Department of Pesticide Regulation
Environmental Monitoring Branch
Surface Water Protection Program
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STUDY 320: Ambient Surface Water and Mitigation Monitoring in Urban Areas in Southern California during Water Year 2025-2026

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1. Introduction

Southern California urban areas have considerable pest pressures, which result in high urban pesticide use. According to the Pesticide Use Report (PUR) over 18,594,600 pounds of pesticide active ingredients were applied for non-agricultural use in 2023 (CDPR, 2023). Non-agricultural use includes applications for residential, industrial, institutional, structural, or vector control purposes (CDPR, 2014). PUR data does not account for non-professional applications by residents and homeowners, so actual pesticide use is higher. Specifically, 14,381,491 pounds of pesticides were applied for professional structural pest control or landscape maintenance in Los Angeles, Orange, and San Diego counties in 2023. Urban areas in Southern California are highly developed, with a high percentage of impervious surfaces. Impervious surfaces enhance surface water runoff, which increases the potential for pesticides to enter urban creeks and rivers via storm drains (Gan et al., 2012).

The California Department of Pesticide Regulation's (DPR) Surface Water Protection Program (SWPP) has been monitoring pesticides in urban waterways since 2008. Study 320 is a continuation of DPR's urban monitoring in Southern California (Budd, 2022, Burant 2019, Burant, 2020). The work described herein complements Study 329, which monitors pesticides in urban areas of Northern California (Ensminger, 2019, Smith, 2020). Study 329 is a continuation of Study 299, DPR's urban monitoring study in Northern California (Ensminger, 2019). These studies have shown that urban-use pesticides (e.g., pyrethroids, fipronil, imidacloprid, and synthetic auxin herbicides) are commonly detected in urban waterways (Burant, 2021, Ensminger, 2021). SWPP is particularly interested in cases where pesticide concentrations repeatedly reach or exceed USEPA Aquatic Life Benchmarks, which are a type of toxicity threshold used to gauge potential risks to sensitive aquatic organisms (Gan et al., 2012; Oki and Haver, 2009; Weston et al., 2014; Weston et al., 2005; Weston et al., 2009, Budd, et al., 2020). Numerous urban waterways are listed on the 2018 Federal Clean Water Act Section 303(d) list due to the confirmed presence of pyrethroid and organophosphate pesticides (Cal EPA, 2021). High use, high potential for pesticide runoff to enter urban waterways, and historical exceedances of aquatic life benchmarks justify the need to continue monitoring California's urban waterways.

This study is designed to evaluate water quality trends that could show changes in pesticide concentrations over time, particularly at long-term monitoring sites. DPR has taken significant mitigation actions to address water quality exceedances for pyrethroids and fipronil. Surface water regulations (Chapter 3, Sections 6970 and 6972 in the California Code of Regulations) went into effect in July 2012 to address pyrethroid concentrations in California surface waters (CDPR, 2013); and in 2018, California-specific labels were adopted for fipronil-containing products registered for outdoor use. These mitigation actions were designed to reduce the loading of pyrethroids and fipronil to surface waters. Long-term monitoring data allows DPR to assess water quality improvements, such as downward trends in pesticide concentrations or fewer exceedances of aquatic life benchmarks. These monitoring activities assist DPR in evaluating the effectiveness of regulations and label changes.

A recent evaluation was conducted of SWPP's urban pyrethroid monitoring data in relation to the implementation of the surface water regulations (Budd, et al., 2020). This study showed decreasing trends in bifenthrin and cypermethrin concentrations in Northern California, complemented by an increase in deltamethrin concentrations. However, there were few observed trends in pyrethroid concentrations in the Southern California region (Budd, et al., 2020). Pyrethroids were still detected at levels that exceeded aquatic life benchmarks in both regions. Continuing monitoring efforts are essential to evaluate the effectiveness of both the surface water regulations and California use restriction labels of fipronil containing products.

This protocol details proposed sampling at DPR monitoring locations receiving urban runoff in southern California for Water Year 2025-2026.

2. Objectives

The goal of this project is to assess pesticide concentrations found in runoff at urban drainages and receiving waters in Southern California. Specific objectives include:

1) Determine presence and concentrations of selected priority pesticides in runoff and waterways of Southern California urban watersheds under dry and storm conditions.
2) Compare measured concentrations of pesticides to aquatic toxicity thresholds.
3) Evaluate pesticide concentration trends through long-term monitoring.
4) Determine the acute toxicity of water samples using laboratory tests conducted with the amphipod *Hyalella azteca,* the midge *Chironomus,* or branchiopod water flea *Ceriodaphnia dubia*.
5) Monitor deposition of sediment-bound pyrethroids within selected watersheds.
6) Evaluate sources of pesticide loading through land use comparisons.

7) Evaluate effectiveness of carbon-filled socks to reduce pesticides in urban runoff under field conditions; and
8) Evaluate effect of filtering samples on pyrethroid concentrations and *Hyalella azteca* toxicity.

3. Personnel

The study will be conducted by staff from DPR's Environmental Monitoring Branch under the general direction of Anson Main, Environmental Protection Manager I. Key personnel are listed below:

Project Leader:	Marie Garcia
Scientific Advisor:	Robert Budd
Field Coordinator:	Rio Mecredy
Laboratory Liaison:	Josh Alvarado
Statistician	Xuyang Zhang
Analytical Chemistry:	Center for Analytical Chemistry, Department of Food and Agriculture (CDFA)
Toxicity Tests:	University of California at Davis, Aquatic Health Program
Collaborators:	University of California, Cooperative Extension Orange County – South Coast Research and Extension Center; Los Angeles Public Works, Los Angeles Sanitation District; Orange County Public Works; City of San Diego, County of San Diego

Please direct questions regarding this study to Marie Garcia, Senior Environmental Scientist (Specialist), at (916) 341-4111 or marie.garcia@cdpr.ca.gov.

