LAKE COUNTY MUNICIPAL STORM SEWER PROGRAM (MS4) MONITORING PLAN 2021 – 2026

For the Jurisdictions of County of Lake, City of Lakeport and City of Clearlake

SUMMARY

This document outlines the methods that Lake County, the City of Lakeport, and the City of Clearlake use to satisfy the requirements set forth by the MS4 Phase II General Permit, Clear Lake's TMDL for nutrients, and Resolution R5-2017-0057.

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Lake County Clean Water Program

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List of Acronyms

BLM – Bureau of Land Management

BMP – Best Management Practice

CFR – Code of Federal Regulations

CFS – Cubic Feet per Second

CL1 – The representative site for the City of Clearlake

COC – Chain of Custody

CO1 – The representative site for Clearlake Oaks

CR1 – The representative site for Clearlake Riviera

CWA – Clean Water Act

DO – Dissolved Oxygen

DOC – Dissolved Organic Carbon

DWR – Department of Water Resources

EC – Electrical Conductivity

HUC – Hydrologic Unit Code

HVL1 – The representative site for Hidden Valley Lake

K1 – The representative site for Kelseyville

LA – Load Allocation

L1 – The representative site for Lucerne

LL1 – The representative site for Lower Lake

Mg/L – Milligrams per liter

MS4 – Municipal Separate Storm Sewer System

M1 – The representative site for Middletown

NL1 – The representative site for North Lakeport

NOAA – National Oceanic and Atmospheric Administration

NO_3 – Nitrate

NO_2 - Nitrite

NPDES – National Pollution Discharge Elimination System

NTU – Nephelometric Turbidity unit

N1 – The representative site for Nice

POC - Particulate Organic Carbon

RSWMP – Regional Stormwater Management Plan

SB1 – The representative site for Soda Bay

TDS – Total Dissolved Solids

TKN – Total Kjeldahl Nitrogen

TMDL – Total Maximum Daily Load

TN – Total Nitrogen

TOC – Total Organic Carbon

TP – Total phosphorus

TSS – Total Suspended Solids

UL1 – The representative site for Upper Lake

USEPA – The United States Environmental Protection Agency

USFS – United States Forest Service

WLA – Waste Load Allocation

Regional Storm Water Monitoring Program

The City of Lakeport, the City of Clearlake, and Lake County (hereinafter referred to as "co-permittees") joined planning, collaboration, and implementation efforts to establish a Lake County Clean Water Program - Regional Storm Water Monitoring Program (hereinafter referred to as "RSWMP"). Its purpose is to (1) collectively fulfill the requirements set forth by the National Pollution Discharge Elimination System (NPDES) MS4 Phase II general permit and (2) to establish a routine baseline monitoring schedule in accordance with the Total Maximum Daily Load (TMDL) for nutrients in Clear Lake. Results from the baseline monitoring will be used to determine BMP effectiveness and will aid in calculating the percent reduction of sediment phosphorus entering Clear Lake in accordance with TMDL goals.

A separate document, the Pyrethroids Baseline Monitoring Plan outlines the monitoring that will be conducted by the co-permittees to fulfill pyrethroid baseline monitoring requirements set forth by Resolution R5-2017-0057 (Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Pyrethroid Pesticide Discharges).

Program development was inspired by permit language that encouraged jurisdictions to comply collaboratively with regulatory requirements, to promote cost savings through economies of scale while simultaneously protecting valuable aquatic resources in Lake County. The Central Valley Regional Water Board (hereinafter referred to as "the Board") require the co-permittees to decrease sediment nutrient inputs to Clear Lake from urban runoff by 40% through water quality monitoring and the implementation of pollutant controls.

The RSWMP, subject to approval from the Board, satisfies the section E.13 of the NPDES MS4 Phase II general permit and TMDL requirements. Urban storm water site samples will be taken from a combination of stationary samplers, portable handheld meters , and grab samples taken from representative locations in each catchment to assess total phosphorus, nitrate + nitrite (NO_3 + NO_2), total Kjeldahl nitrogen (TKN), total suspended solids (TSS), turbidity, total dissolved solids (TDS) pH, temperature, electrical conductivity (EC), and dissolved oxygen (DO). Field bottle samplers to collect storm water flushes when grab sampling is not feasible will be installed and maintained as appropriate during storm season. These bottles will be retrieved from the field later in the day after the storm event and field safety is evaluated. Additional grab samples and increased monitoring during storm events may be necessary to achieve overall program management goals.

Due to the lack of immediately available resources and an absence of previous urban monitoring data and information (i.e. a MS4 monitoring program has never been implemented in Lake County), the first phase of this monitoring plan is to conduct baseline urban storm water sampling and monitoring to identify downstream locations best suited for continued monitoring. Once this information is collected, downstream sites will be paired with upstream sites to monitor Urban / Rural interface contributions to MS4 runoff. The requirement to sample influent and effluent at specific paired upstream / downstream sites is stated in Table 3: Receiving Water Monitoring Parameters and Protocol in the General Permit (Page 67 in 2018-0007-EXEC version https://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/remediated_phase2ms4permit_v2.pdf). Due to the unique and complex nature and design of the Lake County Clean Water Program MS4 areas situated around the lake and the current lack of previously collected urban storm water quality information, the Clean Water Program coordinating staff cannot appropriately identify and pair upstream monitoring sites at this time. The RSWMP will conduct monitoring in all designated downstream urban storm water sites until 2023 winter season, and then revisit the data to determine if upstream and downstream pairing sites are a well-suited determinant of urban storm water contributions to receiving waterbodies.

While the co-permittees will attempt to maintain the timelines and milestones as listed in this monitoring plan, the ability to meet the staffing and financial burden of complying with the Plan, and related programming, is a constant and consistent challenge. Successful compliance and completion with the plan, along the four-year required timeline will, to a great extent, depend on future natural disaster occurrences and recovery capability that may have significant impact on the availability to support the required monitoring requirements and program maintenance needed to accomplish the goals and deliverables outlined in this plan.

Clear Lake Total Maximum Daily Load

Under the Clean Water Act (CWA) § 303(d), States are required to identify a list of impaired water bodies and develop and implement TMDLs for these water bodies (33 USC § 1313(d)(1)). Clear Lake was listed on the CWA § 303(d) impaired water bodies list in 1986 in direct response to phosphorous-driven nuisance algal blooms in the spring and summer months that impaired recreation and increased treatment costs for drinking water treatment plants. On June 23, 2006, the Board adopted Resolution No. R5- 2006-0060, Amending the Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers Basins for the Control of Nutrients in Clear Lake. The United States Environmental Protection Agency (USEPA) approved a TMDL for Clear Lake on September 19, 2007.

TMDLs are established for all water bodies listed on the CWA § 303(d) list and are accompanied with a pollutant reduction target for both point and nonpoint sources. TMDLs are calculated to reflect the maximum amount of a pollutant allowed to enter a water body to ensure it will meet established water quality standards. TMDL's include the following elements: an analysis to identify sources of pollutants contributing to the impairment, load allocations for different sources (point and non-point sources), an implementation plan, and compliance time schedules. Compliance with TMDL requirements via the reduction of a specified pollutant is expected to result in an improvement in water quality leading to improvements in overall ecosystem health.

Clear Lake has a nutrient TMDL for sediment phosphorus. (Attachment G – TMDLs and Time Schedule Order R5-2019-1005.) Several studies characterized the conditions of Clear Lake and concluded that excess phosphorus contributes to the occurrence of nuisance algal blooms, therefore, controlling external phosphorus loading is the best mechanism to reduce algal blooms in Clear Lake (Horne, 1975; Richerson et al., 1994; Tetra Tech 2004). In recent years, however, studies have shifted the focus to internal phosphorus loading as a major contributor to algal blooms in Clear Lake (Winder, 2010). Many sources of phosphorus have been identified for Clear Lake including urban runoff, grading and construction, timber harvesting, construction, historical mining activities, gravel mining, fertilizer use, and wildfires. The ability to mitigate internal phosphorous loading and related impacts is further reduced through the removal and conversion of wetlands to agriculture or development around the lake; an estimated 85% of the lake's natural wetlands having been removed since post-settlement development initiated (Richerson et al. 2008).

Clear Lake's TMDL load allocation (LA) (Figure 1) is 87,100 kg P/year, an overall reduction of 40% from modelled average annual phosphorus loading. The load is shared between co-permittees, Caltrans, the United States Bureau of Land Management (BLM), the United States Forest Service (USFS), and irrigated agriculture. The co-permittees have a waste load allocation (WLA) of 2,000 kg P/year based on a 5-year rolling average for phosphorus. The RSWMP aims to support the co-permittees compliance with the TMDL WLA. The RSWMP will be revised as needed to meet TMDL WLA requirements.

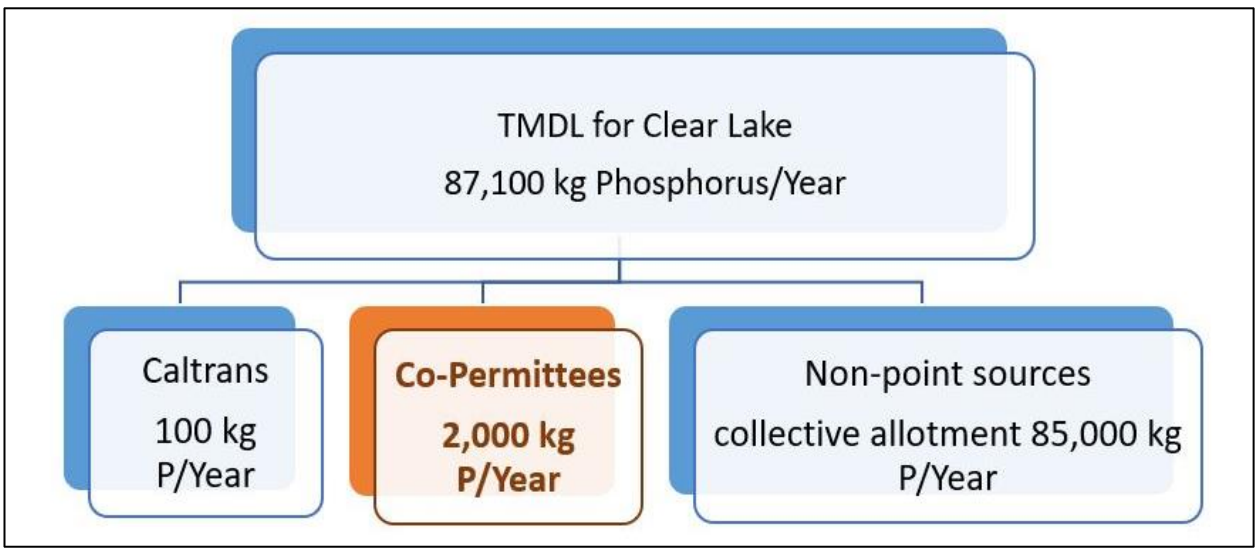


Figure 1 *Conceptual representation of TMDL allotments for Clear Lake. Caltrans and Co-permittees are considered point sources of pollution and have waste allocation allotments (WLA) of 100kg P/year and 2,000kg P/Year, respectively. Non-point sources, including the Bureau of Land Management, the United States Forest Service, irrigated agriculture, and Lake County have a collective load allocation (LA) of 85,000kg P/Year based on a 5-year rolling average.*

Management Questions

The following management questions specified in section E.13 of the permit were used to guide the developments of the RSWMP:

1. Are water quality standards being met in receiving waters?
2. What is the extent and magnitude of the current or potential receiving water problems?
3. What is the relative urban runoff contribution to the receiving water problem(s)?
4. What are the sources to urban runoff that contribute to the receiving water problem(s)?
5. Are conditions in receiving waters getting better or worse?

The RSWMP aims to answer each management question as data from the RSWMP becomes available for analysis. If one or more of these questions cannot be answered after 2023 and the RSWMP is fully implemented, the RSWMP will be modified as necessary to answer all management questions.

Representative MS4 Monitoring Locations

One representative monitoring location was chosen for each catchment subject to the Phase II MS4 permit. The catchments covered by the permit are the City of Lakeport, the City of Clearlake, and several unincorporated areas under Lake County including Clearlake Oaks, Clearlake Riviera, Kelseyville, Soda Bay, North Lakeport, Nice, Lucerne, and Upper Lake. Lower Lake is covered under the Phase II MS4 permit but is not subject to the TMDL requirements for Clear Lake because it drains into Cache Creek - not Clear Lake. However, Lower Lake is included in the RSWMP due to its proximity to Clear Lake. Hidden Valley Lake and Middletown are also covered under the Phase II MS4 permit; however, they are located 10 miles south of Clear Lake in a different watershed. Hidden Valley Lake and Middletown are not included in the RSWMP for TMDL compliance, but representative monitoring locations were selected for these areas to include water quality data from all urban areas under the MS4 permit.

