Nitrogen Total	5.64	4.66	0.59
TKN	2.12	2.72	0.33
OrthoPhosphate	0.13	0.13	0.05
Phosphorus	0.27	0.36	0.08
TOC	7.82	11.98	6.33

2.3.2 Trash

LARWMP's trash assessments revealed that the most prominent category of trash in the Los Angeles River Watershed is plastic, followed by metal, and biodegradable trash categories (Figure 16). The top 10 most prominent trash items are in Figure 17. On average, wrappers and wrapper pieces are the most abundant trash items (Figure 17). Overall, plastic is present in a little under half of stream kilometers in the watershed, compared to 61% of stream kilometers that have some form of trash present.

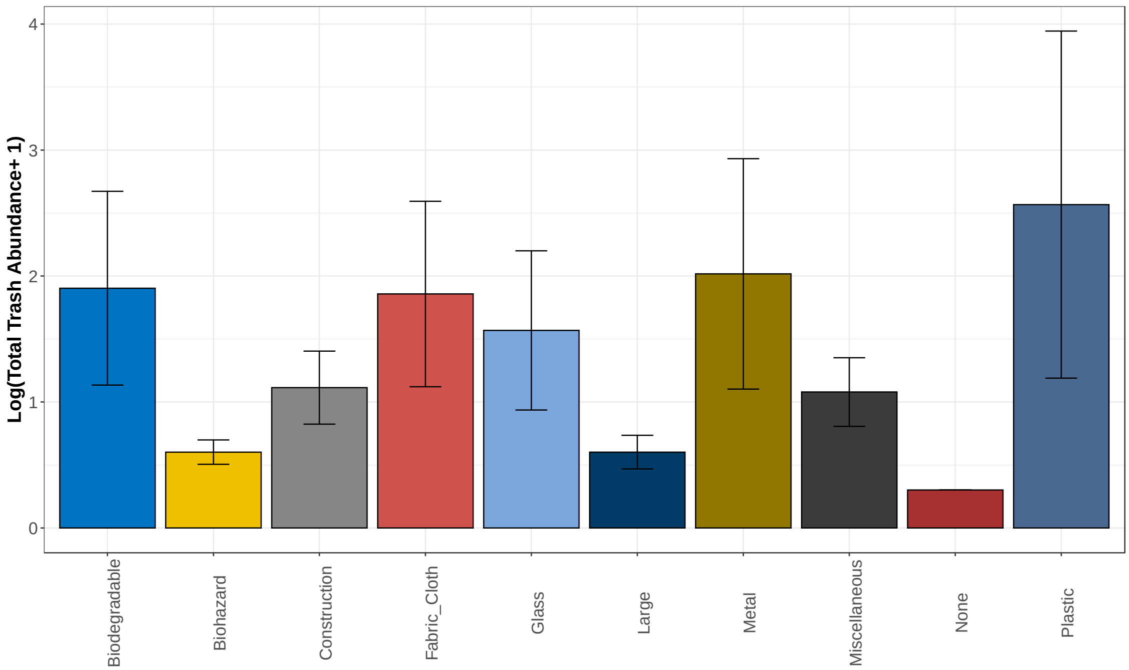


Figure 16: Average trash abundance for each trash category at random sites across the Watershed. Error bars represent standard deviation.

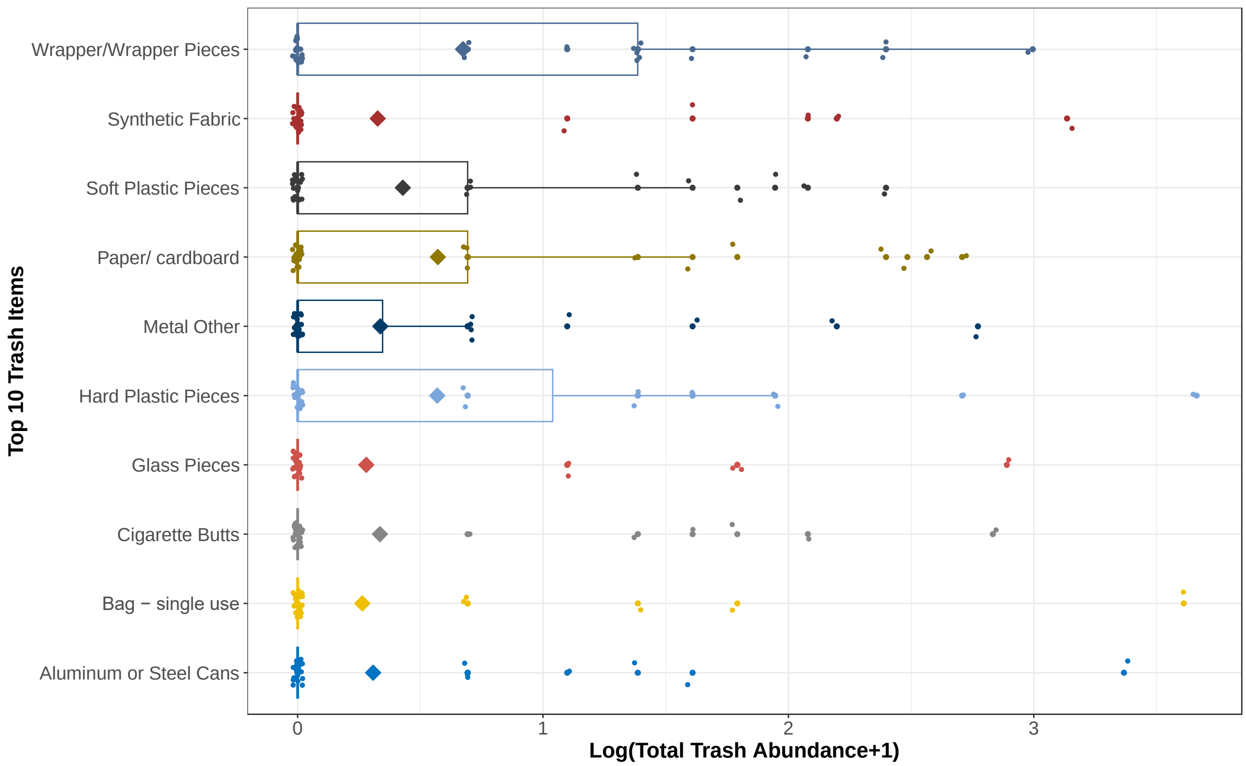


Figure 17: Boxplot of trash abundances for the top ten most prominent trash types. Diamonds represent the mean for each trash type and points show the considerable variability in trash abundance across sites. Median abundance counts are represented by vertical line, often near zero.

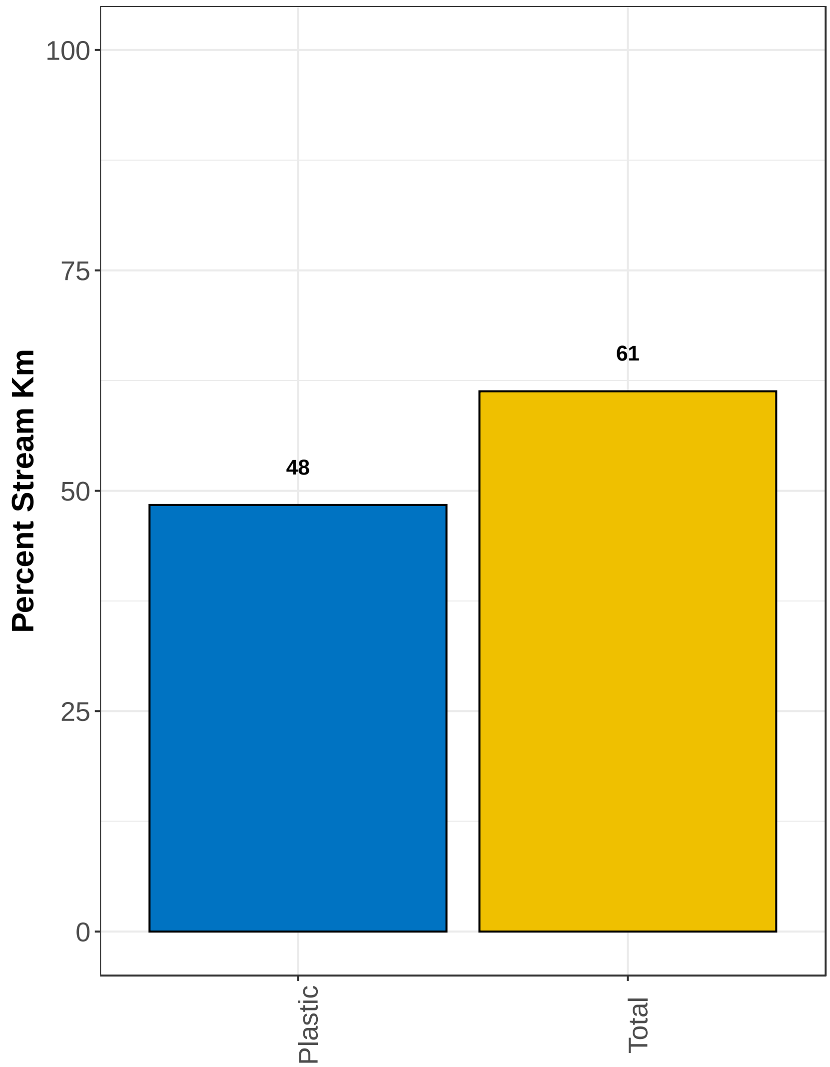


Figure 18: Total stream kilometers that have at least one piece of plastic or trash item present.

2.4 Policies and Ordinances Stemming the Flow of Trash

Event	Date	Description	Region
City of Los Angeles Ordinance 182604 Passed	June 1, 2013	Single-use carryout bag ban for markets	City of Los Angeles
City of Los Angeles Ordinance 182604 In Effect for drugstores and small markets	January 1, 2014	Single-use carryout bag ban for markets	City of Los Angeles
City of Los Angeles Ordinance 182604 In Effect for large supermarkets	July 1, 2014	Single-use carryout bag ban for markets	City of Los Angeles
SB 270 Approved	September 30, 2014	State-wide plastic bag ban	California
A.B. 888 Approved	October 8, 2015	Plastic Waste Reduction Law: Microplastic beads banned from consumer products	California
SB 270 In effect	July 1, 2016	State-wide plastic bag ban	California
S.B. 1335 Approved	September 20, 2018	Plastic Waste Reduction Law: Requires state-owned food services to use compostable food service packaging	California
A.B. 1884 Approved	September 20, 2018	Plastic Waste Reduction Law: Requires single use plastic straws to be given only upon request	California
A.B. 1884 In Effect	January 1, 2019	Plastic Waste Reduction Law: Requires single use plastic straws to be given only upon request	California
A.B. 888 In effect	January 1, 2020	Plastic Waste Reduction Law: Microplastic beads banned from consumer products	California
Covid-19 Emergency Order	April 23, 2020	Plastic bag ban lifted temporarily for 60 days	California
Covid-19 Emergency Order	June 23, 2020	Plastic bag ban reenact	California
S.B. 1335 In Effect	January 1, 2021	Plastic Waste Reduction Law: Requires state-owned food services to use compostable food service packaging	California
AB 1276 Approved	October 5, 2021	Single-use food accessories and standard condiments ban for restaurants	California
AB 1276 In effect	January 1, 2022	Single-use food accessories and standard condiments ban for restaurants	California
SB 54 Approved	June 30, 2022	The bill requires all packaging in California to be recyclable or compostable by 2032	California
LA County Single Use Plastic Ordinance	April 1, 2022	Ban on single-use plastics for restaurants in unincorporated areas of Los Angeles County. The ordinance will expand to food trucks in November 2023 and to temporary facilities in May 2024.	Los Angeles County Unincorporated Areas
City of Los Angeles Ordinance 187716 Passed	December 1, 2022	Second single-use carryout bag ban expansion for retail establishments/shops	City of Los Angeles
City of Los Angeles Ordinance 187716 In Effect for large shops	January 23, 2023	Second single-use carryout bag ban expansion for retail establishments/shops	City of Los Angeles
City of Los Angeles Ordinance 187716 In Effect for all shops	July 1, 2023	Second single-use carryout bag ban expansion for retail establishments/shops	City of Los Angeles

2.5 Summary and Next Steps

Over fourteen years of monitoring, we find that the majority of sites that have been assessed by the LARWMP program are in impaired condition (e.g. "likely altered" or "very likely altered"). As previously reported, there is strong spatial pattern of improved stream condition, assessed using algal and BMI indicators, habitat condition, water quality, and physical habitat, in the upper watershed compared to the developed lower watershed. BMI communities, assessed by CSCI, have strong positive relationship with physical habitat variables while algal communities, as assessed by ASCI, have weaker relationships with both nutrients and physical habitat. Degraded biological conditions at many stream sites is not surprising considering the Los Angeles River watershed is one of the most extensively urbanized areas in the country.

We find that biological conditions at the site and sub-region level are stable over time. However, at a watershed scale we note that Hybrid ASCI scores show a decreasing trend. This suggests that water quality conditions are degrading at a watershed scale and merit further investigation.

Over the next few years, the LARWMP will continue to support and coordinate with larger regional monitoring efforts such as the Stormwater Monitoring Coalition (SMC) Program and the State Water Board's Surface Water Ambient Monitoring Program (SWAMP). Recently, the SMC Program has begun to assess the cause of biological impairment for sites where scores are lower than expected using a unique rapid causal assessment tool. These assessments are important in better informing and targeting management efforts and highlighting the importance of fire, contaminants of emerging concern, or invasives, for example in altering the condition of sites in the watershed.

Trash is present in more than half the stream reaches that were assessed. The majority of trash is some form of plastic. Trash surveys have only started in the past 5-year period so the amount of data collected is too low to explore differences between strata or changes over time. In the following State of the Watershed Report, analysis can explore changes in trash abundance, particularly given recently implemented statewide plastic bag bans, the single use straw statewide ban, the statewide single-use food accessory ban, and the passage of SB 54, which requires all packaging to be recyclable or compostable by 2032.

2.6 References

Collins, J. N., Stein, E. D., Sutula, M., Clark, R., Fetscher, A. E., Grenier, L., Grosso, C., & Wiskind, A. (2008). *California Rapid Assessment (CRAM) for Wetlands, v5.0.2*. San Francisco Estuary Institute.

Fetscher, A. E., & McLaughlin, K. (2008). Incorporating bioassessment using freshwater algae into California's surface water ambient monitoring program (SWAMP). *Prepared for the Technical Report*, *563*.

Mazor, R. D. (2015). *Bioassessment of Perennial Streams in Southern California: A Report on the First Five Years of the Stormwater Monitoring Coalition's Regional Stream Survey.* (Technical Report 844). Southern California Coastal Water Research Project.

Moore, S., Hale, T., Weisberg, S., Flores, L., & Kauhanen, P. (2020). *California Trash Monitoring Methods and Assessments Playbook* (1025). San Francisco Estuarine Institute.

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

3 Are conditions at locations of unique interest getting better or worse?

3.1 Background

Wetland habitats are important as they are limited in number and the multiple benefits of the relatively natural habitat they provide in an otherwise heavily urbanized watershed. The primary goal of this component of the program is to track trends over time at sites that have been identified as important by the technical stakeholder group so as to provide early warning of potential degradation so that management action can be taken. Monitored sites includes high value habitats and target sites (

Figure 19).