4. Study Plan

4.1 Site Selection

Most sites described in this protocol have been previously sampled by DPR (Budd, 2022). These sites were selected using the watershed prioritization component of the Surface Water Monitoring Prioritization (SWMP) Model (Monitoring Prioritization, version 4, Report ran on 9/19/2025). The SWMP Model, which is extensively described in Luo, et al. (2017), identifies priority hydrologic-unit codes (HUC) based on reported pesticide use and toxicity data. Using the SWMP Model and its aggregation tool (Luo, et al., 2017), the top ten priority HUC8s are identified for Southern California (Appendix; Table A1). Of these, SWPP currently has monitoring sites within eight of the top ten HUC8s. These watersheds, located throughout heavily urbanized areas of Southern California, provide data to evaluate the spatial distribution of priority pesticides in Southern California surface waters (Budd et al., 2013; Luo et al., 2013). Other factors such as site accessibility, contributing land use, perennial flow, other monitoring agency representation, and budgetary constraints direct site selection in the remaining HUCs. Sampling locations in receiving water sites are located near the base of their respective watersheds (i.e., the downstream portion of the watersheds), with a few notable exceptions (e.g., Bouquet Canyon Creek, Santa Ana River). For WY25-26 there are a total of 21 monitoring sites, with approximately half located within receiving waters (Table 1). Detailed sampling site information is provided in the Appendix, Tables A1 and A2.

4.1.1 Los Angeles County

Ballona Creek (BAL), Bouquet Canyon Creek (BOQ), Los Angeles River (LAR1, LAR3, and LAR4), and San Gabriel River (SGR), are the watersheds of interest in Los Angeles County (Figure 1). All sites are located within concrete-lined sections of the waterway. These sites are large watersheds with mixed residential and commercial land-uses. BAL is in the Santa Monica Bay HUC8 and drains mostly residential land-uses with single- and multi-family homes. BOQ consists of predominantly single-family homes with a small amount of commercial land-use. Although not in a HUC8 prioritized by the SWMP Model, BOQ has historically high pesticide detections. BOQ is not located at the base of the watersheds, but below the confluence of Bouquet Canyon Creek and Dry Canyon, a tributary of BOQ. LAR1, in the Los Angeles River HUC8, drains residential land-uses, but has a higher percentage of commercial and industrial land-uses than BAL or BOQ. Two storm drain sites along the LA River (LAR3 and LAR4) are included to determine relative contributions from commercial-dominated land-use sites. These sites drain from downtown Los Angeles. SGR consists primarily of wastewater effluent during low flow conditions.

4.1.2 Orange County

Ambient water quality monitoring will be conducted at six sampling locations within Salt Creek (SC), three locations within Wood Creek Canyon (WC), one site in the Anaheim-Barber City Channel (ABCC), one site along Peters Canyon Channel (PCC) and one site in the Santa Ana River (SAR) in Orange County (Figure 2).

Sampling stations within Salt Creek (SC1, SC2, SC3, SC4, SC5, and SC7) have been monitored consistently since 2009 as part of DPR’s urban monitoring program. The surrounding drainage areas within the Salt Creek watershed consist of single-family dwellings, multiple-family dwellings, light commercial buildings, parks, schools, and two golf courses. SC1–SC4 are located directly below storm drains that receive runoff from residential neighborhoods. SC5 and SC7 are located at the receiving waters of urban inputs and will allow evaluation of pesticide concentrations in the watershed as well as downstream transport of pesticides. SC5 is located upstream of SC7, which is located at the base of the Salt Creek watershed. All SC sites are in the Aliso-San Onofre HUC8. Sediment pyrethroid sampling at SC3 will continue during the dry season.

Monitoring locations within WC are in the Aliso-San Onofre HUC8 and have been monitored since 2009 as part of SWPP’s mitigation evaluation monitoring in urban settings. Two sites are situated at the inlet (WC1) and outlet (WC2) of a small (~0.18 acres) constructed wetland designed to reduce pollutants in urban runoff (Budd, et al., 2012). The wetland receives urban runoff from a drainage area consisting entirely of single- and multiple-family residential units. The primary objective of monitoring these stations is to observe the efficacy of pesticide removal within the wetland system. Efficacy will be evaluated through comparisons in median pesticide concentrations between the inlet and outlet. Sediment sampling will continue at WC1. WC3 receives runoff from a small residential neighborhood to the north of the wetland. A carbon sock will be deployed at the outfall of WC3 during dry season conditions. Effectiveness of this treatment technology will be measured by comparing pre- and post- carbon sock pesticide concentrations.

Sampling along the ABCC is a concrete-lined watershed draining mixed residential, commercial, and industrial areas. The watersheds are located within the Seal Beach HUC8, the highest priority HUC8 in Southern California based on estimated urban pesticide use within the delineated HUC.

PCC within the Newport Bay HUC, just upstream of the confluence of PCC and San Diego Creek, explores the relative contributions from commercial-dominated land-use sites. This site is situated upstream of a site monitored by the State Water Resources Control Board's Stream Pollution Trends (SPoT) Monitoring Program (San Diego Creek at Alton Parkway) and has historic detections of pyrethroids in sediment (SWAMP, 2017).

The SAR site is a concrete-lined river draining mixed residential, and commercial area. The site is located within high priority HUC8 in Southern California. This site was added during the WY 2023-2024 monitoring cycle.

4.1.3 San Diego County

Two stations within the San Diego River watershed, as well as one within the Chollas Creek watershed, will be monitored in San Diego County (Figure 3). San Diego River is not channelized or concrete-lined, which may account for historically lower pesticide concentrations (Budd, 2018). Both sites are located within high priority HUC8s in Southern California.

4.1.4 Collaborative Monitoring

DPR has been engaged in a collaborative effort with the State Water Resources Control Board through its SPoT Monitoring Program to increase the data available for trend analysis of current-use pesticides (SWAMP, 2017). The synergistic partnership allows each agency to maximize information gained with limited resources. In coordination with DPR, the SPoT Program also collects sediments throughout California for pyrethroid and fipronil analyses, which greatly adds to the spatial representation of pesticide monitoring data. Several sites described in this protocol also serve as SPoT monitoring locations for sediments, including BAL, BOQ, LAR1, and SGR. DPR collects and analyzes the aqueous samples, while SPoT monitors pyrethroids and fipronil in sediment. Both datasets are considered in long-term trend analysis.