In 2015, the co-permittees collaborated efforts to establish a comprehensive GIS map that outlines all applicable culverts, outfalls, roads, inlets, and parcels covered by the NPDES MS4 Phase II general permit. Using GIS, the co-permittees evaluated HUC 12 watershed boundaries, elevation differences throughout the catchments, drainage patterns (including drain inlet [DI] pipe layout), overland flow on impermeable surfaces, and available sampling locations for each urban catchment area to determine representative sample locations. These sites were then verified by staff field visits and adjusted as needed for accessibility.

Each catchment has unique gradients, watershed boundaries, and drainage patterns, therefore, a combination of the above-mentioned techniques were utilized for each catchment. Each method for selecting the representative sampling location is unique, however, there are similarities in how sampling locations were selected. For example, each urban catchment area that bordered the shoreline of Clear Lake has a representative monitoring location that discharges directly into the lake whereas inland urban catchment areas have sampling locations that discharge into a tributary of Clear Lake.

All representative sampling locations are located down gradient of the most densely-populated portion of the catchment. Each location is at a readily available culvert or outfall, that can be accessed easily and quickly as most sampling will occur at all sites within a short time period. In the event that a representative sampling location is no longer available for sampling due to road construction, natural disaster, or other phenomena, the RSWMP will be revised to reflect these changes. Appendix B describes the methodology used to select representative sample locations in each catchment. Figure 2 is a map that shows the locations of representative sample sites. Table 1 shows the coordinates and nearest address for each representative sample site.

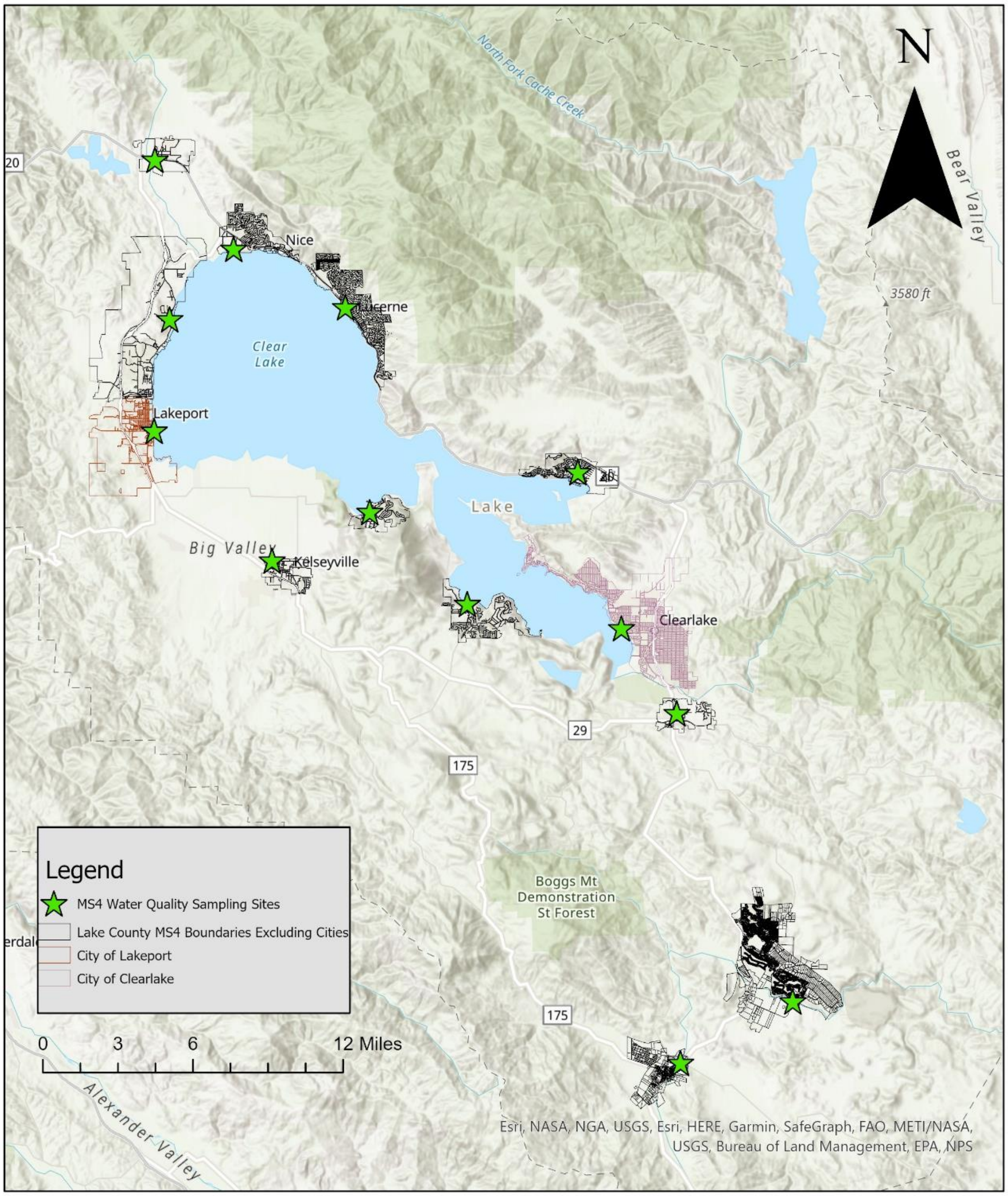


Figure 2 *Lake County MS4 representative urban monitoring sample locations 2021-2026*

Table 1: Representative Monitoring Locations				
Region Name	Site Name	Latitude	Longitude	Closest Address
City of Clearlake	CL1	38.95184	-122.642	14460 Lakeshore Drive, Clearlake, CA
Clearlake Oaks	CO1	39.02295	-122.667	520 Schindler St, Clearlake Oaks, CA
Clearlake Riviera	CR1	38.9628033	-122.731071	9427 Konocti Bay Rd, Kelseyville, CA
Kelseyville	K1	38.98224692	-122.8438834	3616 Merritt Rd, Kelseyville, CA
City of Lakeport	LP1	39.040489	-122.912023	Outfall on First Street, Lakeport, CA
Lower Lake	LL1	38.9137229	-122.609976	9585 Lake St, Lower Lake, CA
Lucerne	L1	39.09584919	-122.8014967	5915 CA-20, Lucerne, CA
Nice	N1	39.12203823	-122.8660893	2503 Lakeshore Blvd, Nice, CA
North Lakeport	NL1	39.09049812	-122.9030792	4220 Lakeshore Blvd, Lakeport, CA
Soda Bay	SB1	39.00403358	-122.7874332	6630 Soda Bay Rd, Kelseyville, CA
Upper Lake	UL1	39.16194759	-122.9115898	9850 Bridge Arbor N, Upper Lake, CA
Hidden Valley Lake	HVL1	38.78406829	-122.5429399	19917 Mountain Meadow S Hidden Valley Lake, CA
Middletown	M1	38.75639598	-122.6078505	St. Helena Creek Rd, Middletown, CA

Data Collection Methods

This section outlines routine monitoring parameters, frequency of sample collection, and methods for making sample determinations. The section satisfies section E.13 – Water Quality Monitoring from the MS4 Phase II General Permit.

To combine and streamline efforts, coordination, credibility, repeatability, and available expertise to conduct sampling, the Cities of Lakeport and Clearlake are contracting with the County of Lake Water Resources Department to conduct sampling at their respective single sample sites.

Routine sampling in accordance with TMDL compliance also satisfies the requirements of section E.13 – Water Quality Monitoring. Additional monitoring may be required at the discretion of the Board per section E.13.b and E.13.c.

Clear Lake's TMDL covers the following urban catchment areas: The City of Lakeport, the City of Clearlake, North Lakeport, Upper Lake, Nice, Lucerne, Clearlake Oaks, Clearlake Riviera, Soda Bay and Kelseyville. Additionally routine monitoring will also occur in Lower

Lake, Hidden Valley Lake, and Middletown, although these portions of the MS4 areas in Lake County fall outside of the TMDL boundaries (or outside the Clear Lake Watershed) but are being included as part of general storm water monitoring. Each urban catchment will be sampled for total phosphorus (TP), nitrate + nitrite (NO_3 + NO_2), total kjeldahl nitrogen (TKN), total suspended solids (TSS), turbidity, total dissolved solids (TDS), pH, temperature, electric conductivity (EC), and dissolved oxygen (DO) during peak storm events. For the purposes of urban runoff TMDL compliance, co-permittees agreed that the following conditions warrant sample collection when the accumulation at the site reaches sample depth sufficient to sample an integrated, mixed grab sample. Due to the flashy tendencies of first flushes and the ephemeral and seasonally dry conditions of both natural and urban streams and ditches within Lake County, staff at County of Lake determined the most likely urban storm water precipitation triggers will include one or any of the following:

- ✓ When rainfall accumulates at the target site with sufficient depth to allow a grab sample or;
- ✓ When rainfall approaches / exceeds one inch in an hour or;
- ✓ When major tributary flow exceeds 100-300 cubic feet per second (cfs).

Samples will be collected during the wet season (October-April). The abovementioned criteria will guide sample collection in the following ways:

1. Each urban catchment will be sampled at the representative sample site. If the representative sample site is routinely or permanently unavailable for sampling, the RSWMP may be revised
2. At least one sampling criteria should be met at the time of sampling
3. Sampling is mandatory for the first storm event of the wet season
4. An additional 4 samples may be taken during the wet season at the discretion of co-permittee staff.
5. If neither criterion is present during the entire wet season, no sampling is required.
6. If a flood is in the forecast, samples should be taken before the peak storm event to avoid safety hazards of high flows.

Because urban drainages and culverts do not have flow gages, co-permittees use publicly available real-time stream flow data provided by a partnership between the United States Geological Survey (USGS) and the California Department of Water Resources (DWR). The California Nevada River Forecast Center website by the National Oceanic and Atmospheric Administration (NOAA) (www.cnrfc.noaa.gov) provides this public data to assist local agents to determine peak storm events, tributary flow, and precipitation patterns over a twelve day period. The website shows six days prior to current conditions and the future forecast for six days. The Co-permittees may supplement the available precipitation data with live flow data in the DWR website for Central Data Exchange (CDEC) (http://cdec.water.ca.gov/dynamicapp/queryGroup?s=MFE). Both data websites will be consistently monitored in the wet season to determine representative sampling events.

At sites where flow cannot be readily determined, and where possible, in ground storm water samplers will be installed to collect first flush water at the 1" accumulation level (unless safety or site-specific conditions preclude this). During the storm year 2021-2022, the monitoring program is being initiated, some troubleshooting and site re-evaluation might be needed.

Sampling Protocols & Analytical Methods

Several analyses will be analyzed by the Alpha Analytical Laboratories. Alpha Analytical Laboratories will provide sample bottles for the analyses conducted at the lab. The various analyses have different hold time ranging from 7-28 days, however, all samples should be kept on ice or refrigerated and delivered or picked up by the lab within 72 hours of the sampling event to ensure the lab has enough time to log and set up the samples. Analytical reports should be provided by Alpha Analytical Laboratories within 10 business days; however, results may be delayed during peak stormwater season. Chain of custody (COC) reports are available on Alpha Analytical Laboratory's website (https://www.alpha-labs.com/forms.html). COC's must be properly relinquished to any additional handlers, transporters, or lab personnel. Samples not analyzed by Alpha Analytical Laboratories have specific instructions for data collection.

Routine MS4 discharge Monitoring

Total phosphorus (TP), nitrate + nitrite (NO_3 + NO_2), and total kjeldahl nitrogen (TKN) samples will be taken by bottle samplers and sent to Alpha Analytical Laboratories, Inc. for analysis via SM4500 (standard method 4500 for stormwater compliance). The bottle requirement is a 1L polyethylene bottle preserved with sulfuric acid (H_2SO_4). The samples have a 28-day hold time. The analysis should be written on the COC as "P Total, N Total". Analytical results will show total phosphorus, nitrate + nitrite, total kjeldahl nitrogen, and total nitrogen (the summation of NO_2+NO_3+TKN) in milligrams per liter (mg/L).

Total suspended solids (TSS) samples will be taken by bottle samplers and sent to Alpha Analytical Laboratories, Inc. for analysis via SM2540 (standard method 2540 for stormwater compliance). The bottle requirement for TSS is a 1-liter unpreserved polyethylene bottle. TP samples have a 7-day hold time. The analysis should be written on the COC as "TSS".