- Working group members identified nine unique habitats of high value. They provide a measure of natural background or provide context against which trends in other portions of the watershed can be evaluated. Repeated measures of riparian habitat condition, assessed using the California Rapid Assessment Method (CRAM), have been completed at habitats of high value. Initially, CRAM assessments were conducted annually. More recently, conditions are being assessed on a three-year cycle, acknowledging the inherently slow rate of change in CRAM's component indicators.
- Beginning in 2018 the work group members identified a new suite of freshwater target sites along the Los Angeles River. One is in the relatively under-sampled Glendale Narrows and another near Lewis McAdams Park, a former random site sampled in 2015, dredged in 2018, and revisited in 2019. Aquatic chemistry, biota, and physical habitat data are collected regularly at target sites. These sites give us better insight about the condition of soft-bottom sites in the urban core of the watershed, particularly given management and maintenance efforts that attempt to balance the socioecological benefits of these sites with flood control requirements.

The **California Rapid Assessment Method** (CRAM) was developed to provide biologists and ecologists a quick way to evaluate the complex ecological condition of wetlands and riverine systems using a finite and ecologically significant set of observable field indicators, such as plant community composition and structure, hydrology, physical structure, and buffers (Stein et al., 2009). CRAM assesses riparian wetland condition with respect to four overarching attributes: Buffer/Landscape Context, Hydrology, Physical Structure, and Biotic Structure.

http://www.cramwetlands.org/

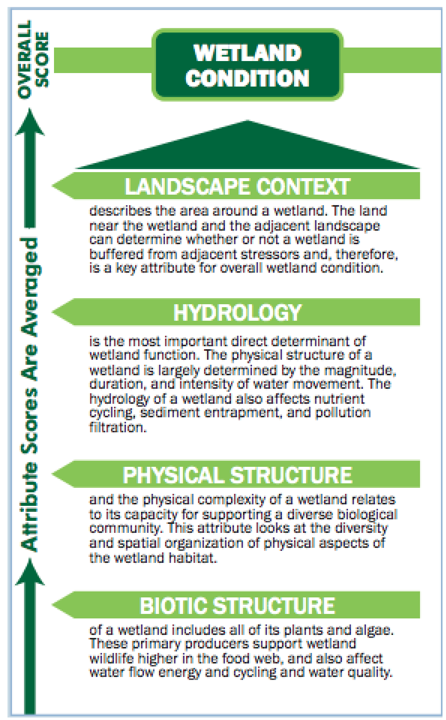


Figure 19: Target and High-value Habitat sites monitored by LARWMP.

3.2 High Value Sites of Unique Concern: Riverine and Estuarine Wetlands

The habitats of value and/or at-risk habitats that are monitored for the LARWMP Program are found in both the upper and lower watershed and are described below. Using repeated measures ANOVA, we assessed whether riparian habitat condition, assessed using CRAM, are changing at high value sites. We found that while conditions are variable from year to year (Figure 20, Figure 21), high value sites are not changing over time (

Table 5)($p>0.05$). As in the previous chapter, habitat condition is generally better for sites in the upper watershed but there are several sites in the lower watershed, like the Golden Shore Wetlands, Arroyo Seco, and Haines Creek Pool and Streams, that had riparian habitat in the healthier reference condition (

Table 5, Figure 20, Figure 21). Upper watershed sites that burned in the 2009 Station Fire have recently returned to reference condition, based on riparian habitat assessments, and are stable (Figure 21, Table 5).

3.2.1 Glendale Narrows (LALT400):

The Glendale Narrows is an approximately seven-mile long section of the Los Angeles River adjacent to Griffith Park, Los Feliz, Atwater Village, and Elysian Valley. It is earthen bottom as a result of the high-water table; however, the banks are shored with concrete which nearly eliminates the biologically valuable riparian buffer zone. The earthen bottom provides a complex streambed composed of cobble, boulders, and sand, which support diverse plant, bird, and fish communities. Frontage roads along both banks serve as walking and cycling paths for the public. This section of the river was opened to non-motorized boating in 2013.

3.2.1.1 The Golden Shores Wetland (LALT 404)

Golden Shores Wetland was constructed in 1997 as part of mitigation for wetlands that were destroyed in Long Beach Harbor. The 6.4-acre wetland at the mouth of the Los Angeles River includes both intertidal and subtidal habitats. The site is one of the few tidally influenced wetlands in southern California. These habitats are important to the coastal ecosystem because they serve as highly productive habitats for fish, waterfowl, and plants. The entire perimeter of the wetland is protected by riprap levees with a single southern inlet connected to the Los Angeles River estuary. The buffer zone surrounding the wetland includes parking lots and port infrastructure.

3.2.2 Sepulveda Basin (LALT405):

Sepulveda Basin, upstream of Sepulveda Dam, is a site that is largely operated under lease by the City of Los Angeles Department of Recreation and Parks. The 225-acre area includes sports fields, agriculture, golf courses, a fishing lake, parklands, a water reclamation facility, and a wildlife refuge. The 3-mile reach of river upstream of the dam is unlined with relatively natural riparian zones. The water source for this reach is nearly 100% tertiary-treated effluent from the D.C. Tillman Water Reclamation Plant during the dry season. These flows support ecological and recreational uses in this reach of the LA River.

3.2.3 Eaton Wash (LALT406)

Eaton Canyon begins at the Eaton Saddle near Mount Markham and San Gabriel Peak in the San Gabriel Mountains. Its drainage flows into the Rio Hondo to the Los Angeles River. The Eaton Canyon Natural Area Park covers 190-acres where Eaton Creek forms a 50-foot waterfall from the mountains to the foothill wash at the base of the San Gabriel Mountains. Several more secluded waterfalls also exist above Eaton Falls. This area is very popular with the public, especially during the summer months for hiking and swimming.

3.2.4 Haines Creek Pools and Stream (Tujunga Ponds Wildlife Sanctuary; LALT407)

The 13-acre Tujunga Ponds in Sunland is a Caltrans mitigation project constructed following completion of the 210-Foothill Freeway. The site was acquired by Los Angeles County Parks and Recreation Department in 1978 and contains two small lakes and surrounding dense willow riparian and cottonwood riparian woodlands. Visitors use the natural areas and existing trails around the ponds for nature study, photography, and similar passive recreation under permit from LACDPW.

3.2.5 Arroyo Seco (LALT450)

The Arroyo Seco site is located downstream of Devil's Gate Dam. The Arroyo Chub, a locally extirpated native fish, was recently re-introduced to this section of the Arroyo Seco following habitat restoration. The site was downstream of the recent 2009 Station Fire and was scoured during heavy rainstorms following the fire.

3.2.6 Tujunga Sensitive Habitat (LALT401)

The Tujunga Sensitive Habitat site is located downstream of the Big Tujunga Dam in a relatively undisturbed, upper watershed riparian zone. Big Tujunga Canyon is high in species richness, including 38 recorded threatened and endangered species of amphibians, reptiles, fish, and birds and twenty-four plants. This area burned during the 2009 Station Fire and, therefore, provides an opportunity to assess the post-fire recovery process along the riparian corridor and the surrounding buffer zones. Since this site is difficult to access, the site is not heavily used for recreation.

3.2.7 Upper Arroyo Seco (LALT402)

The Arroyo Seco Watershed begins at Red Box Saddle in the Angeles National Forest near Mount Wilson in the San Gabriel Mountains. Much of the watershed contains nearly pristine habitat area and as a result, the hiking trails running along its length are very popular with the public for hiking and cycling. The biological condition score at this site (as measured by the CSCI) is one of the highest in southern California, particularly for a lower watershed site. This site was devastated by the 2009 Station Fire and has been the location for an ongoing post-fire recovery study.

3.2.8 Alder Creek (LAUT403)

Alder Creek is located in the upper reaches of the Los Angeles Watershed and is the highest elevation of the unique habitat sites. Due to the remoteness, it provides a sentinel for conditions in the relatively undisturbed upper watershed. The site burned during the 2009 Station Fire.

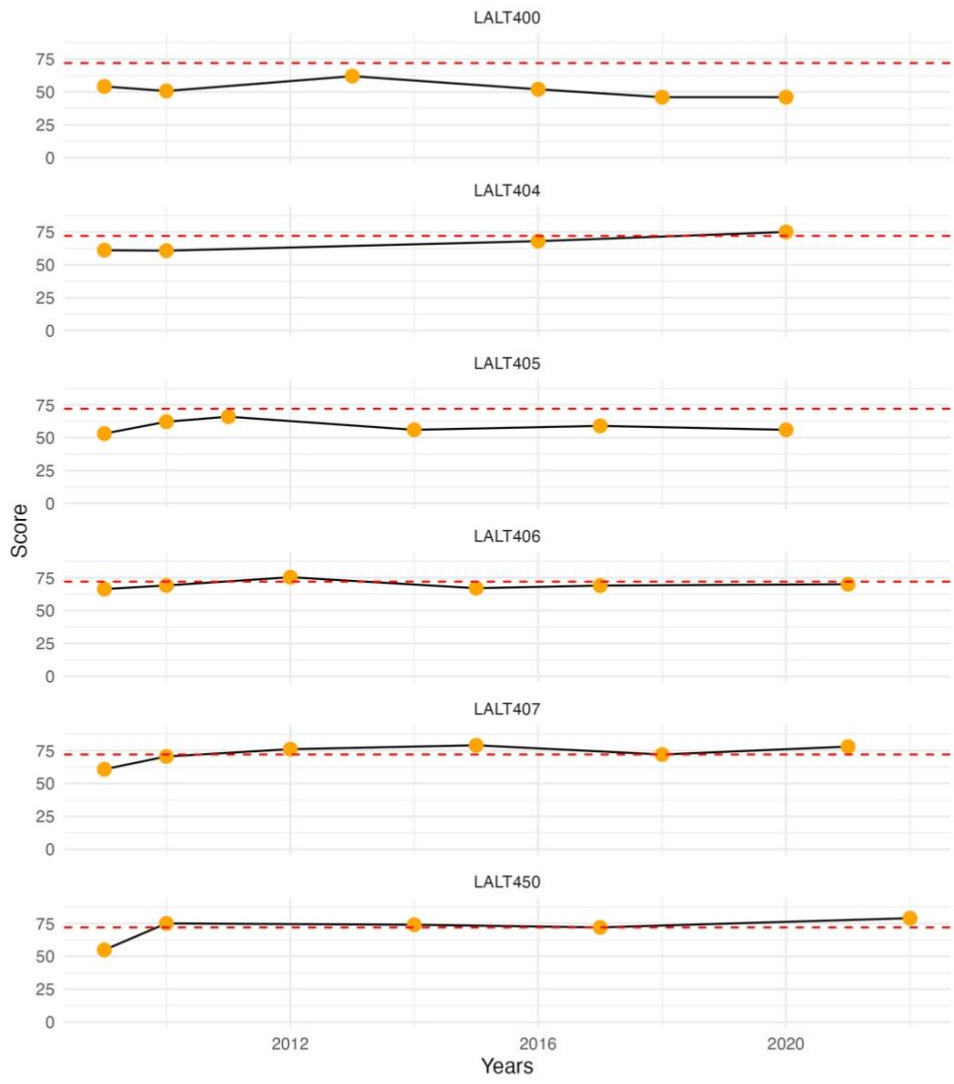


Figure 20. CRAM scores for lower watershed high value habitat sites monitored from 2009-2022.

Red dashed line represents the 10th percentile of reference distribution of CRAM sites.

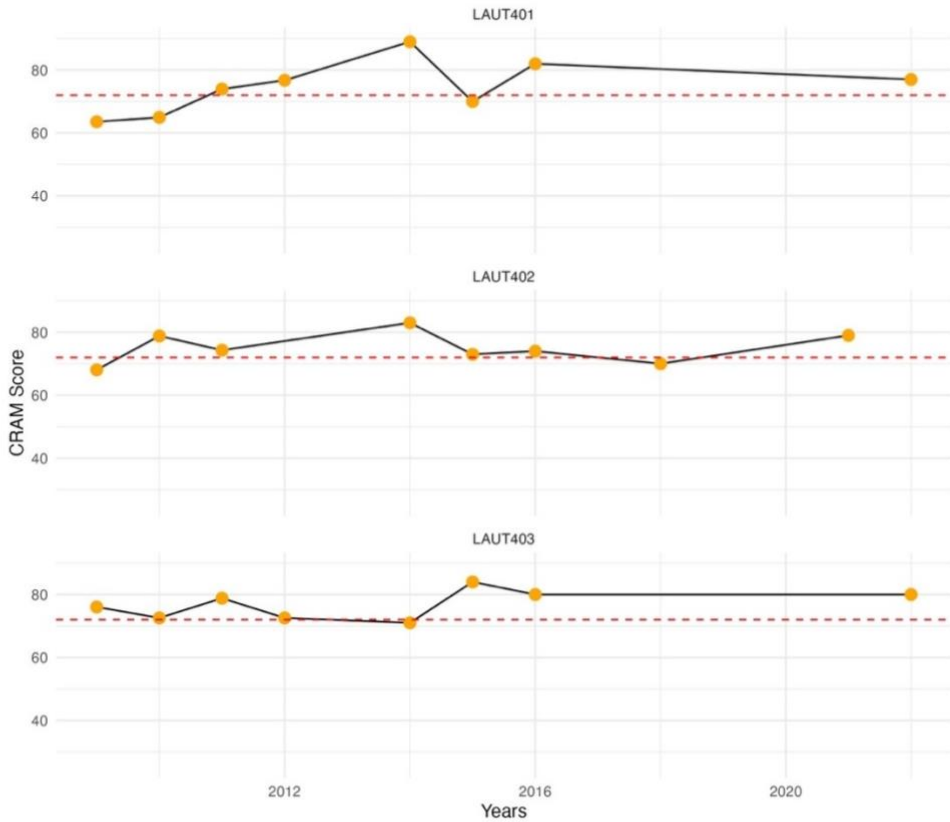


Figure 21: CRAM scores for upper watershed high value sites monitored from 2009-2022.

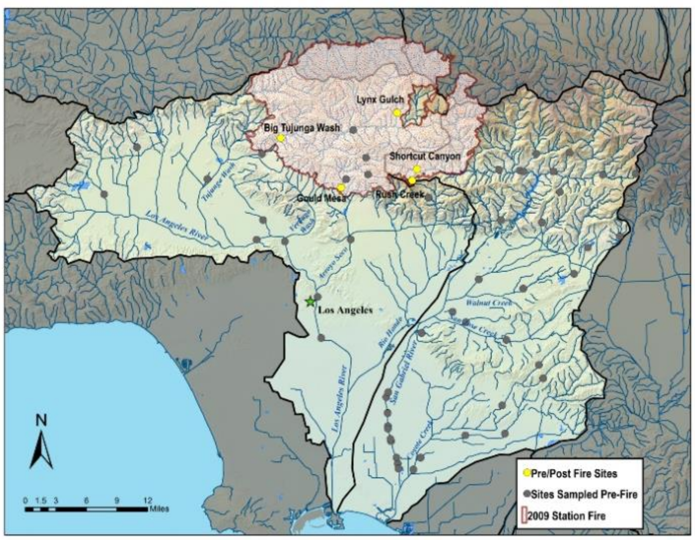
Stratum	Site	CRAM Category	Trend
Lower Watershed	Golden Shore Wetlands (LALT 404)	Reference	Stable
	Arroyo Seco (LALT 450)	Reference	Stable
	Glendale Narrows (LALT 400)	Impaired	Stable
	Sepulveda Basin (LALT 405)	Impaired	Stable
	Eaton Wash (LALT 406)	Impaired	Stable
	Haines Creek Pools and Streams (LALT 407)	Reference	Stable
Upper Watershed	Tujunga Sensitive Habitat (LAUT 401)	Reference	Stable
	Upper Arroyo Seco (LALT 402)	Reference	Stable
	Alder Creek (LAUT 403)	Reference	Stable

Table 5: Habitat condition category based on most recent CRAM score and trend in CRAM score based on 14 years of monitoring at high value sites. Trend assessment is based on repeated measures ANOVA and considered stable since $p>0.05$ at all sites.