4.2 Selection of Pesticides for Monitoring

The SWMP model is utilized to prioritize pesticides for monitoring (Monitoring Prioritization, version 4, Report ran on 9/19/2025). From the generated list, pesticides needing analytical method development can be identified. Luo, et al. (2013) describes the SWMP Model in detail, but briefly, the model is based on current pesticide reported professional use patterns and aquatic toxicity threshold values. Use data from Los Angeles, Orange, and San Diego counties and aquatic life benchmarks set by the U.S. EPA are considered. The product of use score × toxicity score yields a final score that represents a relative prioritization of pesticides. Additionally, the output generates a monitoring recommendation based on physical-chemical properties such as half-life and solubility. Pesticides that receive a final score of nine or higher are given priority for method development (Appendix, Table A3). Pesticides with lower scores have either low use in urban environments or low associated aquatic toxicity. At each aqueous sampling site, collected samples will be analyzed for all pesticides in the liquid chromatography (LC) multi-analyte screen and the pyrethroid (PY) screen. Samples collected at select sites will also be analyzed for pesticides in the neonicotinoid (NN), glyphosate (GL), dinitroaniline (DN), and phenoxy screens (PX; Table 2). These screens represent pesticides that historically have had lower detection frequencies in previous monitoring efforts (e.g., the dinitroanilines) or pesticides that have not previously exceeded benchmarks (e.g., synthetic auxin herbicides). All suites cannot be analyzed at every monitoring location due to budgetary and space constraints. The SWMP model also identified six analytes in need of method development: dithiopyr, dichlorvos (DDVP), novaluron, prallethrin, imazapyr, and sulfoteruron-methyl (Appendix, Table A3).

4.3 Water Sampling

Whole water samples will be collected during two dry-season and two storm sampling events using methods described by Deng and Ensminger, 2021. Dry-season sampling will occur in June and August 2026. DPR will attempt to collect storm samples during the first major storm (rain) event of WY 25–26 and during a second major storm in the winter or early spring of 2026 (Table 2).

Dry-season water samples will be collected as grab samples directly into 1-L amber bottles (Deng and Ensminger, 2021). Where the stream is too shallow to collect water directly into these bottles, a stainless-steel container will be used to initially collect the water samples. Storm runoff composite samples collected at SDR1, SDR4 and CHO1 will be collected by the County and City of San Diego, respectively. Samples will be stored and transported on wet ice or refrigerated at 4°C until analyzed. Duplicate samples will be collected at two sites during first storm and both dry season events. These duplicate samples will be filtered through a glass fiber prior to submission for pyrethroid analysis and toxicity testing on *H. azteca*. Field matrix spike and field matrix spike duplicates will be collected during each sampling event for quality assurance.

4.4 Sediment Sampling

Sediment samples will be collected at three locations (Table 2). Enough sediment will be collected to fill ½ pint (237 mL) Mason jars using stainless-steel scoops from the top of the bed layer, biasing for fine sediments where possible (Deng and Ensminger, 2021). All sediments will be passed through a 2-mm sieve to remove plant debris and then homogenized (Deng and Ensminger, 2021). Samples will be analyzed for pyrethroids.

4.5 Toxicity Sampling

Water samples will be collected at a subset of sampling sites for toxicity analysis (Table 3). Grab samples will be collected in two 1-L amber I-Chem certified 200 bottles (or equivalent) and transported to the Aquatic Health Program at the University of California, Davis. Toxicity testing will measure percent survival of the amphipod *Hyalella azteca,* the midge *Chironomus,* or the water flea *Ceriodaphnia dubia* in water over 96-hours. Several sites described in this protocol also serve as SPoT monitoring locations for sediment toxicity, including BAL, BOQ, LAR1, SGR, and SC5. Data will be shared between monitoring programs.

4.6 Field Measurements

Physical-chemical properties of the water column will be determined using an Aqua TROLL® 400 Multiparameter Probe according to the methods described by In-Situ (2019). At each site, water parameters measured *in situ* will include pH, temperature, salinity, total dissolved solids, and dissolved oxygen. Storm drain flow rates may be measured to characterize the flow regime and to estimate the total loading of target pesticides. Discrete time flow estimations will be determined using either the float method, or fill-bucket method. Continuous flow rates may be obtained at SC2 and SC3 using an installed Keller AccuLevel pressure transducer and Hach Sigma 950 flow meter, respectively (Sisneroz et al., 2012; Oki and Haver, 2009).

4.7 Sample Transport

DPR staff will transport samples following the procedures outlined in DPR SOP QAQC004.01 (Jones, 1999). A chain-of-custody record will be completed and accompany each sample.

4.8 Organic Carbon and Suspended Sediment Analyses

DPR staff will analyze water and sediment samples for total organic carbon (TOC) and dissolved organic carbon (DOC) using a Vario TOC Cube TOC/TNb Analyzer (Elementar Analysensysteme GmbH, Langenselbold, Germany). Water samples will also be analyzed for suspended sediment (Ensminger, 2013b). Lab blanks and calibration standards will be run before every sample set to ensure the quality of the data.

4.9 Modifications from Study 320 WY 23-24

This sampling plan is continuous of Study 320 WY 2024-2025. This sampling and analysis schedule is similar to that of Study 320 WY 2024-2025 except for the following:

1. Toxicity testing may include using the water flea *Ceriodaphnia dubia* in lieu of *Chironomus dilutus,* for sites with historically high fipronil concentrations or detection frequencies.
2. Field matrix spikes will be collected during each sampling event for pyrethroid analysis.
3. Added a study objective to compare observed concentrations against land use data for source identification purposes.

5. Chemical Analysis

Pesticide analysis will be conducted by the Center for Analytical Chemistry at the California Department of Food and Agriculture, Sacramento, CA (CDFA). CDFA will analyze six analytical suites (Appendix, Tables A4-A10). Laboratory QA/QC will follow DPR guidelines and will consist of laboratory blanks, matrix spikes, surrogate spikes, and blind spikes (Segawa, 1995). Laboratory blanks and matrix spikes will be included in each extraction set. In addition, one field matrix spike and one field matrix spike duplicate will be collected during each sampling event for pyrethroid analysis.

6. Data Analysis

Data generated by this project will be entered into a central database that holds all data including field information, field measurements, and laboratory analytical data. We will use various non-parametric statistical methods to analyze the data. The data collected from this project may be used to develop or calibrate urban pesticide runoff models.

Preliminary analysis (Budd et al., 2020) of past monitoring data indicated that the data are skewed and contain several non-detects with multiple reporting limits, which may violate the normality and equal-variance assumptions of the parametric procedures (e.g., ANOVA and *t*-tests). The application of non-parametric procedures to skewed and censored environmental data is most appropriate for this study (Helsel, 2012). The data will be analyzed using the R statistical program (R Core Team, 2014), specifically the Non-detects And Data Analysis for environmental data (NADA) package for R (NADA Package for R).