Turbidity will be taken in-house via a HACH2100Q portable turbidimeter. The HACH2100Q comes with three reusable 10mL glass vials for analysis; only one glass vial is used for the analysis. Before sampling, be sure to rinse the sample bottle with deionized water (DI) and wipe the outside of the vial with a lint-free cloth. Turbidity has a 48-hour hold time, so samples must be analyzed as soon as possible after sample collection. Results should be recorded on the field data collection sheet (see Appendix B). In the case where raw turbidity exceeds the meter maximum, dilution protocols will follow the EPA 180.1 method for the HACH 2100Q meter. No dilutions over 75% will be performed as this level of dilution significantly decreases reliability of resulting measure. Refer to the owner's manual for calibration and verification recommendations. It is considered good practice to verify readings with turbidity standards (20NTU, 100NTU, 800NTU) before each use. Records of calibration should be kept on file indefinitely. Do not use expired turbidity standards for calibration and verification. Most turbidity standards contain formaldehyde and are considered a hazardous waste. Dispose of turbidity standards according to state and federal regulations.

Total dissolved solid (TDS), pH, temperature, electric conductivity (EC), and dissolved oxygen (DO) samples will be taken in situ with a YSI Professional Plus probe and meter. The YSI Professional Plus probe and meter is used by dipping the probe directly in the waterway or sample bottle. If a sample bottle is used, ensure it has been rinsed with DI water and never previously held a preservative. Results should be recorded on the field data collection sheet (see Appendix C). Refer to the owner's manual for calibration and verification recommendations. Records of calibration should be kept on file indefinitely. Table 2 outlines the general requirements for routine sampling and Table 3 provides a sample monitoring schedule.

Repeated measures will be collected, and bracket resolutions calculated for at least one site during each sampling event to ensure equipment is collecting accurate and precise readings. This information is collected on the Storm Water Monitoring Datasheet forms in digital flow datasheets and database when and where applicable.

Table 2: Routine Sampling Protocol

#	Constituent	Analyzed by	Method	Bottle Req.	Hold Time	Temp. Req.	Results Recorded
1	Total Phosphorus (TP)	Alpha Analytical Laboratories	SM4500	1-liter poly preserved with H_2SO_4	28 days	4˚C	Analytical Report
2	Nitrate + Nitrite (NO_3 + NO_2)						
3	Total Kjeldahl Nitrogen (TKN)						
4	Total Suspended Solids (TSS)		SM2540	1-liter poly unpreserved	7 days		
5	Turbidity	Field Personnel	HACH2100Q	10mL glass vial	48 hours	N/A	Field Collection Data Sheet, Electronic Datasheet
6	Total Dissolved Solids (TDS)		YSI Professional Plus probe and meter	N/A	N/A		
7	pH						
8	Temperature						
9	Electrical Conductivity (EC)						
10	Dissolved Oxygen (DO)						
	Flow		SonTek Flow Field Meter	N/A	N/A	N/A	Electronic Flow Field Datasheet

Table 3: Routine Sample Schedule

Urban Area	Sample Location	Analyses	Frequency
The City of Clearlake	CL1		
The City of Lakeport	LP1		

North Lakeport	NL1	TP, $NO_3 + NO_2$, TKN, TSS, Turbidity, TDS, pH, Temperature, EC, DO	Peak Storm Events: When rainfall exceeds one inch in an hour www.cnrfc.noaa.gov or; When tributary flow is 200-400 (cfs) http://cdec.water.ca.gov/dynamicapp/queryGroup?s=MFE) Sampling is required for the first storm event. 4 additional samples can be taken at co-permittee staff discretion.
Upper Lake	UL1		
Nice	N1		
Lucerne	L1		
Clearlake Oaks	CLO1		
Lower Lake	LL1		
Clearlake Riviera	CR1		
Soda Bay	SB1		
Kelseyville	K1		

Program Implementation

Due to the geographic extend and spread of the MS4 regions that comprise the co-permittees jurisdictions situated around Clear Lake, it's nearly impossible with the level of staffing at County of Lake and the cities, to conduct urban storm water sampling at all 13 drainage locations at the same time in any given storm event. For the City jurisdictions of Lakeport and Clearlake, with only one representative sample site each, the sampling burden is reduced and they will maintain grab sample procedures. Therefore, five in-ground storm water bottle samplers (Figure 3) are expected to be installed in 2021. The exact number of bottles needed might be 2-3 at each site depending on the amount required for the desired parameters to be analyzed (i.e. more parameters, more volume of sample water to be sent to lab and analyzed). They will be installed at the representative sampling locations in Clearlake Oaks (CLO1), Lower Lake (LL1), Nice (N1), Lucerne (L1) and North Lakeport (NL1). Grab samples will be taken from representative sample locations in Upper Lake (UL1), the City of Lakeport (LP1), the City of Clearlake (CL1), Kelseyville (K1), Soda Bay (SB1), Clearlake Riviera (CR1), Hidden Valley Lake (HVL1), and Middletown (M1). Table 6 shows a tentative budget for Phase I implementation.

Figure 3 Example of in-ground storm water sample bottle located directly outside an urban discharge source.

By 2024, the co-permittees expect to install bottle samplers at all thirteen catchments, or remaining selected sites for downstream-upstream pairing, so that first flush constituents can be sampled evenly and not rely on staffing to respond at abnormal time periods such as between 6pm and 6am. Any additional sampling will be a mix of grab samples, handheld analysis, and probe analysis. Table 6 shows a tentative budget for program implementation and outlines the average annual costs of routine monitoring.

Table 6: Phase I Implementation Budget (Annual cost Range)

Co-Permittee	Item Description	Quantity	Price per sample event	Total - Max	Single Event - Min
City of Lakeport	Total Phosphorus (TP)	7	$ 55.00	$ 385.00	$ 55.00
	Nitrate + Nitrite ($NO_3 + NO_2$), Total Kjeldahl Nitrogen (TKN)	7	$ 85.00	$ 595.00	$ 85.00
	Total Suspended Solids (TSS)	7	$ 35.00	$ 245.00	$ 35.00
	Duplicates (rotating)	7	$ 59.00	$ 413.00	$ 59.00
	In Situ (ph, DO, temp, conductivity, TDS, ammonia), turbidity in house	7	$ 25.00	$ 175.00	$ 25.00
	Labor hours - Planning & Reporting & Data Handling (10 hours per event)	7	$ 710.00	$ 4,970.00	$ 710.00
	Labor Hours - Field (2 staff min, 2 hours each event)	7	$ 284.00	$ 1,988.00	$ 284.00

	Shipping & Handling ($5 per sample lab + dup + WRD)	7	$ 25.00	$ 175.00	$ 25.00
	Accounting	7	$ 100.00	$ 700.00	$ 100.00
			Total for City of Lakeport	**$ 9,646.00**	**$1,378.00**
City of Clearlake	Total Phosphorus (TP)	7	$ 55.00	$ 385.00	$ 55.00
	Nitrate + Nitrite (NO_3 + NO_2), Total Kjeldahl Nitrogen (TKN)	7	$ 85.00	$ 595.00	$ 85.00
	Total Suspended Solids (TSS)	7	$ 35.00	$ 245.00	$ 35.00
	Duplicates (rotating)	7	$ 59.00	$ 413.00	$ 59.00
	In Situ (ph, DO, temp, conductivity, TDS, ammonia), turbidity in house	7	$ 25.00	$ 175.00	$ 25.00
	Labor hours - Planning & Reporting & Data Handling (10 hours per event)	7	$ 710.00	$ 4,970.00	$ 710.00
	Labor Hours - Field (2 staff min, 3 hours each event)	7	$ 426.00	$ 2,982.00	$ 426.00
	Shipping & Handling ($5 per sample lab + DUP+ WRD)	7	$ 25.00	$ 175.00	$ 25.00
	Accounting	7	$ 100.00	$ 700.00	$ 100.00
			Total for City of Clearlake	**$ 10,255.00**	**$ 1,520.00**
Lake County	Total Phosphorus (TP) (9 sites)	7	$ 495.00	$ 3,465.00	$ 495.00
	Nitrate + Nitrite (NO_3 + NO_2), Total Kjeldahl Nitrogen (TKN) (9 sites)	7	$ 765.00	$ 5,355.00	$ 765.00
	Total Suspended Solids (TSS) (9 sites)	7	$ 315.00	$ 2,205.00	$ 315.00
	Duplicates (rotating)	7	$ 175.00	$ 1,225.00	$ 175.00
	In Situ (ph, DO, temp, conductivity, TDS, ammonia), turbidity in house (9 sites)	7	$ 225.00	$ 1,575.00	$ 225.00

	Labor hours - Planning & Reporting & Data Handling (15 hours per event)	7	$ 1,065.00	$ 7,455.00	$ 1,065.00
	Labor Hours - Field (2 staff min, 8 hours each event)	7	$ 1,136.00	$ 7,952.00	$ 1,136.00
	Shipping & Handling ($5 per sample lab + DUP + WRD)	7	$ 50.00	$ 350.00	$ 50.00
	Accounting	7	$ 50.00	$ 350.00	$ 50.00
			Total for Lake County	**$ 29,932.00**	**$ 4,276.00**

RSWMP Revision History

Table 8. Document Revision History

Date Revised	Reviewer(s)	Changes or Comments
Created: May 2020	Rachel Kennard	Established RSWMP program procedures and phased implementation to satisfy Resolution No. R5-2017-0057, TMDL and MS4 Phase II permit requirements.
Aug 18 2020	Angela De Palma-Dow	Adjusted Pyrethroid section and added Basin plan Pyrethroid trigger table 5b. and added labor hours estimates
February 22, 2021	Rachel Kennard	Updated plan to reflect pyrethroid monitoring requirements based on feedback from the Board. Restructured the plan to include pyrethroids monitoring as an appendix.
March 18, 2021	Angela De Palma-Dow	Reviewed and accepted or updated additions or comments from Rachel, added maps and sample locations to Pyrethroid

		appendix, and prepared plan and associated QAPP for contributions from co-permittees at Clearlake and Lakeport.
August 2, 2021	Angela De Palma-Dow	Updated without Pyrethroid program components for updated budget and for review by the Clean Water Program Management Council
September 9, 2021	Angela De Palma-Dow	Budget for monitoring approved by Clean Water Program Management Council

Appendix A: Methodology for Representative Sample Site Selection

The City of Lakeport

LP1 is the representative monitoring location for the City of Lakeport. It will be located at the Forbes Creek outfall in central Lakeport. Forbes Creek is a major tributary into Clear Lake and goes through a densely-populated region of the City. The City of Lakeport is entirely within the HUC 180201160306 (HUC 306) watershed boundary. HUC 306 spans a relatively flat terrain and does not have a single drainage terminus point. Single drainage terminus points in watershed boundaries are typical of watersheds characterized by sharp changes in elevation. Since there are only relatively minor changes in elevation throughout the HUC 306 watershed boundary, drainage is distributed throughout the catchment with an ultimate discharge into Clear Lake that spans the entire shoreline of incorporated Lakeport.

According to City of Lakeport mapping records, two adjoining drainage areas inside Lakeport contribute to Forbes Creek: Forbes Creek Drainage and North Branch of Forbes Creek Drainage. A GIS analysis determined the combined area inside the Lakeport city limits of these two drainages is approximately 640 acres. This total represents approximately 32% of the City's total land area (3.1 sq mi / 1984 acres). The area served by these drainages features a wide variety of improvements including single family dwellings, multi-family dwellings, retail and service commercial uses, fast food restaurants, professional and government offices, parklands and the Lake County Fairgrounds. Forbes Creek is the most significant stormwater outlet in the City of Lakeport and its outfall located south of the terminus of First Street is the best spot for representative monitoring of urban runoff.