3.2.9 Monitoring Stream Recovery Following the 2009 Station Fire

The September 2009 Station Fire was the largest wildfire in Los Angeles County's history, burning 161,189 acres or 252 square miles of upper watershed mountainous terrain in the Los Angeles and San Gabriel River watersheds. The areas affected by the fire had not burned for decades, resulting in an extremely hot burn that devastated the riparian zones of streams throughout the upper watersheds. The fire burned for 49 days, from August 29th until October 16th, and cost an estimated $95,300,000 to fully contain.

The following winter several heavy rainstorms, that dropped over 4 inches of rain each, caused widespread erosion from the burn areas. The fire, coupled with erosion from the rainstorms, degraded the conditions in the riparian zones and streams throughout the watershed.



Prior to the fire, the Los Angeles River Watershed Monitoring Program (LARWMP) and San Gabriel River Regional Monitoring Program (SGRRMP) had initiated ambient water quality monitoring programs using randomly selected sites where a suite of indicators, including water chemistry, bioassessment, and physical habitat conditions, were collected annually during the summer. Several of the sites burned during the Station Fire, providing an opportunity for the SGRRMP and LARWMP to establish long term trend monitoring programs at these sites to detect the rate and quality of their recovery. Burned upper watershed sites in the Los Angeles River Watershed were revisited starting in 2010.

We found that stream biological conditions decreased immediately following the fire to levels below the impairment threshold at some sites and then gradually began to improve. Sampling at these sites occurred in the summer as part of the larger ambient monitoring program and concentrations of nutrients and metals were similar between pre- and post-fire sampling, probably due to lack of runoff. In contrast, measures of the riparian habitat condition using the California Rapid Assessment Method (CRAM), showed clear decreases in riparian zone biotic structure, increases in eroded and vulnerable banks, and decreased streambed complexity and structure. Recently, these sites returned to reference habitat condition and have stable habitat condition. The populations of aquatic macroinvertebrates in these streams recovered to pre-burn composition within three to four years. It is hoped that these results will help forest service managers to understand the impact of fires on the riparian zones in the watershed and to efficiently manage their recovery in the future.

Big Tujunga Wash

Pre-Fire

Post-Fire

3.3 Target Sites

Target sites along the Los Angeles River were added recently to the program. At one of the two sites, we do not yet have enough data to identify statistically significant changes in biotic condition because LAR10210, the Glendale Narrows Site, was added to the program in 2021. We instead summarize trends, using a linear regression, for the LAR08599 or Lewis MacAdams Park site. This trend analysis should be interpreted cautiously given the repeat data and limited number of sites to examine. We find that conditions, based on analysis of water chemistry, heavy metals, nutrients, and measures of biotic condition, at LAR08599 are generally stable (e.g. there is no strong improving or worsening trend). Scores for channel alteration and sediment deposition, however, show an improving trend. This pattern is likely due to recovery of the site following dredging that occurred in 2018.

Both the target sites have impacted biological conditions and are not in reference condition based on CSCI and CRAM scores (Figure 20). Soft-bottom sites, like the two target sites, tend to have higher CRAM attribute scores for buffer and biotic condition than other effluent sites (*Los Angeles River Watershed Monitoring Program 2021 Annual Report*, 2022), but overall habitat and stream condition scores for the target sites are still in the "likely altered" category. Even in the soft bottom sections of the Los Angeles River, the natural riparian vegetation has either been reduced and/or replaced by invasive or exotic species. These conditions have led to lower habitat condition scores. While the highly altered hydrology and reduced vegetative complexity likely contribute to the "likely altered"(CSCI scores between 0.80 and 0.63) or "very likely altered" (CSCI scores below 0.63) stream condition scores.

Table 6: Summary of most recent chemistry, nutrient, physical habitat, and biotic condition data collected at two target sites of interest in the LA River Watershed. Green boxes denote improving trend over time based on linear regression $R^2>0.7$).

Site	Alkalinity (mg/L)	Hardness (mg/L)	Suspended Solids (mg/L)	Specific Conductivity (us/cm)	Chloride (mg/L)	Sulfate (mg/L)	General Chemistry
LAR- Glendale Narrows	122	216	5.9	1181	159	211	
LAR- Lewis McAdams	118	206	10	1065	163	172	
	TOC (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Total Nitrogen (mg/L)	Ortho Phosphate (mg/L)	Total Phosphorus (mg/L)	Nutrients
LAR- Glendale Narrows	7.52	0.23	2.38	4.13	0.04	0.11	
LAR- Lewis McAdams	7.25	0.37	2.89	4.84	0.05	0.1	
	%Canopy Cover	% Sand Fines	% Concrete and Asphalt	Channel Alteration	Epifaunal Substrate	Sediment Deposition	Physical Habitat
LAR- Glendale Narrows	1.6	32.38	19.05	10	12	13	
LAR- Lewis McAdams	1.2	35.58	21.15	**10**	12	**11**	
	CSCI	CRAM Score	Biotic Structure	Buffer Landscape	Hydrology	Physical Structure	Biotic Condition
LAR- Glendale Narrows	0.653	47.0	47.2	66.7	50.0	50.0	
LAR- Lewis McAdams	0.594	45.0	35.9	25.0	66.7	50.0	

3.4 Summary and Next Steps

The habitat condition of high-value sites is stable and show no significant improving or worsening trends. Many high-value sites are in reference condition for riparian habitat condition based on CRAM scores. This is particularly true for upper watershed, actively managed and restored sites, or sites that burned in the 2009 Station Fire.

Target sites along the main-channel of the Los Angeles River were more recently added to the program. One of the target sites, a site along the Glendale Narrows, does not yet have sufficient data to detect trends in habitat, biotic, or physical habitat condition. While the site near Lewis MacAdams Riverfront Park shows stable conditions in water chemistry, nutrients, metals, and biological condition and strong improvement in channel alteration and sediment deposition scores since dredging in 2018. Target sites reflect the condition of soft-bottom riverine sites near urban land uses, including a reduced and interrupted riparian buffer, altered hydrology and biotic and physical structure.

The analysis of the LARWMP data has revealed the amount of data and investment that is required to confidently detect changes in biotic condition at a watershed scale over time. These datasets are invaluable during this period when the Watershed is undergoing historic changes due to climate, water resource management, and investments in ecological uplift. As a result, the LARWMP should continue to monitor sites that are of ecological and cultural importance to communities of the Los Angeles River Watershed while avoiding disrupting years of data collection at previously established sites. These long-term data sets are rare and powerful in detecting change in our rapidly changing region.

3.5 References

Los Angeles River Watershed Monitoring Program 2021 Annual Report. (2022). https://www.watershedhealth.org/_files/ugd/ceb944_88b8dffa14f0405a9425500f377e9b14.pdf

Stein, E. D., Fetscher, A. E., Clark, R., Wiskind, A., Grenier, L., & Sutula, M. (n.d.). Validation of a Wetland Rapid Assessment Method: Use of EPA's Level 1-2-3- Framework for Method Testing and Refimenet. *Wetlands*, *29*(2), 648–655.

4 Are Receiving Waters Near Discharges Meeting Water Quality Objectives?

4.1 Background

Fluctuations in both discharge sources and seasonal variations greatly affects the composition of pollutants of the Los Angeles River (Wolfand et al., 2022). During the dry season, the Los Angeles River is primarily sustained by wastewater from reclamation plants (point sources), treated to reduce or eliminate nutrients, pathogens, and organic matter, and to a lesser degree, urban runoff and groundwater seepage (nonpoint sources). Conversely, during the rainy season stormwater runoff (nonpoint source) has the greatest impact on the pollutant composition. Ultimately, the goal of this question is to assess the impact of known point source discharges on receiving water quality in the Los Angeles River (Figure 22).

The LARWMP focused on effluents from three publicly-owned treatment works (POTWs) that discharge tertiary-treated effluents to the Los Angeles River, above the confluence with the Arroyo Seco:

- City of Burbank Water Reclamation Plant (BWRP)
- City of Los Angeles Glendale Water Reclamation Plant (LAGWRP)
- City of Los Angeles D.C. Tillman Water Reclamation Plant (DCTWRP)

The treatment capacities of these POTWs range from 9 million gallons per day (MGD) for the Burbank WRP to 20 MGD and 80 MGD for the Glendale and Tillman WRPs, respectively (Table 7). Las Virgenes Municipal Water District (LVMWDs) Tapia Plant is also permitted to discharge 12 MGD to the Los Angeles River at certain times of year. However, discharges are typically much less than the plant's design discharge capacity. In 2019 SWRCB started requiring wastewater treatment and recycled water facilities to report their monthly water usage and quality, aiding in policy decisions and efforts to increase recycled water usage while safeguarding natural water resources (State Water Resources Control Board, 2023).

Table 7: POTW Discharges to the Los Angeles River, their design capacities and 2021 statistics on recycled water production. Discharge amounts are in million gallons per day (MGD).

POTW DISCHARGER	DATE BUILT	DESIGN DISCHARGE CAPACITY (MGD)	RECYCLED WATER DISCHARGED FOR REUSE (MGD)
Las Virgenes Municipal Water District Tapia Plant Waste Water Reclamation Plant	1999 – Outfall to LA River	12	7.5
City of Burbank WRP	1966	9	5.2
City of Los Angeles- Glendale WRP	1976	20	11.9
City of Los Angeles-Tillman WRP	1984	80	32.5

National Pollution Discharge Elimination System (NPDES) permits require these POTWs monitor water quality upstream and downstream of the point of discharge to demonstrate that they attain certain water quality standards. As part of this report, LARWMP consolidated these data from 2018 to 2022 and compared them to the State of California water quality objectives considered to be protective of aquatic life, recreation, industrial, and groundwater recharge uses in some sections of the River.

Figure 22: Locations of water reclamation plants in the Los Angeles River Watershed

4.2 Methods

4.2.1 Water Quality Objectives for Receiving Waters

Nutrients, metals, and *E. coli* were compared against the objectives described in the Los Angeles Region Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (Los Angeles Regional Water Quality Control Board, 2020a). Metals were compared to the State of California Toxics Rule (CTR) to determine if they were above either the acute or chronic thresholds (Environmental Protection Agency, 2015).

For some constituents, objectives are adjusted according to other measured parameters such as hardness for metals; and pH and temperature for ammonia. Acute thresholds represent maximum 1-hr concentrations protective of aquatic life uses and the chronic thresholds represent maximum 30-day average concentrations protective of aquatic life uses.

Dissolved metals concentrations for both Glendale WRP and Tillman WRP were converted from total recoverable metals concentration to dissolved concentration using conversion factors from the CTR (Environmental Protection Agency, 2015). In addition, Burbank and Glendale WRPs use a Water Effects Ratio (WER) adjusted CTR threshold for copper whereas Tillman WRP does not. WERs are used to for variations in the toxicity of a metal between laboratory dilution water and the water at a specific site (Davis, 1994).

4.3 Results: Water Quality Objectives of Receiving Waters (2018-2022)

4.3.1 Heavy Metals

During the 2018-2022 monitoring years, POTWs generally did not contribute to downstream metal exceedances. Glendale WRP and Burbank WRP had no detected exceedances in any of the tested heavy metals at their respective upstream and downstream monitoring locations. Tillman WRP had some exceedances for chronic regulatory CTR threshold for selenium and copper. For selenium, upstream samples had significantly higher selenium concentrations than downstream samples ($p < 0.0001$). Upstream selenium concentrations were diluted by wastewater effluent at the downstream sampling location. Generally, wastewater discharge from POTW effluents is not causing downstream metal exceedances.

Across all POTWs, average copper concentrations in downstream samples (10 ± 8 µg/L; n = 60) were not significantly ($p = 0.4$) lower than upstream (9 ± 4 µg/L; n= 61). However, when examining each POTW individually, the average copper concentration of Tillman WRP's downstream effluent (10 ± 4 µg/L ; n = 20) was significantly higher than upstream (7 ± 3 µg/L; n = 20). To be more specific, we observed that in the period from 2018 to 2020, three samples, all taken in early August, exceeded the chronic regulatory CTR threshold for copper downstream.

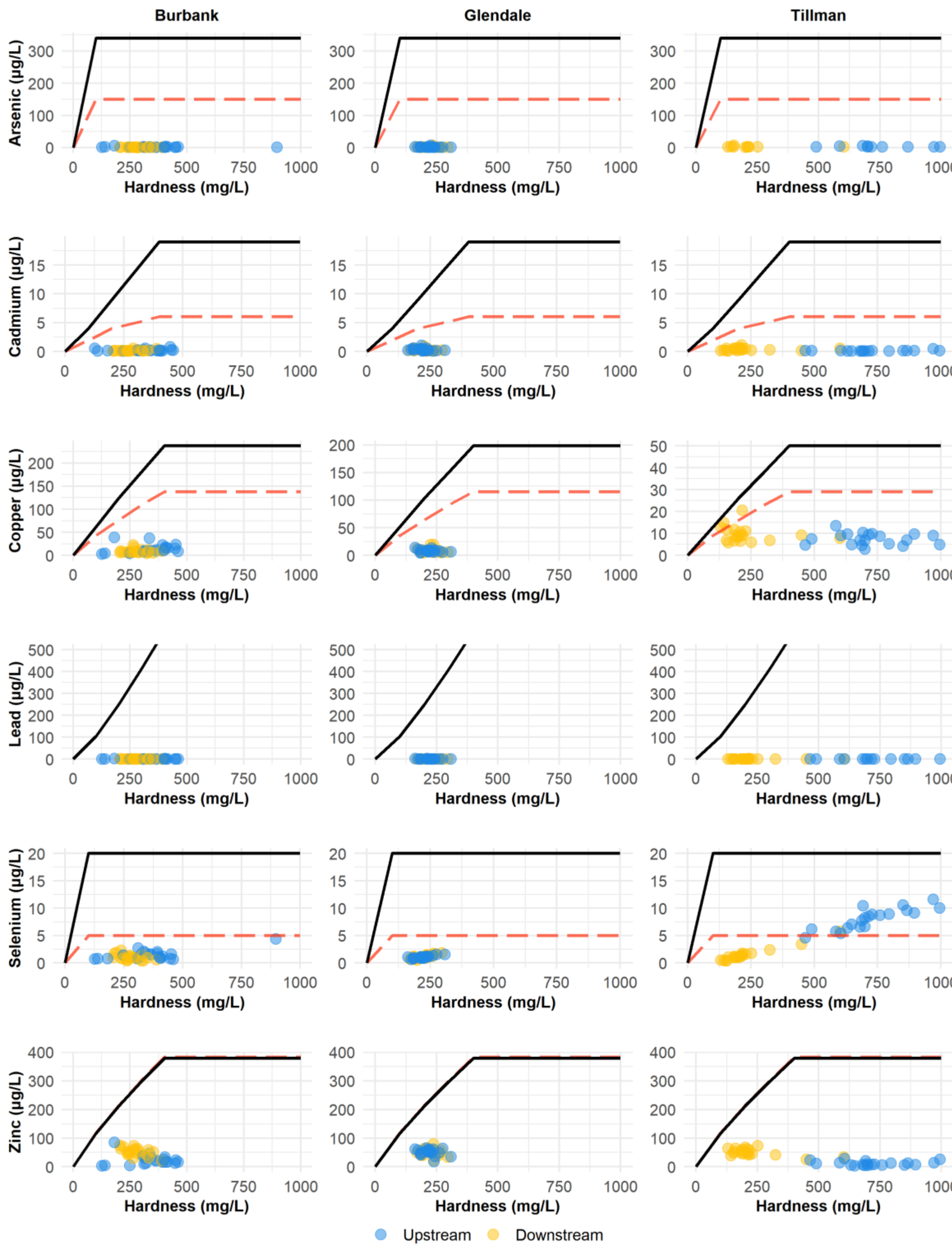


Figure 23: Dissolved heavy metal concentrations upstream and downstream of all POTWs from 2018-2022 effluents. Values are compared to hardness-adjusted, total recoverable CTR thresholds for acute (black line) and chronic (dashed red line) effects. Lead does not have an acute CTR threshold because the USEPA has not established human health criteria for this contaminant. Values are estimated in instances where there were non-detects that did not meet the laboratory's reporting limit. Note that downstream and upstream concentrations may be close in value, as a result it may be difficult to see overlapping yellow and blue points on the graph.