Based on the study objectives, preliminary analysis, and data availability, we propose the following statistical procedures for data analysis (Table 4):

1) Explanatory data analysis will be performed to summarize the characteristics of the sample data. Urban monitoring data have been collected since 2008 for a variety of analytes at multiple locations (e.g., Salt Creek, Wood Creek) with different site types (i.e., storm drain outfalls and receiving waters), and between different seasons (i.e., dry and wet seasons) (Tables 1 and 2). Boxplots, histograms, probability plots, and empirical distribution functions will be produced to explore any potential patterns demonstrated by the data.
2) Hypothesis tests will be conducted to compare the concentration between groups of interest. For example, we will test whether there is significant difference in concentration between the dry and wet seasons, or between the different locations. Non-parametric procedures will be used to compute statistics for hypothesis testing. Data with multiple reporting limits will be censored at the highest limit before proceeding if the test procedure allows only one reporting limit.
3) Trend analysis will be included to demonstrate changes in concentration over time (if any). For the trend analysis, we will use Akritas-Thenil-Sen non-parametric regression or Mann-Lendall trend test,

which regresses the censored concentration over time, or linear regression models, which tests the correlation between the censored concentration and spatial-temporal factors such as year, month, and location.

7. Timeline

Field Sampling: Oct 2025 – Sept 2026

Chemical Analysis: Oct 2025 – Dec 2026

Report to Management: Jan 2027 – Mar 2027

Data Entry into SURF: May 2027 – Jun 2027

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Table 1. Summary of urban pesticide monitoring locations in Southern California.

County	Watershed	Storm drain Outfall	Receiving Water/ Mitigation Outfall	Total Sites
Los Angeles	Ballona Creek	-	1	***1***
	Bouquet Creek	-	1	***1***
	Los Angeles River	2	1	***3***
	San Gabriel River	-	1	***1***
Orange	Anaheim-Barber City Channel	-	1	***1***
	Salt Creek	4	2	***6***
	Wood Creek	2	1	***3***
	Peters Canyon Channel	1	-	***1***
	Santa Ana River	-	1	***1***
San Diego	San Diego River	1	1	***2***
	Chollas Creek	-	1	***1***
	Total	***10***	***11***	***21***

Table 2. Ambient surface water sampling schedule, subject to change. Samples with asterisks (*) are collected by our sampling partners.

Site	**BU/TOC**	**TSS**	**LC**	**PY**	**PX**	**DN**	**NEO**	**GLY**	**TOX**	**SED**	***Total***
SC1	1S,2D	1S,2D	1S,2D	1S,2D				1S,2D			***10***
SC2	1S,2S,2D	1S,2S,2D	1S,2S,2D	1S,2S,2D			2D	1S,2S,2D			***16***
SC3	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	2D		1S	1S,2S,1D,2D	1S,2S,2D	1D,2D	***27***
SC4	1S,2S,2D	1S,2S,2D	1S,2S,2D	1S,2S,2D	1S		1S	1S,2S,2D	1S		***18***
SC7	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	2D		1S,2S,1D	1S,2S,1D,2D	1S,2S,1D,2D		***28***
DC	1S,1D	1S,1D	1S,1D	1S,1D			1S,1D	1S,1D	1S,1D		***14***
WC1	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	2S	2S	2S,2D	1S,2S,1D,2D	2S	1D,2D	***27***
WC2	2S,2D	2S,2D	2S,2D	2S,2D				2S,2D			***10***
WC3	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D			1D	1S,2S,1D,2D			***21***
ABCC	2S,1D	2S,1D	2S,1D	2S,1D	2S	2S	2S	2S,1D			***13***
PCC	2S,2D	2S,2D	2S,2D	2S,2D			2D	2S,2D		2D	***12***
SGR	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D				1S,2S,1D,2D	2S,1D,2D		***23***
BAL	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S	1S	1S	1S,2S,1D,2D			***23***
BOQ	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S	1S	1S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D		***29***
SAR	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	1S,2S,1D,2D	2S	2S	2S	1S,2S,1D,2D	1S,2S,2D		***26***
LAR1	1S,2S,1D	1S,2S,1D	1S,2S,1D	1S,2S,1D			1S	1S,2S,1D	1S		***17***
LAR3	1D	1D	1D	1D				1D			***5***
LAR4	1D	1D	1D	1D			1D	1D	1D		***7***
SDR1	1D	1D	1D	1D				1D			***5***
SDR4*	2S,1D	2S,1D	2S,1D	2S,1D				2S,1D			***10***
CHO*/TCC	2S,1D	2S,1D	2S,1D	2S,1D			1D	2S,1D			***11***
SC3 BMP	1D,2D	1D,2D	1D,2D	1D,2D							***8***
WC3 BMP	1D,2D	1D,2D	1D,2D	1D,2D							***8***
Filt #1	1S,2S,1D,2D			1S,2S,1D,2D					1S,2S,1D,2D		***12***
Filt #2	1S,2S,1D,2D			1S,2S,1D,2D					1S,2S,1D,2D		***12***
FMS				1S,2S,1D,2D							***4***
FMS Dup				1S,2S,1D,2D							***4***
Total	***70***	***62***	***62***	***78***	***8***	***5***	***21***	***58***	***31***	***5***	**400**

1D – 1st Dry, 2D – 2nd Dry, 1S – 1st Storm, 2S – 2nd Storm
BU – Backup, PY- Pyrethroid, LC- Liquid Chromatography, TSS-total suspended Solids, DN- Dinitroaniline, Neo- Neonicotinoids, GLY- Glyphosate, PX – Phenoxy, SED-Sediment, TOX-Toxicity, Filt-Filtered, FMS-Field Metrix Spike, FMSD-Field Matrix Spike Duplicate

Table 3. Toxicity sampling schedule: sites will be rotated.

Site	***H. azteca***	***C. dilutus***	**Total**
SC1			
SC2			
SC3	1S,2S,2D	1S,2S,2D	***6***
SC4	1S	1S	***2***
SC7	1S,2S,1D,2D	1S,2D	***6***
DC			
WC1	2S	2S	***2***
WC2			
WC3			
ABCC			
PCC			
SGR	2S,1D,2D	2D	***4***
BAL			
BOQ	1S,2S,2D	1S,2S,2D	***6***
SAR	1S,2S,2D	2S,2D	***5***
LAR1	1S	1S	***2***
LAR3			
LAR4	1D		***1***
SDR1			
SDR4*			
CHO*/TCC			
SC3 BMP			
WC3 BMP			
Filt #1	1S,2S,1D,2D		***4***
Filt #2	1S,2S,1D,2D		***4***
FMS			
FMS Dup			
Total	***28***	***14***	**42**

1D – 1st Dry, 2D – 2nd Dry, 1S – 1st Storm, 2S – 2nd Storm

Table 4. Non-parametric procedures frequently used for comparing paired data, two samples and three or more samples.