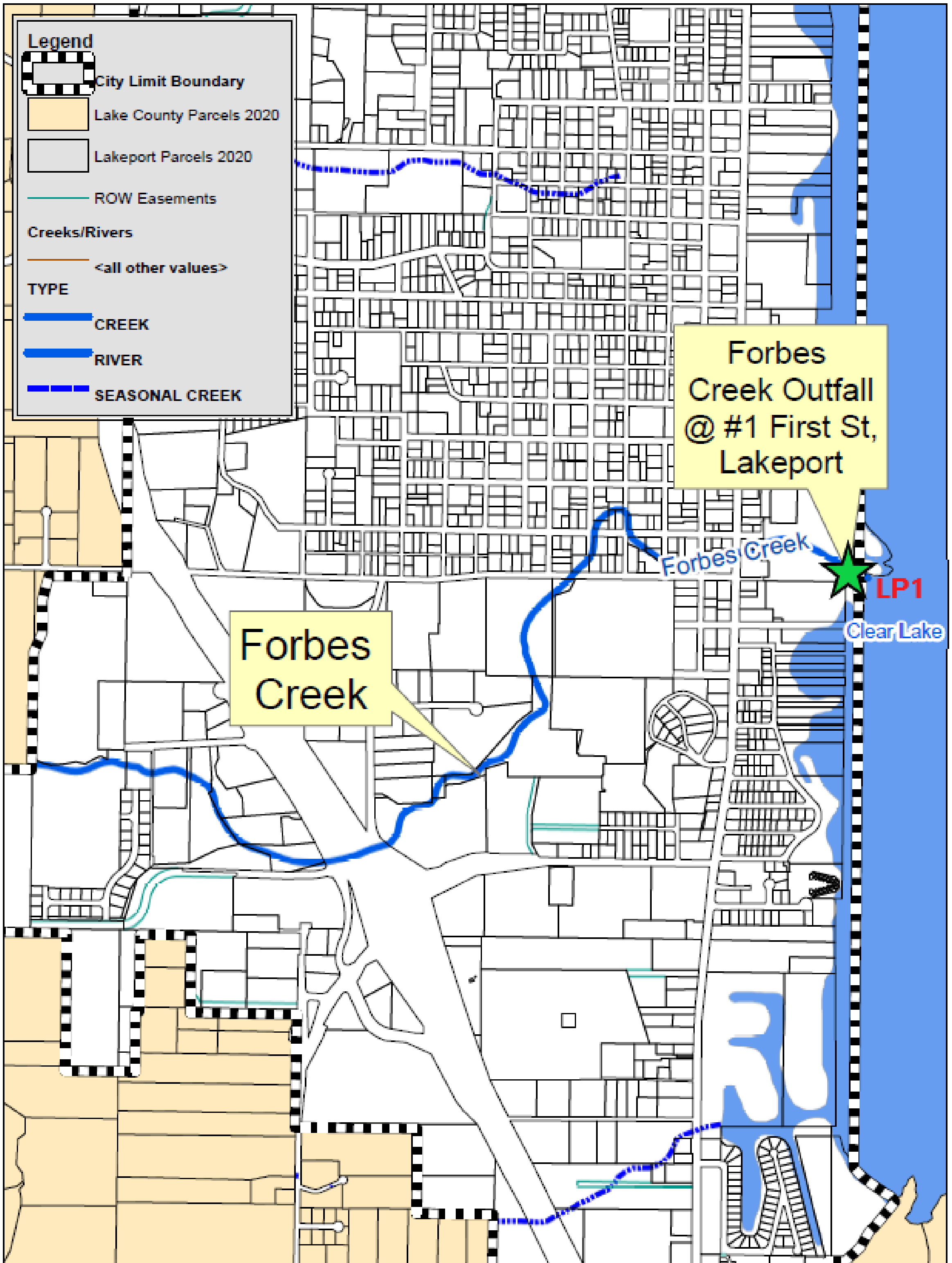


Figure 3: Map showing the representative sample site for urban runoff in the City of Lakeport

The City of Clearlake

CL1 is the representative sample site for the City of Clearlake (see figure 4). The City of Clearlake is the largest city in Lake County. It spans three watershed boundaries: HUC 180201160309 (HUC 309), HUC 180201160310 (HUC 310), and HUC 180201160602 (HUC 602). HUC 309 includes the majority of city and drains into Clear Lake. HUC 310 encompasses a small part of the southern portion of Clearlake and is considered a part of the Clear Lake watershed that includes the entire lake body, and HUC 602 includes the southernmost part of the city and drains into Cache Creek. For the purpose of representative monitoring for the Clear Lake TMDL, the representative sampling location is located in HUC 309. HUC 309 includes the most-densely populated regions of Clearlake and encompasses the vast majority of the city.

The City of Clearlake does not contain any major tributaries into Clear Lake. Directly northeast of the city is the Bald Mountain Range characterized by steep slopes and porous soils. Although the city is backed by a mountain range, the City of Clearlake does not contribute a significant amount of natural runoff mostly due to the porosity of soils in the Bald Mountain range. However, it is the most densely-populated city in the region contributes to urban runoff. A representative monitoring location in Clearlake is best near the densely-populated regions of the city.

The urban area of Clearlake with the highest elevation within HUC 309 is at the intersection of Boyles Avenue and Davis Street (1,579ft) and the points of lowest elevation are at the outfalls that discharge directly into Clear Lake (1,330-1,350ft) for an overall elevation change of 249ft within the urban watershed. The most densely-populated region is the area confined by the intersections of Olympic Drive and Old Highway 53, Old Highway 53 and Lakeshore Drive, and Lakeshore Drive and Olympic Avenue. The Northeastern side of the confined region is composed of a grid structure while the sections closest to Clear Lake are composed of winding roads and larger parcels. The densely populated grid structure drains south through a series of culverts until it reaches Mullen Avenue where is changes directions (southwest) until it drains into Clear Lake. CL1 is located at the bottom of Mullen Avenue. The closest address is 14460 Lakeshore Drive, Clearlake, CA 95422. CL1 is representative for the City of Clearlake because it follows the path of least resistance for the densely-populated grid section and discharges directly into Clear Lake.

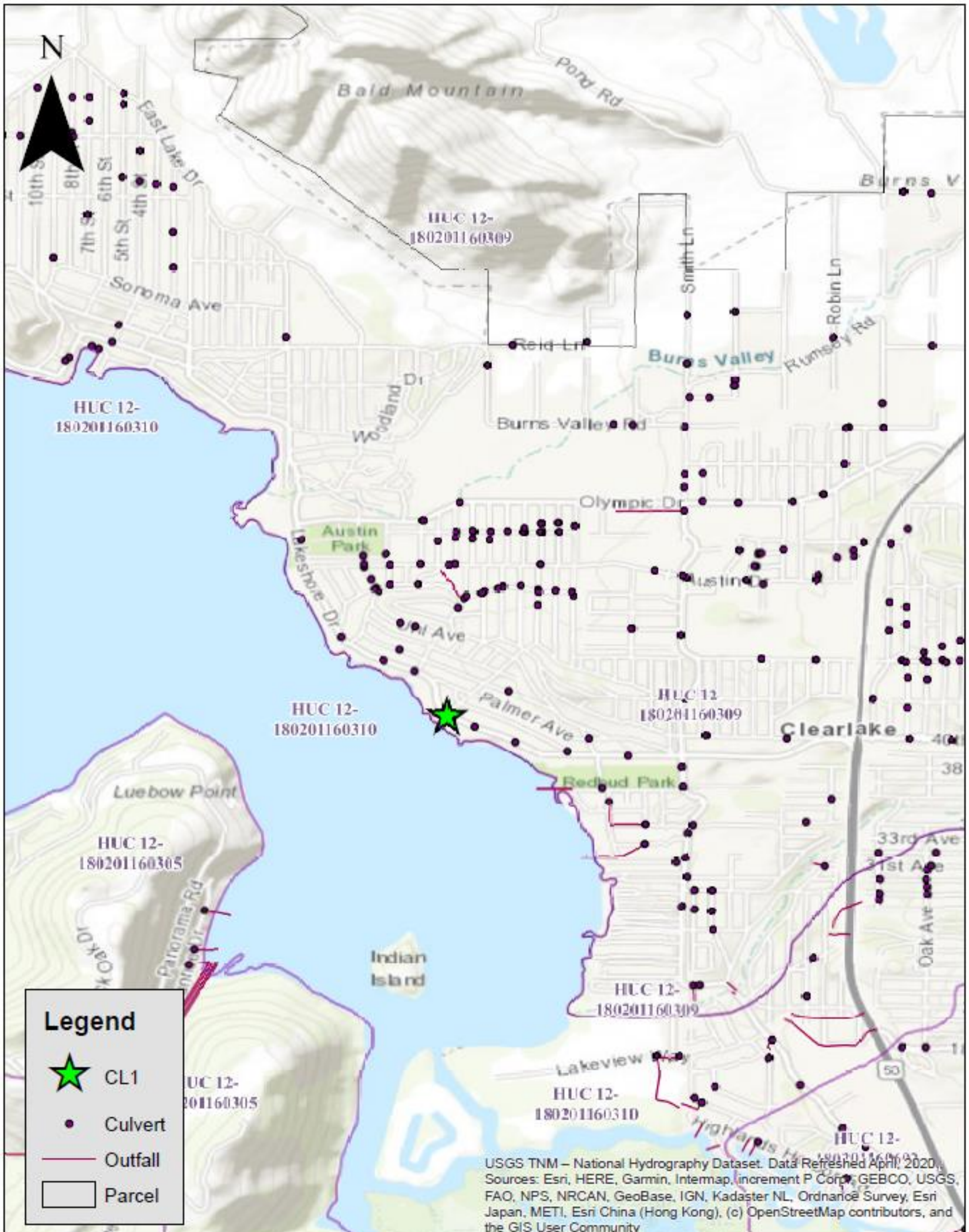


Figure 4: Map showing the representative sample site for urban runoff in the City of Clearlake.

Lake County

This section describes the urban catchment areas and representative monitoring locations for the regions in the MS4 regulated under Lake County. The urban systems subject to TMDL requirements are Clearlake Oaks, Clearlake Riviera, Kelseyville, Lucerne, Nice, North Lakeport, Soda Bay, and Upper Lake. Lower Lake is not subject to current TMDL requirements because, according to the Tetra Tech report forming the TMDL basis, Lower Lake drains into Cache Creek. However, the co-permittees included Lower Lake in the TMDL monitoring program because it is a significant urban center in Lake County. Hidden Valley Lake and Middletown are covered under the MS4 but are not subject to TMDL requirements. Catchment basin descriptions for Hidden Valley Lake and Middletown are discussed in the Supplemental Water Quality Monitoring Program section.

Clearlake Oaks

CO1 is the representative sample site for Clearlake Oaks (see figure 5). Clearlake Oaks is entirely within the HUC 180201160308 (HUC 308) watershed boundary. This region of HUC 308 spans a gradual slope with the highest points in the northernmost points of the urban area and the lowest points near Clear Lake. Clearlake Oaks contributes the least amount of runoff into Clear Lake as compared to other catchment basins addressed in this plan. Most of the drainage occurs on the northeastern side of the lake mostly due to the Mendocino National Forest and the many tributaries that feed the lake. Clearlake Oaks is characterized by a region with little natural drainage; the only significant tributary is Schindler Creek that bisects the most populated area of Clearlake Oaks.

The outfall with the lowest elevation that can be representative of urban runoff is CO1 located near 510 Schindler St, Clearlake Oaks, CA 95423. Clearlake Oaks is unique in that its most densely-populated region is structured in a marina-like setting where a majority of the population has waterfront property. The community layout is a tree-branching system where streets with waterfront property on both sides branch from a landlocked region forming a labyrinth of peninsulas. Storm water should not be monitored on the peninsulas because the water will only represent a small section of the community.

The landlocked region just above the marina-like community is also densely-populated and Schindler Creek runs through the middle of the urban center. The highest elevation in the landlocked region is at the top of Schindler Street at 1,351ft. CO1 is at the end of Schindler Street; water that drains from CO1 discharges into Schindler Creek. CO1 is representative for Clearlake Oaks because it passes through a densely-populated region and discharges directly into a tributary of Clear Lake.