4.3.2 Bacteria

The *E.coli* concentrations among different POTWs from 2018 to 2022 ranged widely (Figure 24). In upstream locations, channel sources, urban runoff, and wildlife, may all be possible sources of *E. coli*. In the case of Burbank, *E. coli* concentrations frequently surpass the Water Quality Objective (WQO). Comparing upstream and downstream locations, both Burbank WRP and Tillman WRP exhibit higher *E.coli* concentrations downstream. However, only Burbank WRP shows frequent exceedances and a statistically significant increase in *E. coli* downstream of discharge ($p = 0.0001$), while Tillman WRP does not ($p = 0.1$). In contrast, the downstream location of Glendale WRP has lower bacteria levels compared to its upstream location ($p = 0.0004$), indicating that its effluent improves water quality by diluting upstream bacteria concentrations.

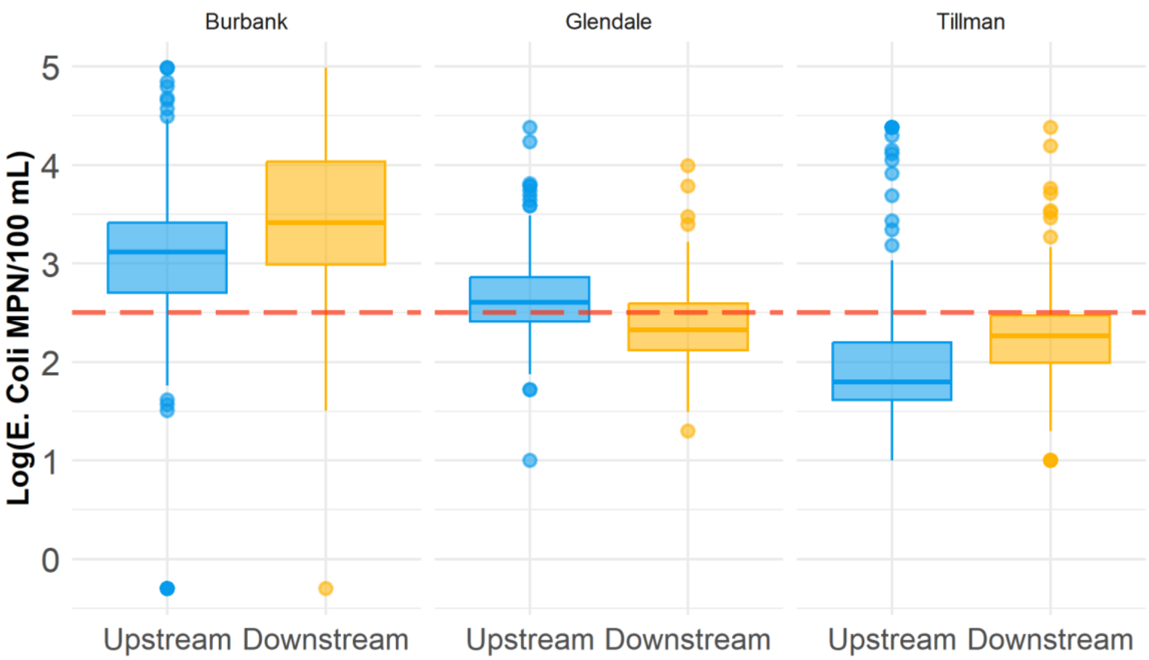


Figure 24: *E.coli* concentrations (Log10 transformed) at upstream and downstream locations of POTW effluents. The red dashed horizontal line denotes the regulatory threshold of 320 MPN/100mL for REC-1 beneficial use.

4.3.3 Nutrients

Generally, effluents from these facilities contain higher concentrations of nutrients (e.g., ammonia, nitrate, and nitrite) than receiving waters (Figure 25). Burbank WRP and Tillman WRP both have higher levels of nitrates downstream ($p > 0.0001$) of discharges while Glendale WRP had slightly lower nitrate concentration downstream ($p = 0.07$). Outside of isolated exceedances at Burbank WRP and Glendale WRP[1], POTWs do not exceed the nitrate WQO (10.0 mg/L).

Average nitrite levels across all POTWs did not exceed the WQO (1.0 mg/L). Overall, there was no significant difference between average upstream (0.2 ± 0.7 mg/L) and downstream (0.2 ± 0.2 mg/L) nitrite concentration across all POTWs ($p = 0.8$).

[1] Exceedance at both Burbank WRP and Glendale WRP occurred on December 15, 2020 at their respective upstream locations.

Lastly, from 2018-2022 ammonia levels for 98% of samples from all POTWs were generally below the WQO[2] (Figure 26). Locations downstream of Burbank WRP (n = 23) and Tillman WRP (n = 16) discharges occasionally exceeded the WQO. Glendale WRP had no occurrences of ammonia WQO exceedance. Overall—despite isolated or occasional nitrate, nitrite, and ammonia WQO exceedances—average nutrient values across all POTWs assessed during the five-year period largely met WQOs.

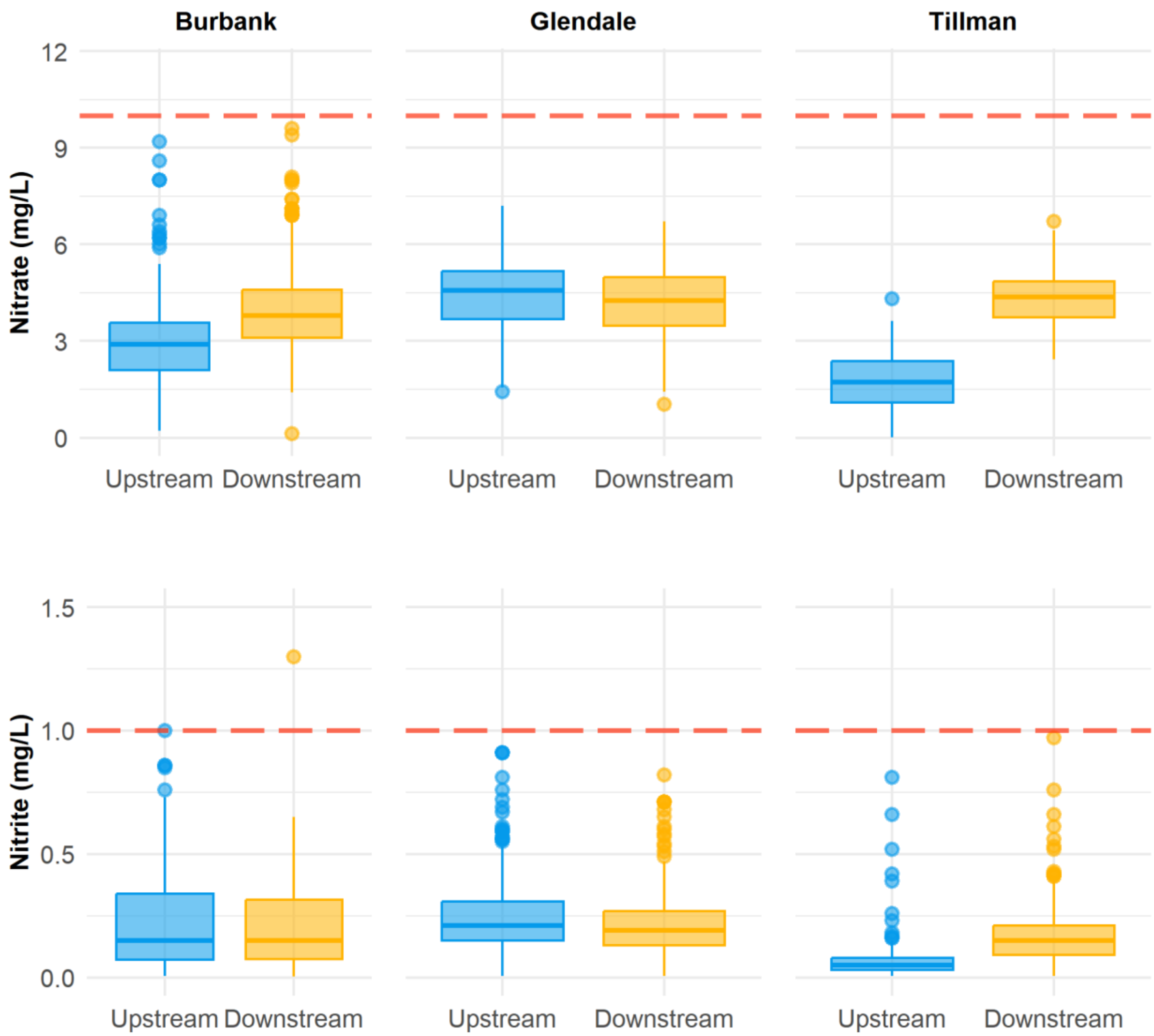


Figure 25: Nitrate (NO_3^-) and nitrite (NO_2^-) concentrations upstream and downstream of POTWs. Red dashed line denotes the regulatory threshold for nitrate (10mg/L) and nitrite (1mg/L). To improve readability and scaling of the graph extreme outliers (nitrate: 2; nitrite: 3) were omitted from the box plots, but their values were considered in the statistical analysis.

[2] WQO for ammonia is a function of pH and temperature.

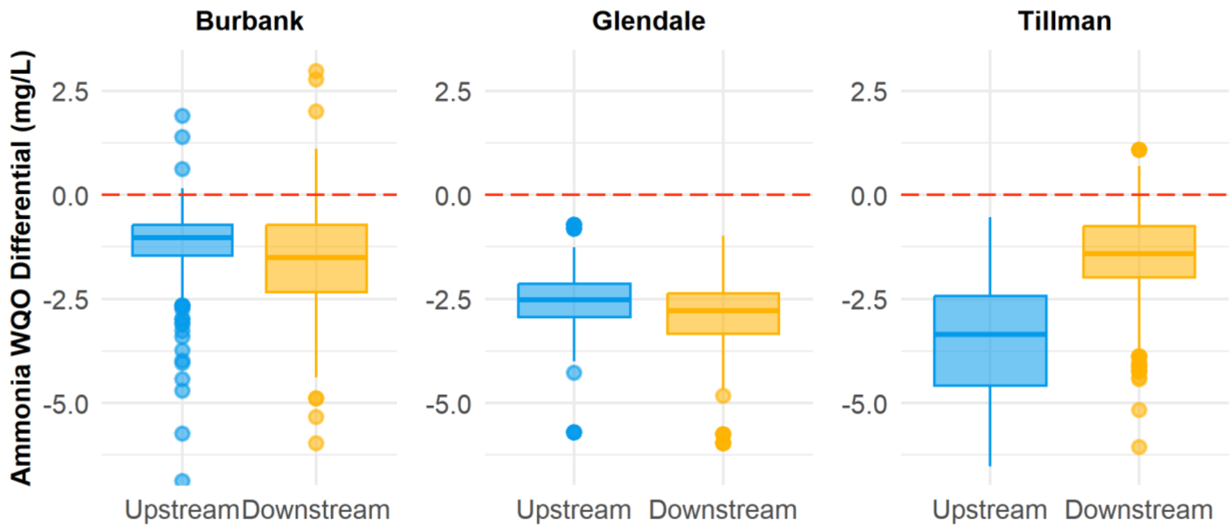


Figure 26: Difference in ammonia (NH3-) concentrations between sampled values and WQOs at POTWs from 2018-2022. The ammonia WQO for each POTW is calculated as a function of pH and temperature at the time of sampling. The horizontal red dashed line indicates no difference between the sample and WQO. Values at or below the line follow ammonia WQOs, while values above the line exceed the WQO.

4.4 Summary and Next Steps

During the 2018-2022 monitoring period, receiving waters near the treatment plant discharges are meeting most contaminant WQOs. Generally, most concentrations of heavy metals are below acute and chronic regulatory CTR thresholds at both upstream and downstream sites. Bacteria concentrations are frequently exceeding regulatory standards at Burbank WRP. Nutrients were generally below water quality objectives across POTWs.

Effluents from POTWs within the LA River Watershed have a variable impact on water quality. Some metals are diluted by POTW effluents (i.e. selenium) while others metals (i.e. copper) have higher concentrations downstream. Downstream concentrations of *E. coli* are elevated in the majority of samples from Burbank POTW and occasionally exceed at Tillman and Glendale. POTWs are a source of nitrates and nitrites to receiving waters, as concentrations are higher downstream of the discharges, although both upstream and downstream concentrations are generally below WQOs.

The Cities of Burbank and Los Angeles will continue to monitor receiving waters to determine if they are meeting the WQOs for their beneficial uses. In the 2022 Triennial Review of the LA River Basin plan identified a number of projects that may impact POTWs, including revising the WQOs for ammonia, incorporating the Statewide Toxicity Provisions, and incorporating the USEPA's s 2007 Freshwater Quality Criteria for Copper, and applying site-specific WQOs for lead (Los Angeles Regional Water Quality Control Board, 2020b).

4.5 References

Davis, T. T. (1994). Interim guidance on determination and use of water-effect ratios for metals. Environmental Protection Agency. https://www3.epa.gov/npdes/pubs/owm624.pdf

LARWQCB. (2020a, May 18). Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties | Los Angeles Regional Water Quality Control Board. California Water Boards. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/basin_plan_documentation.html

LARWQCB. (2020b, November 12). 2020 – 2022 Triennial Review: Consideration and Selection of Basin Planning Priority Projects. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/Triennial_Review/2021/Final2020-2022TRStaffReport.pdf

SWRCB. (2023). Volumetric Annual Report of Wastewater and Recycled Water [dataset]. https://www.waterboards.ca.gov/water_issues/programs/recycled_water/volumetric_annual_reporting.html

Environmental Protection Agency, O. (2015, July 15). Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California (California Toxics Rule) [Reports and Assessments]. https://www.epa.gov/wqs-tech/water-quality-standards-establishment-numeric-criteria-priority-toxic-pollutants-state

Wolfand, J. M., Sytsma, A., Hennon, V. L., Stein, E. D., & Hogue, T. S. (2022). Dilution and Pollution: Assessing the Impacts of Water Reuse and Flow Reduction on Water Quality in the Los Angeles River Basin. ACS ES&T Water, 2(8), 1309–1319. https://doi.org/10.1021/acsestwater.2c00005

5 Is it Safe to Recreate in the LA River and its Tributaries?

5.1 Background

When the public imagines the Los Angeles River and its watershed, they commonly visualize the wide concrete lined channels of the lower watershed. This image overshadows the abundant recreational opportunities provided by the soft-bottom portions of the river and the nearby freshwater lakes and streams, particularly the headwater streams in the Angeles National Forest. During the warm spring and summer months, thousands of locals and visitors enjoy swimming in cool waters of these relatively natural streams. Despite this popularity, prior to LARWMP, little was known about the safety of swimming at popular swimming sites throughout the watershed.