Data	**Non-Parametric Procedure**
Paired data	*Wilcoxon signed-rank test* for uncensored data *Sign test* (modified for ties) for censored data with one reporting limit *Score tests* for censored data with multiple RLs (the PPW test and the Akritas test)
Two samples	*Wilcoxon rank-sum (or Mann-Whitney) test* or *Peto Peto test* for censored data with one reporting limit *Score tests* for censored data with multiple reporting limits (the *Gehan test* and generalized *Wilcoxon test*)
Three or more samples in one-way layout	*Kruskal-Wallis test* (for unordered alternative) or *Jonckheere-Terpstra test* (for ordered alternative) for censored data with one reporting limits *Generalized Wilcoxon score test* for censored data with multiple reporting limits *Multiple comparison* to detect which group is different
Three or more samples in two-way layout	*Friedman's test* (for unordered alternative) or *Page's test* (for ordered alternative) for censored data with one reporting limits Multiple comparison to detect which group is different

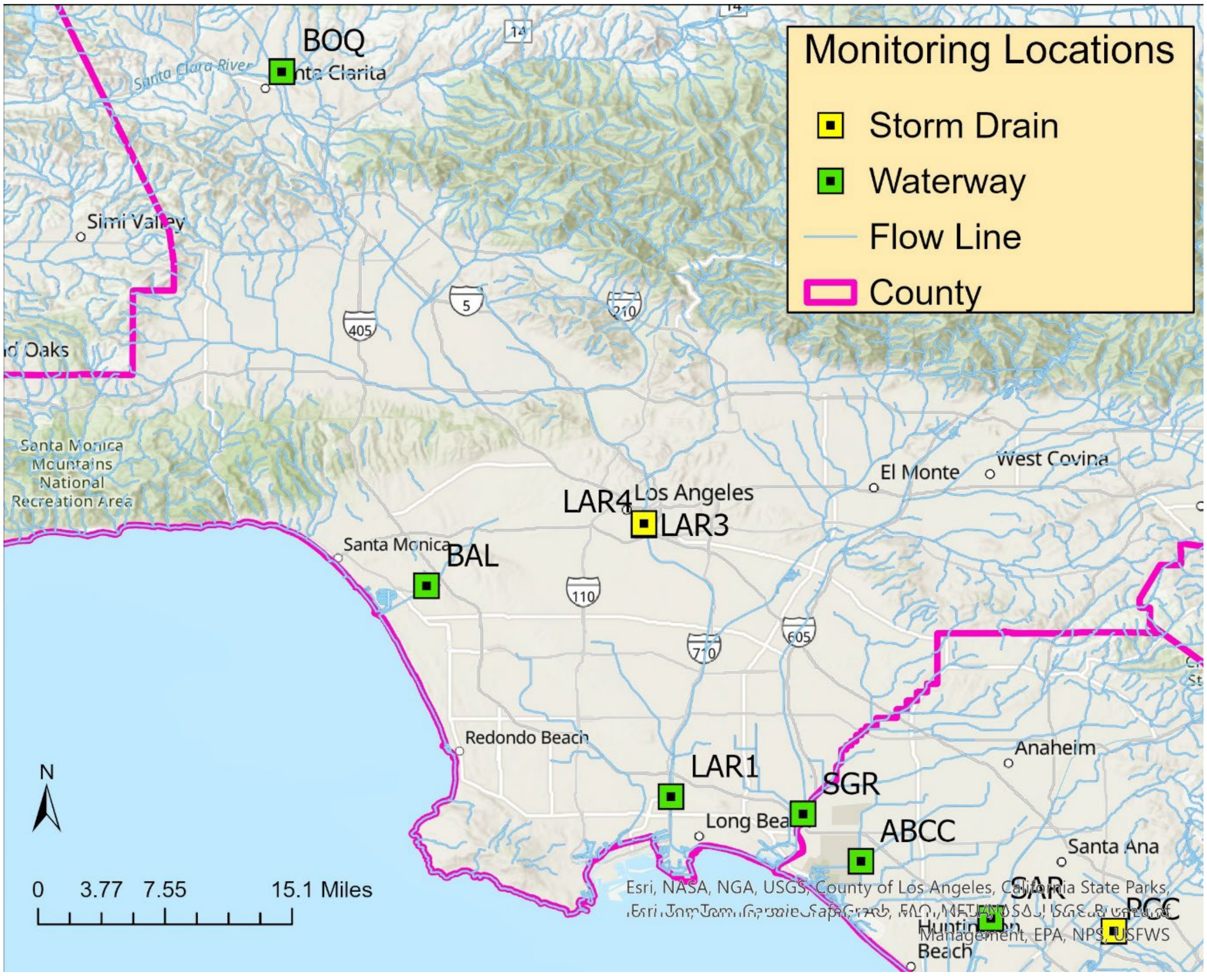

Figure 1. Sampling locations within Los Angeles County, CA.