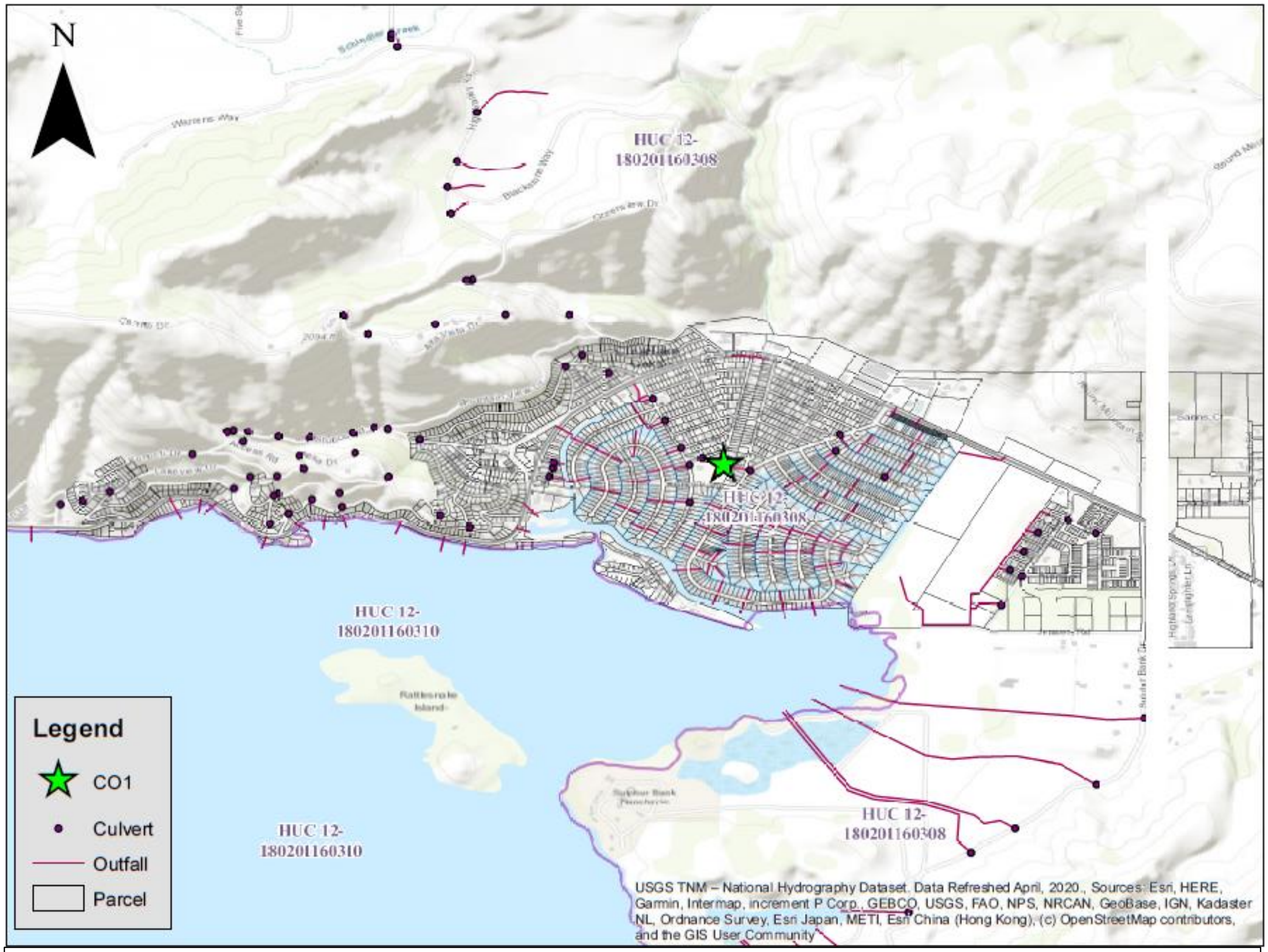


Figure 5: Map showing the representative sample site for urban runoff in Clearlake Oaks.

Clearlake Riviera

CR1 is the representative sample site for Clearlake Riviera (see figure 6). Clearlake Riviera is mostly within the HUC 180201160305 (HUC 305) watershed boundary, with the southwest corner located in HUC 180201160301 (HUC 301). HUC 301 and HUC 305 meet at a high point in the landscape (2,000ft); HUC 301 drains away from Clear Lake toward Ely Flat and HUC 305 drains towards Clear Lake. HUC 305 has steep slopes with the highest points in the southwestern points of the urban area (2,000ft) and the lowest points near Clear Lake (1,400-1,600ft).

The outfall with the lowest elevation that can be representative of urban runoff is CR1 located the intersection of Sequoia Road and Cascade Way (1,422ft). There are 11 outfalls that drain into Clear Lake that range from 1,422-1700ft, However, there is a dip in the landscape at the intersection of Point Lakeview Road and Hawaina Way where storm water accumulates. Several grassy areas were constructed to handle the stormwater in this area. As a result, many of the outfalls northeast of this intersection only represent a small portion of the urbanized area since there is an interruption of overland flow.

There are two main roads in Clearlake Riviera, Soda Bay Road, and Point Lakeview Road. Since most of the drainage for Point Lakeview Road drains into grassy areas, the representative monitoring location should represent runoff from the urban areas around Soda Bay Road. In addition, several of the most densely populated regions have connector outfalls that lead to CR1. CR1 is representative for urban runoff in Clearlake Riviera because it is likely to capture urban runoff from stormwater from urban runoff on Soda Bay Road and is the lowest point before urban storm water discharges into Clear Lake.

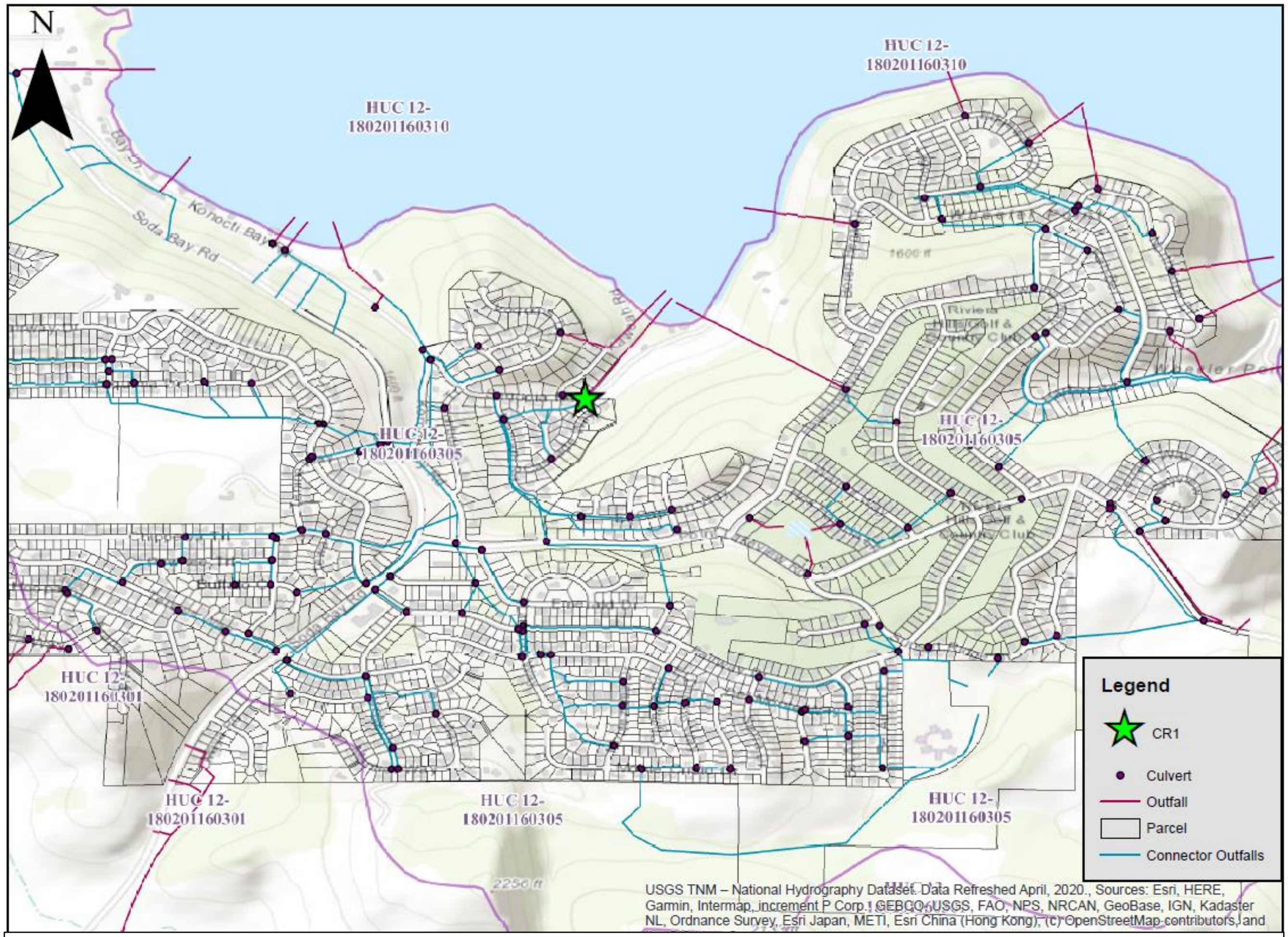


Figure 6: Map showing the representative sample site for urban runoff in Clearlake Riviera.

Kelseyville

K1 is the representative sample site for Kelseyville (see figure 7). Kelseyville is west of Mt. Konocti. Roughly two thirds of Kelseyville is within the HUC 180201160303 (HUC 303) watershed boundary, with the eastern one third of the region in HUC 180201160302 (HUC 302). The representative sample location is in HUC 303 because the most densely-populated region of Kelseyville is in HUC 303, it encompasses the majority of Kelseyville, and it has a defined drainage terminus into Clear Lake. HUC 302 has a wider drainage area with a significant amount of rural land before it reaches the lake, which means sediments are likely to settle out before discharge into the lake. Both Cobb Creek and Kelsey Creek run through the urban areas of Kelseyville; both creeks are significant tributaries to Clear Lake. Cobb Creek is located in HUC 302 and Kelsey Creek is located in HUC 303. Kelsey Creek contributes more sediment to Clear Lake than Cobb Creek because of the distinct narrow terminus of HUC 303 into the Lake. HUC 302, which encompasses the urban portion of Cobb Creek, has a larger, less distinctly sharp drainage basin. K1 is located at the outfall closest to 5185 Gunn St, Kelseyville, CA 95451. The catches the overland flow from the most densely-populated area of Kelseyville and discharges directly into Kelsey Creek.

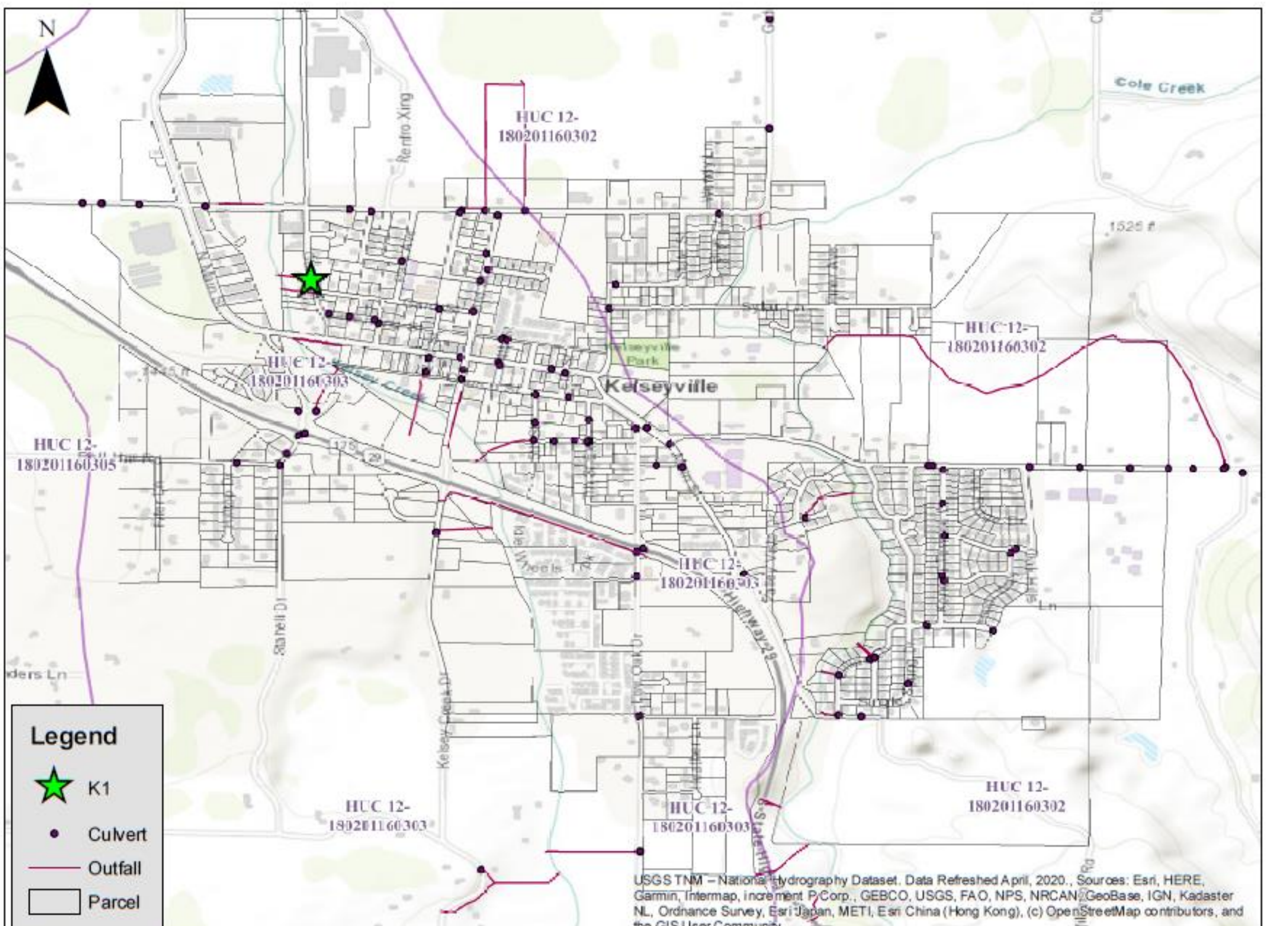


Figure 7: Map showing the representative sample site for urban runoff in Kelseyville.