Since 2009, LARWMP has monitored popular unregulated swim sites for disease risk for gastrointestinal illness. The safety of these swim sites can be determined by measuring the amount of *E. coli*, a type of Fecal Indicator Bacteria (FIB), in the water. The presence of *E. coli* in recreational waters indicates fecal contamination by humans or animals and acts as a freshwater diagnostic tool for the presence of other more harmful pathogens, such as *Salmonella* and *Giardia*.

5.1.1 *E. coli* Water Quality Objectives for Recreation Zones

The Los Angeles Basin Plan *E. coli* water quality objectives (WQOs) are based on a Most Probable Number (MPN) per single sample analysis (Los Angeles Regional Water Quality Control Board, 2014). In California, the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Water Boards determine suitable recreational waters and describe WQOs to protect these waters. WQOs are a crucial tool for monitoring and controlling pollution levels in bodies of water and protecting aquatic ecosystems and human health. LA Sanitation uses WQOs based on fecal indicator bacteria to determine when to issue closure advisories (Table 8). These values were developed based on the relationship between bacteria levels, human health effects, and “historically acceptable illness rates,” which for freshwater bodies has been designated as 32 illnesses per 1,000 swimmers (Los Angeles Regional Water Quality Control Board, 2020b).

SCWRCB has classifies waterways based on the specific types of water activities that take place. Recreational site locations monitored by LARWMP fall into one of two designations:

- REC-1: Designated for water contact recreation activities, such as swimming and wading.
- LREC-1: Designated for activities with limited direct water contact recreation activities, such as kayaking.

While there are a few different acceptable statistical methods available to assess whether a specific location is meeting state WQOs, this chapter will use:

- REC-1 Sites: Statistical threshold value (STV). STVs consider samples over a specified time period, providing a comprehensive view of a location's overall health and trends. To simplify interpretation, the REC-1 STV is also used as a single sample standard in Table 8 and Figure 27.

    - WQO: More than 10% of samples collected within a calendar month[3] are not to exceed the STV. As of 2020[4], the REC-1 *E. coli* WQO STV for freshwater bodies is 320 MPN/100mL (Los Angeles Regional Water Quality Control Board, 2020a).
- LREC-1 Sites: Single sample limit (SSL). SSLs evaluate each sample independently, making it easier to understand and offering a more immediate assessment of water quality. SSLs do not capture fluctuations or trends.
    - LREC-1 *E. coli* WQO SSL for freshwater bodies is 576 MPN/100mL.

5.1.2 Water Quality Notifications in the Los Angeles River

Due to water quality concerns, in 2018 the City of Los Angeles increased monitoring efforts in the Los Angeles River recreational zones to twice a week. Results are posted on the LA Sanitation website (*Los Angeles River Quality*, 2023). When bacteria levels are exceedingly high at two or more sites, a closure advisory is issued (Table 8).

Table 8: LASAN Water Quality Codes and Description

COLOR CODE	DESCRIPTION
OPEN	Water quality is suitable for recreational activities, but swimming in the river is still prohibited. Test results indicate bacteria levels lower than 320 MPN/100mL, the limit for REC-1.
CAUTION	Users should exercise increased caution. Test results indicate bacteria levels between 320 MPN/100mL (REC-1) and 576 (LREC-1) at one or more of the sampling sites located in the recreation zone or above 576 MPN/100 mL at only one of the sites.
CLOSED	This LA River Recreation Zone is not suitable for recreational activities. Test results indicate levels exceeding 576 MPN/100mL (LREC-1) at two or more of the sampling sites located in the recreation zone. A Closure Advisory will be issued by the City of Los Angeles and the MRCA will close the recreation zone and post closed signs. The recreation zone will stay closed until further bacteria testing show that the zone is once again suitable for recreational activities.

5.2 Methods

5.2.1 Sampling and Site Selection

LARWMP conducts semi-weekly sampling in the summer from May to September at high-use recreational sites. A total of 18 different recreational swimming sites were monitored from 2018-

[3] Calendar month is a period of time from a day of one month to the day before the corresponding day of the next month if the corresponding day exists, or if not to the last day of the next month (e.g. from January 1 to January 31, from June 15 to July 14, or from January 31 to February 28) (LARWQCB, 2020a).
[4] Previously, the REC-1 WQO was an SSL of 235 MPN/100mL. The new WQO was adopted into the Los Angeles Basin plan in 2020 (LARWQCB, 2020b, 2020a).

2023, including streams in the Angeles National Forest, streams in the lower watershed, and kayaking areas within the recreational zone of the Los Angeles river. Location of each monitoring site are mapped on Figure 27. Further information about each location can be found in Table 9 and

Table 10. Initially, sites were selected based on the collective knowledge of the workgroup of popular swimming locations. Sites were then added or excluded as LARWMP improved its understanding of the recreational use of streams, as well as depending on drought condition and the accessibility of the site to visitors and monitoring teams.

Overall monitoring statistics for the 2018-2023 summer monitoring periods for both swim sites and kayak areas are summarized in (Table 11). A total of 997 samples were collected from swimming sites and analyzed for *E. coli* during the 2018-2023 reporting period.

To capture site conditions during heavy use and elucidate the relationships between heavy recreational use and *E. coli* concentrations, sampling was concentrated around weekends and holidays when the swimming intensity is greatest. Depending on the site, sources of FIB could include visitors, dogs, wildlife, urban runoff, homeless populations, and trash (for example: diapers or toilet paper).

Table 9: REC-1 Recreational Unregulated Swim Sites Monitored by LARWMP from 2018-2023

RECREATIONAL SWIM SITES	SITE CODES	YEARS SAMPLED	NOTES
BULL CREEK/SEPULVEDA BASIN	LALT200	2018 - 2023	
DELTA DAY USE	LAUT206	2018, 2021-2023	Dropped in 2018 due to limited recreational use. Re-added in 2021.
EATON CYN NATURAL AREA PARK	LALT204	2018 - 2023	
GOULD MESA CAMPGROUND	LAUT209	2018 - 2023	
HANSEN DAM REC. LAKE	LALT224	2019 - 2023	
TUJUNGA WASH AT HANSEN DAM	LALT214	2018 - 2023	
HERMIT FALLS	LAUT213	2018 - 2019	Closure due to Bobcat fire.
HIDDEN SPRINGS	LAUT211	2021 - 2023	
MILLARD CAMPGROUND	LAUT203	2018	Dropped due to limited recreational use
STURTEVANT FALLS	LAUT210	2018 - 2020	Closure due to Bobcat fire.
SWITZER FALLS	LAUT208	2018 - 2023	
VOGEL FLATS	LAUT220	2020 - 2023	Replaced Sturtevant Falls after Bobcat Fire

Table 10: LREC-1 Recreational Kayak Areas Monitored by LARWMP from 2018-2023

RECREATIONAL KAYAK ZONE	SITE CODES	YEARS SAMPLED	NOTES
LA RIVER AT BALBOA BLVD	LALT215	2018 - 2023	Upper Sepulveda Basin Zone
LA RIVER SEPULVEDA BASIN	LALT216	2018 - 2023	Middle Sepulveda Basin Zone
LA RIVER AT SEPULVEDA DAM	LALT217	2018 - 2023	Lower Sepulveda Basin Zone
LA RIVER AT FLETCHER DR.	LALT218	2018 - 2023	Upper Elysian Valley Zone
LA RIVER ELYSIAN VALLEY	LALT219	2018 - 2023	Middle Elysian Valley Zone
LA RIVER AT STEELHEAD PARK	LALT221	2018 - 2023	Lower Elysian Valley Zone

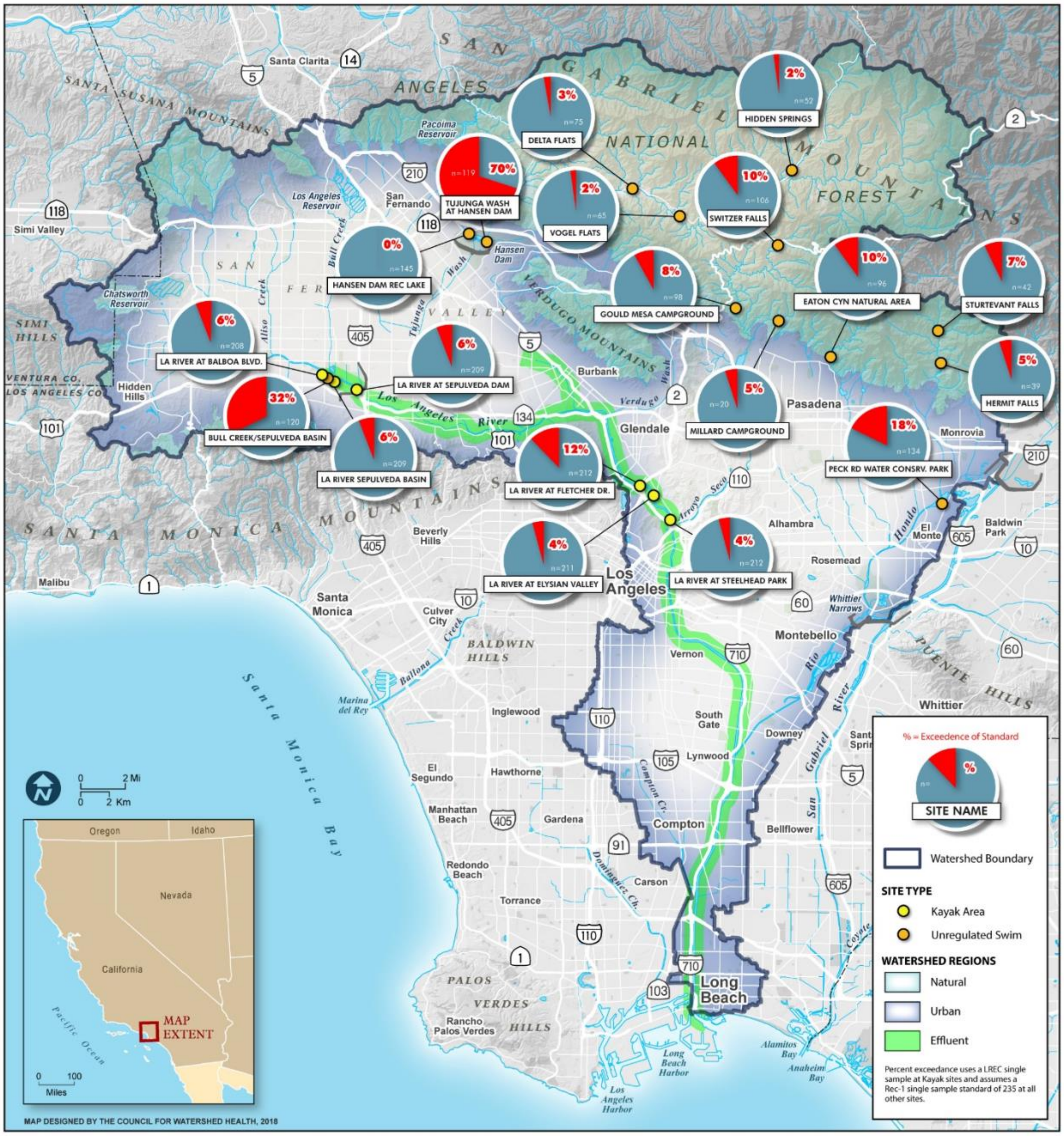


Figure 27: Map of Unregulated Swim Sites and Kayak Areas from LARWMP 2018-2023 with percent of samples exceeding WQOs. Percent of samples that exceeded WQOs were calculated with each site's respective WQO (Table 9 and Table 10). The REC-1 WQO STV was used as an SSL in exceedance percentage calculations to ease interpretation.

5.3 Results

Recreational sites in the Angeles National Forest are very popular with the public during the warm summer months. These sites are readily accessible to the 9.7 million residents of Los Angeles County and provide an opportunity to explore unique habitats in an otherwise highly urbanized watershed (US Census, 2022). Sites vary in condition, use, and in the average number of visitors. Many of the sites in the natural regions of the watershed are popular swimming holes and accessible via a short hike. In the urbanized portions of the watershed, kayaking, hiking, and fishing are popular.

Table 11: LARWMP by the numbers for each monitoring period of the LARWMP. Note the use of REC-1 standard as a single sample standard for ease of comparison.

	SWIM SITES			KAYAK AREAS[5]	
Water Quality Objective	REC-1[6] STV = 320 MPN/100mL			LREC-1 SSL = 576 MPN/100mL	
	2009-2012	2013-2017	2018-2023	2017	2018-2023
Sites	10	11	12	5	6
Summer Monitoring Days	68	96	120	46	217
Samples collected	402	831	977	124	1261
Number of SSL exceedances	49 (12%)	178 (21%)	160 (16%)	19 (15%)	45 (6%)

During the 2018-2023 LARWMP monitoring seasons, most samples collected were below their respective WQO, indicating that these areas were generally safe to recreate (Table 11). At swim sites only 16% of the samples collected during this reporting period exceeded the REC-1 WQO STV for *E. coli*. This is a 4% increase from 2009-2012 and a 5% decrease from 2013-2017. Conclusions drawn from changes among the three periods should be limited. Changes in site selection (discussed on page 57) between report years can introduce variability and affect the interpretation of trends over time. Therefore, any conclusions drawn should be considered within the context of these site selection changes. Other possible explanations include changes in rainfall from year to year and number of sampling dates.

5.3.1 Rec-1 Sites

Most informal recreation sites, or swim sites since visitors tend to wade and swim at these sites, are safe for recreation. The greatest amount of REC-1 WQO STV[6] single sample exceedances occurred at Tujunga Wash at Hansen Dam (70% exceedance) and Bull Creek/Sepulveda Basin (30% exceedance) (Figure 27). The sources of bacteria at these sites are unknown, but because both are within the urbanized portions of the watershed, they may have heightened bacteria levels

[5] Kayak sites were added after the 2016 monitoring year.

[6] The REC-1 WQO STV is being used as SSL to ease interpretation. STVs are not intended to be used as an SSL for regulatory purposes. Please see the discussion regarding STVs and SSLs in WQOs on page 1.

originating from human sources, recreational activities, and wildlife. Notably, Tujunga Wash at Hansen Dam is often used by the equestrian community and horse waste is often found on trails and near streams.

From 2018 through 2023, LARWMP collected data for 24 calendar months during the summer. We determined whether each sample exceeded the STV of 320 MPN/100mL, then grouped into its respective calendar month. The percent of samples that exceeded the STV per calendar month are visualized in Figure 28 and tabulated in Table 16 in the Appendix. Most REC-1 sites had median values below the WQO of 10% of samples that exceed the STV.

Over the 24 LARWMP monitored months from 2018-2023, most sites were found to be safe to swim. Hansen Dam Recreation Lake was the safest swim location where all monitored months[7] were within the WQO. Two notable exceptions to this finding were Tujunga Wash at Hansen Dam and Bull Creek/Sepulveda Basin. These sites had the highest average percentage of samples that exceeded the STV (Tujunga Wash at Hansen Dam average = 75% ± 30%; Bull Creek/Sepulveda Basin average = 31% ± 30%). Furthermore, Tujunga Wash at Hansen Dam exceeded the WQO for 23 months (out of 24 months; 96%) during the monitoring season, while Bull Creek/Sepulveda Basin exceeded the WQO for 16 months (out of 24 months; 67%). As a result, these sites were deemed unsafe for swimming for the majority of the summer season from 2018-2023.