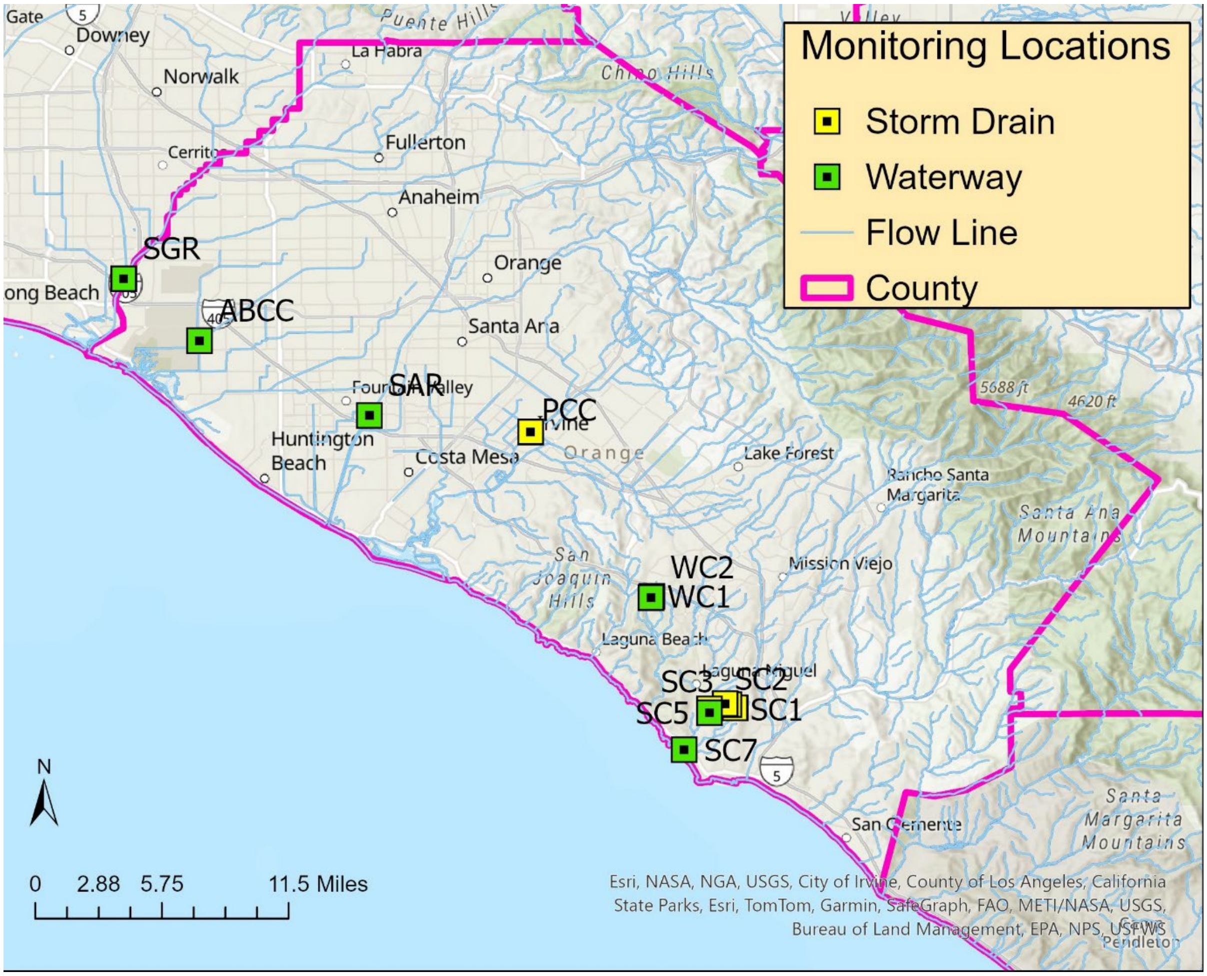

Figure 2. Sampling locations within Salt Creek Watershed, Orange County, CA.

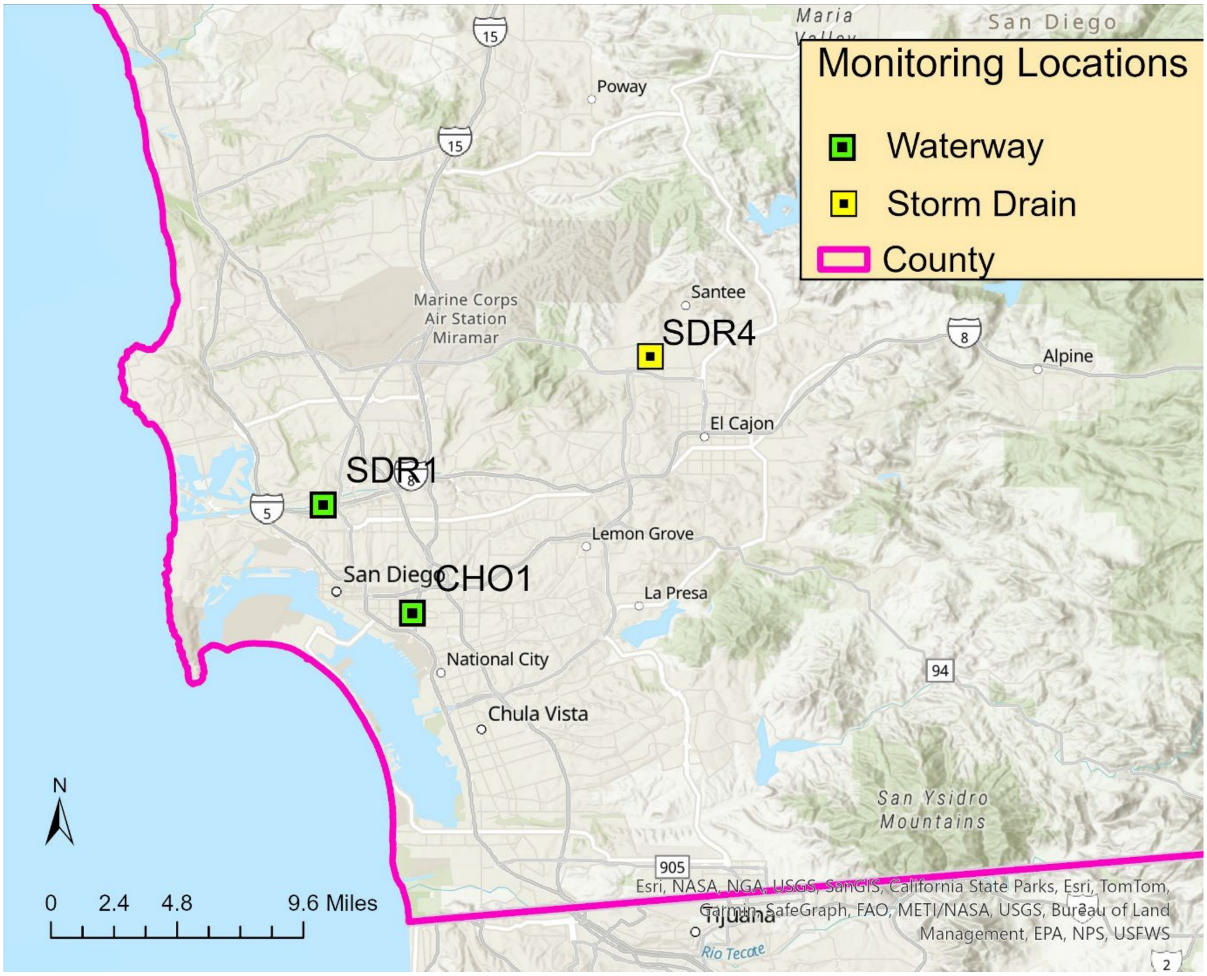

Figure 3. Sampling locations within San Diego County, CA.