Lower Lake

LL1 is the representative sample site for Lower Lake (see figure 8). The western side of Lower Lake is in the HUC180201160602 (HUC 602) watershed and the eastern side of Lower Lake is in the HUC180201160601 (HUC 601) watershed. Both HUC 601 and 602 drain into Cache Creek, the only outfall for Clear Lake. A significant portion of the urbanized area is located in HUC 601; however, it is primarily residential and there is an abundance of vegetative buffer land that surround Copsey Creek before it drains into Cache Creek. The urban areas in HUC 602, however, is a mix of residential and commercial and has noticeably less vegetative buffer land protecting the Seigler Canyon Creek before it drains in Cache Creek. Therefore, LL1 is located in HUC 602.

Seigler Canyon Creek travels north through the urban area of Lower Lake until it discharges into Cache Creek. The southernmost region of the urban area that influences LL1 is located at the intersection of Main Street and Lake Street (1,377ft). LL1 is located at the outfall on Jessie Street (the closest address is 9585 Lake St, Lower Lake, CA 95457) at 1,357ft. LL1 is representative for Lower Lake because it will capture storm water from the most densely-populated urban area and discharges into a tributary of Cache Creek.

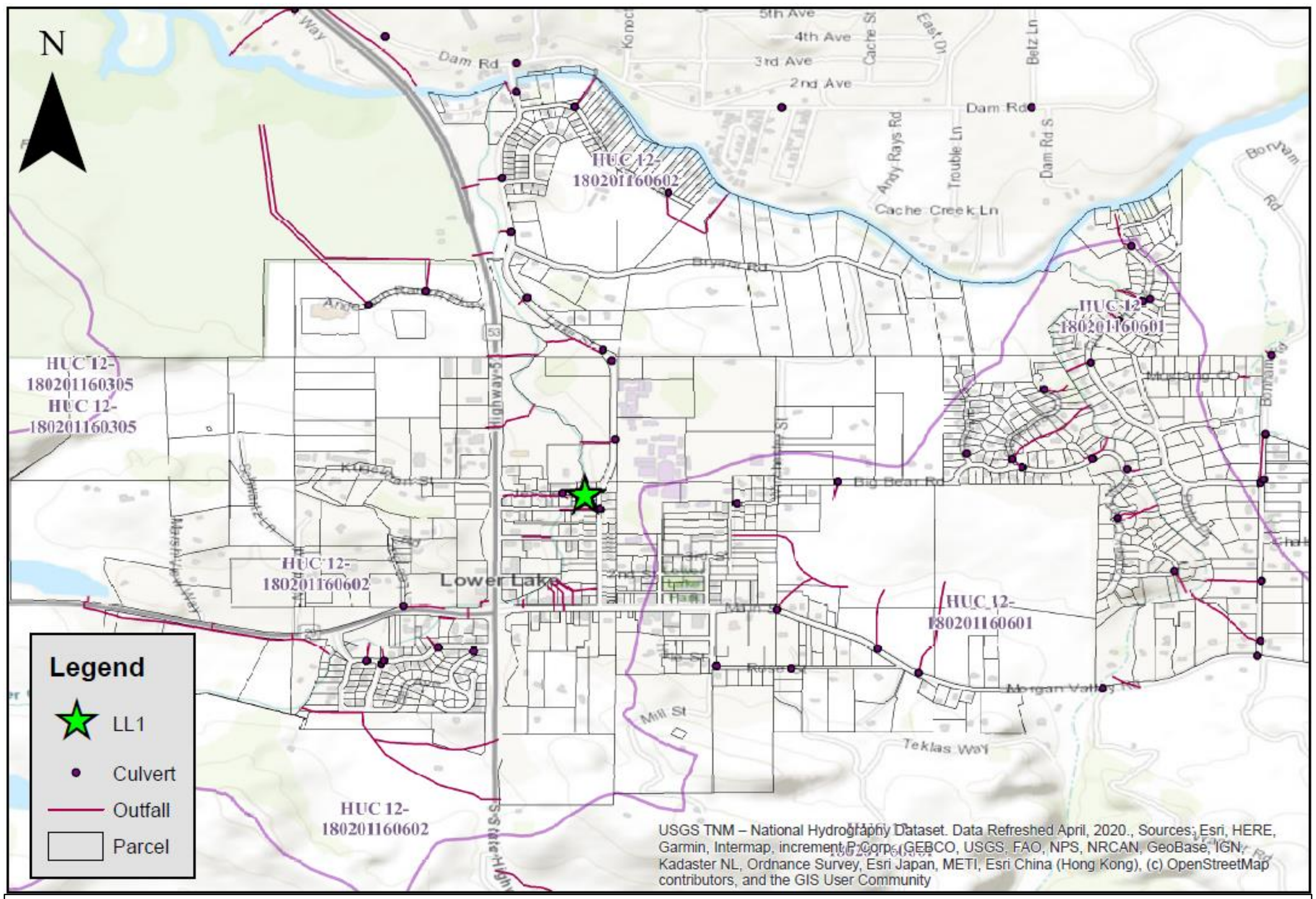


Figure 8: Map showing the representative sample site for urban runoff in Lower Lake.

Lucerne

L1 is the representative sample site for Lucerne (see figure 9). Lucerne is entirely within the HUC 180201160307 (HUC 307) watershed boundary. This region of HUC 307 spans a gradual slope with the highest points in the Mendocino National Forest and the lowest points near Clear Lake. The Mendocino National Forest mountain range located northeast of Lucerne creates several drainage points that span the shoreline of Lucerne. The point of highest elevation in the urbanized area is the peak of Foothill Drive (the closest address is 4240 Foothill Drive, Lucerne, CA) at 1,368ft. Outfalls that drain into Clear Lake range from 1,324-1,360ft for an overall elevation change of 61ft throughout the urban area.

There are 40 outfalls in Lucerne that terminate in Clear Lake. Each outfall's elevation was mapped using the USGS elevation map (TNM Elevation, 2020) to determine the range of outfall elevations. Elevations ranged from 1,324-1,360 feet for an overall difference of 35ft. The outfall with the lowest elevation is likely to be the most representative of storm water quality due to a higher volume and velocity of storm water passing through the points during storm events and additional flow from other urban areas (streets, roads) terminating at lower elevations. However, outfalls with the lowest elevations in Lucerne are located in the northeastern reaches of Lucerne which are less-populated and cannot be representative of urban runoff.

The outfall with the lowest elevation that can be representative of urban runoff is L1 located nearest 6044 State Hwy 20, Lucerne, CA 95458. L1 has an elevation of 1,333ft and is below the highest point of Lucerne (4240 Foothill Drive). Lucerne's main urban center is composed of grid streets numbered from 1st to 17th. The grid has 16 numbered streets perpendicular to Clear Lake and two streets that mark the start and end of each numbered street (Highway 20 and Country Club Drive). L1 is at the end of 3rd avenue, where drainage from the highest point in Lucerne is likely to travel. The second highest peak in Lucene is at the top of Highland Avenue at 1,351ft. Highland Avenue starts above 1st Avenue and terminates at 5th Avenue. Storm water that flows from this point travels south down the impervious street until it reaches 3rd Avenue where it will change direction (southeast) and drain into Clear Lake. L1 is representative for Lucerne because it is likely to capture storm water from the two highest points in the system that run through urban areas.

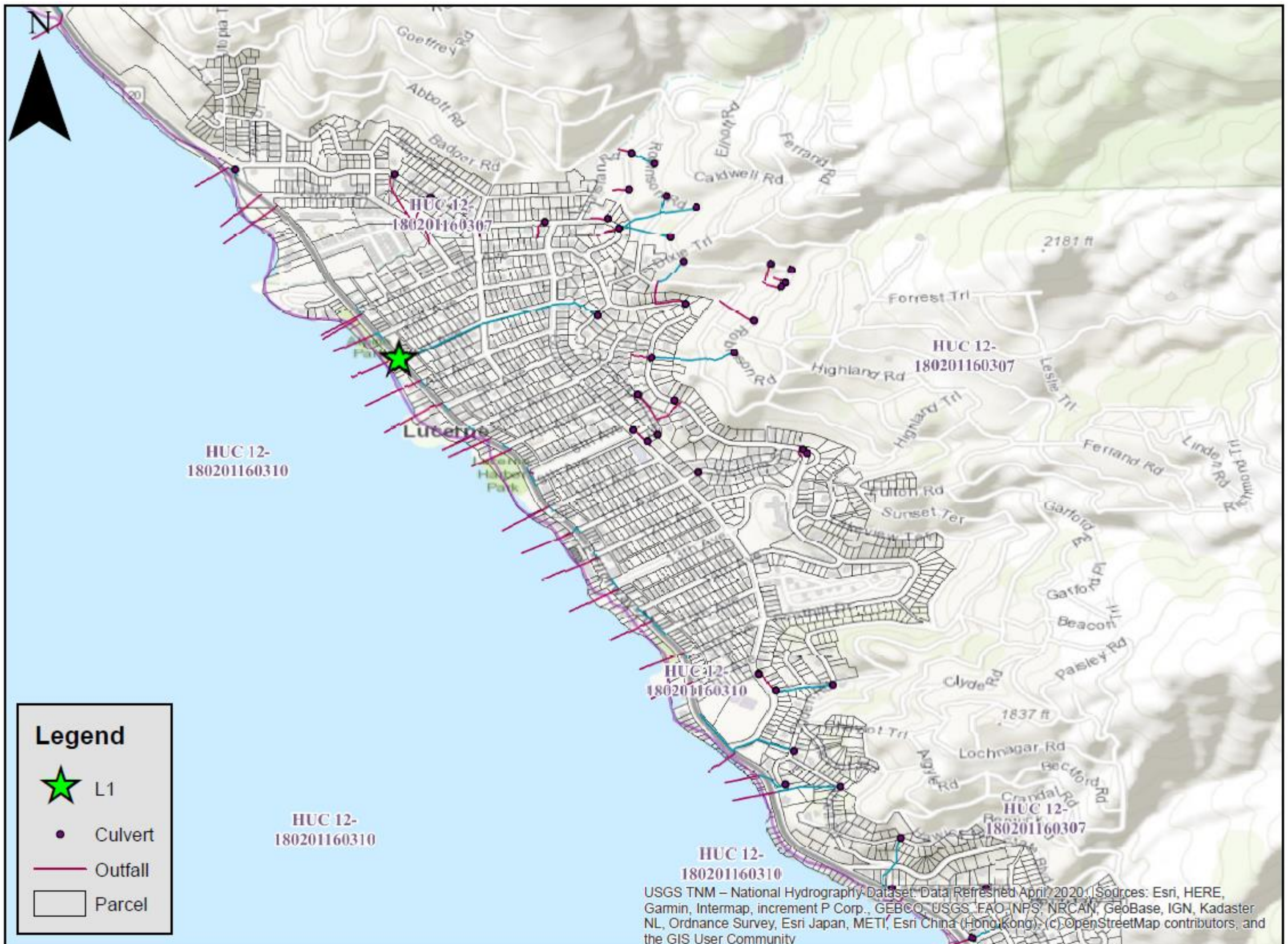


Figure 9: Map showing the representative sample site for urban runoff in Lucerne.

North Lakeport

NL1 is the representative sample site for North Lakeport (see figure 10). North Lakeport is entirely within the HUC 180201160306 (HUC 306) watershed boundary. HUC 306 spans a relatively flat terrain and does not have a single drainage terminus point. Single drainage terminus points in watershed boundaries are typical of watersheds characterized by sharp changes in elevation. Since there are only small changes in elevation throughout the HUC 306 watershed boundary, drainage is evenly distributed throughout the catchment with an ultimate discharge into Clear Lake that spans the entire shoreline of North Lakeport.

There are 34 outfalls in North Lakeport that terminate in Clear Lake. Each outfall's elevation was mapped using the USGS elevation map (TNM Elevation, 2020) to determine the range of outfall elevations. Elevations ranged from 1,329-1,336 feet for an overall difference of 7ft. The outfall with the lowest elevation is likely to be the most representative of storm water quality due to a higher volume and velocity of storm water passing through the points during storm events and additional flow from other urban areas (streets, roads) terminating at lower elevations. However, outfalls with the lowest elevations in North Lakeport are located in rural areas composed of large parcels with open natural chaparral lands. The overall goal of the urban water quality monitoring program is to measure the phosphorus output from urban areas, so the outfalls with the lowest elevation cannot be considered for representative monitoring.

The outfall with the lowest elevation that can be representative of urban runoff is NL1 located at 4252 Lakeshore Blvd, Lakeport, CA 95453. This location has an elevation of 1,331ft and is directly below the most densely-populated area of North Lakeport. The outfall immediately north of NL1 has an elevation of 1,334ft and the outfall immediately south of NL1 has an elevation of 1,335ft. Therefore, the direction of flow from the outfalls north and south of NL1 will flow toward NL1, picking up representative storm water from urban runoff.