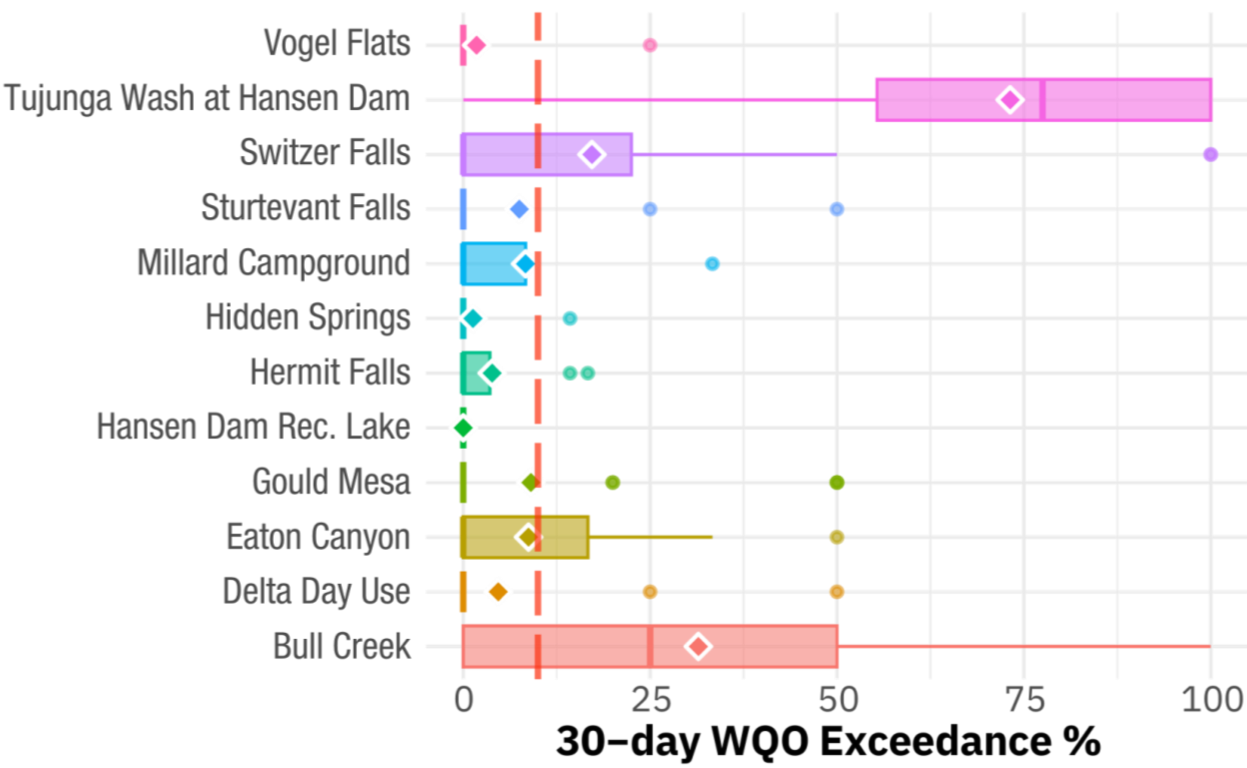


Figure 28: Box plot of monthly E. coli WQO exceedance percentage at LARWMP REC-1 unregulated swim sites from 2018-2023. Percent of exceedances within 30-day periods at unregulated recreational sites monitored by LARWMP. Red dashed line represents the WQO of 10% REC-1 STV exceedances within a 30-day period. The dark vertical line on each bar

[7] Monitoring of this site started in 2019.

represents the median, diamonds represent the average, and dots represent outliers. Results for each month and site are tabulated in Table 16.

5.3.2 LREC-1 Kayak Areas

Generally kayaking areas are safe for low-water contact activities. *E. coli* concentrations of LREC-1 waters (median = 109 MPN/100mL) were below the LREC-1 WQO (576 MPN/mL) (Figure 29). There was a 11% decrease in the exceedance percentage for kayak areas between 2017 and the 2018-2023 period (Table 11). However, one additional location (LALT 219) was added to the program after 2017. There were occasional occurrences of high exceedances, indicating that users should continually refer to LASAN water quality notifications for guidance (Table 8).

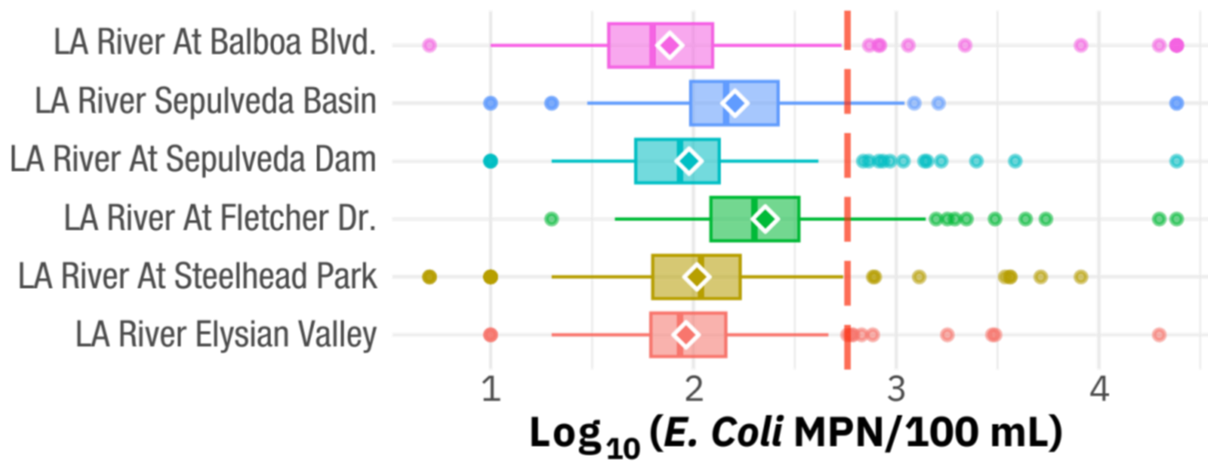


Figure 29: Box plot of Single Sample *E. coli* concentration at LARWMP LREC-1 sites from 2018-2023. *E. coli* concentration of LARWMP LREC-1 sites $\log_{10}$-transformed. Red dashed line represents the LREC-1 single sample WQO (WQO = 576 MPN/100mL; $\log_{10}$(WQO) = 2.76). The dark vertical line on each bar represents the median, diamonds represent the average, and dots represent outliers. Values beyond detection limits were assumed.

5.4 Summary and Next Steps

Overall, most sites within the Watershed are safe to recreate. However, all sites were found to occasionally exceed WQOs. As a result, visitors should take caution when visiting areas that are regularly above WQOs and refer to the LASAN website for water quality notifications for guidance (*Los Angeles River Quality*, 2023). The sites that had the highest percentage of exceedances are Tujunga Wash at Hansen Dam and Bull Creek. Visitors are advised to employ additional caution at these locations.

Monitoring site selection may change in future LARWMP seasons to align with areas of public interest. These adjustments should consider variables that influence visitation patterns, such as fire closures, access, and recreational infrastructure. Additionally, given the popularity of some recreation sites, the frequent presence of trash, and curiosity by visitors of LARWMP monitoring teams, visitors at recreational sites in the watershed present an important opportunity to engage with the public on stewardship and LARWMP's monitoring activities.

5.5 References

LARWQCB. (2014). Beneficial Uses. In *Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/2020/Chapter_2/Chapter_2_Basin_Plan_Text/Chapter_2_Text.pdf

LARWQCB. (2020a). *Attachment A to Resolution No. R20-001*.

LARWQCB. (2020b). *Resolution No. R20-001: Amendments to the Water Quality Control Plan for the Los Angeles Region to Update the Bacteria Objectives for Fresh, Estuarine and Marine Waters Designated for Water Contact Recreation, based on the Statewide Bacteria Provisions*. LARWQCB. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/WaterContactRecreation/3132020/FinalResolution_R20-001_BacteriaProvisions.pdf

Los Angeles River Quality. (2023). LA Sanitation. https://www.lacitysan.org/

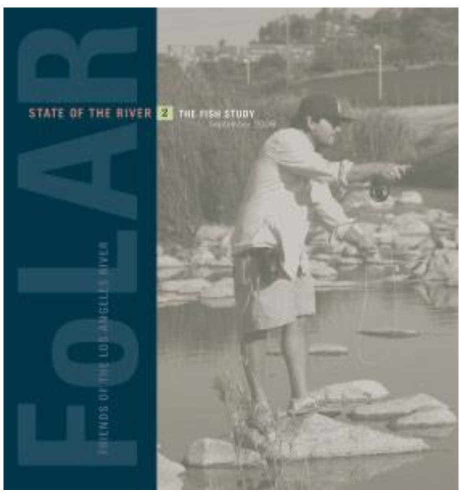
US Census. (2022, July 1). *U.S. Census Bureau QuickFacts: Los Angeles County, California*. https://www.census.gov/quickfacts/fact/table/losangelescountycalifornia/PST045222

6 Are Fish Safe to Eat?

6.1 Background

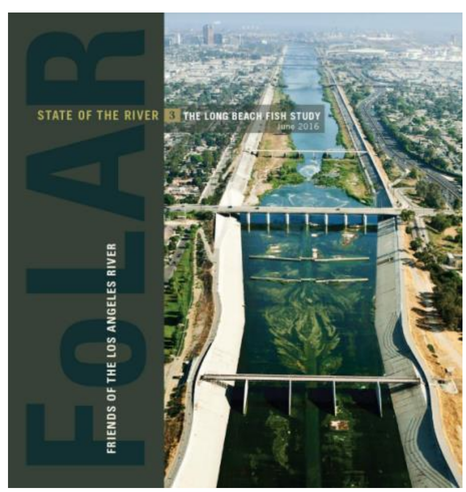
Certain contaminants in the environment can accumulate in fish tissue. This bioaccumulation of contaminants poses a health risk to those that eat fish from local water bodies. The contaminants that bioaccumulate, or accumulate in living organisms, are hydrophobic (or water fearing) compounds that adhere to small particles and accumulate in the fatty tissue of fish. Contaminants that bioaccumulate include DDT, mercury, selenium, and PCBs. These particles are eaten by small organisms and move up the food chain, becoming more concentrated with each increase in trophic level. This is a process known as biomagnification. These contaminants have been introduced into the watershed from insecticide application, natural processes, and industrial activities. While contaminants like DDT and PCBs have been banned for decades, they do not degrade easily and are still commonly detected in fish tissues.

6.1.1 FOLAR Fish Study



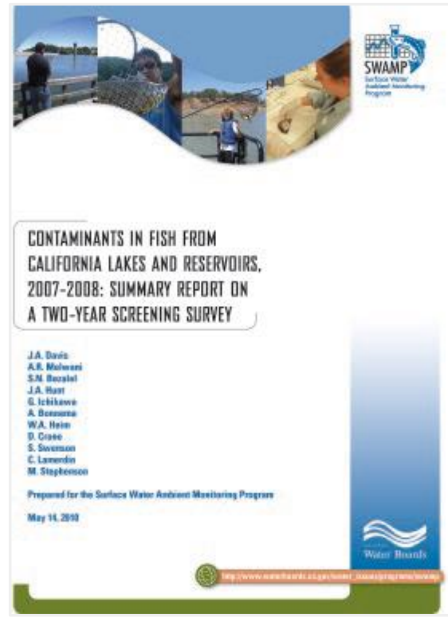
In 2007, the Friends of the Los Angeles River surveyed fish populations in the Glendale Narrows area, an approximately eight-mile stretch of natural bottom river that extends from Riverside Drive near Griffith Park to the Figueroa Bridge in Cypress Park (FOLAR, 2008). The levels of mercury and PCB of four composite samples of bullhead catfish, carp, sunfish and tilapia were well below the three servings per week consumption guidelines described by the California Office of Environmental Health Hazard Assessment (OEHHA). The results showed that fish tissues collected along the Glendale Narrows had lower concentrations of contaminants than found in many lakes and stream sites monitored across the nation. Eight species of fish were collected, none of them native. Species included the fathead minnow, carp, black bullhead, Amazon sailfin catfish, mosquitofish, green sunfish, largemouth bass, and tilapia. Mosquitofish and tilapia were the most abundant species.

In 2016, FOLAR conducted their *Long Beach Fish Study* where they sampled the brackish estuary near the mouth of the Los Angeles River (FOLAR, 2016). The estuary is home to a mix of native and non-native fish species. Natives included California killifish, Northern anchovy, and topsmelt. Non-native species like Asian carp and mosquitofish were also common in this section of the river.



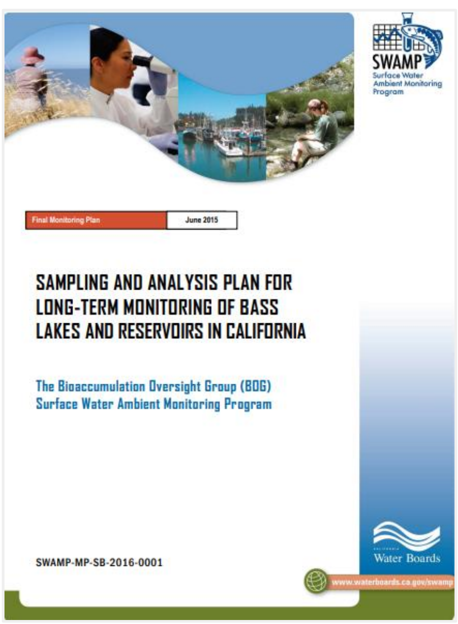
6.1.2 Surface Water Ambient Monitoring Program (SWAMP) Studies

The SWAMP report, *Contaminants in Fish from California Lakes and Reservoirs*, 2007-2008, summarizes the results of a 2-year screening study of 272 of California's more than 9,000 lakes and reservoirs. This represents the beginning of a long-term, statewide, comprehensive bioaccumulation monitoring program for California surface waters (Davis et al., 2010).



The survey identified problems in certain areas of the state, with methylmercury and polychlorinated biphenyls (PCBs) being the contaminants of greatest concern. Methylmercury poses the most widespread potential health risk, 21% of the lakes surveyed had at least one fish species with an average methylmercury level high enough (> 0.44 ppm) that OEHHA would consider recommending no consumption.[8]

The study provides information that will be valuable in prioritizing lakes in need of further study to support development of consumption guidelines and cleanup plans.



Informed by the results of their 2008 screening survey, SWAMP's Safe to Eat Workgroup (STEW; formerly known as the Bioaccumulation Oversight Group or "BOG") initiated the Long-term Monitoring of Bass Lakes and Reservoirs in California project in 2015 (SWAMP, 2015). This survey is an ongoing effort to track mercury concentration in 190 bass-dominated lakes. This study offers updated insights on lake status and statewide trends, aiding the assessment of management effectiveness (e.g., mercury control plans) and the impact of global emissions and climate change on fish mercury levels. Monitoring began in 2015, taking place every other year, with plans for continuation through 2025.

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8 For women between 18 and 45 years of age and children between 1 and 17 years of age

6.1.3 OEHHA advisory tissue levels (ATLs)

OEHHA ATLs were developed with the recognition that there are unique health benefits associated with fish consumption and that the advisory process should be expanded beyond a simple risk paradigm in order to best promote the overall health of the fish consumer (Office of Environmental Health Hazard Assessment, 2008). ATLs protect consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a lifetime cancer risk level of 1 in 10,000 for fishermen who consume an 8-ounce fish filet containing a given amount of a specific contaminant (Table 12).