9. Appendix

Table A1. Top ten HUC8's identified for urban monitoring in Southern California, ordered by the ranking process (Surface Water Monitoring Prioritization, version 4, Report ran on 9/19/2025).

HUC8 Code	HUC8 Name	DPR Monitoring Location	Comments
18070201	Seal Beach (Anaheim Bay)	ABCC	
18070204	Newport Bay	PCC	
18070105	Los Angeles	LAR1, LAR3, LAR4	
18070104	Santa Monica Bay	BAL	
18070106	San Gabriel	SGR	
18070203	Santa Ana	SAR	
18070304	San Diego	SDR1, SDR4, CHO1, TCC	
18070202	San Jacinto		SWAMP monitoring location along Santa Margarita River *
18070301	Aliso-San Onofre	SC1, SC2, SC3, SC4, SC5, SC7, WC1, WC2, WC3	
18070303	San Luis Rey-Escondido		

*Non-DPR monitoring locations evaluated using California Environmental Data Exchange Network (CEDEN) available at: http://www.ceden.org/

Table A2. Detailed sampling site information

Watershed	Site ID	Northing	Easting	Site type
Salt Creek	SC1	33.303292	-117.412653	Storm drain
	SC2	33.304057	-117.414067	Storm drain
	SC3	33.304302	-117.414955	Storm drain
	SC4	33.303100	-117.422634	Storm drain
	SC5	33.302023	-117.423087	Receiving water
	SC7	33.285397	-117.432655	Receiving water
Ballona Creek	BAL	33.591292	-118.245590	Receiving water
Bouquet Creek	BOQ	34.254205	-118.322345	Receiving water
Los Angeles River	LAR1	33.805809	-118.205453	Receiving water
	LAR3	34.0385676	118.228332	Storm Drain
	LAR4	34.0385676	118.228332	Storm Drain
San Gabriel River	SGR	33.775108	-118.097418	Receiving water
Anaheim-Barber City Channel	ABCC	33.750297	-118.042183	Receiving water
Peters Canyon Channel	PCC	33.690339	-117.824827	Storm drain
Santa Ana River	SAR	33.701233	-117.930629	Receiving Water
San Diego River	SDR4	32.845037	-116.991206	Storm drain
	SDR1	32.455179	-117.101224	Receiving water
Chollas Creek	CHO1	32.704850	-117.121143	Receiving water
Wood Creek	WC1	33.345656	-117.444302	Storm drain
	WC2	33.581583	-117.745772	Wetland outfall
	WC3	33.58157	-117.745727	Storm drain

Table A3. Monitoring Prioritization, SWMP 4.0 Report Summary, shorted by final score. Only final scores greater than 8 shown; Model ran on 9/19/2025.

Chem Code	CHEMNAME	Use	Use Score	Benchmark	Tox Score	Final Score	Recom
2300	BIFENTHRIN	16158	5	5.00E-05	8	40	TRUE
3849	IMIDACLOPRID	18593	5	0.01	7	35	TRUE
2008	PERMETHRIN	13387	5	3.30E-03	7	35	TRUE
2297	LAMBDA-CYHALOTHRIN	9641	4	4.00E-05	8	32	TRUE
3010	DELTAMETHRIN	8402	4	2.60E-05	8	32	TRUE
2223	CYFLUTHRIN	6833	4	1.20E-04	8	32	TRUE
677	CHLOROTHALONIL	34806	5	0.6	5	25	FALSE
3995	FIPRONIL	8455	4	0.01	6	24	TRUE
2321	ESFENVALERATE	2445	3	3.09E-05	8	24	TRUE
2171	CYPERMETHRIN	1817	3	5.00E-05	8	24	TRUE
229	DIQUAT DIBROMIDE	9757	4	0.75	5	20	FALSE
4019	PYRIPROXYFEN	1728	3	0.01	6	18	TRUE
3938	CHLORFENAPYR	9656	4	2.91	4	16	TRUE
211	MANCOZEB	8968	4	1.35	4	16	FALSE
5964	CHLORANTRANILIPROLE	7776	4	3.02	4	16	FALSE
2236	PRODIAMINE	4117	4	1.5	4	16	TRUE
3946	GLUFOSINATE-AMMONIUM	13195	5	72	3	15	TRUE
105	CARBARYL	1955	3	0.5	5	15	TRUE
5598	THIAMETHOXAM	1678	3	0.74	5	15	TRUE
2017	OXADIAZON	831	3	0.88	5	15	TRUE
187	DDVP	500	2	5.80E-03	7	14	TRUE
1696	THIOPHANATE-METHYL	12424	4	90	3	12	FALSE
2308	DITHIOPYR	3592	3	6.11	4	12	TRUE
1929	PENDIMETHALIN	1192	3	5.2	4	12	TRUE
597	TRIFLURALIN	876	3	1.9	4	12	TRUE
367	MALATHION	584	2	0.04	6	12	TRUE
5792	CLOTHIANIDIN	326	2	0.05	6	12	TRUE
5754	NOVALURON	150	2	0.03	6	12	TRUE
3919	HALOSULFURON-METHYL	146	2	0.04	6	12	FALSE
3898	FLUAZINAM	601	2	0.69	5	10	FALSE
3985	PRALLETHRIN	494	2	0.65	5	10	TRUE
2149	SULFOMETURON-METHYL	415	2	0.45	5	10	TRUE
5802	FLUMIOXAZIN	390	2	0.49	5	10	FALSE
231	DIURON	262	2	0.13	5	10	TRUE
5024	DIFENOCONAZOLE	176	2	0.86	5	10	FALSE
3850	TEBUCONAZOLE	3936	3	11	3	9	TRUE
2170	TRICLOPYR, BUTOXYETHYL ESTER	3535	3	26	3	9	TRUE
2276	PROPICONAZOLE	3133	3	15	3	9	TRUE
1868	ORYZALIN	2327	3	13	3	9	TRUE

Chem Code	CHEMNAME	Use	Use Score	Benchmark	Tox Score	Final Score	Recom
2257	IMAZAPYR, ISOPROPYLAMINE SALT	1747	3	18	3	9	TRUE
4037	AZOXYSTROBIN	1172	3	44	3	9	TRUE
2244	HYDROPRENE	917	3	25	3	9	FALSE

Note: Green highlighted cells indicate pesticides included in current analytical screen.