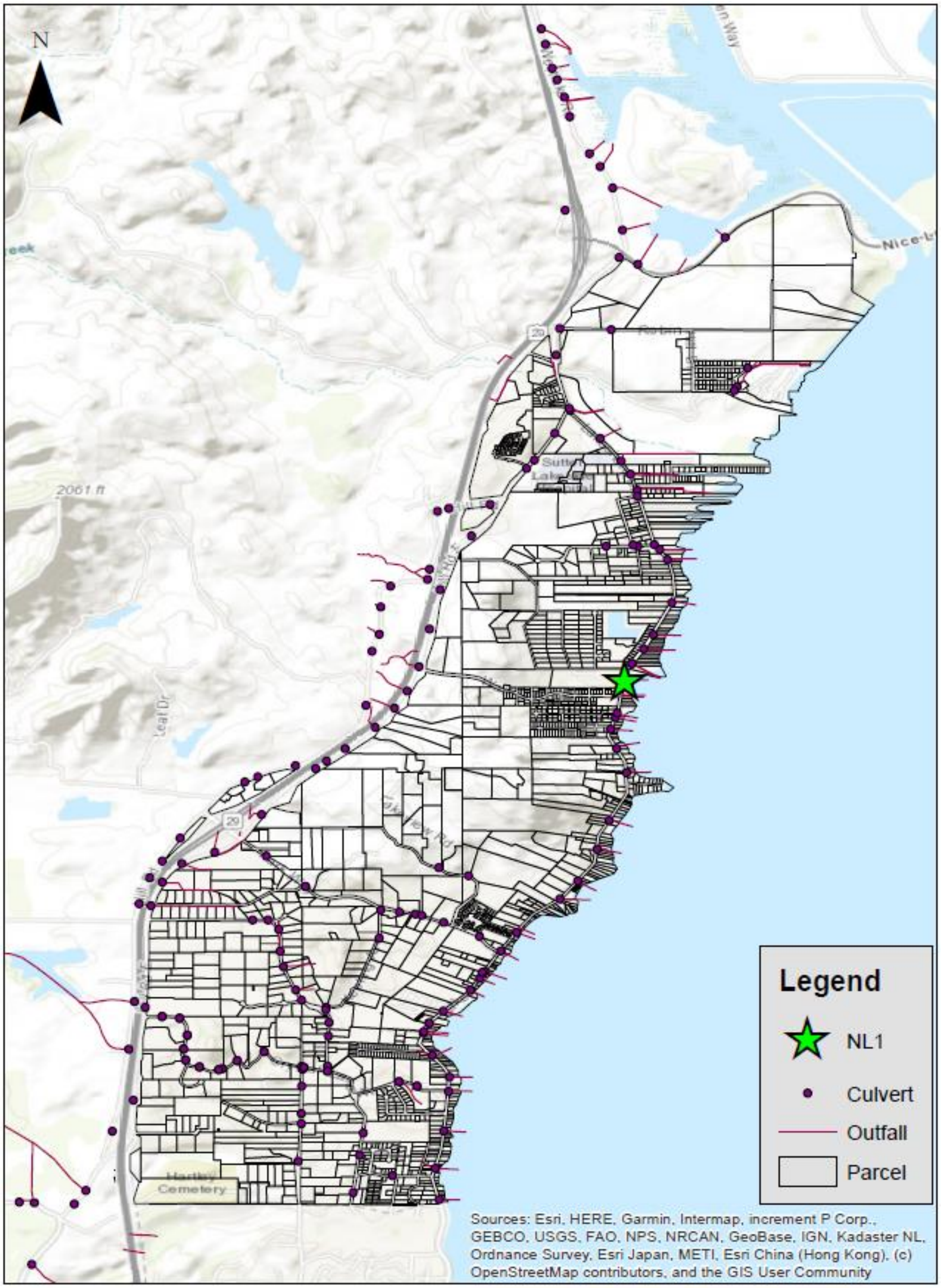


Figure 10: Map showing the representative sample site for urban runoff in North Lakeport.

Nice

N1 is the representative sample site for Nice (see figure 11). Nice is entirely within the HUC 180201160307 (HUC 307) watershed boundary. HUC 307 spans a steep terrain but does not have a single drainage terminus point within the watershed. Rather, the Mendocino National Forest mountain range located directly north of Nice creates several drainage points that span the shoreline of Nice. The northernmost region of Nice is 1,940ft above sea level and the outfalls that drain into Clear Lake range from 1,330-1,347ft for an overall elevation change of 610ft throughout the urban area.

There are 19 outfalls in Nice that terminate in Clear Lake. Each outfall's elevation was mapped using the USGS elevation map (TNM Elevation, 2020) to determine the range of outfall elevations. Elevations ranged from 1,330-1,349 feet for an overall difference of 19.4ft. The outfall with the lowest elevation is likely to be the most representative of storm water quality due to a higher volume and velocity of storm water passing through the points during storm events and additional flow from other urban areas (streets, roads) terminating at lower elevations. However, similarly to the catchment description for North Lakeport, outfalls with the lowest elevations in Nice are located in the westernmost reaches of Nice which are primarily rural areas composed of large parcels of natural chaparral lands. The goal of the urban water quality monitoring program is to measure the phosphorus output from urban areas, therefore, the outfalls with the lowest elevation cannot be considered for representative monitoring in Nice.

The outfall with the lowest elevation that can be representative of urban runoff is N1 located at 2715 Lakeshore Blvd, Upper Lake, CA. N1 has an elevation of 1,331ft and is directly below the most densely-populated area of Nice. Lakeview Drive is a major road that runs from the northernmost part of Nice directly through Highway 20 where the road name changes to Collier Drive. Collier Drive terminates at the shore of Clear Lake where it meets an outfall (N1) that drains into Clear Lake. Lakeview Drive traverses densely-populated regions and Collier Drive traverses less-populated regions. Lakeview Drive is the longest stretch of impermeable surface that runs through Nice and undergoes the most dramatic change in elevation. Storm water flows downhill over impervious surfaces and terminates at N1. Of the locations considered for representative monitoring, N1 follows the path of least resistance throughout the system and is therefore representative for storm water monitoring.

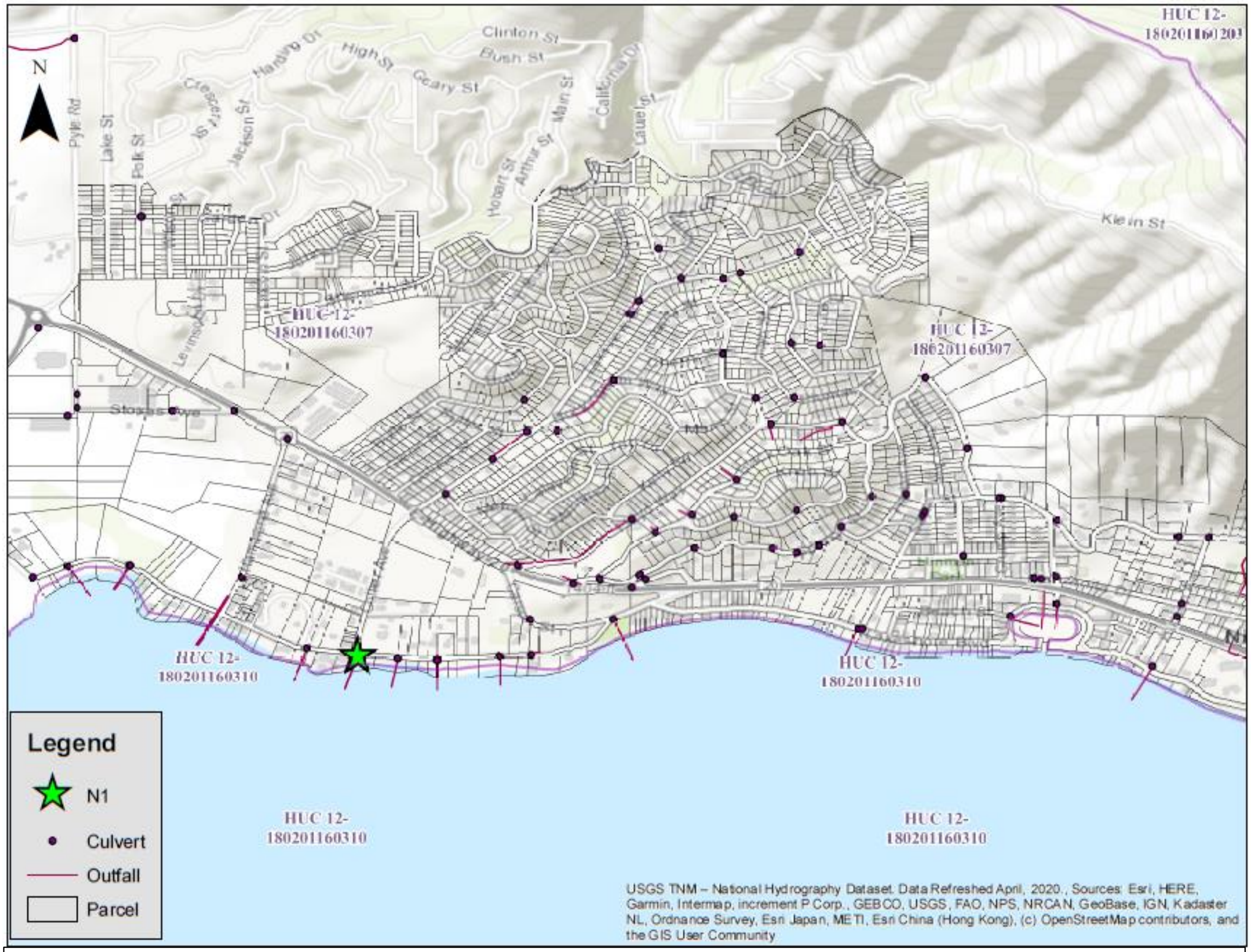


Figure 11: Map showing the representative sample site for urban runoff in Nice.

Soda Bay

SB1 is the representative sample site for Soda Bay (see figure 12). Soda Bay is entirely within the HUC 180201160305 (HUC 305) watershed boundary. HUC 305 spans a steep terrain and includes Mt. Konocti. Mt. Konocti is a volcano with 5 peaks composed of porous volcanic soil. It towers over Clear Lake but has negligible drainage due to the porosity of the soil. Soda Bay sits at the base of Mt. Konocti. There are no tributaries that run through Soda Bay, but the community extends out to the shoreline of Clear Lake.

There are seven outfalls that drain into Clear Lake, however, the outfall most likely to receive runoff from the urban area is SB1. The most densely-populated region of Soda Bay sits above the shoreline with drainage spread out along the downhill gradients. The northernmost point of the elevated urban area is nearest the intersection of Soda Bay Road and Aqua Vista Way. Overland flow the urban area will collect and ultimately drain into SB1 due to the interconnected outfalls that run from the urban area and collect at SB1 before discharging into Clear Lake.