Table 12: OEHHA Advisory Tissue Levels (ATLs) for selected contaminants in parts per billion (ppb).[9]

CONTAMINANT	THREE 8-OUNCE SERVINGS A WEEK	TWO 8-OUNCE SERVINGS A WEEK	ONE 8-OUNCE SERVINGS A WEEK	NO CONSUMPTION
DDTs[10]	≤520	>520-1,000	>1,000-2,100	>2,100
Methylmercury (Women aged 18-45 years and children aged 1-17	≤70	>70-150	>150-440	>440
Methylmercury (Women over 45 years and men)[4]	≤220	>220-440	>440-1,310	>1,310
PCBs[4]	≤21	>21-42	>42-120	>120
Selenium[12]	≤2500	>2500-4,900	>4,900-15,000	>15,000

[9] Serving sizes are based on an average 160-pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts (for example, individuals weighing 80 pounds should eat one 4- ounce serving a week when the table recommends eating one 8-ounce serving a week).

[10] ATLs for DDTs are based on non-cancer risk for two and three servings per week and cancer risk for one serving per week.

[11] ATLs are based on non-cancer risk

[12] ATLs are based on cancer risk

6.2 Methods

Prior to the start of LARWMP fish tissue sampling, little was known regarding the safety of eating fish caught in the watershed's estuary, creeks, and lakes. Designed to leverage and complement fish tissue monitoring studies by SWAMP and FOLAR, the LARWMP program began monitoring sites popular among the angling community in 2008. A regional survey of anglers helped in selecting target species and fishing locations where fish are most likely being consumed (Allen et al., 2008), along with the input of the LARWMP technical stakeholder group (

Figure 30).

Fish tissues were collected following 2005 guidelines established by OEHHA (updated in 2022) using a combination of techniques depending on the water body and included boat drawn seines, hand seines, hook and line, and electro shocking (Klasing et al., 2022).

Figure 30: Map of Fish tissue bioaccumulation sampling locations for 2018-2022.

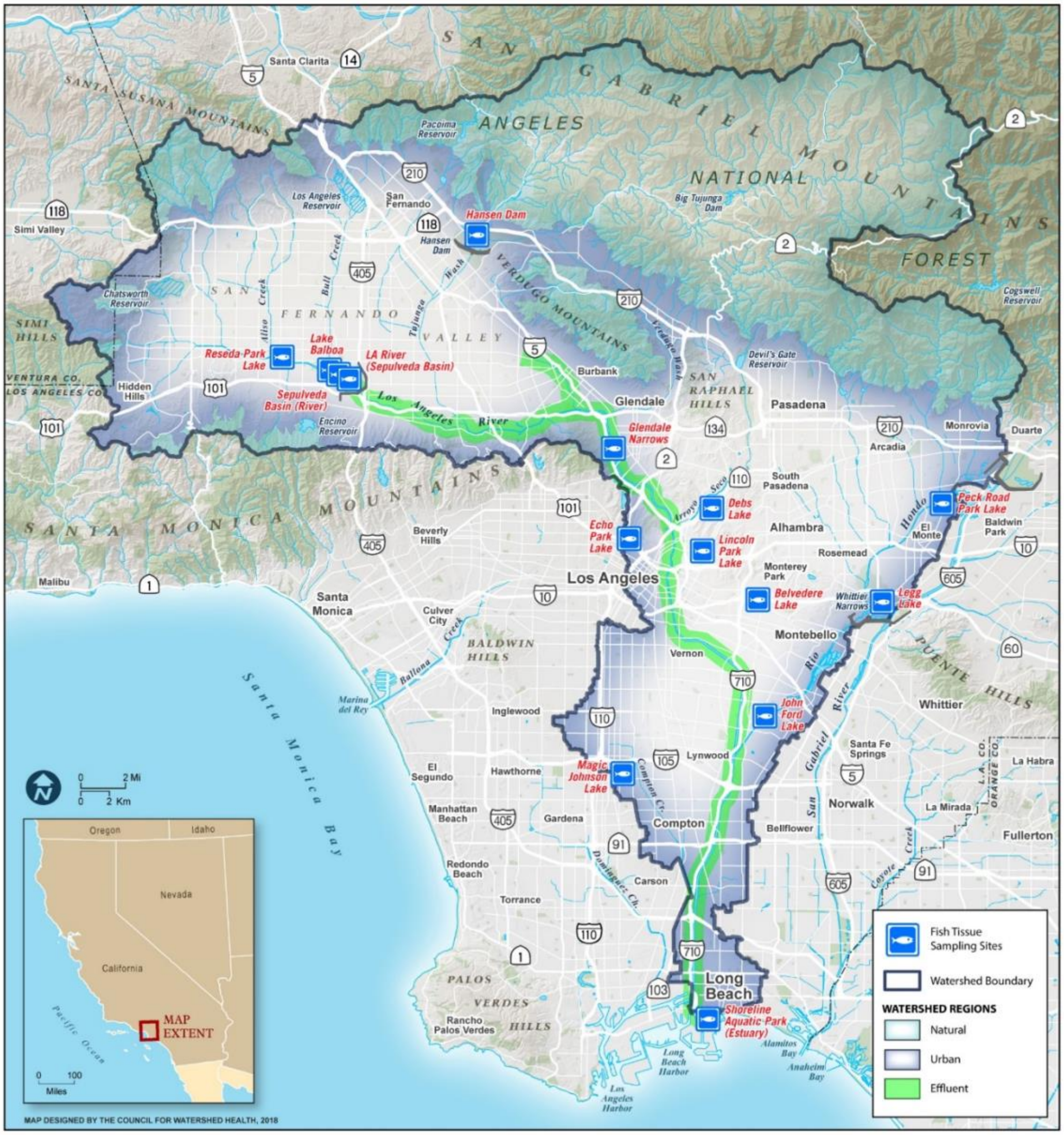

Fish Tissue Sampling Sites
Watershed Boundary
WATERSHED REGIONS
Natural
Urban
Effluent
Hansen Dam
Reseda Park Lake
Lake Balboa
LA River (Sepulveda Basin)
Sepulveda Basin (River)
Glendale Narrows
Debs Lake
Echo Park Lake
Lincoln Park Lake
Peck Road Park Lake
Belvedere Lake
Legg Lake
John Ford Lake
Magic Johnson Lake
Shoreline Aquatic Park (Estuary)
Los Angeles
Long Beach
SAN GABRIEL MOUNTAINS
ANGELES NATIONAL FOREST
SANTA MONICA MOUNTAINS
SAN FERNANDO VALLEY
Santa Monica Bay
MAP EXTENT
MAP DESIGNED BY THE COUNCIL FOR WATERSHED HEALTH, 2018

Table 13: Species of fish collected from the LA River Watershed during 2018-2022. Life histories are adapted from *Inland Fishes of California* (Moyle, 2002). Illustrations are from the US Fish and Wildlife Service National Digital Library (Raver, 1975).

COMMON NAME	SPECIES NAME	OBSERVED RANGE LENGTHS FROM LARWMP
Bluegill	*Lepomis macrochirus*	11 - 29 cm
Non-Native species mostly found in warm water bodies at low elevation. Can survive within a wide temperature range and under conditions of low oxygen. Tend to hide in aquatic vegetation. Omnivorous but primarily an opportunistic predator benthic macroinvertebrates, snails, small fish, and fish eggs. Also known to eat algae and aquatic vegetation when their normal prey items are scarce.		
Channel Catfish	*Ictalurus punctatus*	47 cm
Non-Native species mostly found in channels of warm water. Can survive in a variety of turbidity conditions ranging from gravel-bottomed streams to muddy-bottomed water bodies. Omnivorous but primarily an opportunistic predator Highly variable diet. Will eat anything that can fit in its mouth, including benthic macroinvertebrates, small fish, and even small mammals		
Common Carp	*Cyprinus carpio*	29 - 83 cm
Non-native species that are widespread in their distribution and are resilient to high levels of turbidity, low oxygen levels, and high temperature found in urbanized streams. They are omnivorous, opportunistic, bottom-feeder/scavengers. Primarily eat benthic macroinvertebrates, but will also eat plants and algae. This species is also a popular food fish for many cultures outside the United States.		
Green Sunfish	*Lepomis cyanellus*	11 - 13 cm
Non-Native species most common in small, warm streams with turbid, mud-bottom pools and aquatic vegetation, but can be found in larger water bodies with shallow weeded areas. They can tolerate a large range of conditions. Opportunistic predator with a diverse range of prey, including benthic macroinvertebrates and zooplankton to fish fry.		
Largemouth Bass	*Micropterus salmoides*	17 - 53 cm
Non-Native species that prefer shallow waters with moderate clarity. Cover in aquatic vegetation and submerged trees. Opportunistic predator diverse range of prey, ranging from benthic macroinvertebrates and zooplankton to amphibians and fish fry.		
Redear Sunfish	*Lepomis microlophus*	18 - 27 cm
This non-native species was introduced into warm regions of the U.S. from the Southeastern U.S. Prefer warm, deep, quiet water bodies and backwater habitats that are not too turbid. Feed on snails and clams and the bottom dwelling larval stages of aquatic insects.		
White Catfish	*Ameiurus catus*	58 cm
A non-native species that can be found in deep lakes and reservoirs or slow-moving rivers and streams. Omnivorous opportunistic bottom-feeder/scavenger with a diverse range of prey, including benthic macroinvertebrates and zooplankton to fish fry.		

6.3 Results

A handful of species were commonly caught in lakes and stream sites in the watershed. Common carp was the most prevalent fish species caught as it was captured at every 2018 - 2022 monitoring site (Table 14). Bluegill, largemouth bass, and redear sunfish were also common catches. Of all the monitoring locations, Legg Lake had the most diversity with 5 different fish species caught. Lake Balboa had both the lowest species variety and overall quantity, where only two species and two specimens total were caught. Only one white catfish and one channel catfish specimens were captured during data collection efforts (Table 14). However, COVID-19 related complications delayed the 2020 sampling season at Lake Balboa. Consequently, the total specimen counts may not accurately reflect the actual fish abundance or species diversity at this location. Interpretation of the following findings must be tempered with the understanding that the sample sizes for these particular species and locations were limited. More specimens would be necessary to achieve a sample size representative for the entire LA River Watershed.

Table 14: Number of each fish species collected from the LA River Watershed during 2018-2022.

Cells where no fish of that species were caught are intentionally blank.

FISH SPECIES	ECHO PARK LAKE 2018	LA RIVER, SEPULVEDA BASIN 2019	LAKE BALBOA 2020	LEGG LAKE 2021	BELVEDERE LAKE 2022	TOTAL CAUGHT OF EACH SPECIES
Bluegill	4	4		8	3	19
Channel Catfish			1			1
Common Carp	5	6	2	6	3	22
Green Sunfish		4				4
Largemouth Bass	4			10	10	24
Redear Sunfish	4			4	5	13
White Catfish				1		1
Total Caught at Each Site	17	14	3	29	21	84

6.3.1 Concentration of Contaminants in Fish Tissues

Analysis of fish tissue indicated that during the 2018-2022 sampling period, in general, fish that are often caught and consumed in lakes in the LA river watershed are likely safe to eat in moderate amounts (Figure 31 and Figure 32). None of the fish assessed by the LARWMP program during the 2018-2022 period were found to exceed any of the OEHHA ATLs for DDT or Selenium.

Figure 31: Maximum Mercury in Fish Tissue

Maximum mercury level in fish tissues by species for lakes monitored from 2018-2022. Species not sampled are blank. OEHHA's ATL[8] ranges are color-coded:

- Green: 3 servings/week ATL: ≤70 ppb
- Yellow: 2 servings/week ATL: >70-150 ppb
- Red: 1 servings/week ATL: >150-440 ppb

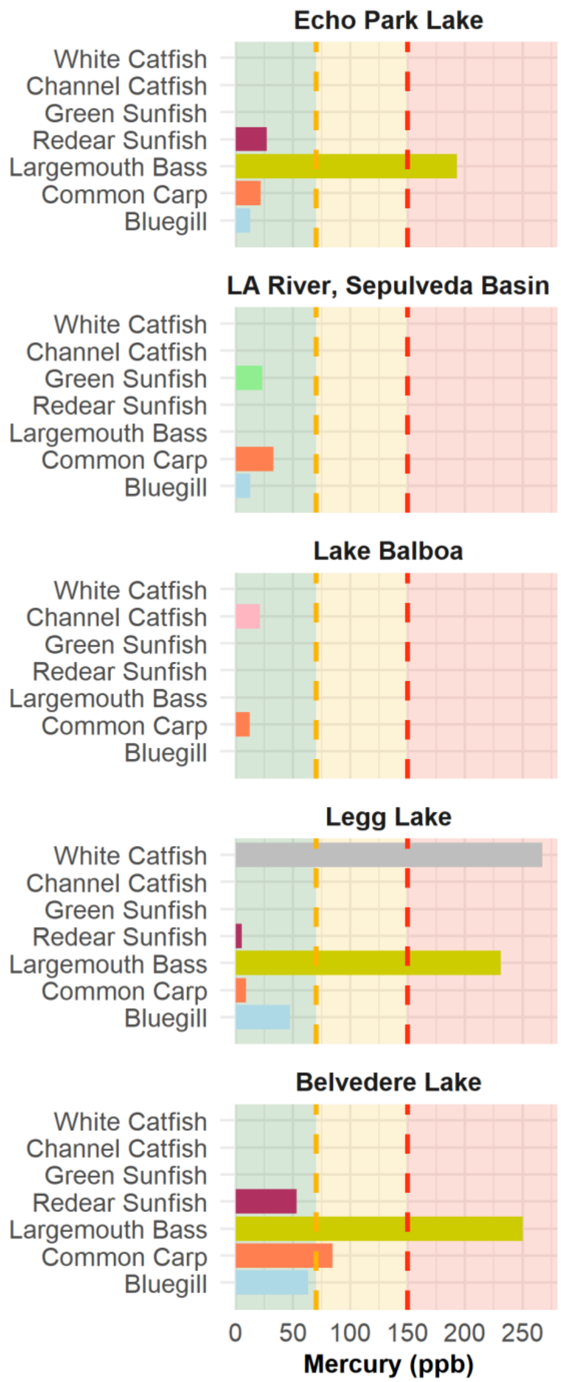
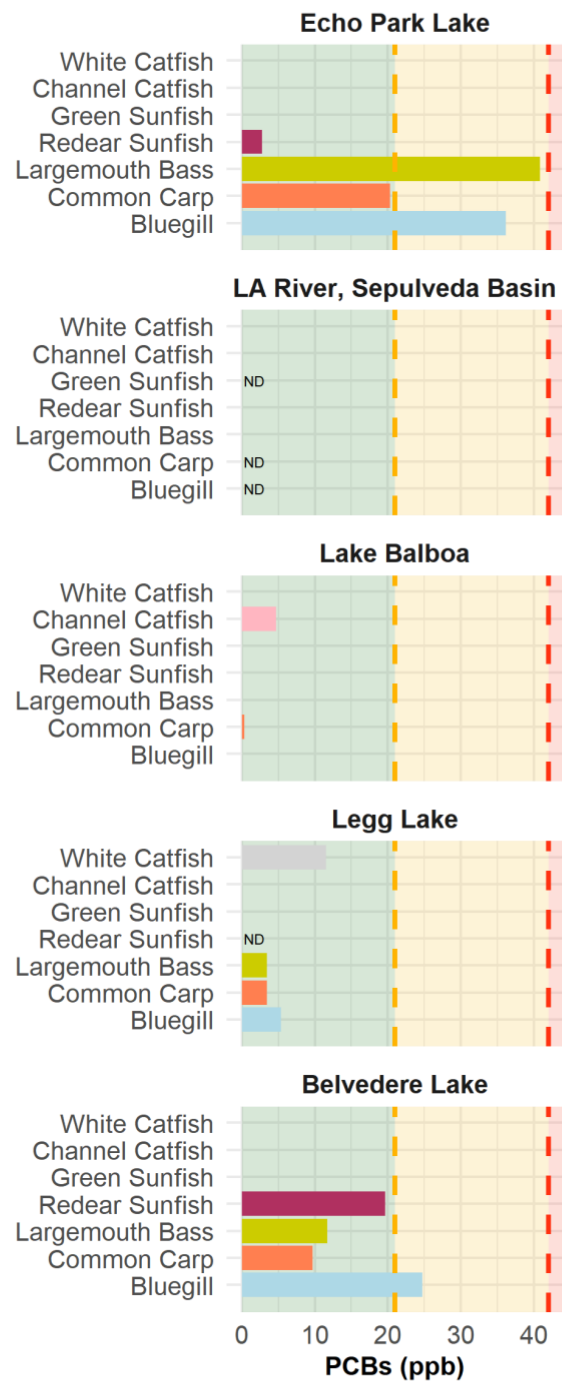


Figure 32: Maximum PCBs in Fish Tissue

Maximum PCB level in fish tissues by species for lakes monitored from 2018-2022. Species where the PCB level was below the detection limit are noted with "ND". Species not sampled are blank. OEHHA's ATL ranges are color-coded:

- Green: 3 servings/week ATL: ≤21 ppb
- Yellow: 2 servings/week ATL: >21-42 ppb
- Red: 1 servings/week ATL: >42-120 ppb



However, maximum concentration of mercury were elevated in largemouth bass and white catfish and merited a limit to consumption to one serving per week (ATL[8] = 150 ppb) at the following locations:

- Largemouth bass
  - Belvedere Lake: 250 ppb
  - Echo Park Lake: 193 ppb
  - Legg Lake: 231 ppb
- White catfish
  - Legg Lake: 267 ppb

For PCBs, most fish species in the sampled water bodies were found to be below the OEHHA ATL for 3 servings per week (ATL = 21 ppb), indicating that PCBs is not a widespread or elevated contaminant at sites monitoring by LARWMP. Species that showed to have elevated concentrations, relative to the data collected by the LARWMP, were bluegill and largemouth bass. Bluegill was found to be elevated in PCBs at Echo Park Lake and Belvedere Lake and a maximum of 2 servings per week are recommended at these locations. Largemouth bass was also found to have elevated PCB concentration at Echo Park Lake.