Table A4. Multianalyte Screen, Method no. EMON-SM-05-037

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Abamectin	Botanical, Macrocyclic Lactone	0.004	0.02
Acetamiprid	Neonicotinoid	0.004	0.02
Atrazine	Triazine	0.004	0.02
Azoxystrobin	Strobin	0.004	0.02
Bensulide	Organophosphorus	0.004	0.02
Boscalid	Carboxamide	0.004	0.02
Bromacil	Uracil	0.004	0.02
Carbaryl	Carbamate	0.004	0.02
Chlorantraniliprole	Anthranilic diamide	0.004	0.02
Chlorpyrifos	Organophosphorus	0.004	0.02
Clothianidin	Neonicotinoid	0.004	0.02
Cyprodinil	Anilinopyrimidine	0.004	0.02
Desulfinyl Fipronil	Fiprole	0.004	0.01
Desulfinyl Fipronil Amide	Fiprole	0.004	0.01
Diazinon	Organophosphorus	0.004	0.02
Diflubenzuron	Benzoylurea	0.004	0.02
Dimethoate	Organophosphorus	0.004	0.02
Diuron	Urea	0.004	0.02
Ethoprop	Organophosphorus	0.004	0.02
Etofenprox	Pyrethroid Ether	0.004	0.02
Fenamidone	Imidazole	0.004	0.02
Fenhexamid	Hydroxyanilide	0.005	0.02
Fipronil	Fiprole	0.004	0.01
Fipronil Amide	Fiprole	0.004	0.01
Fipronil Sulfide	Fiprole	0.004	0.01
Fipronil Sulfone	Fiprole	0.004	0.01
Fludioxonil	Unclassified	0.004	0.02
Hexazinone	Triazinone	0.004	0.02
Imidacloprid	Neonicotinoid	0.004	0.01
Indoxacarb	Oxadiazine	0.004	0.02
Isoxaben	Amide	0.004	0.02
Kresoxim-methyl	Strobin	0.004	0.02
Malathion	Organophosphorus	0.004	0.02
Mefenoxam	Xylylalanine	0.004	0.02
Methidathion	Organophosphorus	0.004	0.02
Methomyl	Carbamate	0.004	0.02
Methoxyfenozide	Diacylhydrazine	0.004	0.02
Metribuzin	Triazinone	0.004	0.02
Norflurazon	Pyridazinone	0.004	0.02
Oryzalin	2,6-Dinitroaniline	0.004	0.02
Oxadiazon	Unclassified	0.004	0.02

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Prometon	Triazine	0.004	0.02
Prometryn	Triazine	0.004	0.02
Propanil	Anilide	0.004	0.02
Propargite	Unclassified	0.004	0.02
Propiconazole	Azole	0.004	0.02
Pyraclostrobin	Strobin	0.004	0.02
Pyriproxyfen	Juvenile hormone mimic	0.004	0.015
Quinoxyfen	Quinoline	0.004	0.02
Simazine	Triazine	0.004	0.02
S-Metolachlor	Chloroacetanilide	0.004	0.02
Tebuconazole	Azole	0.004	0.02
Tebufenozide	Diacylhydrazine	0.004	0.02
Tebuthiuron	Urea	0.004	0.02
Thiabendazole	Benzimidazole	0.004	0.02
Thiacloprid	Neonicotinoid	0.004	0.02
Thiamethoxam	Neonicotinoid	0.004	0.02
Thiobencarb	Thiocarbamate	0.004	0.02
Trifloxystrobin	Strobin	0.004	0.02

Table A5. Pyrethroid Screen, Method no. EMON-SM-05-022

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Bifenthrin	Pyrethroid	0.00091	0.001
Cyfluthrin	Pyrethroid	0.00146	0.002
Cypermethrin	Pyrethroid	0.00154	0.005
Deltamethrin/Tralomethrin	Pyrethroid	0.00177	0.005
Fenvalerate/Esfenvalerate	Pyrethroid	0.00166	0.005
Lambda-cyhalothrin	Pyrethroid	0.00174	0.002
Permethrin cis	Pyrethroid	0.00105	0.002
Permethrin trans	Pyrethroid	0.00105	0.005

Table A6. Phenoxy Screen, Method no. EMON-SM-05-012

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
2,4-D	Phenoxy	0.015	0.05
Dicamba	Benzoic acid	0.017	0.05
MCPA	Phenoxy	0.022	0.05
Triclopyr *	Pyridine	0.02	0.05

Table A7. Dinitroaniline Screen, Method no. EMON-SM-05-006

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Oxyfluorfen	Dinitroaniline	0.01	0.05
Pendimethalin	Dinitroaniline	0.012	0.05
Prodiamine	Dinitroaniline	0.012	0.05
Trifluralin *	Dinitroaniline	0.014	0.05
Chlorfenapyr	Pyrrole	0.0333	0.10

Table A8. Sediment Pyrethroid Screen, Method no. EMON-SM-52-9

Pesticide	Pesticide Class	Method Detection Limit (µg/kg)	Reporting Limit (µg/kg)
Bifenthrin	Pyrethroid	0.108	1
Cyfluthrin	Pyrethroid	0.183	1
Cypermethrin	Pyrethroid	0.107	1
Deltamethrin/Tralomethrin	Pyrethroid	0.0661	1
Fenvalerate/Esfenvalerate	Pyrethroid	0.0661	1
Lambda-cyhalothrin	Pyrethroid	0.115	1
Permethrin cis	Pyrethroid	0.116	1
Permethrin trans	Pyrethroid	0.135	1

Table A9. Neonicotinoids Screen, Method no. EMON-SM-05-052

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Clothianidin	Neonicotinoid	0.00071	0.02
Dinotefuran	Neonicotinoid	0.00074	0.02
Sulfoxaflor	Neonicotinoid	0.00137	0.02

Table A10. Glyphosate Screen, Method no. EMON-SM--050046

Pesticide	Pesticide Class	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
AMPA	Phosphonate	0.02786	0.20
Glufosinate	Organophosphate	0.01154	0.07
Glyphosate	Phosphonate	0.00495	0.07

*Full analytical methods are available at: **Analytical Method Page on DPR Website**