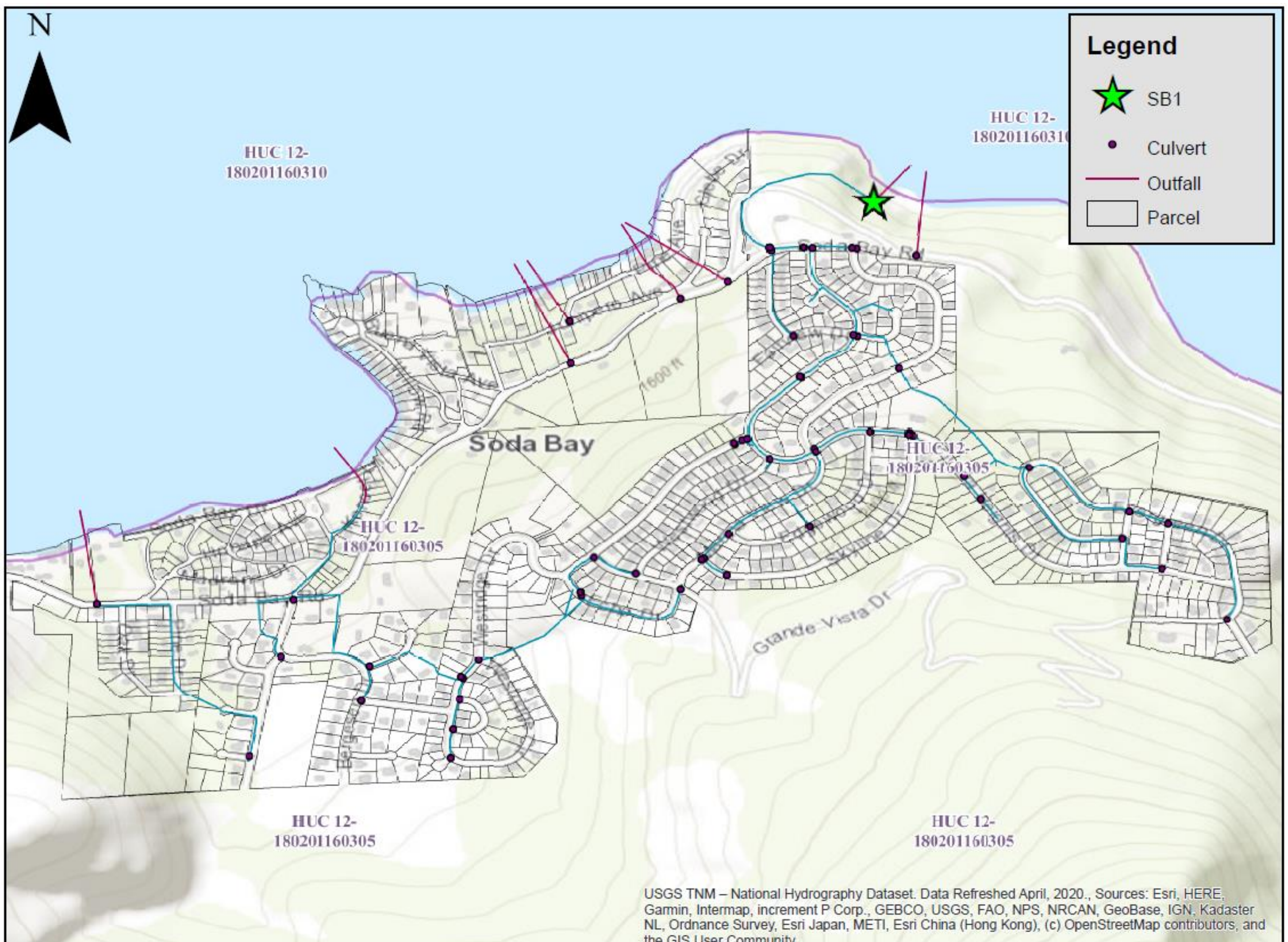


Figure 12: Map showing the representative sample site for urban runoff in Soda Bay.

Upper Lake

UL1 is the representative sample site for Upper Lake (see Figure 13). It is located at the end of a storm water outfall that terminates in Clover Creek. Clover Creeks runs through the urban area of Upper Lake and terminates in Middle Creek – the second largest tributary into Clear Lake. Of the several locations considered for representative monitoring, UL1 has the lowest elevation (1,137 ft), is directly below the most densely-populated area Upper Lake and is near the terminus of the drainage basin.

The Upper Lake region is characterized by steep slopes that drain into several tributaries that feed Clear Lake. UL1 has the lowest elevation of all storm water outfalls in Upper Lake that are influenced by urban runoff. The northern end of urban development in Upper Lake has an average elevation of 1,350 ft. The eastern and western ends of urban development are 1,344ft and 1,343 ft, respectively. The southern end (where UL1 is located) is the lowest at 1,337ft. A representative sample location is one that can catch the confluence of urban runoff, which is often characterized by the area of lowest elevation. Upper Lake has several drainage locations into Clover Creek, however, UL1 has the lowest elevation and can account for the densely-populated region directly above the sample point.

UL1 is located at the terminus of the drainage basin HUC 180201160203 (HUC 203) which immediately flows into the terminus of drainage basin HUC 180201160204 (HUC 204). Sampling locations close to the terminus of a drainage basin are the most representative of water quality. The terminus of a drainage basin is where overland flow (water that flows on the surface due to impervious surfaces or soil saturation) will converge due to slope, elevation, rainfall intensity, and specific soil capacity. HUC 203 converges into the terminus of HUC 204, making UL1 an ideal location for representative sampling.

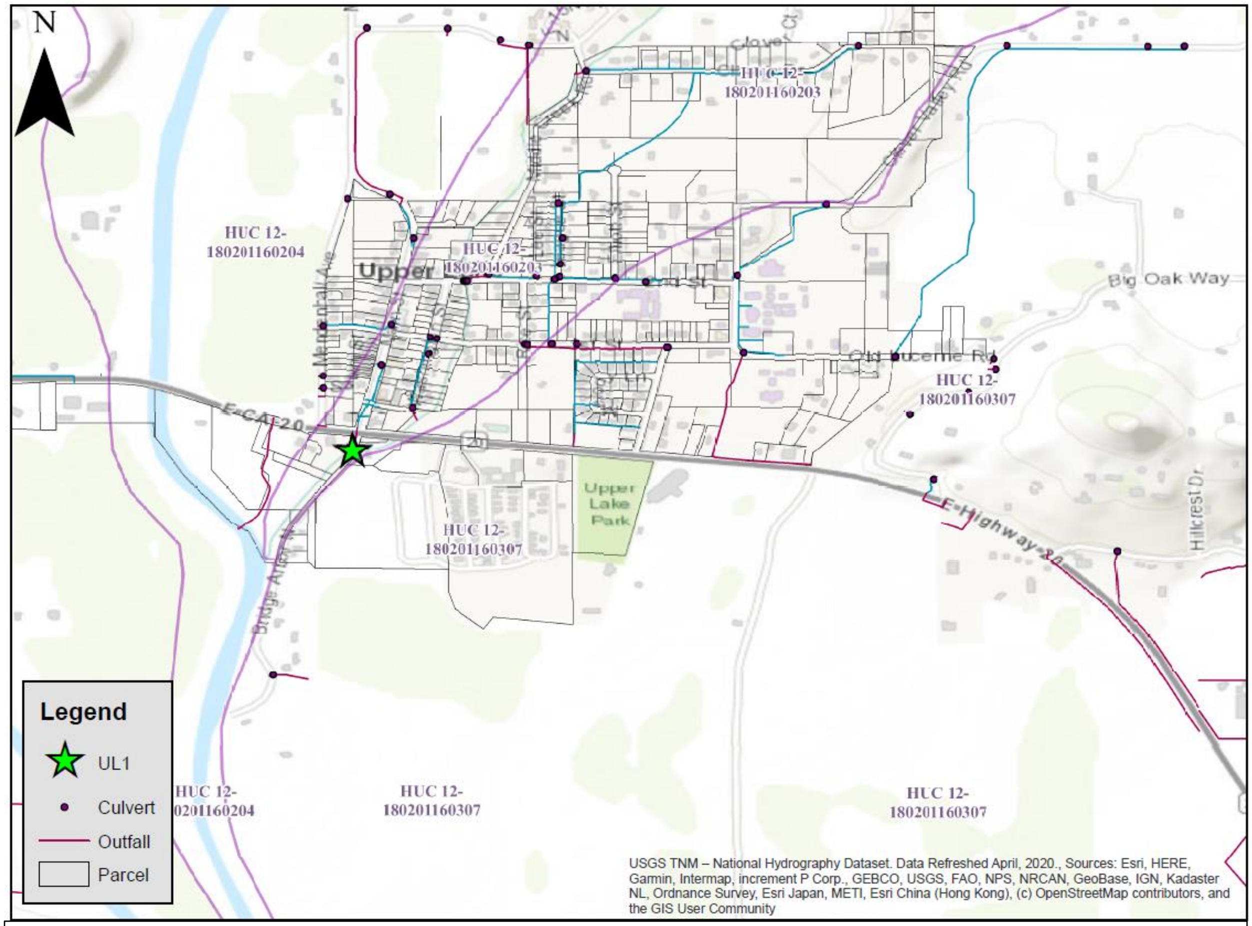
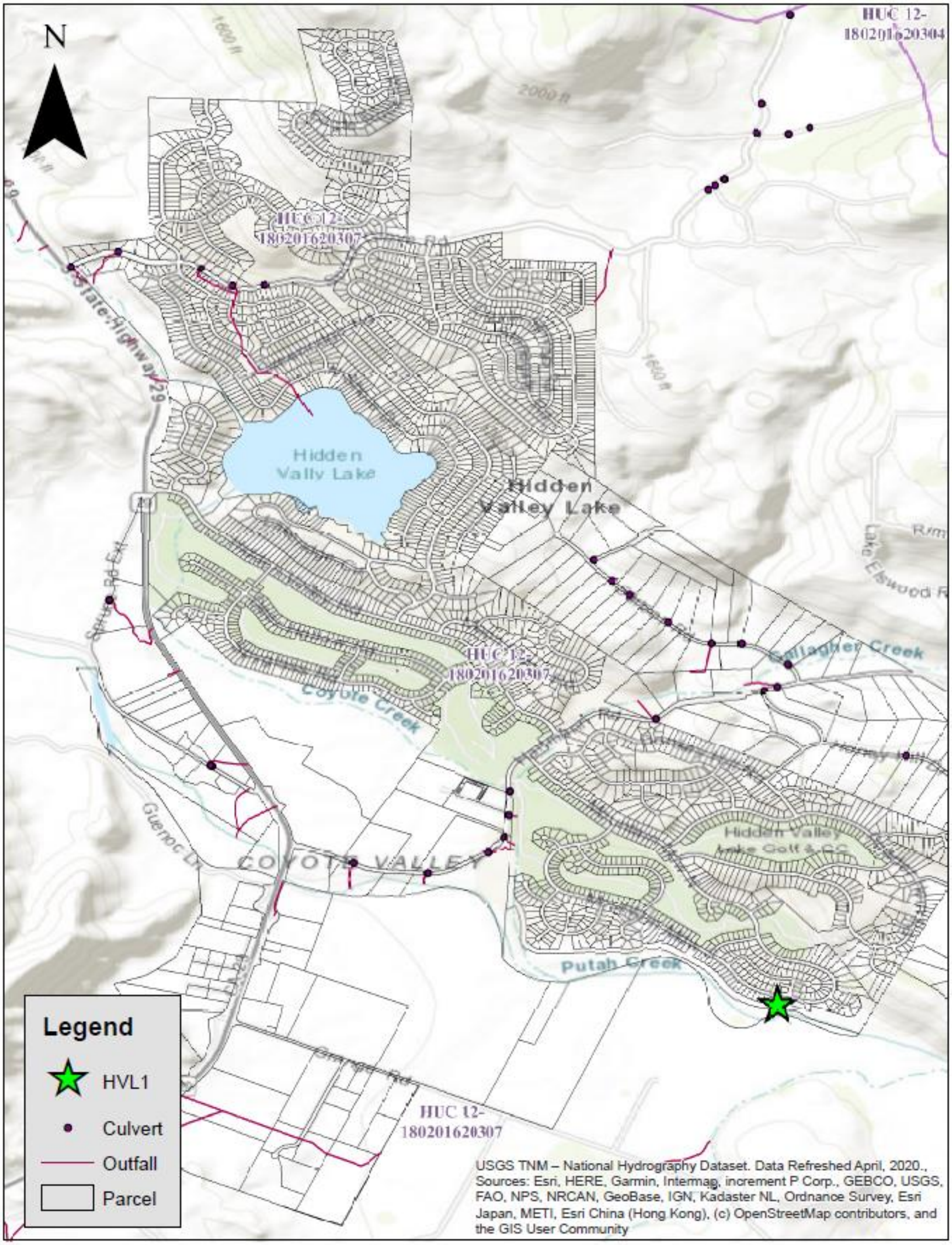


Figure 13: Map showing the representative sample site for urban runoff in Upper Lake.

Hidden Valley Lake

HVL1 is the representative sample site for Hidden Valley Lake (see figure #). Hidden Valley Lake is entirely within the HUC 180201620307 (HUC 20307) watershed boundary. HUC 20307 drains into Putah Creek. The northernmost region of Hidden Valley Lake is 2,011ft and the lowest elevation is at 947ft for an overall change in elevation of 1,064ft. Employees at the Hidden Valley Community Service District identified HVL1 as the lowest point in the urban system where the urban drainage flows into a sedimentation basin before it's discharged into Putah creek. If representative monitoring is required for Hidden Valley Lake, samples will be taken from HVL1 at the 72" gate valve before water is discharged into the sedimentation basin.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HUC 12-
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State Highway 29
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Coyote Creek
Gallagher Creek
Lake Elswood R
Hidden Valley
Lake Golf & CC
COYOTE VALLEY
Putah Creek
HUC 12-
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Legend
HVL1
Culvert
Outfall
Parcel
USGS TNM – National Hydrography Dataset. Data Refreshed April, 2020., Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Middletown

M1 is the representative sampling location for Middletown (see Figure #). Middletown is mostly within HUC 180201620302 (HUC 20302) with the southernmost portion located in HUC 180201620301 (HUC 20301). The most densely-populated urban area of Middletown drains into Saint Helena Creek from M1 located in HUC 20301.