Overall, fish in higher trophic levels were observed to have higher contaminant levels, likely due to biomagnification. Similar to the LARWMP 2013-2017 sampling period, LARWMP 2018-2022 had no species or location exceeding the OEHHA "1 serving per week" or "no consumption" ATLs for any of the tested contaminants (Sanchez et al., 2018). This differs from samples collected in LARWMP 2008-2012, where largemouth bass from a few locations fell in the "no consumption" OEHHA ATL[8] for mercury (Morris et al., 2012).

6.3.2 Contaminant Concentrations at Select Locations

Echo Park Lake and Belvedere Lake were the only two locations where maximum concentrations of both mercury and PCB were noticeably higher than those observed in other locations. Local influences, such as fish species composition, geographic location, and potential sources of contamination may contribute to this observation, warranting further investigation. In addition, fish from Echo Park Lake had the highest observed PCB concentrations of all specimens. The largemouth bass (ATL = 40 ppb) at this location neared—but did not exceed—the OEHHA ATL one servings per week threshold for PCBs (ATL = 42 ppb).

At Legg Lake, both largemouth bass and white catfish was in the one serving per week range for mercury (ATL[8] = 70 ppb). In 2018, OEHHA issued a health advisory for eating fish for Legg Lake (Office of Environmental Health Hazard Assessment, 2018). The results from LARWMP 2018-2022 reports were consistent with OEHHA's health advisory finding that fish caught at this location were generally safe to eat in moderate amounts. Recreational fishermen that frequent Legg Lake should limit their consumption of fish caught at this location.

6.3.3 Comparison of LARWMP Fish Tissue Contaminants to Statewide and Nationwide data

Los Angeles River Watershed fish tissue contaminant concentrations from 2018-2022 are tabulated in Table 15 and include corresponding statewide and national statistics. Maximum values for

LARWMP values are used to display the highest potential concentrations for risk assessment and regulatory compliance considerations. Statewide data is directly from an OEHHA report (Office Of Environmental Health Hazard Assessment, 2022), while nationwide data was derived from the 2018-2018 USEPA dataset[13](Environmental Protection Agency, 2023). The 90th-percentile means were used to mitigate the impact of extreme outliers in statewide and nationwide data. For certain species, such as green sunfish and redear sunfish, the sample sizes were insufficient to accurately represent these species across the respective geographic ranges of each dataset. Furthermore, white catfish was unavailable in the nationwide dataset, which prevented a meaningful comparison.

Table 15: Comparison of Fish Tissue Contaminant Concentrations in LARWMP (2018-2022) with Statewide and National Data

		LARWMP 2018-2022 Maximum Contaminant Concentration		Statewide 90th Percentile Mean Contaminant Concentration		Nationwide 90th Percentile Mean Contaminant Concentration	
Common Name	**Species**	**n**	**Hg (ppb)**	**n**	**Hg (ppb)**	**n**	**Hg (ppb)**
Bluegill	Lepomis macrochirus	19	63	480	291	2	97
Channel Catfish	Ictalurus punctatus	1	21	519	506	62	230
Common Carp	Cyprinus carpio	24	85	525	399	6	263
Green Sunfish	Lepomis cyanellus	4	23	42	271	1	203
Largemouth Bass	Micropterus salmoides	17	250	4151	839	41	525
Redear Sunfish	Lepomis microlophus	13	53	118	137	1	87
White Catfish	Ameiurus catus	1	267	480	580	0	**
		n	**PCBs (ppb)**	**n**	**PCBs (ppb)**	**n**	**PCBs (ppb)**
Bluegill	Lepomis macrochirus	19	36	35	4	2	35
Channel Catfish	Ictalurus punctatus	1	5	92	52	62	548
Common Carp	Cyprinus carpio	24	20	217	67	6	8
Green Sunfish	Lepomis cyanellus	4	*	2	4	1	1
Largemouth Bass	Micropterus salmoides	17	41	176	13	41	190
Redear Sunfish	Lepomis microlophus	13	20	11	4	1	7
White Catfish	Ameiurus catus	1	12	7	37	0	**

* = specimens were captured, but the contaminant was undetected

** = no data available.

All fish species collected during LARWMP 2018-2022 had maximum mercury concentrations lower than both statewide and nationwide 90th percentile averages. In addition, fish species in the LARWMP dataset generally had maximum PCB concentrations lower than or between statewide and nationwide values. However, LARWMP redear sunfish had a higher maximum PCB than both

13 At the time of this writing, USEPA's *National Rivers and Streams Assessment (NRSA) Final Report and Technical Support Documents* have not been published yet. The values in this table are adapted from USEPA's publicly available national database for contaminants in fish tissue.

the statewide and nationwide values. The sample sizes for statewide (n = 11) and nationwide (n =1) data for this species are small, suggesting caution in drawing definitive conclusions. Possible explanations for the elevated PCB levels in this species may include differences in habitat, feeding habits, or local environmental factors affecting the accumulation of contaminants. More data is needed to determine if this is a meaningful difference.

6.4 Summary and Next Steps

In general, fish from lakes in the Los Angeles River Watershed are safe to eat in moderate amounts. Recommended serving size will vary depending on lake and fish species (Figure 31 and Figure 32). Channel catfish, common carp, green sunfish, and redear sunfish were determined to be safe for consumption with a recommended limit of three 8-ounce servings per week at all the lakes and streams where these species were sampled by LARWMP from 2018-2022. Largemouth bass caught in the Los Angeles River watershed were found to be safe to eat at a recommended limit of no more than one 8-oz. servings per week rate at Legg Lake, Belvedere Lake, and Echo Park Lake. Similarly, white catfish[14] at Legg Lake is indicated to be safe to consume at the same frequency of one serving per week[8]. Lastly, based on the maximum PCBs, bluegill caught from Echo Park Lake and Belvedere lake were also found to be safe to eat at limit of two servings per week.

To improve our understanding of the safe to eat program, we recommend:

- Continued sampling and resampling of recreational lakes and reservoirs in the Los Angeles River Watershed where angling activity is high. These steps will help monitor contaminant levels.
- Improved education and outreach to the angling community through ranger programs and community science efforts.
- Await SWQCB to release its microplastics monitoring guidance for fish and implement these methods into the LARWMP monitoring protocols for future reporting.

[14] This conclusion is based on a single sample and should not be regarded as representative of all white catfish at Legg Lake. Please see the discussion regarding the sample size on page 64.

6.5 References

Allen, M. J., Jarvis, E. T., Raco-Rands, V., Lyon, G., Reyes, J. A., & Petschauer, D. M. (2008). *EXTENT OF FISHING AND FISH CONSUMPTION BY FISHERS IN VENTURA AND LOS ANGELES COUNTY WATERSHEDS IN 2005* (Technical Report 574). Southern California Coastal Water Research Project. https://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_FishConsumpLA_Ventura2005.pdf

Davis, J. A., Melwani, A. R., Bezalel, S. N., Hunt, J. A., Ichikawa, G., Bonnema, A., Heim, W. A., Crane, D., Swenson, S., Lamerdin, C., & Stephenson, M. (2010). *Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP)*. California State Water Resources Control Board, Sacramento, CA.

FOLAR. (2008). *The Fish Study* (2; State of the River). FOLAR. https://folar.org/wp-content/uploads/2017/04/FOLAR_Fish_Study_2008.pdf

FOLAR. (2016). *Long Beach Fish Study* (3). https://folar.org/wp-content/uploads/2017/04/FOLAR_Fish_Study_2016.pdf

Klasing, S., Smith, W., & Chumney, L. (2022). Protocol for Fish Sampling and Analysis to Support the Development of Fish Advisories in California. Office of Environmental Health Hazard Assessment.

Moyle, P. B. (2002). *Inland fishes of California* (Rev. and expanded). University of California Press.

Office of Environmental Health Hazard Assessment. (2008). Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. https://oehha.ca.gov/media/downloads/fish/report/atlmhgandothers2008c.pdf

Office of Environmental Health Hazard Assessment. (2022). Statewide Health Advisory and Guidelines for Eating Fish from California's Rivers, Streams, and Creeks without Site-Specific Advice. OEHHA.

Raver, D. (1975). *Duane Raver Freshwater Fish Collection*. USFWS National Digital Library. https://digitalmedia.fws.gov/digital/collection/natdiglib/search/searchterm/Duane%20Raver%20Freshwater%20Fish%20Collection/field/collec/mode/exact/conn/and

SWAMP. (2015). *SAMPLING AND ANALYSIS PLAN FOR LONG-TERM MONITORING OF BASS LAKES AND RESERVOIRS IN CALIFORNIA*. California State Water Resources Control Board, Sacramento, CA. https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/lakes_study/bass_lakes_sampling_plan.pdf

Environmental Protection Agency. (2023, April 21). *National Rivers & Streams Assessment 2018-2019 Dashboard*. NRSA Dashboard. https://riverstreamassessment.epa.gov/dashboard/

Appendix

Table 16: LARWMP 2018-2023 Monthly Single Sampling WQO STV Exceedance Percentages for Recreational Swim Sites from LARWMP 2018-2023.

30-day ranges start on the first day sampling. Note that the final month-period ends on the last day of sampling rather than the end of the calendar month. Percentages represent the monthly proportion of single samples that exceeded REC-1 WQO STV (320 MPN/100mL) for each site. 30-day periods where >10% of samples exceeded the REC-1 WQO STV are highlighted in red. Periods where sampling did not occur are intentionally left blank. These values are visualized Figure 28.

		BULL CREEK/ SEPULVEDA BASIN	EATON CYN NATURAL AREA PARK	TUJUNGA WASH AT HANSEN DAM	HANSEN DAM REC. LAKE	MILLARD CAMPGROUND	DELTA DAY USE	SWITZER FALLS	GOULD MESA CAMPGROUND	STURTEVANT FALLS	HIDDEN SPRINGS	HERMIT FALLS	VOGEL FLATS
Year	Date Range	LALT 200	LALT 204	LALT 214	LALT 224	LAUT 203	LAUT 206	LAUT 208	LAUT 209	LAUT 210	LAUT 211	LAUT 213	LAUT 220
2018	May 28 - Jun 27, 2018	12.5%	50.0%	75.0%		0.0%	0.0%	0.0%	0.0%	25.0%		0.0%	
	Jun 28 - Jul 27, 2018	25.0%	0.0%	50.0%		0.0%	0.0%	0.0%	50.0%	0.0%		0.0%	
	Jul 28 - Aug 27, 2018	0.0%		100%		0.0%	0.0%	16.7%	20.0%	0.0%		0.0%	
	Aug 28 - Sep 27, 2018	0.0%		100%		50.0%	0.0%	0.0%				0.0%	
2019	May 27 - Jun 26, 2019	12.5%	25.0%	12.5%	0.0%			0.0%	0.0%	0.0%		14.3%	
	Jun 27 - Jul 26, 2019	0.0%	33.3%	0.0%	0.0%			0.0%	0.0%	0.0%		0.0%	
	Jul 27 - Aug 26, 2019	28.6%	0.0%	42.9%	0.0%			0.0%	0.0%	0.0%		14.3%	
	Aug 27 - Sep 26, 2019	0.0%	50.0%	100%	0.0%			50.0%	0.0%	50.0%		0.0%	
2020	Jun 3 - Jul 2, 2020	0.0%		60.0%	0.0%								
	Jul 3 - Aug 2, 2020	20.0%	0.0%	80.0%	0.0%			0.0%	0.0%	0.0%			
	Aug 3 - Sep 2, 2020	0.0%	14.3%	37.5%	0.0%			25.0%	0.0%	0.0%			0.0%
	Sep 3 - Sep 30, 2020	25.0%	0.0%	100%	0.0%			100%	0.0%	0.0%			0.0%
2021	May 26 - Jun 25, 2021	85.7%	0.0%	57.1%	0.0%		0.0%	0.0%	0.0%		0.0%		0.0%
	Jun 26 - Jul 25, 2021	0.0%	0.0%	100%	0.0%		0.0%	16.7%	16.7%		0.0%		0.0%
	Jul 26 - Aug 27, 2021	50.0%	0.0%	100%	0.0%		50.0%	66.7%	50.0%		0.0%		25.0%
	Aug 28 - Sep 29, 2021	0.0%	0.0%	100%	0.0%		0.0%		0.0%		0.0%		0.0%
2022	May 25 - Jun 24, 2022	42.9%	0.0%	71.4%	0.0%		0.0%	0.0%	0.0%		14.3%		0.0%
	Jun 25 - Jul 24, 2022	33.3%	0.0%	100%	0.0%		0.0%	16.7%	16.7%		0.0%		0.0%
	Jul 25 - Aug 24, 2022	50.0%	25.0%	100%	0.0%		0.0%	25.0%	25.0%		0.0%		0.0%
	Aug 25 - Sep 24, 2022	66.7%	0.0%	100%	0.0%		0.0%	0.0%	0.0%				0.0%
2023	May 25 - Jun 24, 2023	71.4%	0.0%	71.4%	0.0%		0.0%	0.0%			0.0%		0.0%
	Jun 25 - Jul 24, 2023	66.7%	0.0%	83.3%	0.0%		0.0%	0.0%	0.0%		0.0%		0.0%
	Jul 25 - Aug 24, 2023	100%	0.0%	100%	0.0%		0.0%	0.0%	0.0%		0.0%		0.0%
	Aug 25 - Sep 24, 2023	50.0%	0.0%	50.0%	0.0%		0.0%	25.0%	0.0%		0.0%		0.0%